TABLE 13-8 Herbs, Dietary Supplements, and Cancer *(continued)*

Saffron (Crocus sativus)	This spice contains glutathione and crocetin, which decreases tumor growth and protects platelets from aggregation.	Being studied for effects on depression and Parkinson's disease also.
Saw palmetto (Serenoa repens)	Permixon, a phytotherapeutic agent derived from the saw palmetto plant, is a lipid/sterol extract; mixed research results.	Often used to prevent prostate cancer; no side effects noted.
Shark cartilage	It seems to have a role in inhibiting angiogenesis. Frequently recommended to cancer patients by family members.	No evidence that it plays a role in cancer. Prolonged use can have adverse side effects.
Shark oil	Alkylglycerols, found in shark liver oil, may fight cancer by killing tumor cells indirectly and activating the immune system by stimulating macrophages.	Depending on the supplement, it may be rich in omega-3 fatty acids and vitamin A.
Shiitake mushrooms	Contains lentin, which stimulates T-cell and natural killer cell production; antitumor, cholesterol-lowering, and virus-inhibiting effects.	Additional research is needed.
Skullcap (Scutellaria barbata)	It seems to play a role in the reduction of aflatoxin toxicity. Contains flavanone compounds such as scutellarein, scutellarin, carthamidin, and isocarthamidin.	Do not take orally.
Soy isoflavones	Role in cancer prevention is not clear. Exact dosage and effects on specific genes are not currently known. The best advice is to encourage usual dietary use and not to change drastically. Reduces menopausal symptoms.	Soy should not be used in estrogen-dependent breast cancer or with endometrial cancer. Avoid with use of tamoxifen.
Spirulina; blue–green algae (Spirulina spp)	Adverse effects are uncommon unless contaminated. Used to treat cancers, viral infections, weight loss, oral leukoplakia, increased cholesterol.	If contaminated, it is hepato-, nephro-, and neurotoxic.
St. John's wort (Hypericum perforatum)	Not effective against acute depression. Avoid with all types of chemotherapy; cyclosporine, midazolam, tacrolimus, amitriptyline, digoxin, indinavir, warfarin, and theophylline.	It accelerates the effects of tamoxifen and must be used cautiously. May cause breakthrough bleeding and unplanned pregnancy when used with oral contraceptives. Avoid with selective serotonin reuptake inhibitors and in pregnancy or lactation.
Turkey tail mushroom (Coriolus versicolor; Yunzhi)	A mushroom used in traditional Asian herbal remedies. Polysaccharide K (PSK) and polysaccharide peptide (PSP), are being studied as possible complementary cancer treatments.	
Turmeric (Curcuma longa)	Turmeric and other phenols have an anticancer effect. Additional research is needed about the efficacy of turmeric as a cancer treatment).	Warn breast cancer patients on cyclophosphamide to restrict the intake because it inhibits the antitumor action of these chemotherapeutic agents.
Valerian	Used to promote natural sleep; 2–4 weeks of use is needed. People who are going to have surgery should not use valerian or should taper down slowly, starting several weeks before surgery.	Avoid taking with alcohol, certain antihistamines, muscle relaxants, mental health drugs, sedatives, antiseizure drugs, or narcotics. Talk with their doctors or pharmacists about possible drug interactions before taking valerian.
Wheatgrass	Few scientific studies in humans to support claims made for wheatgrass.	Proponents suggest that wheatgrass strengthens the immune system.
White Birch (betulinic acid)	Potential role in treating melanoma and certain brain cancers; clinical trials are needed.	Birch bark, buds, and leaves are used as folk medicines but have not been studied to find out if they are safe or effective.
HARMFUL	**Avoid oral use:** Aconite (bushi, monkshood) aloe vera arnica (wolfbane, mountain tobacco) aveloz (pencil cactus) belladonna (deadly nightshade) blue cohosh (squaw root) boragebroom (broom tops, Irish broom) calamus (sweet root/flag) cesium chloride chaparral (creosote bush; Larrea tridentate)	May have serious side effects.

(continued)

TABLE 13-8 Herbs, Dietary Supplements, and Cancer *(continued)*

HARMFUL	**Avoid oral use:**
	coltsfoot
	comfrey (bruisewort; Symphytuen officinale)
	Convallaria (lily of the valley)
	DiBella (DMB)
	ephedra (ma huang)
	germander
	germanium
	horse chestnut
	Hoxsey herbal treatment
	jimson weed
	jin bu huan
	Kava (Piper methysticum)
	Kombucha tea
	krebiozin (creatine)
	laetrile (amygdalin)–cyanide toxicity
	licorice (Glycyrrhiza glabra)
	liferoot (golden senecio, ragwort)
	lobelia (Indian or wild tobacco)
	mandrake
	oleander
	Pau d'Arco (Taebuia)
	pennyroyal
	periwinkle
	poke root
	sassafras
	sea cucumber
	tea tree oil
	wormwood (madder, mug or Ming wort, Artemisia)
	yohimbe

This table was developed with assistance of Dr. Vijay Erankl and Valerie Kogut, MS, RD. See also:
American Cancer Society. Herbs, vitamins, and minerals.
http://www.cancer.org/docroot/ETO/ETO_5_2_5.asp?sitearea=&level=.
National Center for Complementary and Alternative Medicine
http://nccam.nih.gov/health/decisions/.

TABLE 13-9 General Patient Education Tips

For **cancer treatment**, start "where the patient is." Instruct patient to use unscientific treatments with caution. Discuss these issues with compassion and an understanding of patient's perspective. Patients want *faith* in their health provider, *hope* for coping and for strength, and *respect* for their wishes.

For **cancer survivors**, optimal attention to physical activity and nutrition should continue. Because there are different phases of cancer survivorship, from active treatment to advanced disease, existing evidence must be reviewed and informed decisions made regarding dietary choices. Obese and overweight patients can pursue modest weight loss provided that close monitoring occurs. Healthy food intake, low in energy density but high in nutrient and phytochemical content, is the goal. This translates into 5–9 fruits and vegetables, more fish, and plenty of whole grains. Teach good sources of folate, vitamin A, calcium and iron; highlight antioxidant foods rich in selenium, vitamins C and E, and beta-carotene. Excellent resources are available from the cancer survivor Web site at http://www.cancerrd.com/ and from the American Institute for Cancer Research Web site http://www.aicr.org/site/PageServer?pagename=reduce_diet_recipes_test_kitchen.

For **family member counseling**, teach that nutrition is fundamental in the molecular basis of cancer. Tailor interventions according to nutritional status, genotype, current health status, and nutritional requirements of the individual. Changes in diet, lifestyle and behaviors may be required.

For **terminal, palliative care**, emotional support and comfort may be the best treatment. The counselor should be aware of the stages of death and dying to identify where the patient is: (a) denial, (b) anger, (c) bargaining, (d) depression and loss, or (e) acceptance.

The patient must be included in all decisions. If not competent, follow the living will or advanced medical directives to follow. A court-appointed legal guardian may be needed. Evaluate the benefits and burdens of the illness on the patient, as well as any court or family decisions. Forego heroic measures, including tube feeding and CPN, if so chosen. Otherwise, maintain measures and re-evaluate at a later date. Hydration is the priority when "palliative care" orders are written.

For More Information

- Cancer Information
  http://www.cancerguide.org/std_books.html
- Cancer Treatments
  http://www.cancer.org/docroot/MBC/MBC_6.asp
- Clinical Trials
  http://www.cancer.gov/clinical_trials/
- Food Safety for Cancer Patients
  http://www.seattlecca.org/food-safety-guidelines.cfm
  http://www.fsis.usda.gov/
- Medicine Online
  http://www.meds.com/
- OncoLink: University of Pennsylvania Cancer Center
  http://oncolink.upenn.edu/
- Supportive Treatments
  http://www.cancer.gov/cancerinfo/pdq/supportivecare/
- Texas Cancer Data Center
  http://www.texascancer.info/
- Treatment Decisions
  http://www.cancer.org/docroot/ETO/eto_1_1a.asp

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Mattox TW. Treatment of unintentional weight loss in patients with cancer. *Nutr Clin Pract.* 20:400, 2005.

Winter N, et al. Elevated levels of HMGB1 in cancerous and inflammatory effusions. *Anticancer Res.* 29:5013, 2009.

BONE CANCER AND OSTEOSARCOMA

NUTRITIONAL ACUITY RANKING: LEVEL 3

Adapted from: Yochum TR and Rowe LJ.*Yochum and Rowe's Essentials of Skeletal Radiology,* 3rd ed. Philadelphia: Lippincott Williams & Wilkins, 2004.

DEFINITIONS AND BACKGROUND

Bone is a fertile ground for cancer cells to flourish (Clines and Guise, 2005). Bone cancers include osteosarcomas, chondrosarcomas, and the Ewing family of tumors. The correct diagnosis depends on an evaluation of clinical, radiologic, pathologic, and genetic features (Li and Siegel, 2010).

Osteosarcoma involves a rapidly growing malignant bone tumor of unknown origin, occurring most often in the long bones of young people. It is most common in males between 10 and 25 years of age.

People who have had previous high doses of radiotherapy to a bone or Paget's disease have an increased risk of developing bone cancer. This type of cancer often spreads to the lung. When metastases from other organs occur, it is considered a secondary bone cancer. Patients with metastasis to the spine may present with pain, neurological deficit, or both. Optimal treatment should include consideration of the patient's neurological status, general health, age, quality of life, and the anatomical extent of the disease (Ecker et al, 2005).

Staging on bone cancer is as follows: stage 1 – low grade, no spread; stage 2 – high grade but not spread; stage 3 – bone cancer of any grade that has spread beyond the bone in which it started to other organs in the body, such as the lungs. In recurrent bone cancer, the cancer has returned after initial treatment.

The most common treatment for bone cancer pain is radiation. Radiation decreases bone cancer pain by direct effects on tumor cells (Goblirsch et al, 2005). Chemotherapy may also be needed; sore mouth or anemia may result. Surgery is reserved for neurological compromise, radiation failure, or spinal instability (Ecker et al, 2005). When possible, limb-sparing surgery is effective. Occasionally, amputation is necessary when the cancer has spread from the bone into the surrounding blood vessels.

Quality of life in this population is affected by depression, socialization problems, and physical limitations (Rustoen et al, 2005). Bisphosphonates are the standard of care for preventing skeletal morbidity and treating hypercalcemia of malignancy in patients with bone metastases; zoledronic acid may be given intravenously at the rate of 4 milligrams monthly (Gnant, 2009).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Bone morphogenetic proteins (BMPs) may impact tumorigenesis and promote tumor spread (Thawani et al, 2009).

Specific Clinical/ History

Height
Weight
BMI
Weight loss
Leg, shin, shoulder pain?
Limited use of the extremity
Fatigue
Warmth in a local area
Fever and cough
Bone scan
CT scan

Lab Work

H&H
Alkaline phosphatase (Alk phos) (increased)
Glucose (Gluc)
Ca^{++}
Mg^{++}
Na^{+}, K^{+}
Albumin (Alb)
C-reactive protein (CRP)
Total lymphocyte count (TLC) (varies)
Alanine aminotransferase (ALT) (increased)

INTERVENTION

OBJECTIVES

- Prevent dehydration; correct fever.
- Relieve pain; prolong and improve quality of life.
- Correct side effects, such as sore mouth or anemia.
- Counteract effects of surgery (perhaps limb amputation), radiation therapy, or chemotherapy.
- Meet needs related to growth or elevated metabolic rate in children.

FOOD AND NUTRITION

- A balanced diet (high in energy and protein) will be needed.
- Extra fluids are used, unless contraindicated.
- Supplement with nutrients that are low in the patient's dietary intake. A diet rich in zinc, vitamins A and C, and other key nutrients will help with wound healing after surgery. A multivitamin–mineral supplement may be suggested.
- Small, frequent feedings may be better tolerated than large meals.

Common Drugs Used and Potential Side Effects

- Bisphosphonates may be used to restrict the action of the osteoclasts, help reduce the breakdown of the bone, reduce the risk of fracture and hypercalcemia, and reduce bone pain.
- Cisplatin, carboplatin (Paraplatin), cyclophosphamide (Cytoxan), doxorubicin (Adriamycin), high-dose methotrexate with leucovorin, ifosfamide (Ifex) may be used.
- Dry mouth, anemia, stomatitis, nausea, esophagitis, or vomiting may occur.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss ways to make meals more attractive and appetizing.
- Discuss with the patient and family how to adjust diet for therapies given.
- Encourage the patient to address depression or other issues that affect quality of life.
- Offer suggestions according to side effects such as sore mouth or dry mouth.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- American Cancer Society – Bone Cancer
  http://www.cancer.org/docroot/CRI/CRI_2_3x.asp?dt=2
- Bone Cancer Information
  http://www.cancerbacup.org.uk/Cancertype/Bone
- Bone Tumor
  http://www.bonetumor.org/
- Clinical Guidelines for Bone Cancer
  http://www.nccn.org/professionals/physician_gls/PDF/bone.pdf
- Medicine Net – Bone Cancer
  http://www.medicinenet.com/bone_cancer/article.htm

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BONE MARROW OR HEMATOPOIETIC STEM-CELL TRANSPLANTATION

NUTRITIONAL ACUITY RANKING: LEVEL 4

DEFINITIONS AND BACKGROUND

Hematopoietic stem cells are cells from which all blood cells evolve. Since bone marrow contains the greatest concentration of blood stem cells, most transplantations, historically, have been bone marrow transplantations. However, with the administration of an artificial growth factor called granulocyte colony-stimulating factor (G-CSF), stem cells are stimulated to grow and leave marrow and can be collected from the bloodstream by apheresis.

The terms "hematopoietic stem-cell transplantation" and "peripheral-blood stem-cell transplantation" are used when referring to bone marrow transplantation. Peripheral-blood stem-cell transplantations are being used with increased frequency because it is much less invasive. Traditional bone marrow harvest requires the use of general anesthesia.

Treatment consists of a preparative regimen that includes high-dose chemotherapy and may also include total-body irradiation. An infusion of autologous (the patient's own), syngeneic (from an identical twin), or allogeneic (from a histocompatible related or unrelated donor) marrow follows.

Hematological malignancies, including leukemias, lymphomas, multiple myeloma, and aplastic anemia, are the main indications for stem-cell transplantation. Nonhematological malignancies, such as testicular cancer and some autoimmune conditions, are also indications for stem-cell transplantation. Stem-cell transplantations are performed in both adult and pediatric populations. Stem-cell transplantations in patients with matched siblings versus unrelated donors have been associated with significantly better long-term survival (Talano et al, 2006).

After transplantation, the patient is often neutropenic, and nutritional status may decline rapidly. Children undergoing bone marrow transplantation may have suboptimal nutritional status; body mass index (BMI) is not an accurate indicator in these cases (White et al, 2005). Hospitalized transplantation patients resume oral intake sooner than ambulatory patients.

Treatment is aggressive and has many side effects. Early side effects are basically the same as those of any other type of high-dose chemotherapy and are caused by damage to bone marrow and other rapidly reproducing tissues of the body. Hepatic veno-occlusive disease (VOD) occurs after high doses of chemotherapy in preparation for bone marrow transplantation. Rapid weight gain, elevated bilirubin, right upper quadrant (RUQ) pain, ascites, jaundice, and hepatomegaly can occur.

Long-term side effects could include radiation damage to the lungs with shortness of breath, graft-versus-host disease (GVHD), damage to the ovaries causing infertility and loss of menstrual periods, damage to the thyroid gland causing problems with metabolism, cataracts, bone damage, and growth changes in children. GVHD causes erythroderma, jaundice, abdominal pain, emaciation, pneumonitis, infections, and gastrointestinal tract problems. Hemolytic uremic syndrome (HUS) is an uncommon but potentially life-threatening complication of stem-cell transplantation.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Umbilical cord blood may be used in children born after a genetic diagnosis for human leucocyte antigen (HLA) matching for donation to a sick sibling.

Specific Clinical/History

- Height
- Weight
- BMI
- Weight changes
- Diet history
- I & O
- Temperature
- Ascites, jaundice
- Frequent infections
- Hepatomegaly?
- RUQ pain?
- Rectal biopsy for GVHD[a]

Lab Work

- H & H
- Bilirubin
- Gluc
- Mg^{++}, Ca^{++}
- Complete blood count (CBC)
- Absolute neutrophil count (ANC) to evaluate engrafting
- Na^{+}, K^{+}
- Alb, transthyretin
- Viral hepatitis screening
- CRP
- Serum phosphorus (low from cyclosporine A)
- Uric acid
- Cholesterol (Chol)
- Triglycerides (Trig)
- TLC (varied reliability)
- Ferritin
- Transferrin
- Blood urea nitrogen (BUN)
- Creatinine (Creat)

[a]Severe colonic crypt loss predicts severe clinical GI-GvHD that is more likely to be refractory to steroid treatment and have high mortality (Melson et al, 2007).

INTERVENTION

OBJECTIVES

Pretransplantation

- Replace the malignant or defective hematopoietic system for the production and development of blood cells.
- Provide adequate nutrient stores (glucose, calories, vitamins, minerals, and protein). Supplementation with EPA

SAMPLE NUTRITION CARE PROCESS STEPS

Decreased Oral Food–Beverages Intake

Assessment Data: Analysis of oral intake compared to requirements from nursing flow sheet; patient states pain while eating; physical examination of the oral cavity.

Nutrition Diagnosis (PES): NI-2.1 oral intake related to pain and mucositis as evidenced by the refusal of food at mealtimes.

Intervention: Diet modification for consistency. Education about foods that may be better tolerated. Counseling about taking pain medicines ahead of meals.

Monitoring and Evaluation: Follow-up in 24 hours to evaluate improvement and changes in oral intake.

fish oil improves energy intake and may reduce complications and inflammatory markers when compared with usual care (Elia et al, 2006).
- Assure adequate hydration.

Posttransplantation

- Restore normal hematopoiesis and immunological function.
- Individualize needs; promote engraftment of marrow.
- Prevent or manage gastrointestinal Graft-Versus-Host Disease (GI-GvHD). Rejection occurs less often in well-nourished patients.
- Prevent infections, viral hepatitis, mucositis, gastroenteritis, and pneumocystosis.
- Reduce nausea, vomiting, diarrhea, appetite loss and fatigue, which can seriously affect nutritional status (Iversen et al, 2009).
- Improve weight status; promote anabolism. Most patients are in the hospital for 4–6 weeks.
- Correct early satiety, anorexia, stomatitis, xerostomia, and depression—all of which reduce total intake.
- Provide nutrition support due to hypermetabolism and side effects of treatments. Promote positive nitrogen balance when possible.
- Correct hyperglycemia from metabolic stress, insulin resistance, and medication side effects.
- Monitor closely for renal insufficiency and necessary changes for diet.
- Prevent or prepare for long-term complications such as hyperphagia and obesity, insulin resistance and diabetes, hyperlipidemia, hypertension, and osteoporosis.
- Maximize quality of life. Health-related quality of life (HRQoL) is reduced before, during, and after intensive therapy (Iversen et al, 2009).

FOOD AND NUTRITION

- Protective isolation may be needed. A low-bacteria (neutropenic) diet may be useful for several months before and after transplantation. A neutropenic diet guide is found in Table 13-10.
- CPN may be needed to initiate recovery after transplantation or with severe intestinal GVHD. Where possible, the use of intravenous fluids and oral diet should be considered as a preference to parenteral nutrition; however, with severe gastrointestinal failure, even with a trial of enteral feeding, use PN (Murray and Pindoria, 2009). A naso-jejunal (NJ) feeding is associated with less vomiting and aspiration. The use of glutamine to decrease oral mucositis or diarrhea among patients receiving autologous or allogeneic HCT is not necessary (American Dietetic Association, 2010).
- Use indirect calorimetry to determine energy requirements where possible (American Dietetic Association, 2010). Provide 30–35 kcal/kg for the first month; increase for weight gain, infection, GVHD, or neutropenia.
- Protein intake should be 1.5–2 g/kg of weight; increase during corticosteroid therapy.
- Fat intake should be 25–30% of total kilocalories to prevent fatty acid deficiency and to support blood glucose control (American Dietetic Association, 2010). Monitor for hyperlipidemia. An olive oil-based lipid emulsion compared with a MCT/LCT emulsion can be well tolerated; maintain essential fatty acids, and support a favorable plasma lipid profile (Hartman et al, 2009).

TABLE 13-10 Neutropenic Diet Guidelines

To reduce the introduction of pathogenic organisms into the gastrointestinal tract of immunocompromised patients, food safety practices and dietary changes are in order. The following are practices that may be helpful to patients after bone marrow transplantation (for 3 months or until immunosuppressive therapies are complete):

- Ensure careful hand washing.
- Keep foods at a safe temperature to prevent food infection.
- Microwave hot foods immediately before service.
- Avoid foods that fall into the following categories:
- All moldy or outdated food products
- Deli cheeses and foods
- Hot dogs, bacon, sausage, luncheon meats
- Miso and tempeh products
- Pickled fish, cold smoked salmon, and lox
- Powdered infant formula
- Raw and unpasteurized milk and dairy products
- Raw brewer's yeast
- Raw honey
- Raw or undercooked meats, fish, shellfish, poultry, eggs, game meats
- Raw vegetable sprouts
- Salad dressings made with raw eggs
- Soft or mold-containing cheese (Brie, feta, blue)
- Stir fried vegetables or fruits
- Tofu
- Unboiled well water (it should be boiled at least one minute)
- Unpasteurized beer or fruit juices
- Unrefrigerated cheese-based salad dressings
- Unwashed fruits or vegetables
- Yogurt and other dairy products with active cultures

Adapted from: Oncology Nutrition Practice Group. *The clinical guide to oncology nutrition*. 2nd ed. Chicago, IL: American Dietetic Association, 2006.

- If there is hyperglycemia, keep carbohydrate intake at a steady amount each day.
- Sterile water may be used for hydration and renal health. Maintain 1 mL/Kg intake.
- A multivitamin–mineral supplement may be useful. Assure adequate intake of vitamin D and calcium with long-term steroid use. Potassium and magnesium can be depleted by some medications; monitor carefully. Avoid iron in supplements if transfusions have been frequent; iron overload may occur.
- Patient may need a low-lactose, low-fiber, low-fat diet. Progress, as tolerated, to normal diet.
- As patient recovers and no longer requires a protective setting, the use of live-culture pasteurized yogurt may be beneficial to increase bowel flora. *Lactobacillus acidophilus* therapy can also be helpful.

Common Drugs Used and Potential Side Effects

- See Table 13-11.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- St. John's wort and echinacea should not be taken with cyclosporine, because they alter drug functioning.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- The neutropenic, low-bacteria diet protocol should be made available, as appropriate.
- Help the patient and family to manage signs of gastrointestinal GVHD; this usually includes anorexia, nausea, vomiting, watery diarrhea, abdominal pain, and GI bleeding (Xu et al, 2008).
- Small, frequent meals of bland, cold consistency may be well-tolerated.
- Discuss any necessary nutritional support methods and procedures to be used at home or in discharge planning.

TABLE 13-11 Drugs Commonly Used in Bone Marrow or Stem-Cell Transplantation

Conditioning chemotherapy or irradiation is given immediately before the transplant to suppress immune reactions.

Drug	Comments
Analgesics, antihistamines, and antidepressants	Monitor for specific side effects.
Antibiotics	Amphotericin may be used to fight infections. Nausea, stomach pain, or vomiting may occur.
Antivirals	Acyclovir may be given prophylactically to resolve oral ulcers. Headaches, gastrointestinal(GI) distress, or diarrhea may occur.
Bisphosphonates	These may be needed if there is osteopenia or osteoporosis.
Chemotherapy	Busulfan (to destroy marrow stem cells) and cyclophosphamide (Cytoxan) are given to prevent rejection of the transplant. They can cause nausea, vomiting, diarrhea, and anorexia. Methotrexate, fludarabine, carmustine, and cyclophosphamide may cause anorexia, mucositis, and esophagitis; some also cause diarrhea. Gleevec interferes with an abnormal enzyme that sends signals to the nucleus of a cancer cell. Nausea, extensive diarrhea, and vomiting are potential side effects. Useful for leukemia or advanced stomach cancer.
Immunosuppressive therapy (graft-versus-host disease [GVHD] prophylaxis)	GVHD prophylaxis consists of T-cell depletion (antibody T10B9 or OKT3 and complement) with posttransplantation cyclosporine (Talano et al, 2006). Antithymocyte globulin may cause vomiting, nausea, diarrhea, and stomatitis. Azathioprine may cause vomiting, nausea, diarrhea, mucosal ulceration, esophagitis, and steatorrhea. Beclomethasone can lead to thrush, nausea, and xerostomia. Corticosteroids cause sodium and fluid retention, weight gain, hyperglycemia, skeletal muscle wasting, growth retardation in children, peptic ulceration, and elevated triglycerides. Cyclosporine (Sandimmune) may cause nausea and vomiting, skin rashes, hemorrhagic cystitis, and altered potassium metabolism. Methotrexate causes nausea and vomiting, mucositis, esophagitis, diarrhea, renal and liver changes, decreased absorption of vitamin B_{12}, fat, and D-xylose, and taste changes. Monoclonal antibodies cause nausea and vomiting. Sirolimus elevates triglycerides. Tacrolimus can be nephrotoxic or cause hyperglycemia, hyperkalemia, or hypomagnesemia. Ursodeoxycholic acid can cause nausea and vomiting, diarrhea, and GI distress.
Filgrastim (Neupogen)	Neutropenia secondary to immune suppression may be managed with Neupogen and a low-bacteria diet.
Insulin	May be needed if there is hyperglycemia.
Oral hygiene	Clotrimazole (Mycelex) may cause nausea or vomiting; it is used for oral hygiene and prevention of oral candidiasis.
Total-body irradiation (TBI)	Side effects vary for each individual, but anorexia, diarrhea, and mucositis or esophagitis are common.

Transition from CPN and PN to enteral nutrition or oral diet will be helpful.
- Physical therapy may be helpful to maintain strength and to regain mobility.

Patient Education—Food Safety

- Educate about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.
- The neutropenic, low-bacteria diet includes the careful use of raw fruits and vegetables, milk, and shellfish—all of which may be contaminated easily with bacteria. These diets are often used in bone marrow transplantation units.

For More Information

- Bone Marrow Support Group
  http://www.bmtsupport.ie/
- Medline Plus – BMT
  http://www.nlm.nih.gov/medlineplus/ency/article/003009.htm
- National Bone Marrow Transplant Link
  http://www.nbmtlink.org/
- National Cancer Institute – BMT
  http://www.cancer.gov/cancertopics/factsheet/Therapy/bone-marrow-transplant

BONE MARROW AND HEMATOPOIETIC STEM-CELL TRANSPLANTATION—CITED REFERENCES

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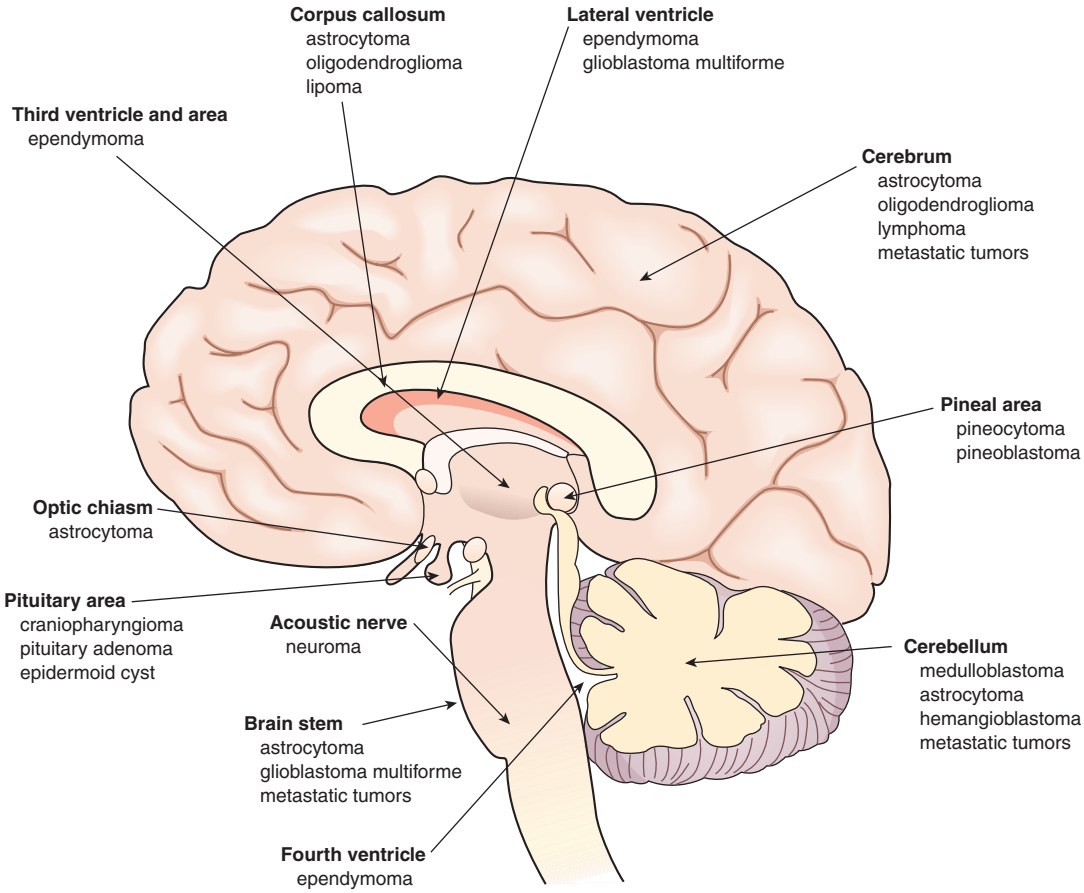
BRAIN TUMOR

NUTRITIONAL ACUITY RANKING: LEVEL 3



DEFINITIONS AND BACKGROUND

Tumors are either primary or secondary when they are found in the brain. Primary brain tumors start their growth in the brain and can be benign or malignant. They can occur in children, particularly girls between the ages of 5 and 9. Approximately 17,000 Americans each year are diagnosed with a primary brain tumor. Secondary brain tumors are more common, with about 90,000 cases diagnosed each year. These tumors result from cancer that has metastasized to the brain from the lung, breast, melanoma, kidney, or other part of the body.

Brain tumors destroy or damage brain cells by producing inflammation, compressing other parts of the brain as the tumor grows, and causing swelling and pressure inside the skull. Headache is the most common symptom. Brain tumor headaches are usually worse upon awakening and do not respond to the usual headache medicines. Depression, fatigue, and memory and personality changes may complicate care (Stewart-Amidei, 2005). Table 13-12 describes types of brain tumors and cells of origin.

The nerve cells (neurons) carry signals, and the cells that support them are called glial cells. There are a number of different types of glial cells, all with different names and functions, and they outnumber the neurons by a ratio of 10:1. A glioma is a tumor of neurological origin; it constitutes over 50% of all brain tumors.

Glioblastoma multiforme (GBM) is the most frequent and devastating primary malignant brain tumor in adults. Surgery followed by standard radiotherapy with temozolomide chemotherapy is the standard of care, but the prognosis remains poor with survival in the range of 12–15 months (Minniti et al, 2009). While fruit, vegetables, and carotenoids do not increase the risk of glioma (Holick et al, 2007), adequate GLA and DHA fatty acids, lycopene, beta carotene, and other antioxidants are under study. There is also no evidence that the intake of meat, nitrate, nitrite, or nitrosamines is related to the risk of glioma (Michaud et al, 2009).

Meningiomas are also common and may be classified as benign, atypical, or malignant. While surgical excision is curative for most patients, up to 20% recur (Lee et al, 2009).

Because malignant brain tumors are largely dependent on glycolysis for energy, normal neurons and glia readily transition to ketone bodies (beta-hydroxybutyrate) for energy when glucose levels are reduced (Seyfried and Mukherjee, 2005). Increased melanocortin activity and reduced neuropeptide Y function lead to catabolism with reduced energy intake, increased energy expenditure, increased muscle proteolysis, and adipose tissue loss (Laviano et al, 2008).

Nutritional status and weight decline early in treatment (Ward et al, 2009). Anorexia, early satiety, changes in taste/smell, and nausea are frequently reported. Ghrelin has anti-inflammatory properties that may help to alleviate cachexia and improve weight gain; ghrelin receptor agonists show promise (DeBoer 2008).

Some brain tumors can be treated successfully with surgery, radiation therapy, and chemotherapy. Emerging technologies allow physicians to target and treat brain tumors more precisely. Antiangiogenesis approaches have the potential to be particularly effective in the treatment of glioblastoma tumors (Anderson et al, 2008). Convection-enhanced delivery (CED) has emerged as a leading investigational delivery technique for the treatment of brain tumors (Bidros et al, 2010).

TABLE 13-12 Types of Brain Tumors

Type of Tumor	Location, Cell Origin, or Function
CNS Lymphoma	Affects the body's immune system, which defends against infection and foreign substances.
Craniopharyngiomas	Located around the pituitary gland.
Germinomas	Germ cell tumors.
Gliomas	Originate in the glial supporting tissues. Types include astrocytoma; brain stem glioma; oligodendroglioma that affects myelin production; ependymoma affects the ventricles that aid in the circulation of cerebrospinal fluid.
Meningioma	The meninges cover and protect the brain and spinal cord.
Medulloblastoma	These cells normally do not remain in the body after birth; primitive neuroectodermal tumors (PNET).
Neuroblastoma	Originate in the brain.
Pineal gland tumors	Pineocytoma or pineoblastoma are around the pineal gland.
Schwannoma	Affects the myelin that protects the acoustic nerve for hearing; acoustic neuromas are in this category.

Source: National Cancer Institute, http://www.cancer.gov/cancertopics/alphalist/a-d, accessed January 5, 2010.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Five "classes" of meningiomas have been detected by gene expression analysis where chromosomes 22q, 6q, and 14q are involved (Lee et al, 2009). Genomic deletion of chromosomes 6, 21, and 22 represents new targets for further research (Lassman et al, 2005).

Specific Clinical/History

- Height
- Weight
- BMI
- Weight changes
- Diet history
- BP (hypertension?)
- Inability to follow commands
- Aphasia
- Cerebral edema, headaches
- Vertigo
- Altered consciousness or convulsions
- Mental or personality changes
- Unequal pupil response
- Hemianopsia, blurred or decreased vision
- Ptosis
- Altered gait or immobility
- Dysphagia
- Vomiting (with or without nausea)
- Tinnitus

Loss of sense of smell
CT scan
Diffusion MRI
Skull x-ray
Electroencephalogram (EEG)
Lumbar puncture

Lab Work

Gluc (elevated)
Cerebrospinal fluid (CSF)—elevated protein levels
Alb, transthyretin
CRP
TLC, white blood cell count (WBC) (altered)
WBC in CSF (normal or increased)
Transferrin
ALT (elevated)
NA^+, K^+
Serum folate

INTERVENTION

OBJECTIVES

- Provide adequate energy (30 kcal/kg or more if needed).
- Provide adequate protein for surgery: 1.2–1.5 g/kg body weight; for radiation: 1.0–1.2 g/kg body weight. Adjust for renal/hepatic dysfunction; obesity; skin breakdown or wound healing.
- Avoid constipation and straining.
- Prevent lower respiratory infections; coughing can increase intracranial pressure.
- Counteract side effects of therapy (e.g., radiation, surgery).
- Monitor carefully for elevated blood glucose levels, which may occur with corticosteroids that are used to control brain edema.
- Prevent complications such as the loss of ability to interact, care for self, or permanent neurological losses.

FOOD AND NUTRITION

- Maintain diet, as ordered. Include extra fluid, unless contraindicated.
- If oral diet is possible, include fish, fruits, vegetables, and adequate fiber. Include green tea, food sources of beta carotene, and fish oil to enhance neuroprotection.
- Alter texture and liquids, if necessary, for dysphagia. If necessary, tube feed or offer CPN.
- Limit sodium to 4–6 g/d to correct cerebral edema.

SAMPLE NUTRITION CARE PROCESS STEPS

Swallowing Difficulty

Assessment Data: Weight loss of 10# in 6 weeks; cognitive changes; brain tumor. Mealtime observation shows choking on thin liquids and inability to swallow solids.

Nutrition Diagnosis (PES): NC-1.1 Swallowing difficulty related to neurological changes as evidenced by inability to consume solids, choking on thin liquids, and 10# weight loss in 6 weeks.

Intervention: Enteral nutrition support with gastrostomy. Educate the patient and family about the benefits of tube feeding.

Monitoring and Evaluation: Recovery of lost weight; tolerance for chemotherapy and radiation treatments.

- Offer meal setup and assistance with eating, altered liquid/food textures, and/or enteral tube feedings for patients with cognitive deficits, swallowing difficulties, or limited function of upper extremity.

Common Drugs Used and Potential Side Effects

- Seizures are best managed with antiepileptic drug therapy (Stewart-Amidei, 2005). Levetiracetam (Keppra), an anticonvulsant, reduces seizures in malignant brain tumors and may help improve chemotherapy outcomes. Monitor for decreased serum folic acid levels and other nutrients.
- The use of procarbazine (an antineoplastic) may warrant the restriction of tyramine-containing foods that are secondary to its monoamine oxidase (MAO) inhibitor–like action.
- Nonsteroidal anti-inflammatory agents may help to reduce inflammation (Byrne, 2005).
- Steroid therapy may be used. Decrease sodium and increase potassium if appropriate. Negative nitrogen balance or hyperglycemia may result. Maintain near-normal blood glucose levels if possible.
- Osmotic diuretics may be needed for edema. Antacids or antihistamines may be needed for stress ulcers.
- Temozolomide (Temodar) was approved for brain cancer and GBM in particular.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- The importance of regular and attractive meals should be stressed to help appetite if fair or poor. Keep in mind that sense of smell may have declined recently.
- Discuss the importance of a balanced diet with good sources of protein at meals.
- Early discussion about end-of-life issues is necessary because the disease can impair the patient's decision-making ability (Stewart-Amidei, 2005).
- A multidisciplinary approach using physical, occupational, and speech therapies is essential to maximize neurological function and activities of daily living.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Brain Tumor Clinical Trials: Musella Foundation
  http://www.virtualtrials.com/musella.cfm

- Interactive Tour of the Brain
  http://www.braintumor.org/TourBrain/index.html
- National Brain Tumor Foundation
  http://www.braintumor.org/
- OncoLink—Brain Cancer
  http://www.oncolink.org/types/article.cfm?c=2&s=4&ss=25&id=9534

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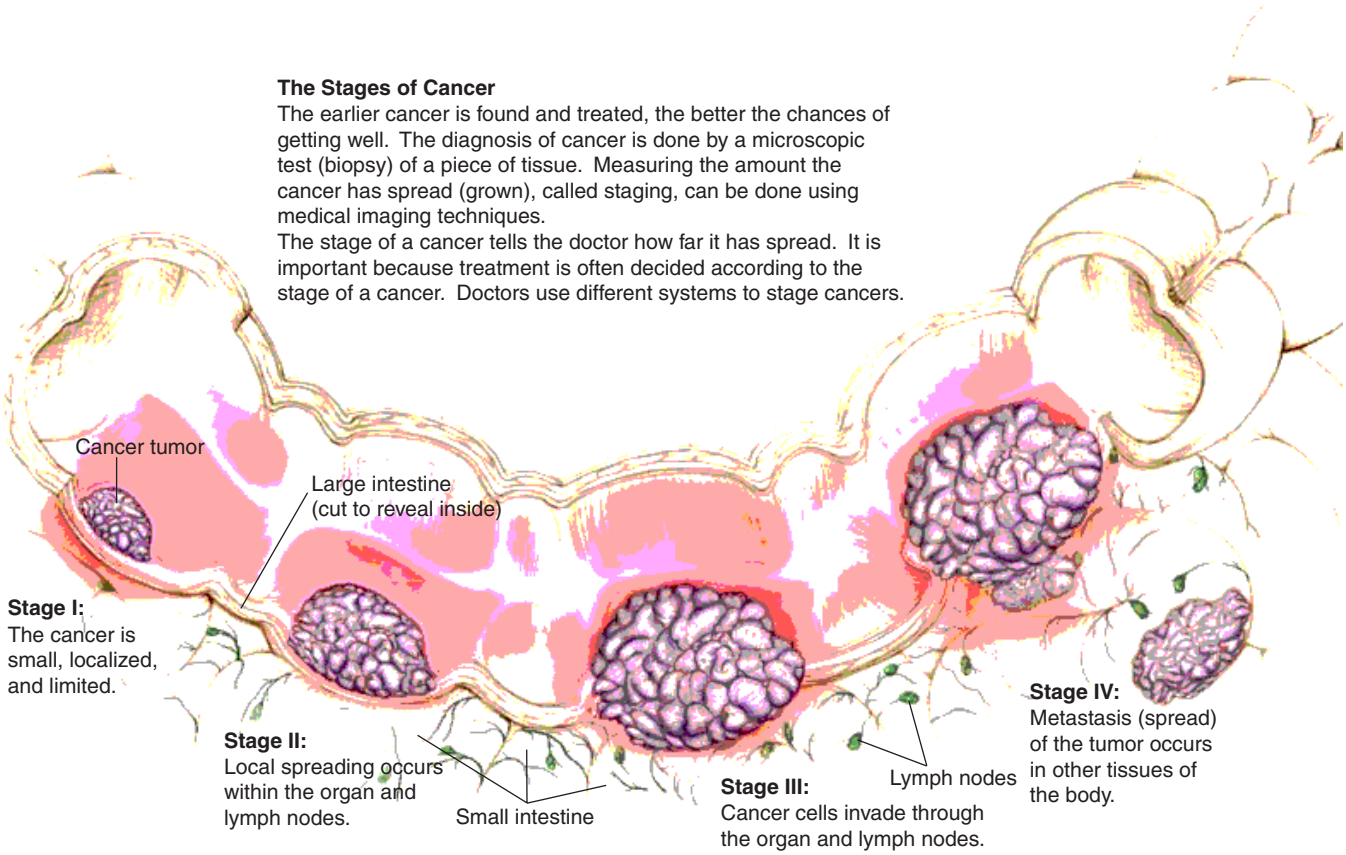
COLORECTAL CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 3–4



Asset provided by Anatomical Chart Co.

DEFINITIONS AND BACKGROUND

Colorectal cancer (CRC) is the third most common type of cancer in the United States, but the second leading cause of cancer deaths. Family history of colorectal cancer is a risk factor in 25% of cases. Hereditary nonpolyposis colorectal cancer (HNPCC, or Lynch syndrome) is one inherited form.

High risk for CRC exists among patients with ulcerative colitis and Crohn's disease after 8 or more years of duration. The incidence of colorectal cancer rises significantly after age 50 and doubles with each successive decade. Cyclooxygenase-2 (COX-2) and its proinflammatory metabolite, prostaglandin E_2 (PGE2), enhance colon cancer progression (Castellone et al, 2005).

Obesity is a risk factor (Fuemmeller et al, 2009). Bile acid deoxycholic acid (DCA) promotes the hyperproliferation of colonic epithelial cells and the risk of colon cancer (Zeng et al, 2009). Table 13-13 lists other factors that either promote or prevent CRC.

The adenomatous polyp is the precursor of most colorectal cancers. In Stage 0 CRC, early cancer is on the innermost layer of the intestine; in Stage 1, it is in the inner layers of the colon; in Stage 2, cancer has spread through the muscle wall of the colon. In Stage 3, the cancer has spread to the lymph nodes and in Stage 4, it has spread to other organs and is usually incurable.

Biomarkers may become a way to find or treat CRC. The 8-OH-dG in colorectal crypts is a biomarker of risk from oxidative DNA damage (Fedirko et al, 2010). Ibuprofen-type drugs, IL6 polymorphisms (rs1800796), and dietary alpha-tocopherol and lycopene significantly decrease the effects of TP53 mutations; beta-carotene and ibuprofen lower the risk of KRAS2 tumors (Slattery et al 2009). The interactions between genes, inflammation, and diet have been elucidated.

Fecal occult blood test and flexible sigmoidoscopy are used for diagnosis. Either standard colonoscopy (optical) or computed tomography (CT) colonoscopy may be used, but the CT (virtual) colonoscopy is not available at all facilities. In **cancer of the small intestine**, malignancy generally is found in the lower duodenum and lower ileum, with a high rate of mortality and few early symptoms; it presents in only 5% of cases. **Rectal cancer** is more common in men than in women and often occurs after middle age, with bleeding, pain, and irregular bowel habits.

In the **colon**, slow-growing malignancies are usually found in the cecum, lower ascending colon, and sigmoid colon. Few early symptoms are found, but the prognosis is optimistic. The right side of the colon (ascending) absorbs fluids and salts; cancer spreads upward here and obstruction is rare. The left side of the colon (the descending colon) stores feces; cancer here tends to encircle the bowel and cause obstructions. If surgery is required, maintaining the ileocecal valve is crucial.

TABLE 13-13 Risks and Protective Factors for Colorectal Cancer

Protective Factors	Risk Factors
Alpha-tocopherol and beta carotene (Slattery et al, 2009)	
Aspirin or nonsteroidal anti-inflammatory drugs (Kaur Saini et al, 2009; Slattery et al, 2009)	Age >50
Calcium and vitamin D_3 (Fedirko et al, 2010; Jenab et al, 2009)	Alcohol intake, excessive (Emmons et al, 2005)
Folic acid (Ulrich, 2005)	Chronic inflammatory and inflammatory cytokines (Bowen et al, 2009)
Lutein and lycopene (Slattery et al, 2009)	Family history of familial adenomatous polyposis (FAP) or hereditary non-polyposis colon cancer (HNPCC)
Green tea	Medical history of colon polyps, inflammatory bowel disease, other types of cancer
Omega-3 fatty acids	Overweight and obesity
Selenium; methylselenol is a critical metabolite (Zeng et al, 2009)	Smoking, particularly at an early age (Botteri et al, 2008; McCleary et al, 2010)
Sulforaphane (broccoli, cruciferous vegetables)	Western-style diet, high in red meat and fat; low in vegetables, folic acid, calcium and vitamin D (Emmons et al, 2005)

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Ulrich CM, et al. Polymorphisms in the reduced folate carrier, thymidylate synthase, or methionine synthase and risk of colon cancer. *Cancer Epidemiol Biomarkers Prev*. 14:2509, 2005.
Zeng H, et al. Deoxycholic acid and selenium metabolite methylselenol exert common and distinct effects on cell cycle, apoptosis, and MAP kinase pathway in HCT116 human colon cancer cells. *Nutr Cancer* 62:85, 2010.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Both cellular factors and genetic changes enhance tumor invasion. Vitamin D receptor (VDR) genes regulate the epithelial changes that initiate tumor cells; the BB genotype of the VDR polymorphism is associated with a reduced risk of colon cancer (Jenab et al, 2009). Chemokine receptor CCR5 expression and increased CD8(+) T-cell infiltration may be found (Zimmermann et al, 2010). While folate status may be linked with CRC because of its role in DNA synthesis, the C>T MTHFR polymorphism decreases risk by 15–18% (Levine et al, 2010). Finally, phosphatase and tensin homolog deleted on chromosome 10 (PTEN) is associated with late stage CRC (Bowen et al, 2009).

Specific Clinical/History

- Height
- Weight
- BMI
- Obesity?
- Unintentional weight loss?
- Diet history
- Rectal bleeding, pain
- Irregular bowel habits
- Alternating diarrhea and constipation
- Abdominal distention, bloating
- Thin, pencil stools
- Weakness
- Anorexia
- Dehydration, electrolyte imbalances
- Intestinal obstruction, bowel abscess
- Fistula
- Proctoscopy
- Colonoscopy
- Digital rectal examination

Lab Work

- CEA level (CEA 125)
- 8-OH-dG in colorectal crypts
- Colon lavage cytology
- Serum folate, B_{12}
- Serum homocysteine
- MTHFR genotyping
- Fecal occult blood test (FOBT)
- H & H (decreased)
- Serum Fe
- Transferrin
- Na^+
- K^+ (often decreased)
- Chol, Trig
- TLC (varies)
- WBC, ESR (increased)
- Alb, transthyretin
- CRP
- Mg^{++}, Ca^{++}
- Serum zinc

SAMPLE NUTRITION CARE PROCESS STEPS

Abnormal Gi Function

Assessment Data: Recent weight loss (10# in 2 months). Diarrhea and constipation; hx of dark, thin stools and blood. Dx of colon cancer.

Nutrition Diagnosis (PES): Abnormal GI function related to alternating diarrhea and constipation as evidenced by dark stools, and constipation 3× weekly on average followed by bloody diarrhea.

Intervention: Food-nutrient delivery—oral nutritional supplement between meals; mild fiber supplement as tolerated. Educate the patient about dietary changes that can be beneficial. Provide counseling about possible nutritional procedures (i.e., colostomy) after surgical resection.

Monitoring and Evaluation: No further weight loss before surgery. Tolerance for fiber in diet and from supplement. Adequate preparation for surgery, followed with appropriate changes in feeding method and counseling after colostomy.

INTERVENTION

OBJECTIVES

- Decrease residue, particularly with obstruction, until fiber is better tolerated.
- Prevent rapid weight loss; correct anemia. Maintain hydration.
- Counteract side effects of therapies: chemotherapy, resection, or radiation. Nutrition counseling improves patient outcomes in radiotherapy (Ravasko et al, 2005).
- Provide nutrients in a tolerable form—oral, parenteral, or enteral.
- Include sufficient total amounts of folate and vitamin B_6 since disrupted DNA synthesis affects carcinogenesis (Sharp et al, 2008).
- Provide sufficient vitamin D_3 (Grant, 2009).
- Prevent or ameliorate starvation diarrhea.
- Protect against recurrence by dietary changes indicated in Table 13-13.

FOOD AND NUTRITION

- CPN or TF may be needed for an extended period of time; include glutamine.
- Administer parenteral fluids with adequate electrolytes, vitamins C and K, and selenium (if used over a long time). Monitor vitamin D, calcium, iron, zinc, and fat intakes for adequacy.
- With ileal resection, vitamin B_{12} deficiency can occur, and bile salts may be lost in diarrhea. Hyperoxaluria and renal oxalate stones can be a problem. With massive bowel resection, malabsorption, malnutrition, metabolic acidosis, and gastric hypersecretion may result.
- With ileostomy and colostomy, salt and sodium/water balance are problems. Ostomy diets may be needed (see ileostomy and colostomy entries in Section 7). Increase energy and ensure adequate protein.
- Decrease fiber until tolerated. Eventually, increase whole grains including rye bread, cereals, fruits, and vegetables.
- Consume less alcohol and more folic acid from spinach, broccoli, asparagus, avocado, orange juice, dried beans, and fortified cereals (Kim, 2007).
- Eat less red meat; use more poultry, fish, tofu, and beans as protein sources.
- Discuss the inclusion of other protective foods, such as calcium-rich foods; lutein and lycopene (tomato products, watermelon, spinach, kale, greens, broccoli, romaine lettuce, and pink grapefruit); cumin; cereal, bean, vegetable, and fruit fiber; flavonoids (apples, onions, green tea, and chamomile tea); cruciferous vegetables; coffee; omega-3

fatty acids from fish and walnuts; selenium foods such as Brazil nuts; and unsaturated fats such as flaxseed, salmon, and canola and olive oils.
- A multivitamin supplement is beneficial, particularly for folic acid and vitamins B_6 and D_3.
- Monitor carefully for lactose intolerance. Use lactase enzyme products when indicated.
- Physical activity should be encouraged as much as possible.

Common Drugs Used and Potential Side Effects

- Chemotherapy may be used for 6–8 months, particularly with stage 3 colon cancer. Monitor for side effects because these agents may further impact bowel function.
- The multidrug combination of oxaliplatin, fluorouracil, and leucovorin is standard treatment for metastatic colorectal carcinoma (Caraglia et al, 2005). Fluorouracil plus levamisole, methotrexate, mitomycin, lomustine, and vincristine may lead to diarrhea, nausea, vomiting, low WBC, and mouth sores.
- Bevacizumab (Avastin) use leads to a significant decrease in colon cancer deaths. Cetuximab (Erbitux), when added to chemotherapy, will shrink tumors and delay progression.
- COX-2 inhibitors may be helpful because 50% of polyps and 85% of colonic tumors in humans overexpress COX-2 (Samoha and Arber, 2005). The nonsteroidal anti-inflammatory drug, Diclofenac, is a preferential COX-2 inhibitor, which can be an effective chemopreventive agent in colon cancer (Kaur et al, 2009).
- Regular low doses of aspirin may reduce prostaglandin production; GI bleeding can result.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Folate vitamers (tetrahydrofolate, 5,10-methylenetetrahydrofolate) should be studied further for their roles in CRC (Sharp et al, 2008).
- With methotrexate (Rheumatrex), avoid echinacea; it may damage the liver.
- A vitamin D_3 supplement, such as 1100 IU daily, seems to be of benefit (Grant, 2009).
- Low-dose fish oil supplementation may be useful to reduce inflammation.
- Sea cucumber extract contains Frondanol A5—a glycolipid extract with potential chemopreventive properties (Janakiram et al, 2009).
- Sour orange (cirtus aurantium) has protective liminoid properties (Perez et al, 2009).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- At first, limit foods that may cause gas, such as corn, broccoli, cauliflower, beans, cabbage, melon, and carbonated beverages. Provide instruction on hydration and the use of fiber to help with bowel management, particularly for rectal cancer patients.
- Family members (offspring and other first-degree relatives) should have a digital examination annually at 40 years of age, stool tests for blood after 50 years of age, and sigmoidoscopy or colonoscopy after age 50 every 3–5 years.
- Medical advice may include regular use of aspirin or nonsteroidal anti-inflammatory drugs (NSAIDs).
- Discuss an appropriate dietary regimen for any specific problems. Weekly Medical Nutrition Therapy (MNT) that includes an individualized nutrition prescription and counseling improves calorie and protein intake, nutrition status, quality of life (QOL), and reduces symptoms of anorexia, nausea, vomiting and diarrhea (American Dietetic Association, 2010).
- Encourage family participation in all levels of care.
- Discuss how to prevent future polyps. High compliance with a low-fat, high-fiber diet is associated with a reduced risk of adenoma recurrence (Sansbury et al, 2009). Omit trans-fatty acids as much as possible (Vinikoor et al, 2009). A high intake of flavonols, which are at greater concentrations in beans, onions, apples, and tea, is also associated with decreased risk (Bobe et al, 2008).
- Suggest an intake of berries, chocolate, coffee, soy foods, folate from foods and supplements, lutein and carotenoids from fruits or vegetables, and whole grains such as rye.
- Encourage dairy products for calcium, vitamin D, and lactose content. If necessary, use lactase enzymes.
- Encourage physical activity when feasible.
- Surveillance following curative treatment generally includes history and physical exams every 6 months for 5 years, then every 3 months for 2 years, and then every 6 months for 3–5 years (Sunga et al, 2005).

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Colon Cancer Page
  http://jama.ama-assn.org/cgi/reprint/300/23/2816.pdf
- Medline Information–Colorectal Cancer
  http://www.nlm.nih.gov/medlineplus/colorectalcancer.html
- National Colorectal Cancer Action Campaign
  http://www.cdc.gov/cancer/screenforlife/

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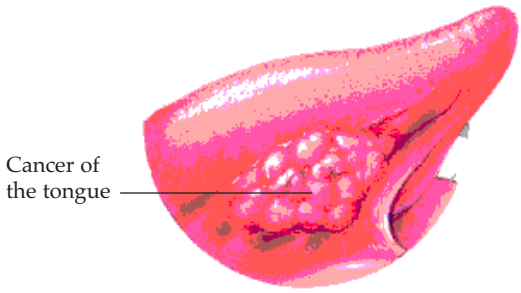
ESOPHAGEAL, HEAD AND NECK, AND THYROID CANCERS

NUTRITIONAL ACUITY RANKING: LEVEL 3–4

Mouth and Throat Cancer

Cancer-causing chemicals from tobacco products increase the risk of cancer of the lip, cheek, tongue, and larynx (voice box). The removal of these cancers can be disfiguring and can result in loss of the larynx.



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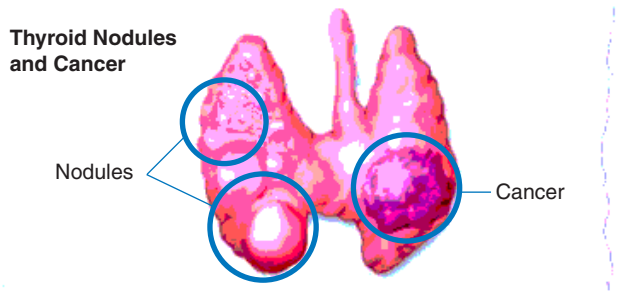

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DEFINITIONS AND BACKGROUND

Head and neck cancers affect esophageal, hypopharyngeal, laryngeal, lip and oral cavity, nasopharyngeal, oropharyngeal, paranasal sinus and nasal cavity, parathyroid, or salivary glands. Annually, approximately 38,000 people in the United States are diagnosed with a head or neck cancer; the highest overall incidence rate is in black males. Tobacco is linked with 85% of these cancers; alcohol is another risk. Obesity is a factor in many cases (Steffen et al, 2009). See Table 13-14 for more details.

Damage from acid reflux may contribute to esophageal cancer. Folate and homocysteine derangements are common. A diet rich in fruits, vegetables, selenium, zinc, and folate is associated with a reduced risk of head and neck cancer (Falciglia et al, 2005; Kane, 2005; Steevens et al, 2010).

Head and neck squamous cell carcinoma (HNSCC) is an aggressive cancer with low survival rates in advanced stages.

TABLE 13-14 Key Factors in Types of Head and Neck Cancer

Site	Comments
Oral cavity	Caused by sun exposure (lip); possibly human papillomavirus (HPV) infection; paan (betel quid) used by Southeast Asians; intake of mate, a tea-like beverage habitually consumed by South Americans. May present with gingival swelling, pain, bleeding, and loosening teeth. The disorder is rare in persons younger than age 40. Risk of metastasis is great; only about half of these individuals will live longer than 5 years.
Nasopharynx	More common in Chinese ancestry. Caused by Epstein-Barr virus infection; occupational exposure to wood dust; and consumption of certain preservatives or salted foods. Signs include unilateral obstruction, epistaxis, pain, otological changes, and nasal obstruction.
Oropharynx	Caused by poor oral hygiene; HPV infection and the use of mouthwash that has a high alcohol content are possible, but not proven, risk factors. There may be a dull ache, dysphagia, referred otalgia, and trismus.
Paranasal sinuses and nasal cavity	Caused by industrial exposures, such as wood or nickel dust inhalation. Tobacco and alcohol use play less of a role in this type of cancer.
Hypopharynx	Plummer-Vinson syndrome is a rare disorder that results from iron and other nutritional deficiencies with severe anemia. Dysphagia results as webs of tissue grow across the upper part of the esophagus.
Larynx	Caused by exposure to airborne particles of asbestos, particularly in the workplace. Voice changes, dysphagia, odynophagia, and dyspnea occur.
Parotid and salivary glands	Caused by radiation to the head and neck. This exposure can come from diagnostic X-rays or from radiation therapy for noncancerous conditions or cancer. Unilateral symptoms and impaired jaw mobility can occur. The parotid gland is the largest salivary gland. Cancer here is rare. Surgery is often curative.
Esophageal cancer	Develops in the middle or lower third of the esophagus. It is one of the more common types of head and neck cancer. It presents as adenocarcinoma or squamous cell cases that require surgical resection. This condition is more common in persons older than 50 years of age, particularly males. Barrett's esophagus (BE) is a premalignant condition associated with esophageal cancer; cyclooxygenase-2 (COX-2) is overexpressed. Aspirin and other nonsteroidal anti-inflammatory drugs may help prevent esophageal cancer. Stage 0 is very early and affects only the first layer of cells; in Stage V, the cancer has metastasized.
Thyroid cancer	A lump on the side of the neck, hoarseness, and dysphagia can be signs. Thyroidectomy may be used, or radioactive iodine (RDI) can be used to destroy cancerous cells that remain after surgery. A low-iodine diet may be needed about 2 weeks before the RDI treatment.

Derived from: National Cancer Institute, http://www.cancer.gov/cancertopics/factsheet/sites-types/head-and-neck, accessed January 9, 2010.

The prognosis for cure worsens as the depth of tumor invasion increases. Surgery is possible for some cases. Cervicofacial and cervicothoracic rotation flaps provide a reliable means to reconstruct complex defects of the face, lateral skull base, and neck (Moore et al, 2005). Many head and neck cancer patients are malnourished before treatment begins, and those who are treated with radiotherapy are at an increased risk of malnutrition due to the severe side effects (Moore et al, 2005; Wood, 2005). Radiation therapy side effects may include odynophagia, dysphagia, mucositis, esophagitis, xerostomia (with occasional osteoradionecrosis), dental caries, weight loss, taste changes, and decreased appetite. Prophylactic placement of a gastrostomy feeding tube is useful.

Thyroid cancer affects approximately 26,000 people in the United States. Thyroid-stimulating hormone (TSH) from the pituitary causes the thyroid gland to produce thyroid hormones and to release thyroglobulin. Papillary tumors are the most common type; they arise as an irregular, solid, or cystic mass from otherwise normal thyroid tissue. Distant metastasis is uncommon, but lung and bone are the most common sites. Tumors that invade or extend beyond the thyroid capsule have a worse prognosis. Often, the thyroid gland is surgically removed as a cure. Thyroxine medicine (Synthroid, Levoxyl, and Unithroid) is needed to keep TSH levels low.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: An epigenome-wide screen has revealed a set of genes that are commonly methylated and downregulated in head and neck cancers (SEPT9, SLC5A8, FUSSEL18, EBF3, and IRX1). All five interact with components of the TGF-beta pathway; their silencing results in a coordinated decrease in apoptosis, increased proliferation, and decreased differentiation (Bennett et al, 2009).

Specific Clinical/History

- Height
- Weight
- BMI
- Obesity?
- Unplanned weight loss
- Diet history
- BP
- I & O
- Dehydration?
- Temperature
- Dysphagia, painful swallowing
- Substernal pain or feeling of fullness
- Regurgitation of undigested food
- Malaise
- Malnutrition
- Anemia

- Regurgitation after eating
- Hiccups, foul breath
- Aspiration
- Increased salivation
- Hoarseness and coughing
- Gingival swelling, pain, bleeding, or hyperplasia
- Nonhealing ulcerative oral lesions
- Mucositis, esophagitis
- Xerostomia
- Dental caries
- Taste changes, decreased appetite
- Loosening teeth
- Oral biopsy
- Esophageal webs with achalasia?
- Palpable mass
- Barium swallow
- Endoscopy
- Nasopharyngoscopy
- Direct laryngoscopy, esophagoscopy
- Biopsy

Lab Work

- Alb, transthyretin
- CRP
- Transferrin
- H & H
- ALT (increased)
- Gluc
- Serum zinc (low?)
- Triiodothyronine (T3)
- Thyroxine (T4)
- Thyroid-stimulating hormone (TSH)
- Ca^{++}, Mg^{++}
- Na^{+}, K^{+}
- Alb, transthyretin
- Chol
- Bicarbonate

INTERVENTION

OBJECTIVES

- Prepare for treatments such as surgery, radiation, or chemotherapy. The dietitian should provide a pretreatment evaluation and weekly visits for 6 weeks during chemoradiation treatment to reduce weight loss, unplanned hospitalization, length of stay, and tolerance for full treatment (American Dietetic Association, 2010).
- Prevent malnutrition, further weight loss, cachexia, and aspiration. Weight loss, caused by acute mucositis and dysphagia, is common during concurrent chemotherapy and irradiation (chemoradiotherapy) of head and neck cancer (Lin et al, 2005).
- Because nutrition support for patients with head and neck cancer is associated with a significant increase in total energy ingestion, placing gastrostomy tubes prophylactically prevents disruption to treatment plans (Moore et al, 2005; Wood, 2005).
- Meet nutritional needs with tube feeding, as needed. Progress to goal with minimal signs and symptoms of intolerance (nausea, fullness). Transition to full or partial oral intake when feasible.
- If resection is needed, fat malabsorption, reflux, dumping syndrome, increased mediastinal pressure, and increased food transit time may be side effects.
- Hydrate adequately; encourage fluids between meals and limit fluid intake at meals to improve intake of other foods.
- Promote adequate wound healing, positive nitrogen balance, and retention of lean body mass.
- Prevent or correct anemia, sepsis, abscesses.
- Monitor for dysphagia, difficulty chewing, mucositis, xerostomia, fibrosis, and dental caries after treatments. Assure adequate mouth care.
- Omit alcoholic beverages and abstain from tobacco, including chewing snuff.
- In patients with advanced cancer: reduce symptoms, preserve organ function, and improve quality of life as much as possible. Provide palliative care if needed.

SAMPLE NUTRITION CARE PROCESS STEPS

Involuntary Weight Loss

Assessment: Recurrent squamous cell carcinoma of the larynx; s/p emergency tracheostomy, radiation and chemotherapy. NPO due to swallowing difficulty; on GT bolus feeding. Elevated BUN & creatinine levels. On oxycodone for pain.

Nutrition Diagnosis (PES): Involuntary weight loss (NC-3.2) related to decreased oral intake and dysphagia as evidenced by weight loss of 21% in 17 months.

Interventions: Nutrient delivery—ND 2.41 enteral feeding tube; ND 3.21 multivitamin supplement.

Education: Discuss home tube feeding that is appropriate for the patient's condition.

Counseling: C-2.2 goal setting: minimize weight loss, maintain adequate hydration, prevent aspiration, and improve quality of life.

Coordination of Nutrition Care: RC-1.1 Interdisciplinary team meeting with nursing, speech therapy, social worker, and recreational therapy.

Monitor and Evaluation: Monitor for weight improvement. No GI problems or enteral nutrition intolerance. Improvement in renal lab values. Reassess nutritional needs via GT. Reassess with speech evaluation for possible transition to full or partial oral intake when feasible.

FOOD AND NUTRITION

- Adjust diet individually to meet the patient's needs. Nutrition support enhances desirable outcomes (Odelli et al, 2005). After radiation: xerostomia, ulceration, bleeding, and pain may result; after chemotherapy, nausea, vomiting, weakness, and fatigue may occur (Dixon, 2005).
- Be careful not to create refeeding syndrome, which is potentially fatal. Progress slowly in patients who have been malnourished for a week or longer. Begin with 10 kcal/kg per day and increase slowly; use thiamin and other B-complex vitamins in a supplement (Mehanna et al, 2009).
- Eventually, provide a diet high in energy and protein with bland or pureed foods as required: 30–35 kcal/kg; 1.0–1.5 g protein/kg.
- A dysphagia diet (thick pureed foods, decrease in thin liquids) may be needed. Tolerance will vary for hot and cold foods and drinks; monitor and alter intake accordingly.
- Patients are often fed with gastrostomy or jejunostomy feedings. Cellular and morphological changes follow a period of malnutrition; enteral feeding is an important strategy for maintaining gut integrity and function (Sica et al, 2005). Use enteral feeding formulas that are high in omega-3 fatty acids (Aiko et al, 2005) and arginine (De Luis et al, 2009).
- Increase fluid intake as tolerated; dehydration is common.

- Increase intake of vitamins D_3, A and C; zinc; and other nutrients that may be low. Otherwise, a multivitamin–mineral supplement is indicated if oral intake is not possible.
- If esophagectomy has been performed, gastric stasis or dumping syndrome may occur. The use of needle catheter jejunostomy (NCJ) is safe, with an extremely low rate of complications over a prolonged period at low costs (Sica et al, 2005).
- If an oral diet is possible, omit irritants such as black pepper and chili powder and dilute acidic fruits or juices such as orange, grapefruit, and tomato.
- Use protective foods to prevent recurrence; use beans, vegetables, fish, foods rich in zinc and lycopene, whole grains, citrus fruits, and vitamin C–rich foods.
- Polyphenols show great promise; EGCG in green tea is particularly beneficial (Baumeister et al, 2009).
- With thyroid cancer, a low-iodine diet may be needed prior to surgery or treatment.
- In advanced cases, offer palliative care. Hydration and comfort are the focus.

Common Drugs Used and Potential Side Effects

- Aspirin can lower esophageal cancer risk by 90% by reducing prostaglandin production. Some doctors will prescribe a low daily dose to prevent recurrence.
- Chemotherapy with cisplatin may be used, along with radiation therapy. Cisplatin can cause nausea, vomiting, altered taste, changes in renal function, and diarrhea. Weight loss during cisplatin-containing chemoradiotherapy is associated with reduced kidney function; findings highlight the importance of intensive supportive measures of nutrition and hydration beyond standard measures, and these steps should be started before 10% weight loss occurs (Lin et al, 2005).
- Bleomycin and methotrexate can lead to nausea, vomiting, anorexia, or stomatitis.
- Steroids may be used to reduce inflammation; hyperglycemia, sodium retention, potassium depletion, and negative nitrogen balance can result.
- Pilocarpine may be used as a saliva substitute for xerostomia.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Avoid the use of echinacea with cyclosporine or methotrexate (Rheumatrex) because of potential damage to the liver. Avoid St. John's wort also.
- Curcumin is a powerful inhibitor of COX-2 expression (Khafif et al, 2009).
- L-carnitine is sometimes used to decrease toxicity from agents such as bleomycin.
- Zinc supplementation helps in managing mucositis after radiation.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss a diet rationale that is appropriate for the patient's condition. If the patient can eat orally, encourage him or her to chew slowly.
- If jejunostomy feeding is required after esophagastric surgery, teach the patient/family/caretaker how to prepare feedings and how to produce the item in a clean environment.
- During radiation therapy/surgical recovery, patients with gastrostomy tubes should be encouraged to practice swallowing exercises, as prescribed by the speech pathologist, to maintain swallowing function and reduce the risk of fibrosis. Encourage help from speech therapy.
- Hypothyroid status can cause dysphagia; counsel accordingly.
- If oral diet is possible, discuss the use of protective foods.
- Relaxation therapy or biofeedback can be beneficial.
- Radiation-induced fibrosis (RIF) is caused by reduced blood supply months or years later. Rinse with vitamin E solutions and use 1000 IU tocopherol with pentoxifylline to decrease mucositis (Chiao and Lee, 2005; Haddad et al, 2005). Use small frequent feedings and oral supplements.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.
- For home tube feeding or CPN, teach the principles of safe handling and administration. Discuss the signs of infection or intolerance and when to contact the health team.

For More Information

- CancerLinks USA–Esophageal Cancer
  http://www.cancerlinksusa.com/esophagus/wynk/
- Liquid Diets
  http://www.cancer.gov/cancertopics/eatinghints/page7
- Low Iodine Cookbook
  http://www.thyca.org/Cookbook.pdf
- Medline–Esophageal Cancer
  http://www.nlm.nih.gov/medlineplus/esophagealcancer.html
- National Cancer Institute–Esophageal Cancer – Nutrition
  http://www.cancer.gov/cancertopics/wyntk/esophagus/page12
- National Institutes of Health Cancer Information
  http://www.nidr.nih.gov/Spectrum/NIDCR3/3menu.htm
- Thyroid Cancer Survivors' Association
  http://www.thyca.org/
- Thyroid Cancer – Mayo Clinic
  http://www.mayoclinic.com/health/thyroid-cancer/DS00492

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GASTRIC CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 3–4

DEFINITIONS AND BACKGROUND

Gastric cancer (GC) is a carcinoma that most commonly occurs in the pyloric segment and along the lesser curvature. Cancer that begins in the glandular cells is an adenoma; this type is over 90% of gastric cancers. If the cancer starts in the immune system, it is a lymphoma; if it starts in the hormonal system, it is called carcinoid syndrome. Another very rare form starts in the nervous system and is called a gastrointestinal stromal tumor (GIST). Diffuse forms have a poor prognosis.

In GC, early definitive signs are rare. GC may follow long-term pernicious anemia, Ménétrier's disease, or chronic gastritis. It is generally found in males aged 50–70 years and among smokers. While frequency is low in the United States, it is high in Japan and China. Gastric carcinoma is the second leading cause of cancer-related deaths in the world, accounting for more than 700,000 deaths each year (Hatakeyama, 2009).

Helicobacter pylori infection plays a role. Chemokine production and antiapoptosis are mediated by *H. pylori* and may drive lymphocytes to malignancy. Infection with cagA-positive *H. pylori* plays an essential role; this protein is delivered into gastric epithelial cells via the bacterial secretion system where it contributes to the transformation of gastric epithelial cells (Hatakeyama, 2009). See Table 13-15 for other risk factors.

A recent study shows a protective role for riboflavin and vitamin B_6 (Eussen et al, 2010). Physical activity and eating a diet high in fruits, vegetables, beta-carotene, and vitamin C may also decrease the risk for GC (Kim et al, 2005; Vigen et al, 2006). Greater adherence to a Mediterranean dietary pattern is associated with a significant reduction in the risk of incident GC (Buckland et al, 2009).

Surgery is the most common treatment. Very small, stage 1 cancers that are limited to the inside lining of the stomach may be removed using endoscopy. In a subtotal gastrectomy, only the affected stomach portion is removed. In stages 3 or 4, it may be necessary to remove the entire stomach and connect the esophagus to the small intestine. Laparoscopic surgery is less invasive and recovery is faster.

Neoadjuvant radiation may be used before surgery to shrink a stomach tumor, or it can also be used after surgery to kill any remaining cancer cells. Radiation therapy may cause diarrhea, nausea, or vomiting. Chemotherapy may also be used along with radiation therapy or for advanced cancers that cannot be treated through surgery.

TABLE 13-15 Risks for Gastric Cancer

Advanced age
Chronic atrophic gastritis, pernicious anemia, gastric polyps
Diet high in red meat
Diet high in salt, salted foods, smoked and preserved foods
Diet low in vitamin E or selenium
Eating foods contaminated with aflatoxin fungus
Ethnicity—young white and Hispanic males; African-Americans from poor socioeconomic backgrounds
Family history of gastric cancer, Ménétrier's disease, intestinal metaplasia
H. pylori gastric infection
Low use of fruits and vegetables
Male gender
Smoking

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Genetic predisposition is a risk factor in gastric cancer. Aberrant methylation of several genes is noted; some have a poor prognosis. E-cadherin is involved with diffuse forms; and SNP analysis (including IL1B) may elucidate the role of inflammation and stem cells in premalignant lesions (Milne et al, 2009).

Specific Clinical/ History

- Height
- Weight
- BMI
- Weight loss?
- Diet history
- I & O
- Dehydration?
- BP
- Feeling of fullness
- Indigestion, belching
- Dysphagia
- Anorexia
- Anemia, pallor
- Vertigo
- Nausea or vomiting
- Melena
- MRI or CT scan
- Barium swallow
- Endoscopy

Lab Work

- *H. pylori*
- Low serum pepsinogen I/II ratio
- Alb, transthyretin
- CRP
- Ca^{++}, Mg^{++}
- Na^{+}, K^{+}
- Gluc
- H & H
- Transferrin
- ALT (increased)
- Melena, occult blood
- Serum folic acid, B_{12}

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Mineral Intake

Assessment Data: Diagnosis of gastric cancer, stage 1; several small polyps found on endoscopy. BMI normal, no sign of *H. pylori*. Lives in region known to have low levels of selenium in the soil (coastal Carolinas). Diet history indicates no intake of selenium-rich foods or multivitamin–mineral supplementation. Some nausea and melena noted.

Nutrition Diagnosis (PES): Inadequate selenium intake related to poor diet and supplementation as evidenced by diet history and residence in area known to have selenium-poor soil.

Intervention: Food-Nutrient Delivery—Provide foods high in selenium; encourage the use of a daily multivitamin supplement that contains the daily value for selenium. Educate—teach the patient and family about food sources of selenium. Counseling—provide tips on other cancer preventive factors. Coordinate care with the medical team after the surgical removal of the gastric polyps.

Monitoring and Evaluation: Successful minor surgery. Improvement in intake of selenium from food and daily supplement; better intake of other protective factors. Able to maintain BMI within desirable range. No further melena or nausea.

INTERVENTION

OBJECTIVES

- Prevent or reverse weight loss and further malnutrition.
- Encourage fluids.
- Counteract side effects of chemotherapy, radiation, or gastrectomy. If gastrectomy is performed, dumping syndrome or hypochlorhydria may result.
- Promote wound healing. Replete visceral proteins as stress level decreases.
- Correct protein-losing enteropathy.
- Prevent cancer recurrence by including protective foods.
- Improve quality of life.

FOOD AND NUTRITION

- Parenteral therapy may be used, particularly before surgery.
- If oral diet is possible, include protective foods such as *Allium* in garlic (raw or lightly cooked), carotenoids and lycopene (Ito et al, 2005), fish, fruits, nonherbal tea, indoles and sulforaphane from cruciferous vegetables, and quercetin from apples and yellow onions. Vitamin B_6 and riboflavin should be included (Eussenn et al, 2010) as should selenium and vitamin E (Qiao et al, 2009).
- After resection, patients are often volume-sensitive and need small meals and snacks with fluids between meals. When oral intake is allowed, try light meals that are nutrient-dense, high-protein/high-energy. Drink 35 mL/kg of fluid or more, unless contraindicated.
- After gastrectomy, manage dumping syndrome, where undigested food enters the small intestine too quickly. Small, frequent feedings may be better tolerated. Concentrated carbohydrates, alcohol, and carbonated beverages should be severely limited or omitted. See entry in Section 7 also.
- Jejunostomy feeding may be needed at the time of a resection. Monitor tolerance carefully.
- Be sure that dietary intake and supplementation includes selenium, zinc, vitamin C, and other key nutrients for wound healing and correction of anemia. Take supplements with food.

Common Drugs Used and Potential Side Effects

- Antibiotic therapy is needed to eradicate *H. pylori* bacteria where present.
- Cytotoxic drugs such as mitomycin C may cause fever, nausea, vomiting, anorexia, and stomatitis.
- With fluorouracil (FU), anorexia and nausea are common. Sore mouth, taste changes, and vomiting also may result. Added thiamin is recommended, and leucovorin is often used with FU.
- In a rare form of gastrointestinal stromal tumor (GIST), imatinib (Gleevec) is useful; it interferes with an abnormal enzyme that sends signals to the nucleus of a cancer cell. Nausea and vomiting are potential side effects. Imatinib shrinks tumors by more than half with minimal side effects (Heinrich and Corless, 2005).

- Sunitinib (Sutent) is useful in stomach cancer when imatinib is not effective.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Treatment with a combination of 50 micrograms of selenium, 30 milligrams of vitamin E, and 15 milligrams of beta-carotene leads to decreased mortality from gastric cancer (Qiao et al, 2009).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Feeding tubes such as jejunostomy may be useful in the home setting.
- If eating orally, instruct patient on postgastrectomy diet. Encourage patient to chew slowly and well.
- Discuss protective foods and phytochemicals.
- If the stomach was resected, vitamin B_{12} anemia is likely to occur within several years; monitor carefully. Injections will likely be needed for life.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.
- With tube feeding, discuss the safe handling of formula and tubing.

For More Information

- *H. pylori* and Cancer Fact Sheet
  http://www.cancer.gov/cancertopics/factsheet/risk/h-pylori-cancer
- Memorial Sloan-Kettering Cancer Center
  http://www.mskcc.org/mskcc/html/1467.cfm
- National Cancer Institute–Gastric Cancer
  http://www.cancer.gov/cancerinfo/pdq/treatment/gastric/healthprofessional
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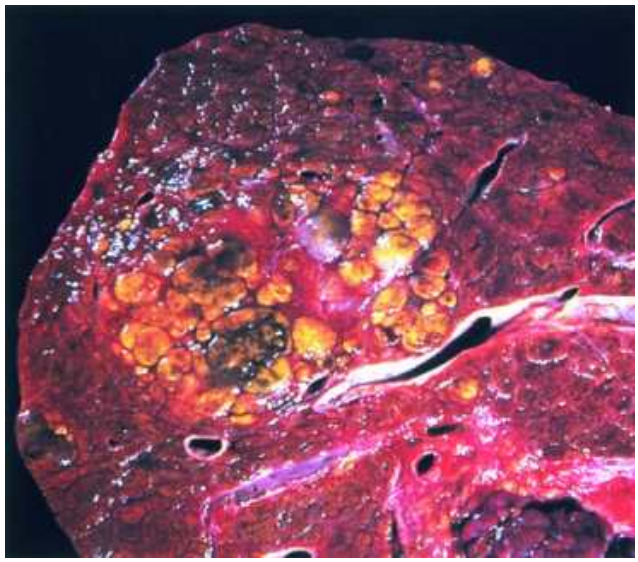
LIVER CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 3–4



Adapted from: Rubin E MD and Farber JL MD. *Pathology,* 3rd ed. Philadelphia: Lippincott Williams & Wilkins, 1999.

DEFINITIONS AND BACKGROUND

Liver cancer (hepatocellular carcinoma, HCC) is the fifth most common cancer and is one of the leading causes of cancer death worldwide (Yam et al, 2010). Primary hepatic tumors are common with alcohol abuse, aflatoxin ingestion, chronic hepatitis, or low weight at birth (see Table 13-16). HCC may develop after years of chronic inflammation and persistent mucosal or epithelial cell colonization by hepatitis B or C viruses. Malignant hepatic tumors are common due to metastatic lesions from other organs. HCC accounts for almost half a million cancer deaths a year, and the incidence is escalating in the Western world and in developing countries. HCC progresses in a stepwise manner, mostly regulated by gene expression; untreated liver cancer may rapidly lead to death within a year.

Early identification of malnutrition status is required for proper intervention. In one study, over 60% of hospitalized patients were malnourished; the prevalence was higher in

TABLE 13-16 Risk Factors for Liver Cancer

Aflatoxins (Voight, 2005)
Anabolic steroids
Arsenic in drinking water
Cirrhosis from alcohol abuse or hemochromatosis (Kuper et al, 2001)
Male gender
Liver disease: hepatitis B virus (HBV) and hepatitis C virus (HCV)
Obesity
Oral contraceptive use (higher dose estrogen)
Tobacco use
Vinyl chloride and thorium dioxide (Voight, 2005)

male patients with long hospital stays, readmitted patients, and patients who had liver cancer (Wie et al, 2009).

Surgical resection is sometimes possible in some cases; laparoscopic procedures are becoming more common. Laser-induced thermotherapy for the treatment of liver metastases may be an option. In some cases, liver transplantation may be possible.

Chemotherapy may be administered. Where radiation is used, radioactive substances are sent into the artery that leads directly to the liver. Computed tomography–guided focal liver irradiation combined with chemotherapy delivered via the hepatic artery may extend the lives of patients with unresectable cancer.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: HCC is strongly linked to increases in allelic losses, chromosomal changes, gene mutations, epigenetic alterations, and alterations in molecular cellular pathways (Yam et al, 2010).

Specific Clinical/History

Height
Weight
BMI
Progressive weight loss
I & O, dehydration
Anorexia, weakness
Nausea and/or vomiting
Increased flatulence
Steatorrhea, diarrhea
Abdominal fullness
Low-grade fever
Anemia, malnutrition
Portal hypertension
Dyspnea
Jaundice, ascites
Hepatic coma?
Melena
Hepatomegaly
Temperature (fever?)
Alcohol abuse?
Pesticide exposure?
CT or MRI

Lab Work

Alpha-fetoprotein (AFP)
Prothrombin time (PT) (prolonged)
H & H
Transferrin
Aspartate aminotransferase (AST) – altered?
ALT (abnormal)
Sedimentation rate (ESR), increased?
Ca^{++}, Mg^{++}
Na^{+}, K^{+}
Ammonia
Alb (decreased), transthyretin
CRP
Gluc (decreased)
Alk phos
TLC (varies)

INTERVENTION

OBJECTIVES

- Reduce fluid retention and ascites.
- Correct serum protein levels and improve hepatic production capacity.
- Prevent further nausea and vomiting, weight loss, anorexia, and malnutrition.
- Counteract side effects of therapy (e.g., surgery, chemotherapy, radiation).
- Improve overall nutritional and hematologic status.
- Maintain adequate hydration.
- Improve prognosis and prolong life as long as possible. Improve quality of life.

FOOD AND NUTRITION

- Tube feed if oral diet is not feasible; patients with hepatic cancer usually have significant fluid balance/overload/retention problems. Avoid CPN.
- Progress, if and when tolerated, to high-protein diet with sufficient carbohydrate intake. Managing weight will be important to prolong life; a carefully planned weight loss diet is needed in those patients who are obese.
- If hepatic coma occurs, decrease protein and supplement with amino acids (see hepatic encephalopathy in Section 8). Branched-chain amino acids may be beneficial (Togo et al, 2005).

SAMPLE NUTRITION CARE PROCESS STEPS

Poor Nutritional Quality of Life

Assessment Data: Liver cancer patient, weight loss of 5# in the past 2 weeks. Anorexia, nausea, and vomiting while on chemotherapy. Very fatigued.

Nutrition Diagnosis (PES): Poor nutritional quality of life related to chemotherapy treatments as evidenced by fatigue, anorexia, nausea, and vomiting.

Intervention: Food and nutrient delivery—offer preferred foods and beverages. Educate the patient about ways to enhance nutrient and energy density in smaller, more frequent meals. Counsel about ways to manage nausea and vomiting during chemotherapy weeks.

Monitoring and Evaluation: Improvement in intake. Tolerance of chemotherapy. No further weight loss. Improved nutritional quality of life.

- Reduce sodium if ascites and edema are significant; extra protein may be needed if albumin is also low. Monitor serum levels of other electrolytes to determine if other restrictions are needed.
- Supplemental vitamins may be beneficial. Monitor serum levels of vitamins A, D, and K because of poor hepatic clearance.
- With surgery, monitor nutritional intake for adequate wound healing and recovery.
- Encourage small meals and snacks as tolerated throughout the day.
- Decreased calcium absorption may occur after surgery. Calcium supplementation is needed, particularly in postmenopausal women.

Common Drugs Used and Potential Side Effects

- Antiemetics may be used for vomiting.
- Diuretics are used commonly; monitor side effects carefully.
- Chemotherapy may include cisplatin, interferon, doxorubicin, and fluorouracil.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Use of prebiotics (inulin and oligosaccharides) and silymarin may be protective.
- Polyphenols, mainly flavonoids and tannins, prevent oxidative stress-induced injury (Soory, 2009). Resveratrol has anti-inflammatory action through hepatic cyclooxygenase (COX-2) inhibition (Luther et al, 2009).
- Vitamin D_3 can be used to treat HCC, but hypercalcemia limits its use; a lower dose is possible if fish oil is given at the same time (Chiang et al, 2009).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Hepatic cancer from hepatitis C virus infection warrants maintaining a lean weight to prolong life.
- Teach the patient about the signs of deficiency of vitamins K and C, such as bleeding gums and easy bruising.
- Discuss signs of hepatic coma that require dietary alterations.
- Encourage hepatitis B virus vaccination and offer information.
- Provide education related to diet (regular, six small feedings) or jejunostomy tube feeding.
- Community-based programs to discourage and deal with excessive alcohol intake, to promote tobacco smoking awareness, and to avoid exposure to aflatoxin and other food toxins and measures taken to reduce the pandemic of obesity and diabetes are vital for lowering the incidence of HCC from nonviral liver disease (Fan et al, 2009).

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.
- Offer tips for managing jejunostomy tube feeding safely at home under sanitary preparation and storage methods.

For More Information

- American Liver Foundation
  http://www.liverfoundation.org/
- Liver Cancer in Children
  http://www.childrenshospital.org/az/Site1015/mainpageS1015P0.html
- Medline–Liver Cancer
  http://www.nlm.nih.gov/medlineplus/livercancer.html

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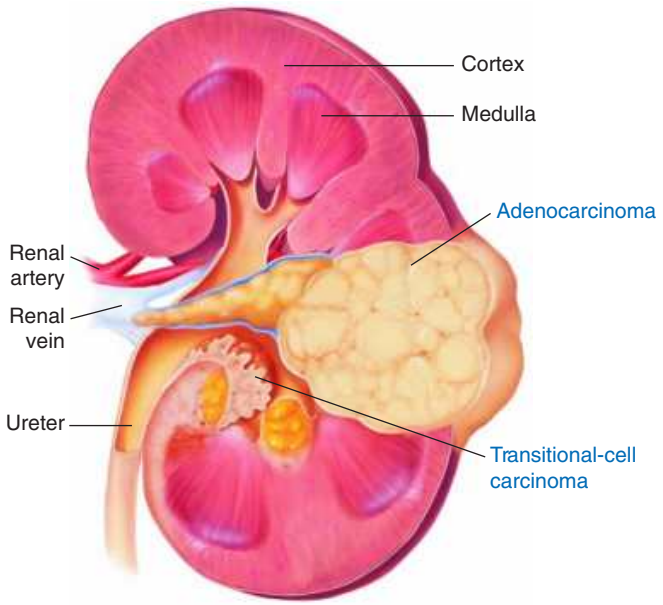
KIDNEY, BLADDER, AND URINARY TRACT CANCERS

NUTRITIONAL ACUITY RANKING: LEVEL 3



Asset provided by Anatomical Chart Co.

DEFINITIONS AND BACKGROUND

Urinary tract cancers affect more than 50,000 Americans each year. Men are more prone to this type of cancer than women. Surgery is usually required; prognosis with early intervention is good. Survival has improved. Fruit, extra fluids, vitamin C, retinol, daily multivitamin supplements, and green and nonherbal tea tend to be protective. It is likely that vitamin D_3 plays a role as well (Grant, 2009).

Renal cell cancer (RCC) accounts for approximately 2% of cancers worldwide. It is most common in persons over 45 years of age, particularly among blacks. Blood in the urine and an increased frequency of urination are the most common symptoms. Smoking, long-term dialysis, occupational exposure to dyes, rubber, and leather products are risk factors. Hypertension increases the risk of RCC in both sexes, while effective blood pressure control may lower the risk (Weikert et al, 2008). Finally, obesity contributes to morbidity and mortality in renal cancer (Anderson and Caswell, 2009). Total consumption of fruits, vegetables, fat, red meat, processed meat, poultry, and seafood are not associated with the risk of RCC (Lee et al, 2008; Weikert et al, 2006). RCC can often be cured if it is diagnosed and treated when still localized to the kidney. Fortunately, the majority of patients are diagnosed at that time. Surgical resection or nephrectomy may be needed.

Wilms' tumor (nephroblastoma or embryoma of the kidney) is a highly malignant tumor occurring almost exclusively in children younger than 6 years of age. It is more common in girls than in boys, and in African-American children. Symptoms and signs include weight loss, anorexia, enlarged kidney, hypertension, fever, anemia, and abdominal pain. A cure may be possible if metastasis has not occurred before nephrectomy. There is now an overall survival rate of 85%, and treatment-related morbidity has been reduced by chemotherapy (Gommersall et al, 2005). Metastasis to lungs, liver, and brain can occur.

Bladder cancer can be caused by factors such as smoking, exposure to chemicals at work (such as hair dyes, textiles, and paint), old age, chronic bladder infections, and infectious parasites. Well water should be tested for arsenic. Bladder cancer is more common in Caucasians. It can often be cured in the early stages using surgery, radiation, chemotherapy, or immunotherapy. If dual nephrectomy is needed, as in a stage 5 tumor, permanent dialysis may be required until a transplant is possible.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Mutation of the VHL gene is associated with the development of RCC and the overexpression of the angiogenesis pathway (George and Bukowski, 2009). Some cases of Wilms' tumor are related to defects in either Wilms' tumor 1 (WT1) or Wilms' tumor 2 (WT2) or to several other genes.

Specific Clinical/History

- Height
- Weight
- Weight changes
- BMI (obesity?)
- Growth percentile in child
- Diet history
- BP (increased)
- I & O; dehydration?
- Hematuria
- Anorexia
- Enlarged kidney?
- Fever?
- Abdominal or lower back pain
- Smoking history
- Painful urination
- Frequent urinary tract infections
- Incontinence
- Abdominal CT scan
- Cystoscopy
- X-ray (intravenous pyelogram)
- Bone scan for metastasis
- Urine cytology

Lab Work

- Urinalysis
- Ca^{++}, Mg^{++}
- Na^{+}, K^{+}
- Alb, transthyretin
- CRP
- BUN
- Creat
- Gluc
- H & H (low?)
- Serum Fe, ferritin
- Transferrin
- Liver function tests
- ALT

SAMPLE NUTRITION CARE PROCESS STEPS

Unintentional Weight Loss

Assessment Data: BMI 20, down from the usual BMI of 24. Poor appetite, stomatitis. Taking temsirolimus for renal cancer.

Nutrition Diagnosis (PES): Unintentional weight loss related to anorexia and stomatitis as evidenced by a BMI of 20 when the usual is 24.

Intervention: Food-Nutrient Delivery—Suggest small, frequent meals of low-acid, mild foods and beverages. Educate the patient about foods that are more easily tolerated with stomatitis. Counsel about the long-term efforts to regain lost weight to tolerate cancer therapies; surgery is a possibility.

Monitoring and Evaluation: No further weight loss; tolerating medication and treatments while managing side effects.

INTERVENTION

OBJECTIVES

- If needed, prepare patient for surgery and for postsurgical wound healing.
- Control the side effects of radiotherapy and chemotherapy.
- Promote normal growth and development, as far as possible, in children and teens.
- Control hypertension; correct anemia, which is common.
- Maintain adequate hydration.
- Minimize unplanned weight loss.
- Promote adequate bowel function.

FOOD AND NUTRITION

- Provide adequate energy and protein according to age and to compensate for weight loss. In obese adults, weight loss regimens are not recommended until several months after surgery.
- Restrict excessive sodium with hypertension. Provide sufficient potassium, calcium, and magnesium; supplement if necessary.
- Monitor protein tolerance and adjust according to lab values, blood pressure, edema, and other signs of renal failure.
- Ensure adequate fluid intake, particularly water.
- Follow the Mediterranean or DASH diets, which encourage plenty of fruits and vegetables that are rich in antioxidants. Include fish that contains omega-3 fatty acids.

Common Drugs Used and Potential Side Effects

- Rapamycin (mTOR) controls translation of key proteins during cancer cell proliferation; temsirolimus is the first mTOR inhibitor approved for the treatment of advanced RCC (Hudes et al, 2009). Side effects may include hyperglycemia, hyperlipidemia, stomatitis, rash, or even pneumonitis.
- Interferon and interleukin-2 may also be used in advanced kidney cancer. Interferon often causes patients to have flu-like symptoms, and nausea and vomiting are common; interleukin-2 can cause nausea and vomiting or fluid retention. Sunitinib (Sutent) is useful in advanced kidney cancer where chemotherapy has not been effective.
- Zoledronic acid is a bisphosphonate that is approved for preventing fractures after bone metastasis from renal cancer.
- For **bladder cancer,** chemotherapy often involves carboplatin, fluorouracil, cisplatin, cyclophosphamide, methotrexate, or vinblastine. Many side effects are common, including nausea, anorexia, diarrhea, or vomiting. The use of gemcitabine and cisplatin is as useful as older treatments.
- **Wilms' tumor** requires perioperative vincristine and dactinomycin, with or without doxorubicin or radiotherapy (Gommersall et al, 2005).

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician. Herbal preparations are subject to contamination with metals such as mercury or may contain potassium—all of which can be harmful to the kidney.
- Some studies promote the use of green tea for prevention, but others have not identified its efficacy.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the side effects that the patient is experiencing in light of the therapies used (e.g., radiation therapy, chemotherapy, or surgery).
- Discuss normal growth and/or desirable weight for the patient. Obesity is a concern.
- Highlight meals that are attractive so that the patient eats as well as possible. Cut down on fried meats and fats.
- Discuss how to manage anemia through appropriate medications or dietary measures.
- There is no risk for bladder or renal cancers from the use of artificial sweeteners.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.
- In some countries, schistosomiasis infestation is a risk. Monitor for water and food safety.

For More Information

- Bladder Cancer
  http://www.mayoclinic.com/health/bladder-cancer/DS00177
- Kidney Cancer Association
  http://www.kidneycancerassociation.org/

- Medine – Bladder Cancer
  http://www.nlm.nih.gov/medlineplus/ency/article/000486.htm
- Medline–Kidney Cancer
  http://www.nlm.nih.gov/medlineplus/kidneycancer.html
- National Kidney Foundation – Council on Renal Nutrition
  http://www.kidney.org/professionals/CRN/
- Wilms' Tumor – Mayo Clinic
  http://www.mayoclinic.com/health/wilms-tumor/DS00436

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LUNG CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 3–4

Bronchiolar carcinoma infiltrating growth

Adapted from: Moore KL, PhD, FRSM, FIAC & Dalley AF II, PhD. *Clinical Oriented Anatomy,* 4th ed. Baltimore, Lippincott Williams & Wilkins 1999.

DEFINITIONS AND BACKGROUND

Lung (bronchial) cancer begins in the lungs and is the most common type of cancer in the Western world. There are two main types of lung cancer: non–small-cell lung cancer and small-cell lung cancer. **Non–small-cell lung cancer (NSCLC)** has three major subtypes: adenocarcinoma (40% of cases), squamous carcinoma (30–35% of cases, slow growing, and formerly called epidermoid carcinoma), and large-cell carcinoma (affecting 5–15% of cases). NSCLC is the leading cause of cancer-related death in the United States (Budde and Hanna, 2005).

Small-cell lung cancer (SCLC) is a more aggressive type of lung cancer that comprises 15% of all lung cancer diagnoses. It is highly correlated to smoking. SCLCs grow quickly but tend to respond to specific chemotherapy protocols. Oat cell cancer is a highly fatal form of SCLC; aggressive chemotherapy is needed.

In 85% of cases, smoking causes lung cancer. Heavy tobacco or marijuana smokers are 25 times more susceptible to lung cancer. Other causes include exposure to industrial chemicals, radon, and passive smoke. Smoking is associated with lower levels of vitamin C. The best protection against lung cancer is the avoidance of airborne carcinogens and increased consumption of fruits and vegetables (Cranganu and Camporeale, 2009).

Foods rich in flavonoids may protect against certain types of lung cancer. Onions and apples have quercetin. Vitamin E food sources (gamma-tocopherol) are protective; supplemental alpha-tocopherol is not. Resveratrol may be beneficial, but excess alcohol is not (Barnardi et al, 2010). Antioxidant sources seems to be an important issue.

The focus should be on food; supplemental beta-carotene is a concern (Roswall et al, 2010) whereas dietary beta-carotene is protective against lung cancer. Cryptoxanthin, alpha-carotene, and ascorbic acid need to be investigated further as potentially protective factors (Comstock et al, 2008). Isothiocyanates from cruciferous vegetables are anticarcinogenic. Because the glutathione S transferase M1 (GSTM1) gene promotes urinary isothiocyanate excretion, the reduced lung cancer risk with higher isothiocyanate intake may be slightly stronger among individuals with a deletion of GSTM1 and GSTT1 (Carpenter et al, 2009; Lam et al, 2009). Novel interventions to prevent lung cancer should be developed based on the ability of diet and dietary supplements to affect reprogramming of the epigenome (Stidley et al, 2010).

Lung cancer's 5-year survival rate is only 15%, which is worse than many other types of cancer. Cancer cells of the lung often spread to the brain, bone, liver, and skin. Radiation and chemotherapy are needed, but surgery after standard chemotherapy and radiation can be an option for some patients. Medical nutrition therapy is often required for the nutrition-related side effects of cancer treatment, which include anorexia, nausea and vomiting, and esophagitis (Cranganu and Camporeale, 2009).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Eight genes are commonly silenced in lung cancer and are associated with risk. Smoke-induced methylation may reduce HtrA3 expression, which is one concern (Beleford et al, 2010). Promoter methylation factors are controlled with the use of leafy green vegetables, folate, and the use of multivitamins (Stidley et al, 2010). Epidermal growth factor receptor (EGFR) mutations in tumors are prognostic markers in patients with early stage lung cancer. Tumor microRNAs may help to predict SCLC patients who are resistant to chemotherapy.

Specific Clinical/History

- Height
- Weight
- BMI
- Diet history
- I & O
- Weight loss?
- Fever of unknown cause
- Persistent cough
- Bloody sputum
- Chest pain
- Recurring pneumonia or bronchitis
- Fatigue
- Hoarseness
- Shortness of breath
- Swelling of neck or face
- Bronchoscopy
- Biopsy
- MRI, CT scan
- Thoracentesis
- Chest x-ray
- Sputum cytology

Lab Work

- Partial pressure of carbon dioxide (pCO_2)
- Partial pressure of oxygen (pO_2)
- CEA
- Alb, transthyretin
- Gluc
- CRP
- Ca^{++}, Mg^{++}
- Na^{+}, K^{+}
- ALT (increased)

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Intake From Parenteral Infusion

Assessment Data: Inability to eat due to esophagitis over the past 1–2 days. Patient has been receiving chemotherapy treatment for lung cancer. Patient is only on PPN. Patient's weight has been stable at home; lung cancer is a recent diagnosis yet quite advanced. Labs: WBC 1.8, slightly below normal for Na, phosphorus, magnesium, Hgb and Hct.

Nutrition Diagnosis (PES):

1- Inadequate intake from parenteral infusion (NI 2.3) related to limitations of peripheral access as evidenced by the inability to meet energy requirements through PPN.

2- Inadequate oral food intake (NI 2.1) related to esophagitis as evidenced by the inability to swallow and decreased food intake over the past 2–3 days.

Interventions: Food and Nutrient Delivery: ND 4.2 Insert enteral nutrition feeding tube; NPO until PEG is surgically placed. ND 2.2 Modify rate, concentration, composition, or schedule. Once the PEG was placed, Jevity 1.5 was started 8 hours later at a rate of 35 ml/h. This was increased as tolerated by 10 milliliters every 8 hours until the goal rate of 65 ml/hr was reached.

Education: Discuss appropriate feeding using a PEG tube; safe handling; signs of intolerance.

Counseling: Adequate intake of tube feeding and how to adjust when oral intake is possible.

Coordination of Care: RC 1.3 Collaboration/referral to other providers; patient to have home health; instruct patient on tube feeding at home.

Monitoring and Evaluation: Patient tolerating goal rate of 65 ml/hr; discharged from hospital. Follow patient weight, tolerance, and intake status in 1 week. Evaluate for progress back to oral diet if esophagitis subsides.

INTERVENTION

OBJECTIVES

- Patient must stop smoking, avoid passive smoke, or discontinue exposure to radon or other contributors.
- Prepare patient for therapy (e.g., surgery, radiation, or chemotherapy).
- Meet energy needs, which are often elevated as much as 30% above normal. The use of indirect calorimetry to measure REE is more accurate than estimation (American Dietetic Association, 2010).
- Maximize intake through side-effects management. Cachexia, infections, atelectasis, syndrome of inappropriate antidiuretic hormone (SIADH), esophagitis, weight loss, and anorexia may occur.
- Minimum weight loss.
- Maximize pulmonary health and improve quality of life. Increase disease-free time.

FOOD AND NUTRITION

- Increase the intake of protein, CHO, energy, and fluids.
- Tube feedings are highly recommended if weight loss, decreased appetite, dehydration, or electrolyte imbalance occurs.
- Alter diet as appropriate for side effects (see general cancer entry). Adequate vitamin-mineral intake should come from diet as much as possible. Providing medical nutrition therapy may help to improve protein and calorie intake, which may prevent weight loss and improve quality of life (American Dietetic Association).
- Small, frequent meals may be beneficial.

- If oral diet is possible, promote a protective diet. Include citrus fruits, vegetables, sesame seeds and pecans (for gamma-tocopherol), quercetin (apples and onions) and other flavonoids, selenium, lycopene, carotenoids, and natural estrogens (such as soy foods). Use curcumin as seasoning if tolerated.
- Include phytosterols from sunflower seeds, pistachio nuts, sesame seeds, and wheat germ (Phillips et al, 2005).
- Include more omega-3 fatty acids from fish, shellfish, flaxseed, and walnuts.
- Include resveratrol from red grapes and juice, berries, peanuts, or red wine if tolerated.

Common Drugs Used and Potential Side Effects

- Cytotoxic drugs are often used. Vincristine can cause severe constipation.
- With methotrexate, nausea and vomiting are common; doxorubicin (Adriamycin) causes stomatitis, anorexia, hair loss, and diarrhea. Coadministration of methotrexate with intravenous glucose may alleviate some of the toxic gastrointestinal (GI) effects.
- Cyclophosphamide (Cytoxan) and other combinations of therapy may cause anorexia, stomatitis, nausea, or vomiting.
- Toxicity is far less than with docetaxel if vitamin B_{12} and folate supplements are used (Budde and Hanna, 2005).
- Tarceva modestly improves survival in NSCLC patients.
- With immunotherapy, bacillus Calmette-Guérin (BCG) vaccine is often used.

Herbs, Botanicals, and Supplements (see Table 13-8)

- The use of complementary and alternative medicine by lung cancer patients is prevalent. Clinicians should investigate to avoid any potential side effects and interactions with conventional therapies (Cranganu and Camporeale, 2009). Herbs and botanical supplements should not be used without discussing with the physician.
- Five promising herbs have been identified in Chinese herbal medicine (CHM) that, when used in conjunction with chemotherapy, may improve quality of life in NSCLC (Chen et al, 2009).
- Luteolin, 3′,4′,5,7-tetrahydroxyflavone, exists in many types of plants and in Chinese medicinal herbs; it functions as an antioxidant with anticancer properties (Lin et al, 2009). Luteolin is found in carrots, celery, olive oil, oregano, peppers, peppermint, rosemary, and thyme.
- Avoid beta-carotene supplements. Diet is more protective.
- Clinical trials using dietary garlic, selenium, N-acetylcysteine, vitamins B_6 and C are needed.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss alternate methods of intake if oral is not feasible.
- A diet high in antioxidant-rich foods such as fruits, vegetables, and spices is protective and a prudent preventive strategy (Roswall et al, 2010).
- Discuss the side effects of drugs being used.
- Dietary acrylamide affects carcinogenesis but not through genetic alterations (Hogervorst et al, 2009). Researchers are reviewing its role from heat-treated foods.
- Self-reported smoking consistently explains approximately 50% of the inequalities in lung cancer risk due to differences in education (Menvielle et al, 2009). Smokers who quit will allow their lung tissues to repair much of the damage.
- Smokers who cannot quit should use a brand of cigarettes with lower nicotine and low tar. Avoid smoking prior to or with meals; smoking may decrease appetite.
- Chewing tobacco or snuff is also carcinogenic and should be stopped.
- Offer tube feeding or nutritional build-up education as appropriate.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.
- If tube feeding is needed, safe preparation, handling, storage, and administration will be important.

For More Information

- Alliance for Lung Cancer
  http://www.alcase.org/
- Cancer Net–Lung Cancer
  http://cancernet.nci.nih.gov/cancertopics/wyntk/lung/page1
- Focus on Lung Cancer
  http://www.lungcancer.org/
- Lung Cancer Information Library
  http://www.meds.com/lung/lunginfo.html
- Lung Cancer Online
  http://www.lungcanceronline.org/
- National Cancer Institute – Small Cell Cancer
  http://www.nci.nih.gov/cancerinfo/pdq/treatment/small-cell-lung/patient

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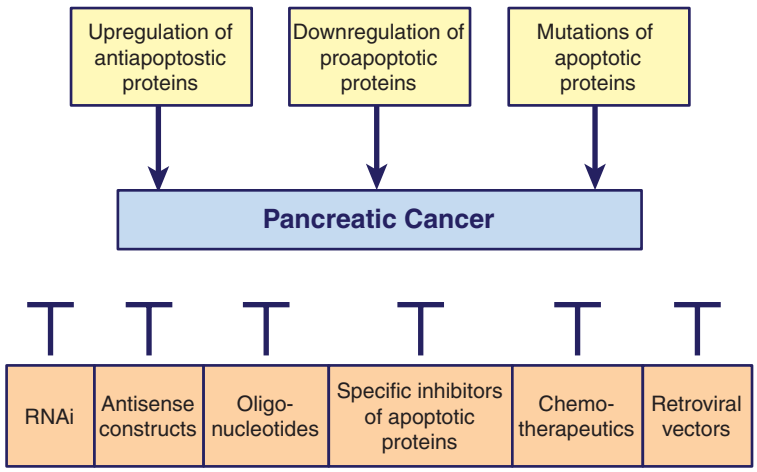
PANCREATIC CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 3–4



DEFINITIONS AND BACKGROUND

Pancreatic cancer is the fourth most common cause of death from cancer in men and the fifth for women, primarily occurring between 65 and 79 years of age. Development of pancreas cancer progresses over many years before symptoms appear, and many people with pancreatic cancer die within 6 months of diagnosis. Nearly all pancreatic cancers are primary pancreatic adenocarcinomas.

About 50–70% of patients have cancer in the head of the pancreas, and 50% have cancer in the body and tail. Patients who have cancer in the head of the pancreas often present with cholangitis, nausea, anorexia, weight loss, new-onset diabetes, light-colored stools, dark urine, steatorrhea, jaundice, and pruritus. Those who have cancer in the body or tail of the pancreas present with vague abdominal pain, dyspepsia, nausea, intermittent diarrhea, unexpected diabetes, and constant back pain. When there are spontaneous blood clots in the portal blood vessels, this may be associated with pancreatic cancer; this thrombophlebitis is called Trousseau sign.

Risks for pancreatic cancer increase with age. It is slightly more common in men, in smokers, in African-Americans, and in people who are obese. Almost a third of the cases of pancreatic cancer are due to cigarette smoking. Persons with a history of pancreatitis are also at risk; type 2 diabetes is not a true risk factor. Diets high in red meat or low in fruits and vegetables may also be linked to pancreatic cancer. Doses of alcohol greater than 30 grams per day contribute to only a modest increase for this type of cancer.

Exercise, such as walking 4 hours or more weekly, may protect against this cancer. Good folate, B_{12}, and pyridoxine status also helps (Schernhammer et al, 2007), as does an increased intake of citrus fruits (Bae et al, 2009). Lifestyle choices are the most preventive steps; cut down on smoking, alcohol and poor food choices (Whitcomb and Greer, 2009).

Nutrition intervention together with chemotherapy improves outcomes in these patients. An increased risk has been found for dietary intakes of saturated and polyunsaturated fat (Thiebault et al, 2009; Zhang et al, 2009). A diet high in omega-3 fatty acids may mitigate pancreatic precancer by inhibition of cellular proliferation through induction of cell cycle arrest and apoptosis (Strouch et al, 2009). DHA may be the primary fatty acid that is beneficial. However, the use of supplemental omega-3 fatty acids is not recommended (American Dietetic Association, 2010).

Malignancy in the pancreas has a high mortality rate from a lack of early symptoms, symptoms that mimic other conditions, and rapid metastasis to other organs. Medical treatment consists of radiation, chemotherapy, immunotherapy, or vaccine therapy. When the tumor has spread (metastasized) to other organs such as the liver, chemotherapy alone is usually used. The standard chemotherapy drug is gemcitabine, which can help some patients.

Unfortunately, only about 20% of patients with pancreatic cancer have a form that can be resected. **Whipple's procedure** (pancreaticoduodenectomy) involves many operations. The entire duodenum is usually removed, and the pancreas, gallbladder, and spleen may also be removed. It has many nutritional implications (Petzel, 2005; Tang et al, 2005). After surgery, the diet can be liberalized after 10–14 days, adding one new food at a time and using supplements when appetite is poor.

Survival rates have improved; approximately 30% will live for 3 years after diagnosis and treatment. But the 5-year survival rate is low; 95% of the people diagnosed with it will not be alive 5 years later.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Five to ten percent of cases are related to family history, such as mutations in BRCA2 or PALB2 genes, Lynch syndrome, Peutz-Jeghers syndrome, familial atypical mole-malignant melanoma (FAMMM), familial adenomatous polyposis, or mutations in the CDKN2 A tumor suppressor gene. Much research is going toward understanding the genes in pancreatic cancer (Hruban et al, 2008). Folate genes may be involved, but more studies are needed.

Specific Clinical/ History

Height
Weight
BMI
Rapid weight loss
Midepigastric pain
Temperature
BP
Jaundice, pruritus
Dark urine?
Biliary obstruction?
Pancreatic insufficiency (indigestion, cramping, bloating)
Belching
Steatorrhea or loose stools
Anorexia
Nausea and vomiting
Thrombophlebitis (Trousseau sign).
Fatigue
Ascites
Angiography
Abdominal CT scan or MRI
Endoscopic ultrasound
Fine-needle biopsy
Endoscopic retrograde cholangiopancreatography (ERCP)

Lab Work

Ca 19–9 (>37 U/mL)
Elevated microRNAs (miR-155, miR196a)
Alk phos (increased)
Bilirubin (increased)
PT (increased)
Gluc (increased)
Serum lipase (increased)
Secretin
PSCA levels
Serum amylase (increased)
ALT, AST (increased)
Transferrin
Serum insulin
TLC (varies)
Serum B_{12}, folic acid
Homocysteine levels
Cholecystokinin
Alb
CRP
Chol, Trig
H & H
Ca^{++}, Mg^{++}
Na^{+}, K^{+}

SAMPLE NUTRITION CARE PROCESS STEPS

Undesirable Food Choices

Assessment Data: BMI 20, recent weight loss of 2#. Diet history reveals high red meat and saturated intake, low use of fruits and vegetables. Dx pancreatic cancer in past month.

Nutrition Diagnosis (PES): Undesirable food choices related to nutrient density and cancer diagnosis as evidenced by diet history showing high intake of red meats and low intake of fruits and vegetables.

Intervention: Food-nutrient delivery—offer acceptable fruit and vegetable choices and juices. Educate the patient and family about the role of diet in cancer. Counsel about tips for managing symptoms, weight changes, and anorexia while including protective food choices. Coordinate care with the medical team for home care and potential hospice care.

Monitoring and Evaluation: No further weight loss; good tolerance for small meals that are nutrient-dense but not high in fat.

INTERVENTION

OBJECTIVES

- Reduce or control nausea and vomiting.
- Prevent or correct weight loss, which is associated with poor outcomes, and restore lean body mass.
- Control side effects of therapies and the disease such as diabetes, anemia, pancreatic fistula, wound infection, bile leak, cholangitis, dumping syndrome, weight loss, and lactose intolerance (Petzel, 2005).
- Provide foods or supplements that include all necessary nutrients to prolong health. Augment nutritional intake; correct anemia. Include protective foods.
- Monitor for depression; encourage the use of antidepressants if needed to help with appetite.
- Manage problems such as pancreatic cancer–related diabetes and vitamin B_{12} malabsorption.
- Parenteral nutrition (PN) is indicated mainly for perioperative use in patients with known malnutrition preoperatively. Postoperatively, tube feeding is the nutrition support method of choice.
- Wean off tube feeding with increasing oral intake and resolving gastroparesis, usually 4–6 weeks postoperatively.

FOOD AND NUTRITION

- **For pancreatic insufficiency:** Medium-chain triglycerides (MCT), fat-soluble vitamins (water-miscible form), and essential fatty acids (EFAs) should be included. Calcium, selenium, zinc, and iron may become deficient unless supplemented.
- After Whipple's procedure, if pain is severe, tube feeding should be attempted before CPN. If possible, feed after bowel sounds return. Pancreatic enzyme replacement will be needed. Use a low-lactose, low-fat diet (40–60 g) and omit fried foods, nuts, and seeds.

- Small meals are best tolerated—six to eight feedings may be better tolerated than three large meals. Delayed gastric emptying is common, so avoidance of simple sugars and hot liquids may also be needed.
- Increased energy and protein intake should be provided to restore lost weight, unless the patient is hyperglycemic or has extensive liver impairment. Carbohydrate control may be needed to manage diabetes.
- Include protective foods, particularly tomato products for lycopene, other vegetables, and citrus fruits (Bae et al, 2009; Nkondjock et al, 2005). Onions, garlic, beans, orange and yellow vegetables, spinach, broccoli, kale, and raw vegetables are particularly protective.

Common Drugs Used and Potential Side Effects

- Chemotherapy may include gemcitabine.
- Pancreatic enzymes (pancrelipase and pancreatin) are given. Enteric coating aids in maintaining the integrity of enzymes until they reach the small intestine. If a pork allergy is present, there may be a reaction to these enzymes; a pork-free product is PAN-2400. As much as 20,000–30,000 units of lipase may be needed per meal; 10,000 units may be needed with snacks. They must be swallowed whole and not chewed.
- Insulin may be needed if the patient is hyperglycemic. In islet cell tumors, hypoglycemia may occur instead. Monitor with meal timing.
- Acid-reducing medications (such as proton-pump inhibitors or H_2 blockers) are usually needed.
- Vitamin B_{12} supplements may be required with total pancreatectomy, particularly with steatorrhea.
- Water-miscible fat-soluble vitamins A, D, E, and K will be needed until intake of pancreatic enzymes is sufficient. Brands may include Vitamax, Source CF, and ADEKs.
- Antiemetics, diuretics, and analgesics may be needed. Monitor side effects according to medications prescribed.
- Calcium carbonate twice daily may be useful to help bulk stools that are loose. Antidiarrheal medications (e.g., Lomotil, opiates, or Imodium) may be needed if loose stools are persistent. Guar gum and psyllium can be used to add soluble fiber.
- Targeted drug therapy blocks chemicals that signal cancer cells to grow and divide. Erlotinib (Tarceva) is usually combined with chemotherapy for advanced pancreatic cancer.
- A pancreatic cancer vaccine is under study.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- There are potential drug-nutrient interactions (e.g., anticoagulant and anti-hypertensive medications/herbal supplements) with the use of EPA fish oil supplements; they are not recommended for pancreatic cancer (American Dietetic Association, 2010).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss specific dietary recommendations appropriate for the patient's condition and therapies.
- Discuss the use of pancreatic enzymes.
- Provide education for diet and jejunostomy feeding.
- With pancreatectomy, a diabetic diet may be absolutely essential. Discuss the rationale with the patient.
- Explain how diet affects malabsorption in regard to fat, protein, vitamins, and minerals.
- Research does not support the theory that high intakes of sugar or sugar-sweetened beverages cause this cancer.
- Lactase enzymes may be helpful if lactose intolerance persists.
- Family members may need genetic counseling. The fundamental problem underlying pancreatic cancer is altered genetics (Whitcomb and Greer, 2009).

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- JAMA Patient Page – Pancreatic Cancer
  http://jama.ama-assn.org/cgi/reprint/297/3/330.pdf
- Johns Hopkins–Pancreatic Cancer Home Page
  http://www.path.jhu.edu/pancreas
- Lustgarten Foundation for Pancreatic Cancer Research
  http://www.lustgartenfoundation.org/
- Mayo Clinic – Pancreatic Cancer
  http://www.mayoclinic.com/health/pancreatic-cancer/DS00357
- Medline–Pancreatic Cancer
  http://www.nlm.nih.gov/medlineplus/pancreaticcancer.html
- National Pancreas Foundation
  http://www.pancreasfoundation.org/
- Pancreatic Cancer Action Network
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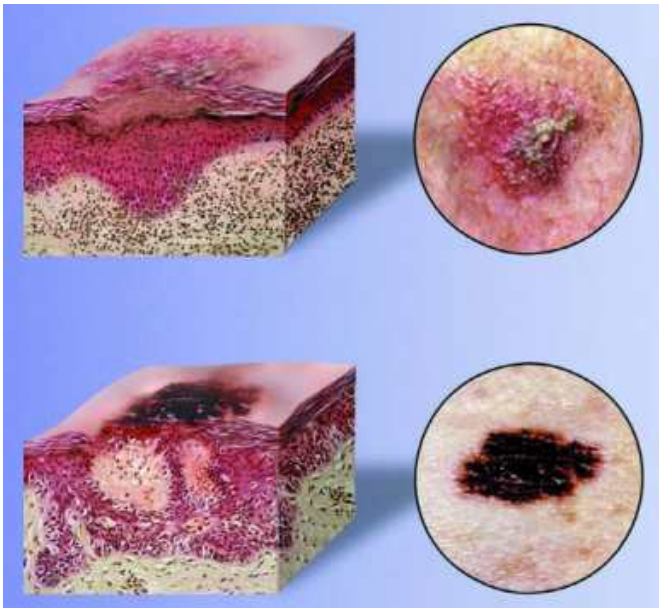
SKIN CANCERS

NUTRITIONAL ACUITY RANKING: 1–2



DEFINITIONS AND BACKGROUND

Skin cancer is the most common cancer in the United States, and the incidence is increasing. Vitamin D is made in the skin upon exposure to solar radiation; regular use of a tanning bed that emits vitamin D–producing ultraviolet (UV) radiation is associated with higher 25-hydroxyvitamin D concentrations, which may benefit the skeleton but not necessarily the skin. UVB–induced skin damage places individuals more at risk for basal cell and squamous cell carcinomas than for malignant melanoma.

Risk factors for skin cancer include certain types or a large number of moles; excessive exposure to sun and ultraviolet light with susceptible vitamin D receptor genes; family or personal history of skin cancer; freckles; light skin color, hair color, or eye color; and sunburns early in life. Since carcinogenesis and photoaging are multistep processes, tumor development may be halted at several points. The intake of flavonols may be protective (McNaughton et al, 2005).

Deficiency of the prohormone calcidiol (25OH vitamin D_3) seems to be associated with cancer, but not calcitriol (Tuohimaa, 2008). Daily brief exposure of a substantial area of the skin to ultraviolet light, climate allowing, provides adults with a safe, physiologic amount of vitamin D, equivalent to an oral intake of approximately 10,000 IU vitamin D_3 per day; the plasma 25-hydroxyvitamin D (25(OH)D) concentration potentially reaches 88 ng/mL (Vieth, 2009). The occupational sun exposure rate is positively correlated with a lower risk of overall organ mortality. Adequate vitamin D_3 is protective; benefits of sunlight may outweigh some risks (Krause et al, 2006).

Skin cancer and photoaging are the result of excessive ultraviolet radiation exposure. UVB (280–315 nm) in natural sunlight is associated with skin cancer through keratinocyte proliferation and cell cycle progression (Han and He, 2009). Excessive UVB light exposure in childhood promotes the development of melanomas (Wolpowitz and Gilchrest, 2006).

Basal cell cancer (BCC) starts as small, shiny, firm nodules that enlarge slowly, bleed and scab, then heal, and finally repeat the cycle. These are the most common type of skin cancer. Basal cell tumors should be removed to avoid destruction to other tissues. Most basal cell carcinomas occur on parts of the body that are excessively exposed to the sun—particularly the face, ears, neck, scalp, shoulders, or back. Rarely, these tumors come from exposure to arsenic or radiation, open sores that will not heal, chronic inflammatory skin conditions, and complications of burns, scars, infections, vaccinations, or tattoos.

Squamous cell carcinoma (SCC) originates in the middle layer of the epidermis and may develop on sun-damaged skin or even in the mouth lining or tongue. This type begins as a reddened area with a scaly, crusted surface that does not heal. A precursor is often an actinic keratosis (solar keratosis) that appears on the bald scalp, face, ears, lips, backs of the hands and forearms, shoulders, neck, or any other areas of the body that are frequently exposed to the sun. SCC may have the appearance of a wart and eventually becomes an open sore. Removal is important before it can spread. Leukoplakia anywhere in the mouth may be an early sign. SCC is more common in men than in women and is most likely to occur after age 50. In addition, people who use tanning beds are twice as likely to get SCC.

Melanoma, the deadliest type of skin cancer, originates in the melanocytes and tends to spread rapidly. Biopsy is essential. It is the most common cancer for women aged 25–29 years and the second most common cancer for women aged 30–34 years. Most melanomas are black or brown, but some may even be skin-colored, pink, red, blue, or white. Early warning signs of melanoma have been identified by the acronym "ABCDE" (A stands for Asymmetry, B stands for Border, C for Color, D for Diameter, and E for Evolving or changing was recently added). Individuals who have had breast cancer are at risk for melanoma and vice versa. Disfiguring surgery is no longer necessary to remove a melanoma. Mohs micrographic surgery is available.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: The melanocortin 1 receptor (MC1R) is a highly polymorphic G protein-coupled receptor; MC1R alleles have been associated with a red hair/fair skin phenotype, increased incidence of skin cancer, and altered sensitivity to ultraviolet (UV)

radiation (Smith et al, 2007). Specific alleles of the gene that codes for the melanocortin 1 receptor are also predictive of skin cancer risk, independent of skin type and hair color (Lynde and Sapra, 2010).

Specific Clinical/ History

Height
Weight
Weight changes
BMI
Diet history
Light-colored hair, skin, eyes
Changes in skin or mole
Itching, bleeding of mole
Nausea and vomiting
Anorexia

Lab Work

Alb
CRP
H & H
Serum ferritin
Transferrin
Ca^{++}, Mg^{++}
Na^{+}, K^{+}
Serum 25(OH)D

INTERVENTION

OBJECTIVES

- Maintain appropriate weight for height.
- General healthy dietary guidelines should be followed.
- Prevent or correct nutritional deficiencies and improve patient tolerance of treatment.
- Minimize potential treatment side effects.
- Optimize immune function to increase effectiveness of therapy.
- Enhance quality of life.
- Ensure appropriate healing of surgical sites, if applicable.

FOOD AND NUTRITION

- Eat a variety of foods, particularly fruits and vegetables and whole grains such as oats. Use flavonols such as apples, tea, and coffee.

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Bioactive Substance Intake

Assessment Data: Diagnosis of skin cancer. Hx of tanning bed use for psoriasis. Diet history indicates low intake of fruits and vegetables. Patient has been following a macrobiotic diet to lose weight for 6 months, eating mostly rice.

Nutrition Diagnosis (PES): Inadequate bioactive substance intake related to low consumption of fruits and vegetables as evidenced by diet history.

Intervention: Food-nutrient delivery—Provide a nutrient-dense diet that includes flavonols and anti-inflammatory foods. Educate the patient about the role of bioactive substances in reducing future skin cancer risks. Counsel about returning to a balanced diet with plenty of phytochemicals.

Monitoring and Evaluation: Improved diet with balanced intake of nutrients and phytochemicals.

- A high-fat diet may influence the UV-induced inflammatory responses in the skin (Meeran et al, 2009). Choose a diet that is moderate in fat while controlled in saturated fat and cholesterol. Include good sources of omega-3 fatty acids regularly (i.e., salmon, tuna, mackerel, herring, and sardines).
- Use sugars, salt, and alcoholic beverages in moderation.
- If anemic, a diet that meets at least DRI requirements for blood-forming nutrients will be needed.
- Weight gain caused by fluid retention is commonly seen in patients receiving biological therapy (immunotherapy). Use a diet with 2–4 grams of sodium or fluid restriction if needed.
- Provide adequate amounts of vitamin D_3 and dietary beta carotene. Consumption of 40 IU/d of vitamin D(3) raises plasma 25(OH)D by approximately 0.4 ng/mL (Vieth, 2009).

Common Drugs Used and Potential Side Effects

- Aldara skin cream reduces basal cell lesions without surgery.
- Interferon-α2b (Intron-A) is used in adult patients who have surgically treated melanoma considered at high risk of recurrence. This immunotherapy (biologic therapy) makes use of chemicals that occur naturally in the body.
- Immunomodulating agent histamine dihydrochloride (Maxamine), when used in combination with interleukin-2 (IL-2), improves survival for stage 4 malignant melanoma patients.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Evidence from clinical trials shows that a prolonged intake of 10,000 IU/d of vitamin D(3) poses no risk of adverse effects for adults (Vieth, 2009).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the rationale for spacing meals throughout the day to avoid fatigue.
- Offer recipes and meal plans that provide the nutrients required to improve status and immunological competence.
- Patients undergoing treatment should be allowed flexibility in their food selections, while focusing on high-energy, high-quality protein, and phytochemical-rich choices whenever possible.
- Offer recipes and menu options for individual planning.
- Use sunscreen with sun protective factor (SPF) 15 or higher and both UVA and UVB protection; apply sunscreen after about 10–15 minutes in the sun.
- Biofeedback and stress management techniques may be useful.
- Dietary protection is provided by carotenoids, tocopherols, ascorbate, flavonoids, or omega-3 fatty acids.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- CDC – Skin Cancer
  http://www.cdc.gov/cancer/skin/basic_info/
- Melanoma Research Foundation
  http://www.melanoma.org/
- Mohs Micrograhic Surgery
  http://www.mohscollege.org/about/
- Web MD
  http://www.webmd.com/melanoma-skin-cancer/melanoma-guide/skin-cancer-melanoma-surgery

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HORMONAL CANCERS

BREAST CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 2–3

DEFINITIONS AND BACKGROUND

Breast (mammary) carcinoma is the second most common cancer in women, with over 200,000 cases diagnosed annually in the United States. It affects one in eight women. Having routine breast screenings for cancer is important. When a woman has specific family history patterns that put her at risk for gene mutations, her primary care physician should suggest DNA testing, but only about 2% of women have this level of risk. Age >30, health history related to fertility, ovarian function, and estrogen exposure play a role in the onset of breast cancer. Exposure to diets that produce high levels of estrogen seems to be most important in utero and after menopause; high estrogen levels during reproductive years seems to be protective. A longer duration of breastfeeding may be associated with a reduced risk. Breast cancer in men is less common and is generally preceded by gynecomastia.

Some breast cancer cells have a high proportion of estrogen and/or progesterone receptors in the nucleus. Those women who are ER/PR positive might benefit from hormonal therapy with tamoxifen or aromatase inhibiters; these drugs block hormone receptors in the cancer cell. Protein phosphatase 2A (PP2A) is a major cellular phosphatase that plays key regulatory roles in growth, differentiation, and apoptosis; its role in the suppression of breast cancer is being studied (Dupont et al, 2009).

Breast cancer may be related to oxidative stress. Receptor CXCR1 (IL-8) is a protein produced during chronic inflammation and tissue injury; it may play a role in breast cancer. Recent studies show that the intake of anthocyanins and ellagic acid can prevent cancer cells from developing (Stoner et al, 2009). Berries and pomegranates are particularly protective.

Being physically active is also protective, whereas obesity and Western dietary patterns increase cancer risk. Weight gain in the years preceding the onset of puberty is a promoter; increased fat cell adiposity increases estrogen availability at this time (Michels et al, 2006). Overweight breast cancer survivors commonly have metabolic syndrome (MetS) and elevated CRP (Thomson et al, 2009). Weight reduction is a reasonable goal.

TABLE 13-17 Staging of Breast Cancer

Stage 0	In situ—Cancer cells are present in either the lining of a breast lobule or a duct, but they have not spread to the surrounding fatty tissue.
Stage 1	Rarely metastasizing/noninvasive (<2 cm or 1 inch in diameter)—Cancer has spread from the lobules or ducts to nearby tissue in the breast; cancer has not spread to the lymph nodes.
Stage 2	Rarely metastasizing/invasive—The tumor can range from 2 cm to <5 cm in diameter (approximately 1–2 inches); sometimes, cancer may have spread to the lymph nodes.
Stage 3	Moderately metastasizing/invasive (≥2 inches)—Cancer cells have grown extensively into axillary (underarm) lymph nodes.
Stage 4	Highly metastasizing/invasive into other parts of the body, such as bone, liver, lung, or brain.

Eating soy foods yields greater benefits than taking isoflavone supplements (Li et al, 2005). Early exposure in childhood or early adolescence to phytoestrogens may be protective (Duffy et al, 2007).

Alcohol intake is a problem if folic acid intake is low; 600 micrograms of folic acid is protective. High intake of well-done meat and high exposure to meat carcinogens, particularly HCAs, may increase the risk of breast cancer (Zheng and Lee, 2009).

Breast cancer can be treated very effectively, particularly when it is diagnosed in the early stages. Staging of breast cancer is described in Table 13-17. Tumors are frequently found in the upper/outer quadrant of the breast (45%) and nipple area (25%), with 30% identified in other breast areas. In the early stages, a single nontender, firm, or hard mass with poorly defined margins may exist. Later, skin or nipple retraction, axillary lymphadenopathy, breast enlargement, redness, mild edema, and pain may occur. In the late stages, ulceration, moderate edema, and metastases to bone, liver, or brain are common.

Four standard types of therapy are used to treat breast cancer: surgery for the removal of cancerous tissue and, sometimes, other tissue; radiation therapy; chemotherapy; and hormonal therapy. New therapies are being researched through clinical trials.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Mutations in the *BRCA1* gene (on chromosome 17) result in an elevated risk of breast cancer and ovarian cancer (Kroiss et al, 2005). The *HER2* (Her2/neu, c-erb-2 or erb-2) gene produces a protein that acts as a receptor on the surface of all cells; some cancer cells have more receptors than normal, and they receive more messages to grow and divide. The C677 T polymorphism of the folic acid (*MTHFR*) genotype increases the risk of postmenopausal breast cancer, particularly with low intakes of folate and vitamin B_6 (Maruti et al, 2009).

Specific Clinical/History

- Height
- Weight
- BMI
- Weight changes
- Diet history
- Anorexia, nausea
- Breast self-examination—masses
- Calcifications
- Biopsy
- Skin or nipple retraction
- Axillary lymphadenopathy
- Breast enlargement
- Redness, mild edema, pain
- Ulceration, moderate edema
- I & O
- Temperature

Lab Work

- Estrogen receptors (positive or negative)
- Serum estrogen
- Carcinoembryonic antigen (CEA)
- Prolactin
- Serum carotenoid levels
- Mg^{++}, Ca^{++}
- H & H
- Gluc
- Alk phos
- Erythrocyte sed rate (ESR) to evaluate metastasis
- Complete blood cell count (CBC)
- Chol, Trig
- Alb, transthyretin
- CRP
- Mammography

INTERVENTION

OBJECTIVES

- Control side effects of therapy and treatments (e.g., local or extensive mastectomy, chemotherapy, external-beam radiation therapy, brachytherapy).
- Promote intake of phytochemicals and protective foods to reduce inflammation.
- Promote good nutritional status to reduce future incidents and recurrence. Encourage regular breast self-examinations, physical activity, and other healthy behavior changes.
- Maintain or attain appropriate weight for height. Obese patients should lose weight before treatment; be careful not to lose lean body mass (LBM).
- Increase the likelihood of survival, wellness, and improved quality of life.
- For mastectomy patients, promote wound healing and prevent infection.

FOOD AND NUTRITION

- Because most studies have found that exercise, weight reduction, low-fat diet, and reduced alcohol intake are associated with a decreased risk of breast cancer, a diet with controlled total energy and fat is helpful (Cummings et al, 2009). While the Western style of diet should be discouraged (Adebamowo et al, 2005), meat, eggs and low-fat dairy foods can be used in moderation (Pala et al, 2009). Use fewer processed meats and less red meat, particularly if well-done (Zheng and Lee, 2009).

SAMPLE NUTRITION CARE PROCESS STEPS

Poor Nutrition Quality of Life

Assessment Data: Status post partial mastectomy; dysphagia and cachexia noted. Poor appetite and BMI dropped to 18.5 from 24 over the past 6 months.

Nutrition Diagnosis (PES): Poor nutrition, quality of life (NB-2.5) related to dysphagia, depression, and cachexia as evidenced by appetite <50% and BMI of 18.5.

Nutrition Intervention:

Food and Nutrient Delivery: ND 1.3 specific food/beverage: Puree, nectar, thick liquids and thinned soft foods. ND 3.1.1 commercial beverage supplement: 1 can 2× daily. ND 3.2.1: MVI.

Counseling:

C-2.2 Goal setting: Minimize weight loss, maintain adequate weight loss, monitor for signs and symptoms of aspiration, improve quality of life with exercise, and improve intake of phytochemical and nutrient-dense foods and tea.

Coordination of Nutrition Care:

RC 1.1 Interdisciplinary team meeting with nursing, social worker, recreational therapy, physical therapy, speech therapy.

Monitoring and Evaluation: No signs of aspiration, nausea, vomiting, speech evaluation follow-up, promote wound healing and prevent infection; reassess nutrition and quality of life.

- Promote use of the Mediterranean diet (Cottet et al, 2009; Masala et al, 2006). Olive/sunflower/canola oils, grape juice, red wine, and cheese are beneficial. Calorie restriction and use of omega-3 fatty acids decrease inflammation (Jolly, 2005).
- High fiber diets reduce hormone production and decrease cancer risk (Gaskins et al, 2009). At least 5–9 fruits and vegetables (Ahn et al, 2005; Rock et al, 2005) and 6 grain foods daily should be encouraged. The fruits and vegetables should include sources of alpha- and beta-carotene, zeaxanthin, and lycopene. Berries, pomegranate, garlic, and spices such as curcumin should be used often. Use cruciferous vegetables often (Warin et al, 2009).
- Sources of choline and betaine should be included (Xu et al, 2009). Choline is found in beef liver, wheat germ, and eggs. Betaine is found in beets.
- Alcohol may promote estrogen receptor–positive tumors (Suzuki et al, 2005). Red wine and resveratrol may be acceptable; limit to one drink per day.
- While some women are estrogen-sensitive (Fang et al, 2005; Li et al, 2005), overall, soy-enhanced diets are significantly associated with a decreased risk of death and recurrence (Shu et al, 2009; Steiner et al, 2008). This may be due to a new phytochemical found in soy called glyceollin I (Zimmermann et al, 2010). An isoflavone-rich diet might include wild leafy greens (as in the Greek diet), celery stalks, shredded lettuce, sweet peppers, raw spinach, fresh lemon, and sprigs of fresh parsley.
- A general supplement also may be safely recommended for folic acid (Zhang et al, 2005), calcium, vitamin D, vitamin A, vitamin C, and vitamin E as alpha-tocopherol.

Common Drugs Used and Potential Side Effects

- For patients who are **estrogen receptor positive**, hormonal therapy may be a breast cancer promoter; oral contraceptive use should be monitored or discontinued. Estrogen replacement (to prevent osteoporosis) increases risk levels.
- Antiestrogen therapy with tamoxifen (Noraldex) may be prescribed to treat estrogen-dependent breast cancer or be used in women at high risk. Nausea, vomiting, and hot flashes are common side effects. Avoid high doses of soy when using tamoxifen.
- For patients who are **estrogen receptor negative**, hormonal therapy actually may be recommended (e.g., progesterone and androgen therapy). Megestrol acetate (a hormonal antineoplastic drug and a synthetic derivative of progesterone) may reverse anorexia and weight loss.
- Chemotherapy may be used. Cyclophosphamide (Cytoxan) requires extra fluid intake. Doxorubicin, fluorouracil, and methotrexate are also commonly used; many gastrointestinal (GI) side effects are noted. Taste alterations are common for beef, chicken, and coffee. Anastrozole (Arimidex) can cause anorexia, weight changes, nausea, vomiting, dry mouth, constipation, and diarrhea. Gemcitabine (Gemzar) in combination with paclitaxel is used with metastatic breast cancer after failure of other chemotherapy.
- Trastuzumab (Herceptin) helps with early-stage HER2 breast cancer as an adjunct to chemotherapy to decrease recurrence.
- Repertaxin, originally developed to prevent organ transplant rejection, blocks receptor CXCR1 and kills breast cancer stem cells. It is under study in humans.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician. Women with a history of breast cancer may seek out "natural" phytoestrogens in the belief that they are safe or perhaps even protective against recurrence, but studies do not support a protective role (Duffy et al, 2007). The following herbal/botanical supplements should be avoided by patients with breast cancer because of their phytoestrogen content: Ginseng, Gingko biloba, Licorice root, Black cohosh, Wild yam root, DHEA.
- Grape seed extract, berry powder, and pomegranate products are beneficial (Kim, 2005; Stoner, 2009). Dietary sources of omega-3 fatty acids, vitamin C, vitamin E, beta-carotene, selenium, and coenzyme Q10 may be of particular value.
- With the use of methotrexate (Rheumatrex), avoid echinacea because of potential damage to the liver.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Breast cancer detection projects are available throughout the United States; check with local chapters of the National Cancer Institute (NCI) and the American Cancer Society (ACS). Early detection of new tumors is crucial because lower stage tumors are much easier to control.

- Attain or maintain healthy body weight. Low total energy or lower fat dietary patterns may also be helpful (Elias et al, 2005). Reduce intake of sweets and high-glycemic index foods (Tavani et al, 2006). Eat a diet high in whole grains, fruits, and vegetables (Ahn et al, 2005).
- Discuss ways to make meals more appetizing, particularly if appetite is poor.
- Use of moderate amounts of soy may be encouraged. Increase use of cruciferous vegetables (Warin et al, 2009).
- Exercise and consumption of tea are important preventive factors to reduce depression among breast cancer survivors (Chen et al, 2010). Yoga and hypnosis may also be beneficial.
- Daughters of women with breast cancer should have a first mammogram before 40 years of age as a baseline and annually every 1–2 years thereafter. Lumps and changes should be reported immediately to a physician.
- Limit alcoholic beverages to one drink per day (Suzuki et al, 2005) and avoid high intakes of well-done meats and processed meats (Zheng and Lee, 2009).
- Calcium and vitamin D_3 supplementation may be indicated for patients who are menopausal or postmenopausal as they are at increased risk for developing osteoporosis.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Breast Cancer
  http://www.breastcancer.org/
- Cornell University
  http://envirocancer.cornell.edu/factsheet/diet/fs49.BCRisk.cfm
- National Alliance of Breast Cancer Organizations
  http://www.nabco.org/
- National Breast Cancer Coalition
  http://www.stopbreastcancer.org/
- Sisters Network
  http://www.sistersnetworkinc.org/
- Y-Me National Breast Cancer Organization
  http://www.y-me.org/

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CHORIOCARCINOMA

NUTRITIONAL ACUITY RANKING: LEVEL 3

Adapted from: Michael S. Baggish, Rafael F. Valle, Hubert Guedj, *Hysteroscopy: Visual Perspectives of Uterine Anatomy, Physiology and Pathology*. Philadelphia: Lippincott Williams & Wilkins, 2007.

DEFINITIONS AND BACKGROUND

Choriocarcinoma involves a highly malignant neoplasm of the placenta with a secretion of human chorionic gonadotropin (hCG). It may develop in women after a molar pregnancy (where the fetus does not develop but a tumor develops instead), a miscarriage, or a full-term delivery.

Gestational choriocarcinoma occurs in approximately 1 in 20,000–40,000 pregnancies (Alvarez et al, 2005). It is more common among Asian women. Alternative names include chorioblastoma, trophoblastic tumor, chorioepithelioma, gestational trophoblastic disease, and gestational trophoblastic neoplasia. Rarely, a hydatidiform mole grows as a mass inside the uterus at the beginning of a pregnancy. When choriocarcinoma occurs in males, it presents as a testicular neoplasm, with skin hyperpigmentation (from excess beta hCG cross-reacting with the alpha MSH receptor), gynecomastia, and weight loss.

Diet affects the development of this type of cancer, because the placenta has such a large role in nutrient availability (Briese et al, 2005). Placental trophoblasts and immunomodulatory molecules are under investigation (Petroff et al, 2005). Phytoestrogens (PEs) induce biologic responses by mimicking or modulating the action or production of endogenous hormones; isoflavonoids and coumestrol increase progesterone receptor protein expression and decrease ERalpha expression (Taxvig et al, 2010).

Fatty acid synthase (FASN) is a tumor-associated marker found in all choriocarcinomas (Ueda et al, 2009). After the initial diagnosis, a careful examination is done to rule out metastasis. It can be fatal if there is metastasis to the kidney.

Gestational choriocarcinoma is responsive to chemotherapy; surgical excision or D & C is reserved for acute emergencies (Alvarez et al, 2005). A hysterectomy is rarely indicated but may be used for some women under age 40.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Trophoblast factors are activated by hypoxia; interleukin (IL)-6, CD126, CD130, vascular endothelial growth factor (VEGF), and hypoxia inducible factor-1alpha (HIF-1alpha) are silenced in JEG-3 choriocarcinoma cells (Dubinsky et al, 2010).

Specific Clinical/History

- Height
- Weight
- BMI
- Weight loss?
- Diet history
- Nausea, vomiting
- I & O
- BP; hypertension?
- Vaginal bleeding
- Cough, hemoptysis
- Chest pain
- Headache
- Chest X-ray

Lab Work

- Human chorionic gonadotropin β-hCG levels
- Elevated TSH
- Alb, transthyretin
- CRP
- Transferrin
- Gluc
- H & H
- Serum Fe, ferritin
- Mg^{++}, Ca^{++}
- Na^{+}, K^{+}
- ALT (increased)
- Kidney function tests

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Bioactive Substance Intake

Assessment Data: Pregnancy 6 months ago; still breastfeeding but showing high levels of β-hCG. Diagnosis of choriocarcinoma. BMI 25. No other unusual medical history. Diet history completed.

Nutrition Diagnosis (PES): Inadequate bioactive substance intake related to phytoestrogens as evidenced by food frequency records showing no intake of soy or other isoflavonoids.

Intervention: Food-nutrient delivery—Offer recipes and tips for ways to increase the intake of isoflavonoids from soy, legumes, spinach, and Brussels sprouts. Educate the patient about the role of bioactive substances in isoflavonoids in the prevention of relevant forms of cancer. Coordinate care with the medical team for the methotrexate treatment.

Monitoring and Evaluation: No undesirable outcomes (e.g., no renal metastasis); methotrexate treatment successful.

INTERVENTION

OBJECTIVES

- Maintain appropriate weight for height. Correct weight loss and cachexia.
- Increase intake of isoflavonoids and other bioactive substances.
- Correct side effects of chemotherapy if used.
- Treat and correct all other side effects of therapy and disease state.
- Prepare patient for surgery, if necessary.

FOOD AND NUTRITION

- Modify diet to patient preferences. Include isoflavonoids and coumestrol from soy products, legumes, spinach, and Brussels sprouts.
- Increase liquids as needed.
- Provide adequate protein, B-complex vitamins, iron, calories, and other nutrients for wound healing, as appropriate. Use RDA and DRI levels as a guide.
- Alter the texture of the diet if the patient is fatigued at mealtimes or if stomatitis occurs after chemotherapy.

Common Drugs Used and Potential Side Effects

- Methotrexate or actinomycin D may be used; nausea and vomiting are common side effects. Administer with glucose to reduce toxicity.
- Combined EMACO therapy (etoposide, methotrexate, actinomycin D, cyclosphosphamide, and oncovin) may be used with high-risk disease; thinning hair or GI distress can occur.
- A new FASN inhibitor, C93, is being developed to initiate apoptosis in these cells (Ueda et al, 2009).

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Phytoestrogens from isoflavonoids may prove to be quite effective in the treatment of this cancer.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Nausea or vomiting may require small, frequent feedings and control of fluid intake at mealtimes.
- With the high hCG levels, menstrual periods stop; periods start again when the levels are normal again. Delay pregnancy for 6 months or longer after treatment. With chemotherapy, periods will stop temporarily, and there may be early menopause.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Cancer Help – UK
  http://www.cancerhelp.org.uk/type/GTT/choriocarcinoma/about/index.htm
- Family Practice Notebook–Choriocarcinoma
  http://www.fpnotebook.com/OB65.htm
- Medline–Choriocarcinoma
  http://www.nlm.nih.gov/medlineplus/ency/article/001496.htm

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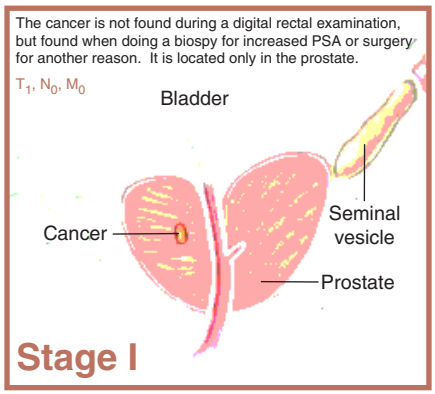
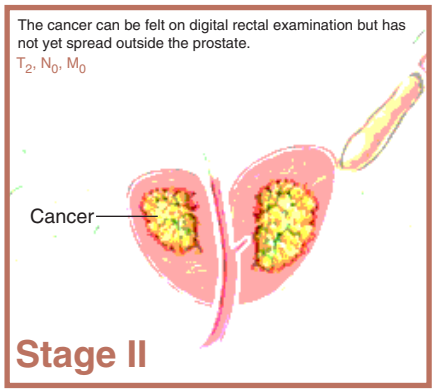
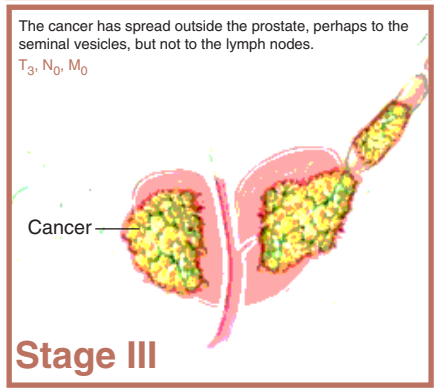
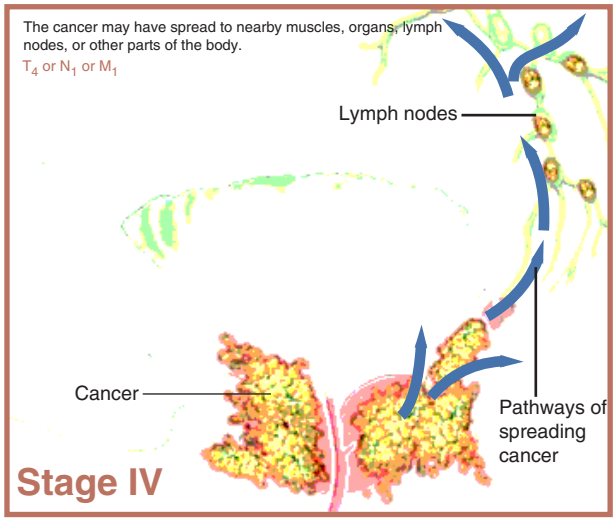
PROSTATE CANCER

NUTRITIONAL ACUITY RANKING: LEVEL 2









DEFINITIONS AND BACKGROUND

Prostate cancer is third to lung and colon cancer as the cause of cancer-related deaths in American men (Colli and Amling, 2009). Prevalence is high in northwestern Europe and the United States, highest among African-American males worldwide. Men also at great risk are those with abdominal obesity, those with family history of the disease, and those whose diets are low in fiber and high in saturated fats or red meats. High serum cholesterol levels may be linked with the progression of prostate cancer (Freedman and Aronson, 2009).

An effective chemoprevention strategy for prostate cancer serves as a model for chemoprevention of other adult malignancies (Canby-Hagino and Thompson, 2005). Diets rich in specific vitamins, grains, fish, fruits, and vegetables may be associated with lower cancer rates (Chan et al, 2005; Lamb and Zhang, 2005). Chemoprotective factors are listed in Table 13-18.

Surgical intervention, radiation, and hormonal therapy are used. Radiation therapy may cause temporary changes in bowel habits (such as increased frequency, increased flatulence, and bowel cramping). Brachytherapy is internal radiation therapy in which small radioactive pellets are inserted or implanted into the prostate gland.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Overexpression of the *AMACR* gene is associated with prostate cancer risk (Xu et al, 2005). Strict nutritional interventions can change gene expression (Ornish et al, 2008). Secondary analyses of two randomized, controlled phase III trials have demonstrated that selenium and vitamin E could reduce prostate cancer incidence through cell type- and zone-specific tissue effects (Tsavachidou et al, 2009).

Clinical/History

- Height
- Weight
- BMI
- Weight changes
- Diet history
- I & O
- Urine testing (infections, enlarged prostate)
- Urinary dribbling, frequency, pain, burning
- Persistent pain (pelvis, lower back, upper thighs)
- BP
- Transrectal ultrasound
- Doppler scan
- Digital rectal examination
- Bone scan, chest x-ray
- CT scan, MRI

Lab Work

- Prostate-specific antigen (PSA) (>2.5 ng/mL is a concern)

Alb, transthyretin	BUN, Creat	H & H
CRP	Serum vitamin D	Ca^{++}, Mg^{++}
	Transferrin	Na^{+}, K^{+}

INTERVENTION

OBJECTIVES

- Prepare patient for surgery, radiation, medications, chemotherapy, or hormone therapy.
- Prevent or correct side effects such as nausea, vomiting, and diarrhea.
- Prevent or correct weight loss.

TABLE 13-18 Preventive Dietary Factors for Prostate Cancer

Allium vegetables (garlic, scallions, onions, chives, and leeks)
Apigenin
Cruciferous vegetables (Chan et al, 2005)
Curcumin
Epigallocatechin gallate (EGCG)
Grains, nuts, cereals
Grape seed extract
Green tea (Trottier et al, 2010)
Herbs and herbal supplements (saw palmetto)
Lignans
Lower fat diet
Lycopene, other carotenoids (Trottier et al, 2010)
Omega-3 fatty acids, EPA and DHA (Chan et al, 2005)
Physical activity and exercise (Jian et al, 2005; Zeegers et al, 2005)
Polyphenols (Chan et al, 2005)
Pomegranate (Trottier et al, 2010)
Quercetin
Resveratrol
Selenium (Chan et al, 2005; Trottier et al, 2010)
Soy genistein and isoflavones (Chan et al, 2005; Trottier et al, 2010)
Statins, 5-alpha-reductase inhibitors, and NSAIDs
Vegan diet
Vitamin D_3 (Schwartz, 2005; Tokar and Webber, 2005; Trottier et al, 2010)
Vitamin E as gamma-tocopherol in walnuts, pecans, sesame seed, corn and sesame oils (Chan et al, 2005; Trottier et al, 2010)

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SAMPLE NUTRITION CARE PROCESS STEPS

Increased Energy Needs

Assessment Data: 90-year-old male resident in a long-term care facility; diagnosed with prostate cancer 1 year ago. Gradual weight loss, recently 5# in past month. Intake records show 25–50% at mealtime in the past month; previously 50–75% at all meals and taking oral supplements between meals.

Nutrition Diagnosis (PES): NC-3.2 Increased energy needs related to the inflammatory process and diagnosis of prostate cancer as evidenced by the insidious weight loss over six months.

Intervention:

Food and Nutrient Delivery—Provide fortified foods such as super oatmeal and potatoes because of increased energy needs; MVI with minerals to ensure adequate nutrients are available. Coordinate care—Continue high calorie supplements between meals and with medication passes by nursing.

Monitoring and Evaluation: No further weight loss. Improved intake of kilocalories as noted on 3-day calorie count.

- Promote intake of protective foods and phytochemicals. Support intensive nutrition and lifestyle intervention to change gene expression, where appropriate (Ornish et al, 2008).
- Maintain or achieve a healthy body weight.

FOOD AND NUTRITION

- Provide adequate calories and protein; avoid excesses.
- It may be beneficial to have some weight loss prior to surgery using a low-fat, low glycemic index diet (Schenk et al 2009).
- After surgery, a multiple vitamin—mineral supplement may be indicated to promote wound healing.
- Monitor the need for lower sodium if corticosteroids are prescribed.
- Increase the use of fruits and vegetables, particularly green and yellow-orange, and sources of folic acid. Tomato products, pizza sauce, strawberries, and salsa provide lycopene. Pomegranate juice may reduce the likelihood of recurrence (Malik et al, 2005).
- Increase the use of isoflavonoids (Haddad et al, 2006; Steiner et al, 2008). Choose beans, soybeans, lentils, tofu, tempeh, soy nuts, soymilk, and dried fruit often.
- Low-fat, vegan, and high-fiber diets may be indicated (Dewell et al, 2008; Van Patten et al, 2008).
- Increased use of omega-3 fatty acids has been shown to be useful; include salmon, sardines, tuna, mackerel, and herring in the diet.
- Vitamin D_3 is needed; drink fortified milk, get a modest exposure to the sun, and take a vitamin pill that contains cholecalciferol.

Common Drugs Used and Potential Side Effects

- Aspirin improves survival after prostate cancer. NSAIDs and statins may also be beneficial.

TABLE 13-19 Antioxidant Color Link

Colors	Examples of Fruits-Vegetables	Antioxidants
Red	Grapes, red wine	Resveratrol
Red/Pink	Tomatoes, pink grapefruits, watermelon	lycopene
Red/Purple	Pomegranates, grapes, plums, berries	Anthocyanins
Orange	Carrots, mangoes, apricots, cantaloupes, pumpkin, sweet potato	Alpha and beta carotenes
Orange/Yellow	Oranges, peaches, papaya, nectarines	Beta-cryptoxanthin
Yellow/Green	Spinach, collard, yellow corn, green peas, avocado, honeydew melon	Lutein and zeaxanthin
Green	Broccoli, Brussels sprouts, cabbage, bok choy, kale	Sulforaphane, isothiocyanates, indoles
Whit/Green	Garlic, onions, asparagus, leeks, shallots, chives	Allyl sulfides

Source: Prostate Cancer Foundation, http://www.prostatecancerfoundation.org/atf/cf/%7B705B3273-F2EF-4EF6-A653-E15C5D8BB6B1%7D/Nutrition_Guide.pdf, accessed January 15, 2010.

- Chemotherapy drugs have varying side effects; monitor closely. Fatigue, nausea and vomiting, mouth sores, hair loss, and a low white blood cell count are common.
- The Prostate Cancer Prevention Trial (PCPT) identified the benefits of reducing prostate cancer risk with the use of 5alpha-reductase inhibitors (Crawford et al, 2009). Finasteride lowers prostate cancer risk and can be available to men who are at high risk (Kaplan et al, 2009).
- Hormonal therapy may be used as the treatment of choice (Bracarda et al, 2005). Luteinizing hormone–releasing hormone (LH-RH) agonists can decrease the amount of testosterone produced by a man's testicles as effectively as surgical removal. Lupron Depot (leuprolide acetate for depot suspension), an LH-RH agonist, is used in the palliative treatment of advanced prostate cancer.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Complementary and alternative medicine (CAM) includes the use of vitamin and mineral supplements, herbs, antioxidants, saw palmetto, selenium, vitamin E, and lycopene (Chan, Elkin et al, 2005). Herbs and botanical supplements should not be used without discussing it with the physician.
- Saw palmetto has some efficacy. Avoid taking it with estrogens, testosterone, anabolic steroids, oral contraceptives, or finasteride because the herb and drugs function in similar ways and additive effects are possible.
- Phytoestrogens found in common herbal products are effective inhibitors of prostate tumor cell growth through different mechanisms; these include quercetin, genistein, epigallocatechin gallate (EGCG), curcumin, apigenin, resveratrol, and isoflavones in soy and red clover.
- Pygeum and nettle are being studied at this time.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the side effects of therapy and the long-term plans for recovery.
- Maintain adequate hydration.
- Discuss lifestyle and dietary changes. This may include lowering the intake of red meats and saturated fats, increasing fruits and vegetables and tomato products, increasing fiber and whole grains, and consuming vitamin D–fortified milk.
- Chemopreventive agents include 5-alpha-reductase inhibitors; statins; NSAIDs; selenium; vitamins E and D; lycopene; allium vegetables (garlic, scallions, onions, chives, and leeks); soy/isoflavones; pomegranate and green tea polyphenols (Colli and Amling, 2009; Trottier et al, 2010; Van Patten et al, 2008). Table 13-19 provides a color chart to remember the antioxidant foods.
- Lifestyle changes tend to correlate with quality of life after prostate cancer treatments (Sheriff et al, 2005). Diet and exercise changes are important.
- Offer menu plans for sufficient intake of protective nutrients. Lycopene can be found in foods such as tomatoes, watermelon, guava, and red grapefruit. Include pomegranates, soy, fish, and more vegan or plant-based choices.
- Help to maintain a positive, optimistic outlook to yield favorable results (Kronenwetter et al, 2005).

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Association for the Cure of Prostate Cancer
  http://www.capcure.org/
- Medline
  http://www.nlm.nih.gov/medlineplus/prostatecancer.html
- Minorities and Underserved Populations
  http://www.ustoo.org/Minority_Program.asp
- Prostate Cancer Research Institute
  http://www.prostate-cancer.org/
- Prostate Cancer Support Group
  http://www.ustoo.com/

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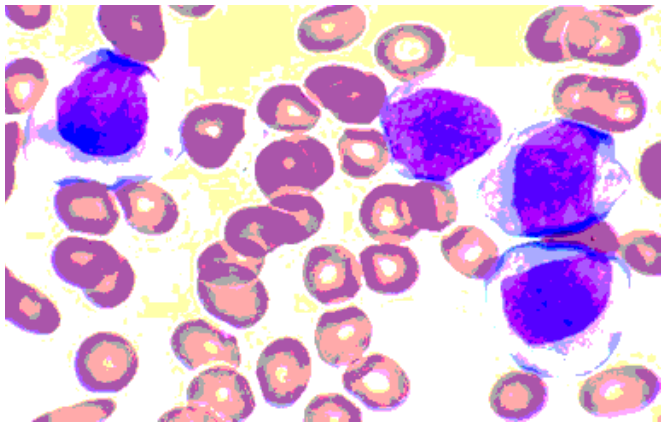
HEMATOLOGICAL CANCERS

LEUKEMIAS

NUTRITIONAL ACUITY RANKING: LEVEL 3–4



Adapted from: McClatchey KD M.D., D.D.S. *Clinical Laboratory Medicine,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2002.

DEFINITIONS AND BACKGROUND

Leukemia involves the uncontrolled proliferation of leukocytes and their precursors in blood-forming organs, with infiltration into other organs (Table 13-20). The blood has a grayish-white appearance. Leukemia incidence is highest among whites and lowest among American Indians/Alaskan natives and Asian and Pacific Islander populations. Acute leukemia progresses rapidly, with an accumulation of immature, functionless cells in the marrow and blood. Then, the marrow stops producing enough normal red cells, white cells and platelets and anemia develops. Chronic leukemias progress more slowly.

Leukemia is the most common childhood cancer. Because chromosomal abnormalities are present at birth in children who later develop leukemia, nutrition during pregnancy affects their risk. Insulin-like growth factor I (IGF-I) is associated with high birth weight and an increased risk of childhood leukemia (Tower and Spector, 2007). Both insulin and IGF-I act to promote cell proliferation and to inhibit apoptosis (Fair and Montgomery, 2009). Obesity is a well-known problem in children with ALL; it may be the result of an excess in energy intake, reduced energy expenditure, or both (Jansen et al, 2009).

Dietary exposures to cured/smoked meat or fish, nitrites, and nitrosamines are associated with leukemia in children and adolescents (Liu et al, 2009). It may be prudent for women to consume a diet rich in vegetables, fruit, iron, soybean curd, and protein (particularly fish and seafood) prior to and during pregnancy to reduce the ALL risk in their children (Kwan et al, 2009; Liu et al, 2009; Petridou et al, 2005).

Phytochemicals, such as grape extract, apigenin, quercetin, kaempferol, and myricetin, are protective against cancer cell survival (Chen et al, 2005). Red wine polyphenolic extract may inhibit leukemia cell growth (Sharif et al, 2010). In adults with AML, individuals who smoke, do not drink coffee, and eat more meat have a higher risk (Ma et al, 2009).

The primary treatment of leukemias currently involves chemotherapy to kill attacking abnormal blood cells. Bone marrow transplantation may be feasible in some cases. Table 13-21 lists various types of leukemias, relevant signs and symptoms, and treatments.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: FLT3 is a receptor tyrosine kinase that plays an important role in hematopoietic stem cell proliferation, differentiation and survival; alterations have a role in leukemia. BCR-ABL cancer gene is another gene of importance in leukemias. Persons with Down syndrome, Fanconi's anemia, and other genetic disorders have a high risk of leukemia. Lack of maternal folate causes DNA hypomethylation and increased DNA strand breaks; *MTHFR* gene polymorphisms have been associated with adult and childhood ALL (Smith et al, 2005; Tower and Spector, 2007). Chronic lymphocytic leukemia (CLL) is a malignancy of B cells of unknown etiology; deletions of the chromosomal region 13q14 are commonly associated with CLL (Klein et al, 2010).

Specific Clinical/ History

- Height
- Weight
- BMI
- Weight changes (slight weight loss?)
- Diet history
- BP
- Fever (over 101°F?)
- Frequent infections
- Malaise, irritability
- Pallor
- Hemorrhage
- Petechiae, ecchymosis, purpura
- Palpitations
- Shortness of breath
- Bone or joint pain
- Cough, sternal tenderness
- Splenomegaly, hepatomegaly
- Hemorrhages, nosebleeds
- Headache
- Anorexia
- Nausea and vomiting
- Mouth ulcers
- Bleeding
- Enlarged lymph nodes?
- Night sweats?
- Lumbar puncture

Lab Work[a]

- WBC (increased)
- Ferritin (increased)
- Platelets
- Lactate dehydrogenase (LDH) (elevated)
- Zinc (decreased)
- Uric acid (increased)
- Immunocytochemistry
- Cytogenetics (FISH test)
- Molecular genetic studies
- Alb, transthyretin
- CRP
- Serum copper (increased)
- Gluc
- H & H, Serum Fe, Ferritin
- Transferrin
- PT or International Normalized Ratio (INR)
- Na^+, K^+
- Ca^{++}, Mg^{++}

[a]A useful Web site describing lab tests is available at http://www.leukemia-lymphoma.org/attachments/National/br_1216925469.pdf.

INTERVENTION

OBJECTIVES

- Prevent hemorrhage and infections.
- Promote recovery and stabilization before bone marrow transplantation, if performed.

SAMPLE NUTRITION CARE PROCESS STEPS

Intake of Unsafe Foods

Assessment Data: Status post bone marrow transplant for ALL in a 14-year old male. Now at the emergency room, complaining of gastric pain and vomiting after eating items at a restaurant salad bar. BMI normal for age. Labs all within normal limits.

Nutrition Diagnosis (PES): Intake of unsafe foods related to raw vegetables and salad items at public restaurant following BMT procedure, as evidenced by gastric pain and vomiting.

Intervention: Education about the benefits of the low bacteria (neutropenic) diet for a few months longer until the immune system and tolerance improves. Counseling about the use of cooked fruits and vegetables and avoidance of salad bars until tolerance is better.

Monitoring and Evaluation: No further episodes of vomiting and GI pain with the use of the neutropenic diet. Good acceptance of the restrictions until immunity improves.

- Correct anorexia and nausea or vomiting.
- Prevent complications and further morbidity, such as veno-occlusive disease (VOD).
- Alter diet according to medications and therapies such as chemotherapy. A low-bacteria (neutropenic) diet may be useful, particularly if bone marrow transplant is used.
- Maintain weight that is appropriate for height. Correct weight loss and cachexia.
- Maintain adequate hydration.

FOOD AND NUTRITION

- Serve attractive meals at temperatures that are tolerated.
- Choose soft foods or foods that can be cooked until tender. Cut foods into bite-sized pieces; grind or blend them so that less chewing is needed.
- Follow neutropenic diet guidelines for BMT. Avoid all uncooked vegetables, most uncooked fruits, raw or rare-cooked meat, fish. All eggs should be thoroughly cooked. Avoid salad bars and deli counters. Buy vacuum-packed luncheon meats rather than freshly sliced meats. Eat or drink only pasteurized milk, yogurt, cheese, or other dairy products. Avoid soft mold-ripened and blue-veined cheeses including Brie, Camembert, Roquefort, Stilton, Gorgonzola, and Blue. At home, use tap water or bottled water; avoid well water or boil it for one minute before using.
- Small meals may be better tolerated than large ones. In some cases, cold or iced foods may be preferred.
- A high-protein, high-energy, high-vitamin/mineral intake should be offered. Tube feeding in these patients is often useful, but intolerance due to treatment side effects may be an obstacle.
- Extra fluids will be important during febrile states or with the use of interferon, but avoid overload. Sip water and

TABLE 13-20 Various Forms of Leukemia

Form	Description
Acute Leukemias	Sx: easy fatigue, malaise, irritability, fever, pallor, petechiae, bruising, purpura, hemorrhage, palpitations, shortness of breath, slight weight loss, bone or joint pain, painless lumps in underarm or stomach, cough, sternal tenderness, splenomegaly, hepatomegaly, anemia, hemorrhages or nosebleeds, headache, nausea, vomiting, and mouth ulcers.
Acute lymphocytic leukemia (ALL)	ALL affects bone marrow and lymph nodes. It progresses rapidly and mainly affects children; it accounts for 50% of all childhood leukemias. Control of bone marrow and systemic disease is the goal. Treatment may include monthly lumbar punctures. ALL often spreads to the coverings of the brain and spinal cord; patients may receive chemotherapy into spinal fluid, or radiation therapy to the head. Bone marrow transplantation (BMT) treatment or peripheral-blood stem-cell transplant (PBSCT) may lead to bloody diarrhea, fever, and other symptoms of graft-versus-host disease (GVHD).
Acute myelogenous leukemia (AML)	AML starts in the bone marrow but moves into the blood and to the lymph nodes, liver, spleen, central nervous system, and testes. AML consists of proliferation of myeloblasts, which are immature polynuclear leukocytes. AML is more common in adult males but also accounts for just under half of cases of childhood leukemia. Average onset of AML is the sixth decade. Smoking, obesity, chronic workplace exposure to benzene, large doses of irradiation have been established as causes. Treatments vary according to the age of the patient and according to the specific subtype. The goal is to control bone marrow, CNS, and systemic disease.
Chronic Leukemias	Sx: anemia, increased infections, bleeding, enlarged lymph nodes (in lymphatic form), night sweats, fever, weight loss, and anorexia.
Chronic lymphocytic leukemia (CLL)	CLL involves a crowding out of normal leukocytes in lymph glands, interfering with the body's ability to produce other blood cells. CLL is more common in people older than 50 years of age and in males. It is twice as common as CML. Treatment depends upon the stage and symptoms of the individual patient. Low-grade disease does not benefit from treatment. With complications or more advanced disease, treatment may be needed. Hairy cell leukemia is a subtype of CLL.
Chronic myelogenous leukemia (CML)	CML affects mostly adults and is very rare in children. The standard of care for newly diagnosed patients is oral administration of imatinib (Gleevec), which has few side effects and makes CML a chronic, manageable condition.
T-cell prolymphocytic leukemia	Has similar overproduction of white blood cells in the bone marrow; less common than the other types. Difficult to treat and does not respond well to chemotherapy drugs. Alemtuzumab (Campath) is a monoclonal antibody that attacks white blood cells with some success.

other clear liquids such as broth, ginger ale, or lemonade frequently.
- Vitamins A and D may be beneficial (Trump et al, 2005) but avoid excesses above the UL levels.
- Include protective foods such as isoflavones in soy and flavonoids in grapes, coffee, tea, nuts, seeds, fruits, and vegetables.

Common Drugs Used and Potential Side Effects

- See Tables 13-22.
- Methadone kills leukemia cells while not affecting the normal ones; it activates the mitochondrial pathway, which activated specific enzymes within the cancer cell, causing pre-programmed death. This is a great breakthrough in leukemia research.

TABLE 13-21 Medications for Acute Leukemias

Induction: The first phase destroys as many cancer cells as quickly as possible to bring about a remission.

Consolidation: The goal is to get rid of leukemia cells where they reside.

Maintenance: After the number of leukemia cells has been reduced by the first two phases of treatment, lower doses of chemotherapy drugs are given over 2 years.

CEP-701 (lestaurtinib) inhibits the receptor tyrosine kinase FLT3 in AML patients

Chemotherapy often includes methotrexate, 5-azacitidine, cytarabine, thioguanine, and daunorubicin, which may cause stomatitis, nausea, or vomiting. Coadministration of these agents with glucose and adequate fluid is needed. When methotrexate is used, neurotoxicity is a concern; use low-dose folinic acid rescue (Leucovorin).

Gemtuzumab ozogamicin (Mylotarg) may be added. Granulocyte colony-stimulating factors (Neupogen, Leukine) may improve response to chemotherapy. This intensive therapy, which usually takes place in the hospital, typically lasts 1 week.

L-asparaginase (Elspar) may be used; hepatitis or pancreatitis may result; watch carefully.

Pegaspargase (Oncaspar) can cause nausea, vomiting, anorexia, and glucose changes.

Interferon may be used.

Prednisone may be used, with side effects related to steroids with chronic use. Alter diet and intake accordingly to manage hyperglycemia, hypokalemia, and nitrogen losses.

TABLE 13-22 Medications for Chronic Leukemias

Chemotherapeutic agents may be used with varying side effects. Chlorambucil (Leukeran) and busulfan are common; nausea, severe fatigue, flu-like symptoms, low-grade temperature, vomiting, glossitis, and cheilosis may occur. Avoid hot, spicy, or acidic foods, if not tolerated.

Pegaspargase (Oncaspar) can cause nausea, vomiting, anorexia, and glucose changes.

Imatinib (Gleevec), for CML, interferes with an abnormal enzyme that sends signals to the nucleus of a cancer cell. Nausea and vomiting are potential side effects. Dasatinib (Sprycel) and nilotinib (Tasigna) block the BCR-ABL cancer gene, but each works in a different way than Gleevec. Sprycel and Tasigna are approved for certain CML patients who are resistant or intolerant to prior therapy including Gleevec. All three drugs are given orally.

For CLL: Multiple treatments include purine analogs, monoclonal antibodies, and stem-cell transplantation.

Antifungals, antivirals, or antibiotic drugs may be used; side effects vary.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- For CML, bioflavonoids, vitamin A, Retin-A, vitamin D_3, vitamin E, vitamin B_{12}, indirubin (found in herbs including *Indigofera tinctoria* and *Isatis tinctoria*), and *Curcuma longa* have shown promise (Matsui, 2005).
- Omega-3 fatty acid supplements may increase the blood-thinning effects of aspirin or warfarin.
- St. John's wort reduces the effectiveness of imatinib, which is used to treat CML and Philadelphia-positive ALL.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- A well-balanced diet is essential; discuss ways to improve or increase intake.
- Tumor lysis syndrome is a side effect caused by the rapid breakdown of leukemia cells. When these cells die, they release substances into the bloodstream that can affect the kidneys, heart, and nervous system. Giving patient extra fluids or certain drugs that help rid the body of these toxins can prevent this problem.
- Offer guidelines to transition from CPN or PN to enteral nutrition and oral intake.
- Discuss guidance for graft-versus-host disease (acute vs. chronic symptoms).
- Discuss alternative ways to make meals more attractive and appealing.
- Instruct patient on nutrition repletion if appropriate. For extra calories, blend cooked foods or soups with high-calorie liquids such as gravy, milk, cream or broth instead of water.

Patient Education—Food Safety

- People who are being treated for leukemia have weakened immune systems and increased risk for food-borne illness.
- Keep hands, counters, dishes, cutting boards, and utensils clean. Change sponges and dishtowels often.
- Keep foods at proper temperatures, reheating foods properly.
- Wash fruits and vegetables thoroughly.
- Use separate dishes, cutting boards, and utensils for preparing raw meat, fish, or poultry.
- Thaw frozen items in the microwave or refrigerator, not on the kitchen counter.
- Use a food thermometer to make sure that meat is fully cooked.
- Read the expiration dates on food products. Look for signs of food spoilage; if in doubt, throw it out.

For More Information

- Leukemia and Lymphoma Society
  http://www.leukemia-lymphoma.org
- People Living With Cancer
  http://www.plwc.org
- Partnership for Food Safety Education (PFSE)
  http://www.fightbac.org
- University of Virginia Health System
  http://www.healthsystem.virginia.edu/internet/hematology/hessidb/leukemias.cfm

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LYMPHOMAS

NUTRITIONAL ACUITY RANKING: LEVEL 3

DEFINITIONS AND BACKGROUND

Chronic antigenic stimulation leads to lymphoid malignancy (Anderson et al, 2009). There are two types: **Hodgkin's lymphoma (HL)** and non-Hodgkin's lymphoma (NHL), which is far more common. In HL, patients present with enlarged lymph nodes that are firm and rubbery, severe pruritus, jaundice, night sweats, fatigue and malaise, weight loss, slight fever, alcohol-induced pain, cough, dyspnea, and chest pain. It presents most commonly in males between the ages of 15 and 34 or after age 60 in persons who have lupus, Epstein-Barr virus (mononucleosis) or HIV infection. Abnormal B cells, called Reed-Sternberg cells, develop and enlarge. The treatment of HL involves radiation and chemotherapy. Stage 1 is limited to one body part; stage 2 involves two or more areas on the same side of the diaphragm; stage 3 involves lymph nodes above and below the diaphragm; and stage 4 involves lymph nodes and other areas such as the lungs, marrow, and liver. Patients who present with weight loss initially have a worse prognosis than those without weight loss. The 5-year survival rate for Hodgkin's disease is 84%; it is one of the more curable forms of cancer. Unfortunately, survivors may have a stroke later in life, and young women who receive high-dose radiation for Hodgkin's disease are more at risk for breast cancer. **Non-Hodgkin's lymphoma (NHL)** is a malignant tumor of lymphoid tissue, resulting from an invasion of the lymph nodes and other tissues by lymphocytes. NHL is relatively common among individuals whose immune system is suppressed. Rheumatoid arthritis, Sjögren syndrome, T-cell lymphoma with hemolytic anemia, psoriasis, discoid lupus erythematosus, and celiac disease are associated with an increased risk of NHL (Anderson et al, 2009). *H. pylori* is associated with the development of lymphoma in the stomach wall. Burkitt's lymphoma is most common in children, young adult males, and patients with AIDS; it originates from a B lymphocyte and requires chemotherapy. This lymphoma is associated with a prior infection with the Epstein-Barr virus.

Exposure to certain chemicals (such as nitrates) in herbicides and pesticides promotes risk. Enteropathy-associated T-cell lymphoma (EATL) is a rare form of high-grade, T-cell NHL of the upper small intestine that is specifically associated with celiac disease (Catassi et al, 2005). Capsule endoscopy is used to evaluate this celiac disease–associated enteropathy (Joyce et al, 2005). Strict adherence to the gluten-free diet protects against NHL, particularly if started early (Hervonen et al, 2005).

Symptoms and signs of NHL include difficulty breathing, swelling of face, thickened or dark, itchy skin areas, increased incidence of bacterial infections, night sweats, weight loss, fever, anemia, and pleural effusion. It is possible, as well, to develop chylous ascites or chyloperitoneum. By the time of NHL diagnosis, it is often widely spread. It may spread to the cervix, uterus, and vagina in women. Radiation is a common treatment for the early stages. A cure is less likely for those over age 60.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: HL and NHL have several gene mutations. The presence of the Reed-Sternberg cell in HL is an expression of the CD30 antigen. In NHL, t(14;18)(q32;q21) chromosomal translocations occur in the BCL2 gene.

Specific Clinical/History

- Height
- Weight
- BMI
- Weight loss?
- Diet history
- Enlarged, rubbery lymph nodes
- Painless adenopathy
- Pruritus, severe
- Jaundice
- Night sweats
- Fatigue and malaise
- Slight fever, temperature
- Alcohol-induced pain
- Cough, dyspnea, and chest pain
- Diarrhea
- I & O
- Lymphangiogram
- X-ray or CT scan
- Bone marrow biopsy

Lab Work

- Ceruloplasmin (increased)
- Reed-Sternberg cells (more than one nucleus)
- ESR
- Uric acid (increased)
- PT (increased)
- Gluc
- CRP
- Serum Cu (increased)
- H & H
- Bilirubin (increased)
- Alk phos (often increased)
- Ferritin (increased)
- ALT (increased)
- Serum lipids—Chol, Trig
- Ca^{++}, Mg^{++}
- Na^{+}, K^{+}

SAMPLE NUTRITION CARE PROCESS STEPS

Obesity

Assessment Data: BMI 42, new diagnosis of NHL. Diet hx indicates low intake of whole grains and vegetables and high intake of sugary, refined foods and beverages.

Nutrition Diagnosis (PES): Obesity related to poor food choices as evidenced by BMI 42 and preference for sugary, refined foods.

Intervention: Food-Nutrient Delivery—Promote the use of low energy foods and beverages. Educate the patient about the risks of obesity in cancer promotion. Counsel about ways to safely lose weight, with the focus on a healthy body weight and nutrient density.

Monitoring and Evaluation: Reasonable amount of weight lost, slowly and without loss of lean body mass but with tolerance for chemotherapy treatments. Improved BMI.

INTERVENTION

OBJECTIVES

- Prevent or correct weight loss, fever, malaise, and infections such as candidiasis.
- Correct dysphagia, nausea and vomiting, and anorexia.
- Control protein-losing enteropathy, chylous ascites, and other side effects.
- Control enteropathy in patients who also have celiac disease.
- Modify diet according to the side effects of therapy (e.g., radiation or chemotherapy).
- If obese, a gradual weight loss plan may be indicated.

FOOD AND NUTRITION

- Increase protein and fluids. Balance energy intake to meet the needs of treatments without causing weight gain.
- Six small feedings are generally better tolerated than three large meals. Alter diet according to symptoms.
- Bland, low acidic foods may be better accepted for a while.
- With celiac disease, the gluten-free diet is required.
- With hyperglycemia, control carbohydrates and overall energy intake.
- Support the use of a protective diet with folate and B vitamins, vegetables, and legumes. Include vitamin D_3, particularly from sunlight (Grant, 2009; Kelly et al, 2009).

Common Drugs Used and Potential Side Effects

HL

- Chemotherapy is often given in combination. The regimen MOPP, which includes mechlorethamine (nitrogen mustard), vincristine (Oncovin), procarbazine, and prednisone may cause nausea, vomiting, diarrhea, weakness, constipation, and mouth sores. The regimen ChlVPP, which includes chlorambucil, vinblastine, procarbazine, and prednisone, may cause similar side effects. After chemotherapy, young women may have amenorrhea.
- Corticosteroids can aggravate the electrolyte status and will decrease the calcium, potassium, and nitrogen balance over time. Hyperglycemia may also occur; monitor blood glucose levels.

NHL

- Chemotherapy is often given as a regimen called CHOP, which includes cyclophosphamide, doxorubicin, vincristine (Oncovin), and prednisone. CHOP may cause nausea, vomiting, anorexia, diarrhea, and other gastrointestinal (GI) side effects. Single agents may also be used. Methotrexate causes GI pain, mouth ulcers, nausea, and folic acid depletion.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.
- Lymphoma survivors tend to use CAM therapies more than the general population (Habermann et al, 2009). Chiropractic, massage, and use of St. John's wort and shark cartilage have been noted.
- Acupuncture, coenzyme Q10, and polysaccharide K are under study.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss methods of improving appetite by the use of attractive meals.
- Encourage rest periods before and after meals to reduce fatigue.
- Encourage a diet that is protective with plenty of vegetables and legumes.
- Vitamin D_3 may protect against both types of lymphomas (Grant, 2009; Kelly et al, 2009).

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Cancer Information Network
  http://www.ontumor.com/
- Leukemia and Lymphoma Society
  http://www.leukemia-lymphoma.org/all_page?item_id=7030
- Lymphoma Information Network
  http://www.lymphomainfo.net/lymphoma.html
- National Cancer Institute–Hodgkin's Lymphoma
  http://www.cancer.gov/cancerinfo/types/hodgkinslymphoma
- National Library of Medicine
  http://www.nlm.nih.gov/medlineplus/hodgkinsdisease.html
- Non-Hodgkin's Lymphoma
  http://www.nlm.nih.gov/medlineplus/ency/article/000581.htm
- Wellness After Treatment
  http://www.cancer.gov/cancertopics/life-after-treatment/page4

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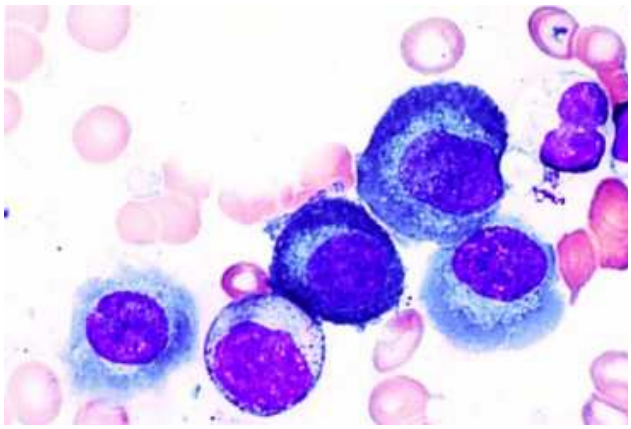
MYELOMA

NUTRITIONAL ACUITY RANKING: LEVEL 3



Adapted from: Raphael Rubin, David S. Strayer, *Rubin's Pathology: Clinicopathologic Foundations of Medicine,* 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

DEFINITIONS AND BACKGROUND

Myeloma is the second most common blood cancer. Multiple myeloma (MM) is a malignant cancer in which plasma cells proliferate, invade bone marrow, and produce abnormal immunoglobulin. Different types of myeloma are classified by the type of immunoglobulin produced by the abnormal cells. The condition is rare, affecting only 4/100,000 persons and representing only 1% of all cancers. Males are affected more often than females, and the disorder usually strikes after age 50. African-Americans are twice as likely to acquire MM as Caucasians, Hispanics, or Asians.

Obesity promotes this type of cancer. MM affects several areas of bone marrow. If significant bone lesions, renal failure, or hypercalcemia occur, chemotherapy or transplantation is recommended. Stem-cell transplantation or radiation therapy may be administered (Iversen, 2009).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: The premalignant condition of monoclonal gammopathy of undetermined significance (MGUS) precedes all cases of MM (Jagannath, 2010).

Specific Clinical/History

- Height
- Weight
- BMI
- Weight loss?
- Shortened stature?
- I & O
- BP
- Bone pain
- Pathological fractures
- Nausea and vomiting
- Anorexia
- History of bleeding
- Fatigue, weakness, apathy
- Sudden confusion
- Renal disorders
- Bleeding tendency (particularly gums)
- Frequent urinary tract infections
- Pneumonia?
- Skeletal survey

Lab Work

- Ca^{++} (increased)
- Mg^{++}
- Na^{+}, K^{+}
- Total protein
- Parathormone (PTH) (increased)
- TLC (varies)
- Hypercalciuria
- Alb (often increased)
- CRP
- Transferrin
- H & H
- Proteinuria (Bence Jones proteins)
- Sedimentation rate (increased)
- Uric acid (increased)
- RBP
- ALT (increased)

INTERVENTION

OBJECTIVES

- Avoid fasting. Space meals and snacks adequately.
- Counteract episodes of fatigue and weakness.
- Manage pain effectively.
- Counteract side effects of antineoplastic therapy, steroid therapy, and radiotherapy.
- Avoid infections and febrile states.
- Prevent spontaneous fractures, as far as possible.
- Correct anorexia, nausea and vomiting, and weight loss.

FOOD AND NUTRITION

- Provide diet as usual, with six small feedings rather than large meals.
- A higher protein intake may be useful to counteract losses.
- Provide adequate energy to meet requirements of weight control, preventing unnecessary losses.

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Oral Food and Beverage Intake

Assessment Data: Mucositis following chemotherapy for the treatment of multiple myeloma. Unable to chew and swallow comfortably because of inflamed oral tissues.

Nutrition Diagnosis (PES): Inadequate oral food and beverage intake (NI-2.1) related to sore mouth as evidenced by mucositis after chemotherapy and difficulty finding tolerated foods and beverages.

Intervention: Food-nutrient delivery—offer soft, ground, or pureed foods that are low in acid and spices. Educate the patient about the use of a soft, easily tolerated diet that has nutrient-density. Counsel with tips for gradually increasing the oral diet as mucositis subsides.

Monitoring and Evaluation: Resolution of mucositis with an improvement in oral intake.

- Avoid dehydration by including adequate fluid intake (e.g., 3 L daily). This is important.
- Ensure sufficient intake of omega-3 fatty acids, vitamins, minerals, and phytochemicals, particularly from fruits and vegetables.

Common Drugs Used and Potential Side Effects

- Arsenic trioxide (Trisenox), carmustine (BiCU, BCNU), cyclophosphamide (Cytoxan), doxorubicin (Adriamycin, Rubex), idarubicin (Idamycin), interferon-alpha (Roferon-A, Intron-A), lenalidomide (Revlimid), pamidronate (Aredia), vincristine (Oncovin), or zoledronic acid (Zometa) may be given as chemotherapy, often with several in a mixture. Melphalan (Alkeran) or nitrosoureas may also be used; monitor for anorexia, anemia, nausea, vomiting, and stomatitis.
- Bisphosphonates may be used to prevent bone fractures.
- Pamidronate may be used. Ensure adequate fluid intake but not excess. Avoid use with calcium and vitamin D supplements. Extra phosphorus may be needed. Nausea, vomiting, gastrointestinal bleeding or distress, and constipation can occur.
- Prednisone, if used chronically, can increase nitrogen losses and potassium and magnesium depletion and can cause hyperglycemia and sodium retention.
- Lenalidomide delays disease progression in late-stage multiple myeloma. It also helps to reduce the need for blood transfusions.
- The immunomodulatory agents thalidomide and lenalidomide and the proteasome inhibitor bortezomib are now routine components of MM therapy (Jagannath, 2010). However, all patients with MM eventually relapse; efforts to identify novel synergistic combinations and agents are ongoing (Jagannath, 2010).
- Bortezomib (Velcade), a proteasome inhibitor, delays disease progression and extends survival.

Herbs, Botanicals, and Supplements (see Table 13-8)

- Herbs and botanical supplements should not be used without discussing it with the physician.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the rationale for spacing meals throughout the day to avoid fatigue.
- Offer recipes and meal plans that provide the nutrients required to improve status and immunological competence.

Patient Education—Food Safety

- Educate the patient about food safety issues. Discuss safe food handling and preparation, keeping foods at proper temperatures, the use of sterile water, and reheating foods properly.

For More Information

- Cleveland Clinic–Multiple Myeloma Programs
  http://www.clevelandclinic.org/myeloma/
- International Myeloma Foundation
  http://www.myeloma.org/
- Mayo Clinic Myeloma
  http://www.mayoclinic.com/health/multiple-myeloma/DS00415
- Multiple Myeloma Foundation
  http://www.multiplemyeloma.org/
- National Library of Medicine
  http://www.nlm.nih.gov/medlineplus/multiplemyeloma.html

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SECTION 14

Surgical Disorders

CHIEF ASSESSMENT FACTORS

Presurgical Status

- Anemia, Blood Loss
- Appetite Changes
- Blood Pressure, Abnormal
- Electrolyte Status
- History of Illness—Acute or Chronic (Such as Diabetes, Cerebrovascular Disease, Coronary Heart Disease)
- Hydration Status
- Infections
- Nausea, Vomiting
- Obesity and Anesthesia Risk
- Recent Starvation or Prolonged Malnutrition
- Recent Weight Changes, Especially Unintentional Loss
- Respiratory Function, Oxygen Saturation
- Serum Albumin, Transferrin, Retinol-Binding Protein, and C-Reactive Protein (CRP) (Inflammation)
- Surgical Procedure with Gastrointestinal (GI) Impact

Postsurgical Status

- Abnormal GI Function (diarrhea, constipation, obstruction)
- Altered Labs Such as Glucose, CRP, Electrolytes
- Breathing Rate
- Fever
- Impaired Skin Integrity, Wound Dehiscence
- Infection or Sepsis
- Nausea, Vomiting
- Pain, Sleep Disturbance
- Paralytic Ileus, Abdominal Distention
- Pneumonia or Lung Collapse
- Respiratory Function, Oxygen Saturation
- Urinary Tract Infection

General Surgical Guidelines

SURGERY

NUTRITIONAL ACUITY RANKING: LEVEL 2

Adapted from: Smeltzer SC, Bare BG. *Textbook of Medical-Surgical Nursing*, 9th ed. Philadelphia: Lippincott Williams & Wilkins, 2000.

DEFINITIONS AND BACKGROUND

Nutritional risk from surgery is related to the extent of surgery, prior nutritional state of the patient, and the effect of surgery on the patient's ability to digest and absorb nutrients. Weight loss is one of the most important assessment tools to predict surgical risk as related to nutritional status. Techniques to assess body composition help to quantify weight loss and clarify the impact of malnutrition on postsurgical status.

Surgery is the term used for treatments that involve cutting or stitching tissue, laser surgery, and robotic surgical procedures. Major surgery involves opening a major body cavity, such as the abdomen (laparotomy) or the skull in a craniotomy. "General anesthesia," a surgical team, and a hospital stay are required. Minor surgery may be done in an outpatient or emergency room setting, often with minimal anesthetic treatment. Surgeries with high risk include hip replacement, open heart surgery, and prostatectomy. Patients who are at high surgical risk include those with heart or renal failure, those who have had a recent heart attack, those who are severely malnourished, and those with chronic lung or liver diseases.

After surgery or injury with extensive tissue damage, plasma cortisol generally increases rapidly and fat breaks down rapidly to fatty acids and glycerol. The metabolic response to surgical or accidental injury leads to breakdown of skeletal muscle protein and the transfer of amino acids to visceral organs and the wound. At the wound site, substrate serves to enhance host defenses and support vital organ function and wound repair. Increased excretion of nitrogen and sodium retention occur, but these are reversed in approximately 5–7 days or as late as 12–14 days in elderly individuals and after severe burns. Increased excretion of potassium occurs but begins to reverse itself 1–2 days after surgery.

Malnutrition is prevalent among surgical patients and is associated with higher surgical complication rates and mortality (Figure 14-1). Some causes of poor nutritional status are related to the underlying disease, socioeconomic factors, age, and length of hospitalization. If medical teams overlook malnutrition, patients are at risk for malnutrition and complications. Use of tools such as the Subjective Global Assessment identifies malnutrition in many patients.

Elective surgery involves minimal increases in nitrogen loss and a 10–15% increase in energy requirements. Major surgery involves greater intensity and duration that will increase catabolic effects. Prevention of hypoxia in surgical wounds is especially important and preventable; fluid and temperature management are key factors. Table 14-1 defines the average length of time and stages of catabolic response after surgery, followed by anabolism.

The presence of cancer, infection, age more than 60 years, upper gastrointestinal (GI) disease, and longer length of hospital stay all negatively influence nutritional status. Nutritional status plays an important role in determining outcome after many types of operations. Enteral immunonutrition is an important consideration preoperatively as well, if time permits. Early postoperative enteral nutrition with a formula supplemented with arginine, omega-3 fatty acids, and RNA increases hydroxyproline synthesis and improves surgical wound healing in patients undergoing gastric surgery (Farreras et al, 2005).

Fever causes increased nutritional needs; for every 1°F increase, there is an increased energy requirement of 7–8% and the need for extra fluid. Optimal wound healing requires integration of responses to inflammatory mediators, growth factors, cytokines, and mechanical forces (Falanga, 2005). Extra protein is needed for wounds, burns, and hemorrhage; major wounds and burns can cause a loss of greater than 50 g of protein per day. With hemorrhage

TABLE 14-1 Postsurgical Phases in Nutrition

3–7 days	Marked catabolic response
2–5 weeks	Turning point and anabolic phase at which spontaneous improvement begins
>6 weeks	Fat gain phase; vigorous nutritional support could promote excessive fat stores

or major blood loss, or even when much blood is drawn for laboratory tests, loss of iron and plasma protein may be significant; loss of 1 L of blood equals a loss of 500 mg of iron and 50 g of plasma protein.

C-reactive protein (CRP) is a risk factor for cardiovascular outcomes and mortality in the general population; it predicts all-cause mortality (Winklmayer et al, 2005). Preoperative serum albumin concentration may predict surgical outcomes such as sepsis, renal failure, and major infections. Early identification of high-risk patients undergoing major surgery allows aggressive management. After surgery, the presence of systemic inflammatory response syndrome is a predictor of later sepsis (Mokart et al, 2005). Other patient risk factors predictive of postoperative morbidity include anesthesia and complexity of the operation.

A complete, balanced diet is recommended after surgery. A clear liquid diet has about 600 kcal/d and D5W solutions have only 170 kcal/L. Early postoperative oral feeding has been demonstrated to be safe (Lucha et al, 2005). Enhanced rate of recovery can be achieved by enhancing the metabolic status of the patient before (e.g., carbohydrate and fluid loading), during (e.g., epidural anesthesia), and after (e.g., early oral feeding) surgery (Fearon and Luff, 2003).

Healing of wounds involves blood cells, tissues, cytokines, growth factors, and metabolic demand for nutrients. Vitamin A is required for epithelial and bone formation, cellular differentiation, and immune function. Vitamin C is necessary for collagen formation, for proper immune function, and as a tissue antioxidant. Adequate protein is absolutely essential for proper wound healing.

Tissue levels of the amino acids arginine and glutamine (GLN) influence wound repair and immune function. GLN depletion in skeletal muscle is an outstanding metabolic marker related to acute skeletal muscle wasting (Roth and Oehler, 2010.) Energy-saving signals may be switched on to protect organs in a mode similar to hibernation; this may explain the low energy expenditure in septic patients (Roth and Oehler, 2010.) Its use in various enteral or parenteral products is accepted in many facilities.

Patients who receive enteral immunonutrition with multiple nutrients before and after major GI surgery often have lower treatment costs. Arginine is helpful in wound healing after trauma (Wilmore, 2004; Wittman et al, 2005). Major surgery, skeletal trauma, prolonged immobilization, and soft tissue damage are followed by increased calcium loss. Vitamin C may be destroyed by extensive inflammation in postoperative conditions. Table 14-2 indicates the extent of body reserves of nutrients. Higher nutrient reserves are advantageous in most surgeries.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Surgery may be needed to repair a genetic condition, such as a congenital heart disorder.

Clinical/History

- Height
- Weight
- Body mass index (BMI)
- Weight changes
- Diet history
- Blood pressure (BP)
- Intake and output (I & O)
- Nausea, vomiting
- Constipation
- Anorexia
- Urinary tract infection
- Skin integrity; pressure ulcers
- History of dehydration or slow wound healing
- Transfusions

Lab Work

- Glucose (Gluc)
- C-reactive protein (CRP)
- Platelet count
- Albumin (Alb), transthyretin
- Blood urea nitrogen (BUN)
- Creatinine (Creat)
- Na^+
- K^+
- Ca^{++}
- Mg^{++}
- Phosphorus (P)
- Urinary electrolytes
- Serum osmolality (Osm)
- N balance
- Transferrin
- Prothrombin time (PT) or international normalized ratio (INR)
- Hemoglobin and hematocrit (H & H)
- Serum Fe
- Vitamin B_{12}

INTERVENTION

OBJECTIVES

Preoperative

- Maintain or enhance reserves. Many patients admitted to hospitals are malnourished; therefore, proper presurgical assessment and nourishment should be emphasized.

TABLE 14-2 Time Required to Deplete Body Nutrient Reserves in Well-Nourished Individuals

Nutrient	Time
Amino acids	Several hours
Carbohydrate	13 hours
Sodium	2–3 days
Water	4 days
Zinc	5 days
Fat	20–40 days
Thiamin	30–60 days
Vitamin C	60–120 days
Niacin	60–180 days
Riboflavin	60–180 days
Vitamin A	90–365 days
Iron	125 days (women); 750 days (men)
Iodine	1000 days
Calcium	2500 days

From: Guthrie H. *Introductory nutrition.* 7th ed. St Louis: Times Mirror/Mosby College Publishers, 1989.

SAMPLE NUTRITION CARE PROCESS STEPS

Involuntary Weight Loss

Assessment Data (sources of info): Food records, input and output reports, medication history, assessment of depression.

Nutrition Diagnosis (PES): NC-3.2 Involuntary weight loss related to depression and poor intake after above-knee (AK) amputation as evidenced by weight loss of >6% in past 2 weeks and statement that "I just don't feel like eating any more."

Intervention: Food-Nutrient Delivery—Offer nutrient and energy-dense foods until appetite improves. Counsel about desired food and beverage intake for wound healing. Coordinate care—Discuss status of depression and medications or counseling with health care team.

Monitoring and Evaluation: Improved food intake as per I & O records. Better weight status and rate of wound healing. Improvement in symptoms of depression with medication.

TABLE 14-3 Measuring Energy Expenditure in Critical Illness

Measuring energy expenditure via indirect calorimetry (IC) is the most accurate method of determining needs. For short-term use, predictive equations such as the Ireton-Jones calculation for nutrition support are recommended.

Ireton-Jones Equations for Estimated Energy Expenditure (EEE) (Ireton-Jones and Jones, 1998)

1. Spontaneously Breathing Patient: $EEE = 629 - 11(A) + 25(W) - 609(O)$
2. Ventilator-Dependent Patient: $EEE = 1784 - 11(A) + 5(W) + 244(G) + 239(T) + 804(B)$

Key: A = age in years; W = weight in kg; O = obesity (>130% ideal body weight); G = gender (female = 0, male = 1); T = diagnosis of trauma (absent = 0, present = 1); B = diagnosis of burn (absent = 0, present = 1).

Some facilities use glucose and potassium intravenous loading in nondiabetic, nonrespiratory patients for surgical preparation.

- Identify risks for cardiac events after surgery, which are common and costly (Maddox, 2005).
- Prepare patients who are morbidly obese. Fatty tissues are not resistant to infections, hard to suture, and prone to dehiscence. A large amount of anesthesia is needed in the morbidly obese patients, and it is difficult to awaken them. Controlled weight loss should be instituted before surgery whenever possible.
- Elevated serum glucose on admission is an accurate predictor of postoperative infection, length of stay, and mortality (Bochicchio et al, 2005). Reducing hyperglycemia is important.

Postoperative

- Replete nutrient stores, such as protein and iron from hemorrhage or other blood losses. Replace important vitamins and minerals (vitamin C, 100–200% recommended amounts; vitamin K, zinc, and vitamin A).
- Correct imbalances in fluid, sodium, potassium, and other electrolytes.
- Promote wound healing. The surgical wound has priority only for the first 5–10 days. Wound tensile strength peaks at 40–50 days.
- Use enhanced immunonutrition where needed to provide sufficient amounts of protein and energy to preserve muscle function; stimulate and protect enterocytes while limiting bacterial translocation; keep liver function as normal as possible; and prevent or compensate for disturbances in the immune response. Arginine triggers anabolic hormones (e.g., insulin, growth hormone) and speeds wound healing (Zaloga et al, 2004). Arginine is important for growth, wound healing, cardiovascular function, immune function, inflammatory responses, energy metabolism, urea cycle function, and other metabolic processes (Zaloga et al, 2004). While somewhat controversial, it may be helpful to select an immune-enhanced tube feeding (TF) product for GI surgeries.
- Attend to special needs such as fever, trauma, pregnancy, and growth in infants and children.
- Prevent infection and sepsis, which can occur in more than 10% of surgical cases.
- Prevent aspiration, a leading cause of pneumonia and the most serious complication of enteral TF. Traditional clinical monitors of glucose oxidase strips and blue food coloring (BFC) should never be used; evaluation of gastric residual volumes is recommended.
- Minimize weight loss, which is not obligatory.
- Prevent or correct sarcopenia and protein—energy malnutrition (PEM). Table 14-3 describes the use of estimated energy requirement calculations when indirect calorimetry is not available. With complete bed rest, young adults lose about 1% of their muscle per day; seniors lose up to 5% per day because of lower levels of growth hormone, which maintains muscle tissue. Sitting up in bed, moving, standing, and exercising as soon as possible and safe is good for surgical patients.
- Manage pain, blood clots, and other complications. Constipation or difficulty urinating may also occur, especially with opioids and anticholinergic drugs, inactivity, and not eating.

FOOD AND NUTRITION

Preoperative

- Because malnutrition is a recognized risk factor for perioperative morbidity, the Nutrition Risk Screening 2002 score should be used to identify patients at nutritional risk who may benefit from nutritional support therapy; it has been officially adopted by the European Society of Parenteral and Enteral Nutrition (Schiesser et al, 2008.)

- Use a high-protein/high-energy diet, a TF, or parenteral nutrition, if needed. Enteral nutrition is effective, poses lower risks than parenteral nutrition, reduces infection rates, and shortens hospital length of stay of critically ill patients (Grimble, 2005).
- If patient is obese, use a low-energy diet that includes carbohydrates adequate for glycogen stores and protein to protect lean body mass. Elevated serum glucose on admission is an accurate predictor of postoperative infection, length of stay, and mortality (Bochicchio et al, 2005).
- Ensure that intakes of zinc and vitamins C and K are adequate.
- Bowel cleansing regimens commonly require adherence to liquid diets for 24–48 hours before examination, which often leads to poor compliance. Offering patients a regular breakfast and a low-residue lunch before bowel cleansing with sodium phosphate oral solution may be better tolerated.
- Gradually restrict diet to clear liquids and then nothing by mouth (NPO).

Postoperative

- Immediately after surgery, use intravenous glucose, insulin, or electrolytes as needed (Bossingham et al, 2005). As treatment progresses, advance diet as tolerated to a combination of liquid and solid items.
- A complete, balanced mix of nutrients is best. Excessive vitamin and mineral supplements do not increase rate of healing. In fact, because zinc and iron are bacterial nutrients, excesses may be detrimental.
- If oral feeding is not possible, use enteral nutrition. Initiate TF within 12–18 hours for less sepsis and fewer complications. The gut can generally tolerate early feedings, even in patients with pancreatitis (Gabor et al, 2005; Lucha et al, 2005; Marek and Zaloga, 2004). Early postoperative feeding is generally safe, effective, and cost-effective (Braga and Gianotti, 2005).
- When necessary, because of prolonged GI compromise or short bowel syndrome, use central parenteral nutrition (CPN). Use caution with intravenous lipids due to proinflammatory omega-6 fatty acids. Omega-3 fatty acids are acceptable and not inflammatory. The adaptive role of the small intestine after surgery is described in Table 14-4.
- For elective GI surgery, specialized immunonutrition does not have to be routine (Klek et al, 2008.) Enteral nutrition is preferred over parenteral nutrition when the GI tract is functional (Zaloga, 2006). GLN-enhanced products are useful, especially in malnourished patients; they improve antioxidant levels (Grimble, 2005; Luo et al, 2008). If PN is needed, glutamine-supplemented parenteral nutrition (GLN-PN) significantly decreases infections in surgical intensive care patients after cardiac, vascular, and colonic surgery (Estivarez et al, 2008.)
- With oral diet, offer increased fluid and include sources of protein, zinc, and vitamins C and A for wound healing. Use 25–45 kcal/kg and 1–1.5 g protein/kg; this varies depending on extent of surgical intervention and degree of catabolism. Losses of 5–15 g of nitrogen daily may occur.
- An analysis of clinical studies using enteral formulas with supplemental arginine suggests overall benefits (Zaloga et al, 2004). Arginine is found in shrimp, lean ground beef, pumpkin seeds, garbanzo beans, cottage cheese, peanuts, and soymilk.
- Hyperglycemia is associated with poor wound healing, increased susceptibility to infection, and other complications. While perioperative hyperglycemia has been associated with increased surgical site infections, there is insufficient evidence to support strict versus conventional glycemic control (Kao et al, 2009.)
- Electrolyte imbalances are common after surgery; see Table 14-5.
- Fluid imbalances are also common. Monitor for changes in urine output or concentration. Check labs such as BUN, albumin, sodium, and glucose. Check for

TABLE 14-4 The Small Intestine After Surgery

- The small intestine has a large adaptive capacity, with resection of small segments generally not causing nutritional problems.
- If the terminal ileum is removed, vitamin B_{12} and bile salts will not be reabsorbed.
- Diarrhea can be massive if the ileocecal valve is removed with the terminal ileum, with great electrolyte losses and hypovolemia.
- Cholestyramine may be needed to bind bile salts.
- Fat malabsorption with steatorrhea and inadequate vitamin A, D, E, and K absorption may also occur. Medium-chain triglycerides (MCT) and water-miscible supplements may be necessary.
- Hyperoxaluria and renal stones may occur. Calcium supplements, altered polyunsaturated fatty acid (PUFA) intake, and aluminum hydroxide binders may be needed.

Adapted from: Nettina, Sandra M., MSN, RN, CS, ANP, *The Lippincott Manual of Nursing Practice*, 7th ed. Lippincott Williams & Wilkins, 2001.

fever. Calculate fluid needs; evaluate using I & O records. Be sure that medications are given with 4 oz of fluid and that sufficient fluid is served with and between meals.

- Intravenous therapy will likely be used to give fluids directly into a vein. IVs can be intermittent or continuous. Risks of IV therapy may include infiltration, fluid overload, electrolyte imbalances, phlebitis, or infection. It is important to calculate the content of IV fluids when they contain glucose, as indicated in this example:

Solution	Name	Na^+ (mmol/L)	Cl^- (mmol/L)	K^+ (mmol/L)	Ca^{2+} (mmol/L)	Glucose (mg/dL)
D5W	5% *dextrose*	0	0	0	0	5000
2/3D & 1/3 S	3.3% dextrose/0.3% saline	51	51	0	0	3333
Normal saline	0.9% NaCl	154	154	0	0	0
Ringer's lactate	Lactated Ringer	130	109	4	3	0

Follow an interdisciplinary protocol for managing dehydration, as shown on the following page.

Common Drugs and Anesthesia Used with Surgery and Potential Side Effects

- Anesthesia delays peristalsis; eat ice chips or sip carbonated beverages until nausea subsides.
- Analgesics should provide effective pain relief. Epidural analgesia in GI surgery yields shorter duration of postoperative ileus, attenuation of the stress response, fewer pulmonary complications, and improved postoperative pain control and recovery (Fotiadis et al, 2004). Pain medications should be taken sufficiently in advance of meals to allow a pleasant, pain-free mealtime.
- Antibiotics may be needed; monitor specific side effects for selected medication.
- Insulin may be needed if hyperglycemia persists.
- Laxatives may deplete electrolytes. When able to progress, use a higher fiber intake and plenty of liquids.
- Metoclopramide (Reglan) may help with postoperative ileus (Chan et al, 2005). Dry mouth or nausea can result after prolonged use.
- Vitamin K can help with clotting. There are generally no side effects with this injection. Warfarin (Coumadin), a blood thinner used to prevent emboli, requires that patients maintain steady intake of vitamin K foods (cabbage, kale, and spinach) to control levels. Heparin has no dietary consequences.

Herbs, Botanicals, and Supplements

- Interactions between herbs, anesthesia, and surgery must be noted. For surgical patients, herbs can affect sedation, pain control, bleeding, heart function, metabolism, immunity, and recovery. As many as one third of presurgical patients take herbal medications, and many of those patients fail to disclose herbal use during preoperative assessment, even when prompted. Table 14-6 describes these potential interactions.
- Antioxidant foods are protective. Consume plenty of tea and foods listed in Table 13-2. Coenzyme Q10 may help to lower angiogenesis markers and lipid levels; studies are ongoing.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Immobilization of the patient can produce unwanted side effects. Have patient drink plenty of fluids and ambulate as soon as possible.
- Patients tend to lose 0.5 lb daily early in postoperative period. Weight gain during this time suggests fluid excess.
- Eat and drink slowly to prevent gas formation from swallowed air.
- Discuss the role of surgery as "planned trauma," allowing adequate time for return to homeostasis. Discuss wound healing priority, tensile strength, and role of nutrients (zinc, vitamin C, vitamin A, and amino acids). Note that poor nutrient intake can decrease anabolism, delaying scar formation. B-complex vitamins are also beneficial. While zinc deficiency impairs wound healing, supplementation in people who are not deficient does not accelerate wound healing and an excess can interfere with immune system function and copper absorption.
- During the rehabilitative anabolic stage (3 months to 1 year postoperatively), energy intake should be adequate but not excessive.
- With amputation, determine the percentage of body mass lost and decrease estimated energy needs accordingly; see Table 14-7.
- Table 14-8 lists other types of surgeries and their specific nutritional impact.

Patient Education—Food Safety

Surgical patients may be vulnerable to foodborne illness; safe food handling and handwashing are essential.

INTERDISCIPLINARY NUTRITION CARE PLAN
Dehydration

Client Name: _____ **#:** _____ **Initiated by:** _____ **Date:** _____

SCREEN
Nutrition Screen diagnosis: Dehydration
Signed: _____ Date: _____

ASSESS *(Check any/all)*
Hydration status
- ❑ Fluid intake ≤ fluid output
- ❑ Diuretics' multiple medications
- ❑ Ostomy*
- ❑ Increased environmental temperature/ no air conditioning/low humidity

Biochemistries
- ❑ ↑BUN
- ❑ ↑Serum sodium

Complex diet order
- ❑ High-protein, high-calorie diet
- ❑ Fluid restriction

Infection/Wounds
- ❑ Fever
- ❑ Pneumonia, UTI, URI
- ❑ Pressure ulcers, wounds

Poor Oral Intake Symptoms
- ❑ Anorexia
- ❑ Nausea/vomiting*
- ❑ Poor appetite
- ❑ Diarrhea*

Signed: _____ Date: _____

1 or more

HIGH-RISK INTERVENTIONS *(Check any/all)*
- ❑ **Getting the Fluid You Need** provided and explained
- ❑ **Food Record** provided and explained
  - ❑ Assure intake of a 2qt (2L) of appropriate fluids/day

Obtain Dr. orders as needed:
- ❑ RD referral for home visit(s)
- ❑ Monitor weight q:_____
- ❑ Monitor I & O q: _____
- ❑ Oral rehydration fluid if diarrhea, vomiting, ostomy are present
- ❑ **Other:**_____ (See notes for documention.)

Signed: _____ Date: _____

Next visit

ASSESS RESPONSE *(Check any/all)*
- ❑ Further weight loss
- ❑ Fluid intake less than fluid output
- ❑ Onset of new infection
- ❑ Dehydration
- ❑ Exhibiting Fewer Oral Intake symptoms
- ❑ **Other:**_____ (See notes for documention.)

Signed: _____ Date: _____

1 or more

OUTCOMES NOT ACHIEVED
Notify physician. Reassess/evaluate need for EN/PN (refer to Tube Feeding Nutrition Care Plan). Document on Nutrition Variance Tracking form.

None

OUTCOMES ACHIEVED
- ❑ Hydration status maintained or improved
- ❑ Weight maintained or improved
- ❑ Nutrition status maintained or improved
- ❑ **Other:**_____ (See notes for documention.)
- ❑ Repeat Nutrition Risk Screen in ____ days

Signed: _____ Date: _____

GOALS (Check any/all):

- ❑ Assure intake of minimum daily water need of _____ mL in _____(goal time). (Calculate using **Daily Water Need for Adults**.)
- ❑ Maintain or improve hydration status as indicated by weight gain, fluid intake greater than or equal to output and normalization of biochemistries in ____ (goal time).
- ❑ Prevent dehydration-related adverse events in ____ (goal time).
- ❑ Reduce or eliminate dehydration risk factors in _____ (goal time).

None

MODERATE RISK INTERVENTIONS *(Check any/all)*
Getting the Fluid You Need provided and explained
Food Record provided and explained
Obtain Dr. orders as needed:
- ❑ RD chart consult
- ❑ Monitor weight q:_____
- ❑ **Other:**_____ (See notes for documention.)

Signed: _____ Date: _____

Next visit

ASSESS RESPONSE *(Check any/all)*
- ❑ Weight loss
- ❑ Fluid intake less than fluid output
- ❑ Onset of new infection
- ❑ Dehydration
- ❑ Exhibiting Poor Oral Intake symptoms
- ❑ **Other:**_____ (See notes for documention.)

Signed: _____ Date: _____

1 or more

None

OUTCOMES ACHIEVED
- ❑ Hydration status maintained or improved
- ❑ Weight maintained or improved
- ❑ Nutrition status maintained or improved
- ❑ **Other:**_____ (See notes for documention.)
- ❑ Repeat Nutrition Risk Screen in ____ days

Signed: _____ Date: _____

* Requires replacement of water and electrolytes.

Adapted with permission from www.RD411.com, Inc.

TABLE 14-5 Managing Electrolyte Imbalances

Three variables regulate pH in blood plasma: carbon dioxide, electrolyte concentrations, and total weak acid concentrations.

Acid–base balance is when blood pH is out of the normal range (7.35–7.45). An excess of acid leads to acidosis (pH < 7.35) and an excess of base leads to alkalosis (pH > 7.45). Imbalance is classified according to the source: respiratory or metabolic.

There are four basic conditions: metabolic acidosis, respiratory acidosis, metabolic alkalosis, and respiratory alkalosis.

Dietitians typically address electrolyte imbalances, which involve calcium, potassium, magnesium, and sodium and are discussed here.

Normal Range	Causes of Elevation	Causes of Decline
Sodium (Na): 135–145 mEq/L	**Hypernatremia:** Excessive loss of water through GI system, lungs, or skin; fluid restriction, certain diuretics, hypertonic IV solutions, tube feeding; hypothalamic lesions, hyperaldosteronism, corticosteroid use, Cushing's syndrome, diabetes insipidus	**Hyponatremia:** Congestive heart failure, cirrhosis, nephrosis, excess fluid intake, syndrome of inappropriate antidiuretic hormone secretion (dilutional hyponatremia); sodium depletion, loss of body fluids without replacement, diuretic therapy, laxatives, nasogastric suctioning, hypoaldosteronism, cerebral salt-wasting disease
Potassium (K): 3.5–5.0 mEq/L	**Hyperkalemia:** Aldosterone deficiency, sodium depletion, acidosis, trauma, hemolysis of red blood cells, potassium-sparing diuretics	**Hypokalemia:** Lack of dietary intake of potassium, vomiting, nasogastric suctioning, potassium-depleting diuretics, aldosteronism, salt-wasting kidney disease, major GI surgery, diuretic therapy with inadequate potassium replacement
Calcium (Ca): 8.5–10.5 mg/dL	**Hypercalcemia:** Excessive vitamin D, immobility, hyperparathyroidism, potassium-sparing diuretics, ACE inhibitors, malignancy of bone or blood	**Hypocalcemia:** Hypoparathyroidism, malabsorption, insufficient or inactivated vitamin D or inadequate intake of calcium, hypoalbuminemia, diuretic therapy, diarrhea, acute pancreatitis, bone cancer, gastric surgery
Magnesium (Mg): 1.5–2.5 mg/dL	**Hypermagnesemia:** Excessive use of magnesium-containing antacids and laxatives, untreated diabetic ketoacidosis, excessive magnesium infusions	**Hypomagnesemia:** Malabsorption related to GI disease, excessive loss of GI fluids, acute alcoholism/cirrhosis, diuretic therapy, hyper- or hypothyroidism, pancreatitis, preeclampsia, nasogastric suctioning, fistula drainage

Kee J, et al. *Fluids and electrolytes with clinical applications: a programmed approach*. 7th ed. Clifton Park, NY: Delmar Learning, 2004.

Signs and Symptoms	Comments and Nutritional Concerns
HYPONATREMIA Lethargy, anorexia, nausea, vomiting, cramping, muscular twitching, confusion, fingerprinting over the breastbone, seizures, and coma. Hyponatremia is associated with increased morbidity and mortality.	Distinguish between the different types of hyponatremia and their treatments. Contracted extracellular fluid volume may occur; a hypertonic or isotonic saline solution is given (perhaps salty broth). Avoid giving large water flushes with isotonic tube feeding. Fluid restriction and low-sodium diet with diuretics may cause hyponatremia. D5W used in excess can cause hyponatremia with water intoxication.
HYPERNATREMIA Thirst, dry and sticky mucous membranes, fever, dry and swollen tongue, disorientation, and seizures. Flushing, fever, loss of sweating, dry tongue and mucous membranes, tachycardia, hallucinations, or coma.	High-protein tube feedings without adequate water flushes, excessive diaphoresis, diabetes insipidus, or watery diarrhea may cause problems. Correct dehydration. Monitor thirst, the first sign of water loss. High doses of steroids, solutions that contain NaCl, other sodium additives, and sodium-containing analgesics should be managed or omitted. Determine patient's fluid needs (generally 30 mL/kg or 1 mL/kcal given in enteral or total parenteral infusions. Adjust according to the renal or cardiovascular status, especially in seniors. Patients with dysphagia may have difficulty obtaining enough fluid; monitor closely.
HYPOKALEMIA Severe muscle weakness, electrocardiogram (ECG) changes and arrhythmias, lethargy, hypotension, shallow breathing, fatigue, anorexia, constipation, confusion, and impaired carbohydrate (CHO) tolerance. Chloride depletion usually accompanies hypokalemia; alkalosis is also common.	Replace potassium (generally done with intravenous or oral KCl, except in renal tubular acidosis). Kaochlor, Kay-Ciel, K-Lor, K-Lyte, K Tab, Klotrix, Micro-K, K-Dur, Klor-Con, Ten-K, and Slow-K are all sources of potassium. Some products are slow release. Diarrhea, nausea, or vomiting may occur; take with meals. A potassium-rich diet may also be needed. Monitor serum levels and adjust accordingly. Be sure fluid intake is adequate.

(continued)

TABLE 14-5 Managing Electrolyte Imbalances *(continued)*

Signs and Symptoms	Comments and Nutritional Concerns
HYPERKALEMIA Weakness, anxiety, altered ECGs (with >7 mEq/L, a fatal arrhythmia can occur), flaccid muscle paralysis, or even respiratory arrest, if severe.	Immediate treatment is needed to prevent arrhythmias, bradycardia, heart block, and respiratory arrest. If all else fails, dialysis may be needed. Intravenous feedings are likely to be used (glucose, insulin, bicarbonate) to shift potassium intracellularly. Sodium or calcium may also be needed as physical antagonists; infusions will be given until serum potassium is corrected. Monitor closely. Avoid high-potassium foods and K^+ in salt substitutes. Kayexalate may be needed and should be given with sorbitol to prevent constipation; take separately from calcium or antacids. Read labels of oral supplements to be sure total K^+ is calculated.
HYPOCALCEMIA Tetany, seizures, and cardiac arrest. In the long term, bone demineralization with bone pain and compression fractures may result.	Correct symptomatic condition (usually calcium gluconate intravenously). Supplement with vitamin D_3 as needed. When able to eat orally, provide a high-calcium intake; dry milk can be added to foods. Avoid excesses of caffeine, oxalate, fiber, and aluminum-containing antacids. Calcium carbonate (as in Tums) provides 40% elemental calcium. Drink extra water. Avoid use of iron supplements at the same time. Beware of bone meal and dolomite because of their toxic metal content.
HYPERCALCEMIA Drowsiness, lethargy, stupor, muscle weakness, decreased reflexes, nausea and vomiting, anorexia, constipation, ileus, polyuria, renal stones, azotemia, nocturia, hypertension, bradycardia, pruritus, and eye abnormalities.	Correct underlying condition with rehydration (usually with normal saline) and hemodilution. Correct nausea, vomiting, constipation, and other side effects. Avoid excesses of milk, vitamins A or D, calcium supplements and antacids, and lactose. Potassium and magnesium may also be depleted; monitor carefully. Extra caffeine, oxalates, fiber, and phytates can help to decrease calcium absorption and can help excretion. Sometimes furosemide or prednisone is used to excrete calcium also. Intravenous etidronate (Didronel) may be used; nausea and vomiting could occur.
HYPOMAGNESEMIA Anxiety, hyperirritability, confusion, hallucinations, seizures, tremor, hyperreflexia, tetany, tachycardia, hypertension, arrhythmias, vasomotor changes, profuse sweating, muscle weakness, grimaces of facial muscles, and refractory hypocalcemia.	Correct low serum magnesium levels to prevent sudden death. Discuss long-term measures to prevent further episodes. Long-term use of magnesium-free CPN can be one aggravating source of the problem. Monitor intake from all sources (oral, TF, CPN.) Milk of magnesia (MOM) can be used for liquid form of magnesium hydroxide; nausea, cramps, or diarrhea may result. Normal renal function is needed for use of magnesium sulfate; diarrhea can occur. Chocolate, nuts, fruits and green vegetables, beans, potatoes, wheat, and corn are considered good sources.
HYPERMAGNESEMIA Lethargy, hyporeflexia, and respiratory depression. Bradycardia, myocardial infarction, and respiratory failure may be fatal.	Reduce or eliminate sources of exogenous magnesium from diet, supplements, CPN solutions, and medications until resolved. Calcium-containing medications may be given to help with excretion of excessive magnesium. Avoid megadoses of multivitamin–mineral supplements.
HYPOPHOSPHATEMIA Anorexia, weakness, bone pain, dizziness, and waddling gait may be observed. In severe cases, elevated creatine phosphokinase (CPK) levels are seen, with rhabdomyolysis superimposed on myopathy. Hypophosphatemia may result in sudden death, rhabdomyolysis, red cell dysfunction, and respiratory insufficiency. Heart failure can result if phosphorus is not administered. Low serum phosphorus levels will result in lowered 2,3-diphosphoglyceric acid (2,3-DPG), which facilitates oxyhemoglobin dissociation and leads to tissue hypoxia and low partial pressure of oxygen.	Phosphorus is a major component of bone and is one of the most abundant constituents of all metabolic processes and tissues; 85% is found in the skeleton. Only about 12% is bound to proteins; a typical laboratory assessment is of elemental phosphorus, with some values for HPO_4 and $NaHPO_4$ as well. Prevent further complications. Use appropriate measures according to the cause; for example, low-phosphorus diet with high calcium and adequate vitamin D will be needed in renal osteodystrophy. Note that 50–60% of dietary phosphorus is absorbed, and more is absorbed in depleted persons. If potassium phosphate (K-Phos) is used as an acidifier, it may cause nausea, vomiting, or diarrhea.
HYPERPHOSPHATEMIA Phosphorus levels tend to be higher in children and to rise in women after menopause.	Provide appropriate levels of phosphorus according to age and serum status. Monitor glucose and phosphorus intake, especially from enteral or parenteral nutrition. Monitor dietary intake of milk, meat, and other foods high in phosphorus. Observe serum levels regularly, especially in renal patients. Antacids containing aluminum will prevent phosphorus absorption in intestinal lumen. Calcium acetate is useful in dialysis patients.

Resources:
FreeMD, http://www.freemd.com/electrolyte-imbalance/, accessed January 19, 2010.
Medline Plus, http://www.nlm.nih.gov/medlineplus/fluidandelectrolytebalance.html, accessed January 19, 2010.
Merck Manual, http://www.merck.com/pubs/mmanual_ha/sec3/ch18/ch18d.html, accessed January 19, 2010.

TABLE 14-6 Herbal Medications and Recommendations for Discontinued Use before Surgery

Most commonly used herbs and antidepressant medications have potentially deleterious effects on the patient during surgery, ranging from increased risk of bleeding to fatal interactions (Chin et al, 2009.) The top four used by the general public are Echinacea, garlic, ginseng, and ginger (Heller et al, 2006.)

Herb	Relevant Effects	Perioperative Concerns	Recommendations
Echinacea	Boosts immunity	Allergic reactions, impairs immune system, especially for transplantation patients	Discontinue as far in advance as possible.
Ephedra (ma huang)	Increases heart rate and increases blood pressure	Risk of heart attack, arrhythmias, stroke, kidney stones, interaction with other drugs	Discontinue 24 hours before surgery.
Garlic	Prevents clotting	Risk of bleeding, especially when combined with other drugs that inhibit clotting	Discontinue at least 7 days before surgery.
Ginkgo	Prevents clotting	Risk of bleeding, especially when combined with other drugs that inhibit clotting	Discontinue at least 36 hours before surgery.
Ginseng	Lowers blood glucose, inhibits clotting	Increases risk of bleeding; interferes with warfarin (an anticlotting drug)	Discontinue at least 7 days before surgery.
Kava	Sedates, decreases anxiety	May increase sedative effects of anesthesia	Discontinue 24 hours before surgery.
St. John's wort	Inhibits reuptake of neurotransmitters	Alters metabolisms of other drugs	Discontinue at least 5 days before surgery.
Valerian	Sedates	Could increase effects of sedatives. Long-term use could increase amount of anesthesia needed.	If possible, taper dose weeks before surgery. Withdrawal symptoms resemble diazepam (Valium) addiction.

Sources:
Ang-Lee M, et al. Herbal medicines and perioperative care. *JAMA*. 286:208, 2001.
Chin SH, et al. Perioperative management of antidepressants and herbal medications in elective plastic surgery. *Plast Reconstr Surg*. 123:377, 2009.
Heller J, et al. Top-10 list of herbal and supplemental medicines used by cosmetic patients: what the plastic surgeon needs to know. *Plast Reconstr Surg*. 117:436, 2006.
Yuan CS, et al. Brief communication: American ginseng reduces warfarin's effect in healthy patients: a randomized, controlled Trial. *Ann Intern Med*. 141:23, 2004.

TABLE 14-7 Percentage of Body Weight in Amputees

Body weight is a good indicator of a person's size and is widely used in assessments. Body mass index (BMI) values in subjects with limb amputation are not useful unless lost weight of the limbs is not considered in the calculation. To reduce the underestimation of nutritional status in persons with limb amputation, estimation of body weight is necessary so that BMI can be reliably estimated for persons with limb amputation. Estimated body weight after amputation uses the following formula:

$$\text{Estimated Ideal Body Weight (IBW)} = (100 - \%\ \text{amputation})/100 \times \text{IBW for original height.}$$

Body Part and % Loss from Amputation
Below knee 6.5%
Bilateral below knee (BK) 13%
Bilateral above knee (AK) 16%
BK + AK 14.5%
Foot 1.5%
Both feet 3%
Hand 0.7%
Both hands 1.4%
Forearm and hand 3%
Both forearms/hands 6%
Entire arm 5%
Both entire arms 10%
Entire leg 16%
Both entire legs 32%

Adapted from: Osterkamp LK. Current perspective on assessment of human body proportions of relevance to amputees. *J Am Diet Assoc*. 95:215, 1995.
Amputee BMI calculator, http://touchcalc.com/calculators/bmi_amputation, accessed January 20, 2010.

TABLE 14-8 Surgeries, Level of Nutritional Acuity, and Nutritional Recommendations

Background	Specific Objectives	Food and Nutrition Recommendations
Amputation, Level 2 Amputations may result from poorly controlled diabetes, trauma, peripheral artery disease, congenital deformity, chronic infections, gangrene, or tumors such as osteosarcoma.	Postoperative: Determine percentage of body weight of amputated area and calculate changes from preoperative to postoperative status in height, weight, and body mass index (BMI). Provide adequate protein, calories, zinc, vitamins C, K, and A for healing. Low albumin levels, serum carotene, zinc, and vitamin C are commonly found.	Postoperative: Use a high-protein/high-energy diet for healing. Supplement diet with vitamins and minerals, especially zinc, vitamins A, C, and K, and arginine. Use tube feeding (TF) if necessary; consider use of an immune-enhanced product. For hand or arm amputations, consider adaptive feeding equipment with Occupational therapy (OT) specialists.
	Long Term: Provide a low-calorie diet, if needed. For patients who lose too much weight, a higher energy diet should be used. Otherwise, immobilized patients tend to gain weight and will need weight control measures.	Long Term: Discuss how to control or increase calories in diet for energy use. Patients with an AK amputation who walk with or without prosthesis use 25% more energy than a nondisabled person who walks at the same speed; these patients have difficulty maintaining weight.
Appendectomy, Level 1 Appendectomy generally is an uncomplicated procedure with minimal recovery time. A low-fiber diet may contribute to appendicitis.	Preoperative: White blood cell count and erythrocyte sedimentation rate may be increased.	Postoperative: Use a balanced diet with adequate amounts of zinc and vitamins C, K, and A.
	Postoperative: Reduce fever. Lower risks of infection or sepsis, peritonitis, or abscess formation.	Long-Term: After recovery, include more fruits, vegetables, and whole grain for fiber.
Cesarean delivery (C-section), Level 1 C-section is performed for numerous reasons, including HIV infection, maternal diabetes, or edema-proteinuria-hypertensive (EPH) gestosis.	Postoperative: Manage nausea, which is common after anesthesia. Replenish stores of nutrients from blood and fluid losses. Reduce likelihood of complications such as hemorrhage, infection, fever, drainage, cystitis, anemia, or pneumonia after the operation.	Postoperative: Nothing by mouth (NPO) with intravenous or clear liquids and ice chips will be given until nausea subsides. Progress to usual diet, with increased fiber and fluid to soften stools. Promote wound healing with protein and energy; include iron, vitamins C and A, and zinc in diet or supplemental form.
Coronary Artery Bypass Graft (CABG), Level 3 Open heart procedures require use of a cardiopulmonary machine for extracorporeal circulation. Narrowed or blocked arteries are bypassed; the vein usually comes from the leg. Blood can then flow directly into the heart muscle. CABG usually takes 4–5 hours.	Preoperative: Monitor serum levels of electrolytes, albumin, and glucose. Provide the diet as prescribed (may be sodium, energy, or fluid restricted). Provide ample amounts of glycogen for stores. Use nutrition support, if needed, for malnourished cardiac patients.	Postoperative: Control fluid intake by measuring previous day's output plus 500 mL for insensible losses. Provide adequate protein, kilocalories, and micronutrients for wound healing. Use TF or CPN if severely malnourished. Replete slowly and keep head of bed elevated 30° to prevent worsening of heart failure. Low-sodium, high-calorie, low-volume TF products may be useful.
Heart valve replacement involves replacing the damaged valve with a mechanical prosthesis (St. Jude valve) or biological tissue valve. This may be done with robotic techniques, which are less invasive than open heart procedures.	Postoperative: Promote wound healing and restore normal fluid and electrolyte balance. Promote weight control. Wean from ventilator support when possible. Prevent hyperglycemia, coma, sepsis, renal failure, cardiac tamponade, wound dehiscence, and atelectasis. Maintain comfort and educate regarding follow-up.	
	Long Term: Avoid excessive weight gain, which can further aggravate heart condition. Teach appropriate measures for changes in daily diet to prevent further problems while wound is healing. Discuss need to alter lifestyle (diet, exercise, and stress) to prevent additional problems; many patients have atherogenic effects even after heart surgery. Control carbohydrates in patients with diabetes or hypertriglyceridemia.	Long-Term: Modify diet to control sodium and potassium intake, lessen edema, and improve blood pressure. Diuretics and digoxin may deplete potassium; anorexia, nausea, and diarrhea may occur. Beta-blockers, ace inhibitors, and other cardiac drugs may require use of low-sodium, low-calorie diets. Hypoalbuminemia can cause digoxin toxicity. National Cholesterol Education Program guidelines may be used if serum cholesterol remains high.

(continued)

TABLE 14-8 Surgeries, Level of Nutritional Acuity, and Nutritional Recommendations *(continued)*

Background	Specific Objectives	Food and Nutrition Recommendations
Craniotomy, Level 2 Craniotomy involves removing and replacing the bone of the skull to provide access to intracranial structures, usually for a brain tumor.	Postoperative: Prevent aspiration. Prevent or correct dysphagia, constipation, urinary tract infection (UTI), nausea and vomiting, and diabetes insipidus. Normalize electrolyte levels. Prevent blood clots using anticoagulant therapy. If anticonvulsants are used, prevent folic acid depletion. Prevent or manage nausea, vomiting, facial or extremity paralysis, wound drainage, hyperthermia, dysphagia, diabetes insipidus, and syndrome of inappropriate antidiuretic hormone (SIADH). Monitor consciousness, gag reflex, results of examinations such as ECG and cerebrospinal fluid (CSF) levels.	Postoperative: NPO is needed until nausea and vomiting subside. Progress from liquids to soft diet as tolerated. Patient should be fed while lying on his/her side or with his/her head elevated 30° to prevent aspiration. Check swallowing reflex. Assist with feeding if needed, and TF may be required. Adequate fiber may be beneficial. If steroids are used, reduce sodium intake to 4–6 g/d (or less). Long-Term: Discuss importance of diet in correcting any malnutrition or anemia. As needed, teach family about a diet for dysphagia (e.g., thick, pureed foods with reduced thin liquids). When oral intake is possible, suggest slow chewing and eating. Aphasia occurs in some patients, making it hard to communicate their needs.
Hip Replacement, Level 2 A total hip replacement (arthroplasty) is the formation of an artificial hip joint. Prostheses are either cemented in place or uncemented. The procedure is performed for severe degenerative joint disease, rheumatoid arthritis, or congenital deformities.	Preoperative: Enhance nutritional intake in preparation for surgery. Postoperative: Replenish stores. Prevent side effects of immobilization (renal calculi, pressure ulcers, and UTIs). Promote adequate wound healing. Regain maximum mobility. Use small, frequent meals if nausea is a problem. Long-Term: Promote early ambulation, when possible, to promote healing and increase strength.	Preoperative: Nutritional status before arthroplasty is a good predictor of surgical outcomes after surgery; albumin levels >3.4 often predict a better outcome. Postoperative: Use a high-protein/high-energy diet. Supplement diet with zinc and vitamins A, C, and K. Determine whether blood loss can cause anemia; provide sufficient iron and protein in cooperation with medical team. Long-Term: If weight loss is needed, provide a balanced, low-energy diet after wound healing is completed. Include calcium and phosphorus.
Hysterectomy, abdominal, Level 1 Abdominal hysterectomy is the surgical removal of the uterus through an abdominal incision. This approach is used if the uterus is enlarged or if an oophorectomy (ovary removal) and salpingectomy (removal of the fallopian tubes) are also performed.	Postoperative: Promote wound healing and rapid recovery. Replete nutrient reserves and glycogen stores. Replace protein, iron, and vitamin K if blood loss was extensive. Prevent complications such as UTIs, incisional infections, fever, nausea, vomiting, or diverticular colovaginal fistula. Long-Term: Support gradual return to normal activity; exercise improves nutrient repletion and tissue repair.	Postoperative: Use a high-protein/high-calorie diet. Ensure that adequate fiber and fluid are provided to alleviate constipation. Provide a diet with adequate iron, zinc, and vitamins K, C, and A. Long-Term: Emphasize the importance of a good diet for wound healing.
Pancreatic Surgery, Level 3 This may include total pancreatectomy with or without islet cell autotransplantation for chronic pancreatitis and cancer; subtotal or pancreatoduodenectomy (Whipple's procedure) for islet cell tumors.	Preoperative: Monitor for history of ethanol (ETOH) abuse with resulting malnutrition and malabsorption; replete if possible. Postoperative: Prevent or correct sepsis, which is a common complication. Encourage nourishing and well-balanced meals; control CHO if diabetes occurs or is present. Determine pancreatic function according to type and extent of resection and underlying disorder. Whipple's procedure results in dumping syndrome, diarrhea, dyspepsia, ulceration at gastroenterostomy site, and extensive weight loss unless a pylorus-saving technique is used. Long-Term: Monitor impact of medications and replacement enzymes or hormones that are ordered. Alter fat source with malabsorption or steatorrhea. Offer resources for control of diabetes or for alcohol addiction, as needed.	Preoperative: Use enteral nutrition or CPN to prepare patient for a major operation. Postoperative: Enteral nutrition, CPN, or oral intake may progress as tolerated. Enteral nutrition has better outcomes if the tube is placed in the jejunum. Standard treatment following major pancreatic surgery includes the administration of pancreatic enzymes and inhibition of acid secretion by proton pump inhibitors; monitor effects on vitamin B_{12} status. Long-Term: A carbohydrate-controlled diet may be needed, along with small, frequent feedings. Most patients develop diabetes that may require insulin; hypoglycemia is the most difficult problem to manage.

(continued)

TABLE 14-8 Surgeries, Level of Nutritional Acuity, and Nutritional Recommendations *(continued)*

Background	Specific Objectives	Food and Nutrition Recommendations
Parathyroidectomy, Level 1 Surgical removal of the parathyroid glands	Preoperative: Prepare patient for surgery. Postoperative: Manage hypoparathyroidism (with tingling, tetany, hoarseness, and seizures.) Long-Term: Vitamin D, calcium, and chemotherapy are often required. A low-phosphorus diet with aluminum hydroxide (Amphojel) may be needed; constipation is one side effect.	Postoperative: IV or TF may be needed. Avoid CPN because of high risk for sepsis in the neck area. Provide extra fluids. Long-Term: A high-calcium/low-phosphorus diet may be necessary. Monitor carefully. Counsel about follow-up measures and potential medication interactions.
Pelvic Exenteration, Level 1 This surgery involves removal of all female reproductive organs and adjacent tissues (i.e., radical hysterectomy, pelvic node dissection, cystectomy and formation of an ileal conduit, vaginectomy, and rectal resection with colostomy). Cancer is usually the reason.	Preoperative: A low-residue or elemental diet may be needed, regressing to clear liquids, NPO. Vitamin K may be needed 24–48 hours before the procedure. Postoperative: Colonic stasis occurs after major abdominal surgery and persists for approximately 3 days. Prevent hemorrhage, infection, urinary or GI problems, shock, fever, anemia, and sepsis. Long-Term: Promote wound healing and recovery. Provide colostomy teaching if needed.	Postoperative: Parenteral fluids with electrolytes may be needed (3–4 L/d unless contraindicated). CPN or TF may also be appropriate. If nausea is an extensive problem, give fluids between meals. Long-Term: Progress, as tolerated, to a high-protein/high-calorie intake with snacks (eggnog, custard, oral supplements). Adequate iron, zinc, and vitamins A and C help with wound-healing process.
Spinal Surgery, Level 2 This surgery generally is performed to relieve pressure on spinal nerves or cord due to herniated discs, trauma, displaced fractures, osteoporosis, or incomplete vertebral dislocation from rheumatoid arthritis. Laminectomy, discectomy, or spinal fusion may be performed.	Preoperative: Nutrients may be needed for adequate stores (e.g., glucose, protein, vitamins A, C, and K, and zinc). Postoperative: Correct nausea and vomiting if a problem. Prevent calculi, UTIs, and pressure ulcers. Fluid and fiber will be important, but prevent overhydration. Long-Term: Avoid weight gain.	Postoperative: Parenteral fluids may be given as ordered. A balanced diet, when patient is ready, with control of total energy intake to prevent excessive weight gain, may be used. If patient has been malnourished, a gradual increase in calories may be beneficial. Adequate hydration will be necessary unless contraindicated. Long-Term: Increase fiber intake if constipation is a problem; prune juice, crushed bran, and other items may be used. If tolerated, extra fruits and raw vegetables may be used.
Tonsillectomy/Adenoidectomy, Level 1 These tissues are considered to be part of the protective immune system; removal is for severe and chronic ear, throat, and sinus infections.	Preoperative: Supply adequate nourishment for glycogen stores. Long-Term: Help patient select nonirritating foods for use at home. Avoid hot, spicy foods, raw vegetables, toast and crackers, citrus juices, and other related foods until full recovery.	Postoperative: Give cold liquids (sherbet, ginger ale, nectars, and gelatin). Do not use red gelatin as it may mask blood if there is any vomiting. Use extra fluid intake; large swallows are less painful than many small ones. Avoid milk products only if patient cannot tolerate them. On day 2 or 3, use soft, smooth foods (pudding, strained cereals, soft-cooked eggs). Progress to regular diet when tolerated. Long-Term: Use supplements of vitamin C if patient cannot tolerate juices. Evaluate zinc intake and encourage dietary sources when possible.

For More Information

- American Academy of Physical Medicine and Rehabilitation http://www.aapmr.org/
- Amputees http://www.nlm.nih.gov/medlineplus/amputees.html
- Amputee Resource Foundation of America http://www.amputeeresource.org/
- National Library of Medicine—Surgery http://www.nlm.nih.gov/medlineplus/surgery.html
- Refeeding Syndrome http://www.ccmtutorials.com/misc/phosphate/page_07.htm

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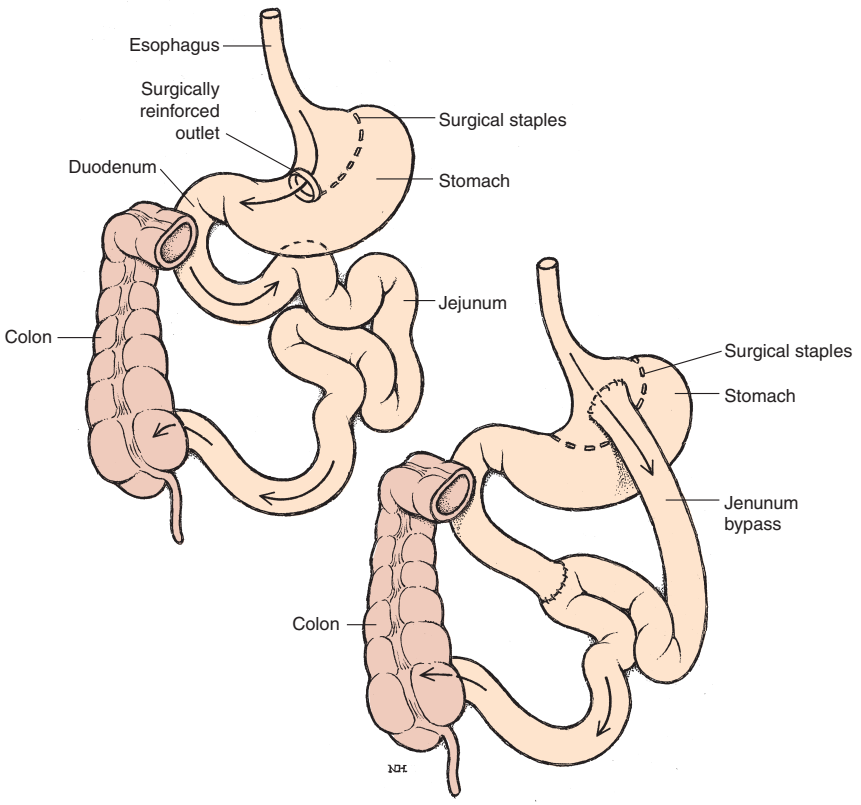
GASTROINTESTINAL SURGERIES

BARIATRIC SURGERY AND GASTRIC BYPASS

NUTRITIONAL ACUITY RANKING: LEVEL 3



The gastric bypass procedure has replaced the jejunal bypass, which had many undesirable nutritional consequences. Adapted from: Neil O. Hardy. Wesport, CT. *Stedman's Medical Dictionary,* 27th ed. Baltimore: Lippincott Williams & Wilkins, 2000, p. 1249.

DEFINITIONS AND BACKGROUND

More than 10 million Americans are severely obese. Bariatric surgery is a viable option for the treatment, resulting in long-term weight loss and improved health risk factors. Bariatric surgery is expensive, $20,000 and $25,000, but is an effective weapon against the consequences of morbid obesity. Candidates should be 100 lb or more over ideal weight range, have a BMI greater than 40, or a BMI greater than 35 in addition to serious medical comorbidities. Obesity surgery is superior to medical intervention in this population (Leslie et al, 2007.) Results show lower incidence rates of diabetes, hypertriglyceridemia, and hyperuricemia. In fact, bariatric surgery should be considered for adults who have type 2 diabetes and a BMI greater than 35 kg/m^2, especially if the diabetes is difficult to control with lifestyle and pharmacologic therapy (American Diabetes Association, 2009.)

Bariatric surgery may be implemented in carefully selected, older, severely obese adolescents (Jen et al, 2010). However, surgical treatment should be considered only when adolescents have tried for at least 6 months to lose weight and have not been successful, have a BMI greater than 40, have reached their adult height (usually 13 or older for girls and 15 or older for boys), **and** have serious weight-related health problems such as T2DM, heart disease, or sleep apnea (NIDDK, 2010). Teens should be referred only to specialized adolescent bariatric centers.

Gastric bypass (GBP) achieves permanent and significant weight loss. The **Roux-en-Y gastric bypass (RYGB)** induces long-term remission of type 2DM, returning impaired glucose tolerance to euglycemia in a matter of days (Pories and Albrecht, 2001). Exclusion of food and alteration in signals from the antrum, duodenum, and proximal jejunum to the pancreatic islet cells improve glucose tolerance. While altered gut and pancreatic hormone secretion may resolve insulin resistance after RYGB, the independent effects of weight loss and hormonal secretion on peripheral glucose disposal are observed only after substantial weight loss (Campos et al, 2010.)

GBP procedures reduce capacity to 40–60 mL and induce physiological and neuroendocrine changes that affect the weight regulatory centers in the brain. Major adverse events include anastomosis leakage, pneumonia, pulmonary embolism, band slippage, and band erosion (Picot et al, 2009.) **Laparoscopic Roux-en-Y gastric bypass (LRYGB)** has fewer side effects, but anastomotic leak is one of them.

Biliopancreatic diversion with duodenal switch reduces the stomach to 20%, like a thin sleeve. The duodenal switch (valve) remains along with a limited portion of the duodenum; the intestine is connected to the duodenum near the stomach (biliopancreatic diversion). This weight loss leads to more malnutrition and vitamin deficiencies and requires close monitoring.

Lap-band adjustable gastric banding uses an inflatable band to divide the stomach into two parts by wrapping a band around the upper part and tightening it like a belt. Lap-band adjustable gastric banding is simple, has a lower complication rate, and can be adjusted or removed if necessary.

Most patients lose more than 60% of their excess weight after bariatric surgery. GBP and laparoscopic isolated sleeve gastrectomy are more effective for weight loss than vertical banded gastroplasty and adjustable gastric banding; more research is needed (Picot et al, 2009.) Because gallstones are common after the surgery, cholecystectomy may be done at the same time as the bariatric procedure.

Bariatric surgery appears to be a clinically effective and cost-effective intervention for moderately to severely obese people compared with nonsurgical interventions (Picot et al, 2009.) Expected long-term outcomes include improvement or resolution of diabetes, metabolic syndrome, coronary artery disease, dyslipidemia, gastroesophageal reflux disease, sleep apnea, hypertension, osteoarthritis, and cardiovascular mortality (Jhaveri et al, 2009; Madan et al, 2006; Torquati et al, 2005.)

Deficiencies in protein, iron, vitamin B_{12}, folate, calcium, fat-soluble vitamins (A, D, E, and K), and other micronutrients are common and become clinically significant if not recognized and treated with supplements (Carlin et al, 2006.) Copper deficiency, for example, has been noted in this population with cardiovascular and neurological changes (Tan et al, 2006).

Rhabdomyolysis is a risk from extended immobilization. It is accompanied by pain in the region of the referred muscle group, increase in creatine phosphokinase levels, myoglobinuria, severe renal failure, multiorgan system failure, and death if not treated in time (Filis et al, 2005). Another rare complication is hyperfunction of the pancreatic beta cells (nesidioblastosis) which can lead to life-threatening hypoglycemia (Service et al, 2005). Weight regain after RYGB occurs in approximately 20% of patients and constitutes another serious complication; failure to sustain elevated plasma PYY concentrations occurs (Meguid et al, 2008.)

Quality assurance produces better outcomes (Rendon and Pories, 2005). A multidisciplinary clinical pathway, preprinted orders, discharge home instruction sheet, and daily guidelines are important aspects of treatment. As long as obesity and the popularity of bariatric surgery continue, medical practitioners must be aware of preexisting nutritional deficiencies and treat any nutritional deficiencies that may arise or worsen following surgery (Xanthakos, 2009.) Monitoring and follow-up with a dietitian should be standard procedure. Tips are available in Table 14-9.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: The usual reason for GBP is morbid obesity, some of which may be genetically related, but it is believed that environment plays a greater role.

Clinical/History

- Height
- Weight
- Postoperative weight
- BMI (pre-/post-surgery)
- Diet history
- Waist-hip ratio (WHR)
- Waist circumference
- Vomiting
- I & O
- BP
- Sleep apnea
- Endoscopy

Lab Work

- Gluc
- Hemoglobin A1c
- CRP

TABLE 14-9 Tips for Diet after Gastric Bypass

Diet Order	Timing	Beverage and Food Choices
Clear Liquids (*no more than 1/2 cup total*)	1–2 days after surgery	Water, unsweetened drinks, sugar-free gelatin or popsicles, and clear broths. Diluted (pulp-free) juices (1 part juice to 10 parts water.) Decaffeinated tea. NO CARBONATED BEVERAGES. Sip at least 48–64 oz of liquid (especially water) each day. Take a prescribed multivitamin every day.
Full Liquids (*gradually increase to no more than 3/4 cup total*)	Days 3–21	*Items listed above, plus:* Use nonfat acidophilus milk, sugar-free Carnation Instant Breakfast drink, plain soymilk, low-fat cream soups made with skim milk for protein in this stage. May also add cream of wheat or rice cereal; sugar-free yogurt or pudding; unsweetened applesauce or strained infant fruits; sugar-free powdered drinks or iced tea. Sip at least 48–64 oz of liquid (especially water) each day. Take a prescribed multivitamin every day.
Pureed (*gradually increase to no more than 1 cup total*)	3–6 weeks after surgery	*Items listed above, plus:* Low-fat cottage cheese, eggs, tofu, baby food chicken or turkey for protein in this stage. May also add hummus, regular unflavored oatmeal, baby food or toddler fruits and vegetables, blended fruit smoothies, chicken or vegetable broth. Sip at least 48–64 oz of liquid (especially water) each day. Take a prescribed multivitamin every day.
Regular (*small meals and snacks with no more than 1 cup total; 2 oz total meat*)	6 weeks on	*Items listed above, plus:* Low-fat foods (<5 g fat per serving) such as plain rice, well-cooked pasta. Avoid concentrated sweets and sugar (>10 g sugar per serving). For protein, use lean chicken or deboned fish and most tender meats except for tough meats like beef or pork. Allow 30–45 minutes for each meal. Take small bites, and chew food until fairly liquefied before swallowing. Sip at least 48–64 oz of liquid (especially water) each day. Take a prescribed multivitamin every day.

Interleukin-6	Serum Fe	Alkaline phosphatase
Na^+, K^+	Serum B_{12}	Cholesterol
Ca^{++}, Mg^{++}	Serum folic acid	Triglycerides
Alb, transthyretin	Serum vitamin D	
H & H	Serum copper	

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Vitamin Intake

Assessment Data: Medication history. Intake records after GBP surgery indicating no animal protein sources. Not taking prescribed vitamin–mineral supplement. BMI >50 before surgery; 6-month postoperation, BMI 48. Low serum B12 level. Recent complaints of tingling and numbness in extremities.

Nutrition Diagnosis (PES): NI-5.9.11 Inadequate vitamin B_{12} intake related to inadequate intake and not taking vitamin supplement as evidenced by diet history, low serum B_{12} level, and symptoms of neurological changes (tingling in hands and feet.)

Intervention: Food-nutrient delivery—Encourage use of milk products as tolerated throughout the day. Educate—Discuss the importance of vitamin B_{12} from supplemental intake when dietary intake is poor. Counsel about acceptable sources of B_{12} while on the highly restricted GBP diet. Coordinate care with medical team and family members to emphasize improving the diet.

Monitoring and Evaluation: Pill count for prescribed vitamin supplements. Improvement in neurological symptoms; normalized vitamin B_{12} lab values within 1–2 months of therapy.

INTERVENTION

OBJECTIVES

Preoperative

- Provide adequate glycogen stores and vitamins C and K for surgical procedure. Consider enteral immunonutrition.
- Patients with diabetes should be under fairly good glucose control or at least stable.

Postoperative

- Promote wound healing and restoration of depleted glycogen in the liver.
- Prevent side effects during weight loss. The weight loss results of GBP surgery average 10 lb per month and stabilize between 18 and 24 months after surgery. Most patients will never achieve an ideal body weight, but they will be closer to a healthy body weight.
- Prevent complications such as alkaline reflux gastritis, esophagitis, perforation, gastric dilation, stomal obstruction, peptic ulcer, staple line disruption, and excessive vomiting.
- Monitor and manage rare conditions such as rhabdomyolysis, nesidioblastosis, bowel obstruction, and acute renal failure (Capella et al, 2006; Sharma et al, 2006.)
- At 4–6 weeks postoperatively, patients often report that foods taste sweet and will modify intake accordingly. Aversions to meat may occur. Pica may be found in some patients who also have iron deficiency anemia (Kushner and Shanta Retelny, 2005).
- Have patient eat and sip liquids slowly to prevent vomiting; take meat and toast in small bites.

- Prevent neurological, hematological, and cardiovascular side effects of thiamin, vitamin B_{12} deficiency, and other nutrients that may be inadequate (Bloomberg et al, 2005).

FOOD AND NUTRITION

Preoperative

- Use a balanced diet with adequate energy, protein, vitamins, and minerals. Enteral immunonutrition may be useful.
- Diet should regress from liquids to NPO.

Postoperative

- Over several days, progress from clear to full liquids. Enteral feeding with a high-protein intake may be useful to promote healing. Provide at least 1000 kcal/d with 1.5–2.0 g protein/kg.
- Until weight loss is achieved, add semisolid or pureed foods in small amounts. Initial gastric capacity is 30–60 mL; progression is up to 250 mL. Three meals and two snacks are better tolerated than three meals.
- Include 60–80 g of protein per day when possible. High-protein, low-fat foods such as milk, eggs, yogurt, boneless fish, and skinless poultry are important for maintaining adequate lean body mass while losing weight.
- Carbohydrate should be less than 30 g total per meal. A minimum of 130 g of carbohydrate per day should be included to meet Dietary Reference Intakes (DRIs).
- Patients will vomit if they eat too rapidly, drink fluids right after eating, lie down after eating, or overeat. Recommend chewing slowly and consuming liquids 30 minutes before or after meals.
- Dumping syndrome may also occur. Avoid alcoholic beverages, soft drinks, high-fat food such as fried foods and pastries, and high-carbohydrate foods such as cookies, cake, and candies.
- Ensure adequate fluid intake to prevent dehydration. Use at least 40 mL/Kg of noncaffeinated/noncaloric fluid daily, especially water.
- Meet micronutrient requirements, such as a daily liquid multivitamin–mineral supplement and a monthly vitamin B_{12} injection (Johnson et al, 2005). Monitor for iron and calcium deficiencies. Progress to a chewable supplement that meets 100% of the DRIs.
- Avoid obstructive foods, such as popcorn, celery, nuts, seeds, and membranes of citrus fruits.

Common Drugs Used and Potential Side Effects

- Drugs used will be for the specific condition and side effects of surgery.
- Combining RYGB with pharmacologic stimulation of PYY secretion may increase long-term success of surgical weight reduction in morbidly obese adults (Meguid et al, 2008.)

Herbs, Botanicals, and Supplements

- Answer questions about the use of herbs and botanicals; stop them before surgery.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- **Preoperative evaluations** include: all weight loss attempts and outcomes; usual eating patterns and nutritional intake evaluations; frequency of eating away from home; cooking and shopping habits; reasons and motives for surgery; knowledge about protein, vitamins, and minerals; awareness of signs of dehydration; and food allergies and intolerances. Keeping a food diary and sharing it with the dietitian is important. Continuous nutrition monitoring can prevent poor outcomes if the patient and the dietitian work together.
- **Postoperative education** includes: use of high-protein supplemental beverages, especially for wound healing. Thinned baby food, low-fat and sugar-free milk shakes, thinned hot cereals, blenderized soups, vegetable juices, and sugar-free instant breakfast drinks are useful.
- Patients require close monitoring, with special regard to the rapidity of weight loss and vigilant screening for signs and symptoms of subclinical and clinical nutritional deficiencies (Bloomberg et al, 2005.)
- Discuss appropriate quantities and qualities of foods that will be consumed; overeating may stretch the stoma or cause dumping syndrome. Have patient take small bites and sip liquids slowly to prevent vomiting.
- Help patient progress to normalized diet with 120–200 mL per meal. Increase awareness of the eating and satiety process.
- A multivitamin–mineral preparation is definitely needed. Vitamin B_{12}, folacin, iron, potassium, copper, and vitamins A and D are special risks for deficiency. Nutritional deficiencies may become apparent, including PEM (Shuster and Vasquez, 2005).
- Discuss methods for blenderizing foods and recipes.
- Avoid fasting, as it may cause hypoglycemia.
- Promote adequate sleep, exercise, and other lifestyle measures that support a sense of well-being.
- Discuss how to manage dumping syndrome by avoiding simple sugars.
- Most patients lose a significant amount of weight and maintain their weight loss for long term, thereby having an improved quality of life. Unfortunately, between 5% and 30% of patients lose little weight or are unable to maintain their weight loss postoperatively (Puzziferri, 2005). Encourage exercise to help with weight loss and self-esteem.

Patient Education—Food Safety

Surgical patients may be vulnerable to foodborne illness; safe food handling and handwashing are essential.

For More Information

- American Society for Metabolic & Bariatric Surgery
  http://www.asbs.org/
- Cleveland Clinic
  http://cms.clevelandclinic.org/bariatricsurgery/
- Consumer Guide to Bariatric Surgery
  http://www.yourbariatricsurgeryguide.com/intro/
- Gastric Bypass
  http://www.nlm.nih.gov/medlineplus/ency/article/007199.htm

- Longitudinal Assessment of Bariatric Surgery (LABS)
  http://www.niddklabs.org
- Mayo Clinic
  http://www.mayoclinic.com/health/gastric-bypass/HQ01465
- Presurgical Psychological Assessment
  http://www.asbs.org/html/pdf/PsychPreSurgicalAssessment.pdf
- Weight-Control Information Network
  http://win.niddk.nih.gov/

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BOWEL SURGERY

NUTRITIONAL ACUITY RANKING: LEVEL 3

DEFINITIONS AND BACKGROUND

Small bowel surgery may be needed for inflammatory bowel disease, intestinal blockage, precancerous polyps, cancer, necrotizing enterocolitis, and other problems. Emergency surgical procedures in patients with inflammatory bowel disease are rare but can have a high morbidity unless carefully managed. Patients with short bowel syndrome (SBS) may have a higher than average prevalence of small intestinal bacterial overgrowth and may be at risk for septicemia due to bacterial translocation while on PN (Walzer and Buchman, 2010.) Failure to provide enteral nutrients creates a physiologic profile that exacerbates oxidative stress and increases the systemic inflammatory response syndrome (McClave and Heyland, 2009.)

After small bowel surgery, SBS occurs. Earlier feeding may reduce the risk of postsurgical complications after gastrointestinal (GI) surgery (Andersen et al, 2006.) When possible, early enteral feeding should be attempted (Lewis et al, 2009.). Residual small bowel length remains an important predictor of duration of the need for PN.

Most people with SBS experience spontaneous small bowel adaptation over time, when they can be weaned from PN. There are some individuals who cannot be weaned and are potential candidates for techniques to promote intestinal adaptation. Small bowel transplantation has become the treatment of choice for patients with chronic intestinal failure, whose illness cannot be managed with medications or who cannot be maintained on home parenteral nutrition. Rejection, bacterial translocation, and sepsis rates are high.

Colectomy removes part or all of the colon. A colostomy or ileostomy creates an opening on the abdomen (stoma) for the drainage of feces; it may be permanent or temporary. Patients who have an ileostomy lose a considerable amount of fluid that contains sodium and potassium. Fat and vitamin B_{12} absorption is reduced. See section 7 for more details on nutritional management.

Patients who have had a **hemorrhoidectomy** usually tolerate a low-residue diet to delay defecation and allow healing at operative site. After patient is healed, it is important to have patient return to a high-fiber diet to prevent constipation.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Clinical/History

- Height
- Weight
- Body mass index (BMI)
- Weight changes
- Diet history
- Blood pressure (BP)
- Intake and output (I & O)
- Nausea, vomiting, anorexia
- Constipation
- Infection or pressure ulcers
- History of dehydration?

Lab Work

- Gluc
- CRP
- Platelet count
- Alb, transthyretin
- BUN, Creat
- Na^+, K^+
- Ca^{++}, Mg^{++}
- Serum Osm
- N balance
- PT, INR
- H & H
- Serum Fe, ferritin
- Vitamin B_{12}

INTERVENTION

OBJECTIVES

Preoperative

- Replenish depleted reserves by using special immune-enhanced formulas. Uninterrupted enteral nutrition (before, during, and after surgery) is popular in practice to achieve energy intake goals.
- Mechanical bowel preparation before surgery offers no major benefits.

Postoperative

- Restore enteral autonomy (Weseman and Gilroy, 2005).
- Early enteral feeding is generally recommended; this down-regulates systemic immune responses, reduces oxidative stress, and improves patient outcome (McClave and Heyland, 2009.)
- Slowly progress back to a normal diet. Progress from clear liquids to soft—solid diet and avoid dairy products if there is lactose intolerance. Modify diet, as needed, for part of bowel that was affected.
- Correct inadequate digestion or absorption of fluid, electrolytes, and nutrients (Matarese et al, 2005).
- Prevent complications, such as peritonitis or ileus. Chewing gum can prevent ileus in some patients.
- Coordinate efforts with a transplantation team to restore nutritional autonomy to transplantation recipients (Weseman and Gilroy, 2005). Successful transplantation recipients can resume unrestricted oral diet eventually.
- Fight surgical infections by adding probiotics to enteral nutrition (EN) improve the immune status of the colon.

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Fluid Intake

Assessment Data: Food records, input and output reports showing poor fluid intake, medication history, assessment of depression following bowel surgery for cancer. Showing signs of dehydration.

Nutrition Diagnosis (PES): Inadequate fluid intake related to semiconscious state after bowel surgery and decreased oral intake as evidenced by I & O records showing only 800 mL intake for the past 3 days. Poor skin turgor, sunken eyeballs.

Intervention: Food-Nutrient Delivery—Add extra fluids to meal trays; encourage nursing to provide at least 4–5 oz with each medication given. Educate family and nursing staff about desired fluid intake; ensure that I & O records are kept accurately. Counsel about the dangers of dehydration. Coordinate care with medical team to increase fluid intake.

Monitoring and Evaluation: Improved fluid intake as per I & O records; achieving 35 mL/Kg fluid goal.

FOOD AND NUTRITION

Preoperative

- Regress from soft diet to full liquids and then clear liquids.
- If needed, use a hydrolyzed formula or jejunostomy.

Postoperative

- Enteral nutrition is a primary therapy. Growth hormone, GLN, short-chain fatty acids, and fermentable fiber sources are useful. Intestinal rehabilitation regimens provide specialized oral diets, soluble fiber, oral rehydration solutions, and tropic factors to enhance absorption (Matarese et al, 2005).
- Probiotics may be beneficial (Floch et al, 2006).
- Slowly progress from a low-residue diet to a normal diet. Suggest that patient eat slowly and chew foods well. Excesses of fiber should be avoided. Probiotics may be included (Jenkins et al, 2005).
- Focus on adequate fluids; needs are usually greater than normal.
- Long-term nutritional support may be needed; CPN may be required for a short time.

Common Drugs Used and Potential Side Effects

- Drugs used will be for the specific condition and side effects of surgery. New medications to reduce rejection in transplant patients are under study.

Herbs, Botanicals, and Supplements

- Answer questions about the use of herbs and botanicals; stop them before surgery.
- Patients may benefit from prebiotics and probiotics to decrease sepsis. Use with caution.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Evaluate and discuss preoperative weight loss, eating problems and fears, nutritional intake evaluations, frequency

of eating away from home, and cooking and shopping habits. Discuss changes that will be needed after the specific bowel surgery. See section 7 for ileostomy and colostomy guidance.

Patient Education—Food Safety

Surgical patients may be vulnerable to foodborne illness; safe food handling and handwashing are essential.

For More Information

- The American College of Gastroenterology
  http://www.acg.gi.org
- Atlas of Gastrointestinal Endoscopy
  http://www.endoatlas.com/atlas_1.html
- Bowel Sounds
  http://www.nlm.nih.gov/medlineplus/ency/article/003137.htm
- Ileostomy, Colostomy, and Other Surgery
  http://digestive.niddk.nih.gov/ddiseases/pubs/ileostomy/index.htm
- Ostomy
  http://www.cpmc.org/learning/documents/crm-ostomysurg-ws.html
- Small Bowel Resection
  http://www.nlm.nih.gov/medlineplus/ency/article/002943.htm
- Society for American Gastroenterological and Endoscopic Surgeons
  http://www.sages.org/
- Society for Surgery of the Gastrointestinal Tract
  http://www.ssat.com/

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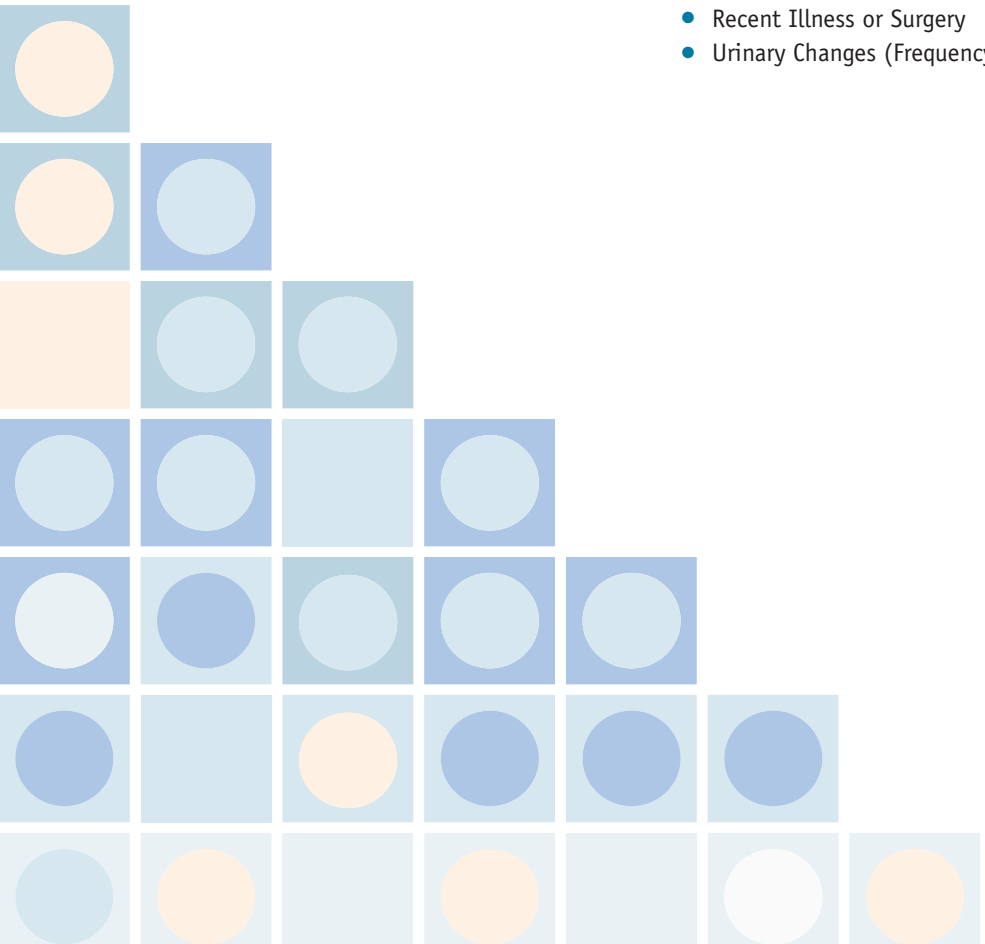
SECTION 15

AIDS and Immunology, Burns, Sepsis and Trauma

CHIEF ASSESSMENT FACTORS

- Accidents or Trauma
- Altered Breathing
- Altered White Blood Cell (WBC) Count and Differential
- Anemia
- Anorexia, Malnutrition
- Culture Results, Specimens
- Environmental Sanitation and Level of Personal Hygiene
- Fever, Chills
- Fluid Status, Edema
- Infection, Sepsis (Heat, Pain, Redness, Swelling, or Drainage in Any Area)
- Indicators of Immunity (T Cells, Other Lymphocytes)
- Medications, Prescription and Over-the-Counter
- Metabolic Rate (Indirect Calorimetry or Estimated)
- Multiple Organ Dysfunction Syndrome (MODS)
- Nutritional Status for Zinc, Iron, Selenium; Vitamins A, C, E; Albumin, CRP
- Presence of Chronic Diseases
- Pulse Rate
- Recent Illness or Surgery
- Urinary Changes (Frequency, Urgency, Burning)



OVERVIEW OF NUTRITION AND IMMUNOCOMPETENCE

The interdependency between the disciplines of nutrition and immunology has been recognized for many decades. Fetal and early infant programming of thymic function suggests that early environments have long-term implications for immunocompetence and adult disease risk. Nutrition and physical growth affect immunocompetence and morbidity from infections.

Common diseases such as atopy and allergy, autoimmunity, chronic infections, and sepsis are characterized by a dysregulation of the pro- versus anti-inflammatory and T helper (Th) 1 versus Th2 cytokine balance. Proinflammatory cytokines promote atherosclerosis, major depression, visceral-type obesity, metabolic syndrome, and sleep disturbances (Elenkov et al, 2005).

Studies regarding the role of nutrients on gene expression and cytokine production have established the importance of maintaining a balanced immune system throughout life. Lack of adequate macronutrients or selected micronutrients, especially zinc, selenium, iron, and the antioxidant vitamins, can lead to clinically significant immune deficiency and infections, especially in children (Cunningham-Rundles et al, 2005). Reduced number of lymphocytes causes loss of host defense in zinc deficiency. In turn, infections aggravate micronutrient deficiencies by reducing nutrient intake, increasing losses, and altering metabolic pathways (Wintergerst et al, 2007). See Table 15-1 and Table 15-2.

Large variations in immunity relate to genetics, age, gender, smoking habits, exercise habits, alcohol consumption, diet, stage in the female menstrual cycle, stress, history of infections, vaccinations and early life exposures. Sound nutritional practices, stress management, good hygiene and sanitation, adequate rest and sleep, and maintaining healthy physical activity can enhance immunocompetence and reduce risks of infection in any population. Even in older adults, improved nutrition can decrease risks for infection. Nutritional supplementation may reduce this risk and reverse some of the immune dysfunction associated with advanced age. The role of calorie restriction and zinc on immunity, aging, autoimmunity, and malignancy has been studied extensively; adding omega-3 fatty acids (fish oil) is also beneficial (Fernandes, 2008).

Hospital admission screening that best identifies patients who are at risk for malnutrition-related complications include presence of a wound, poor oral intake or evident malnutrition, low serum albumin or hemoglobin values, and low total lymphocyte count (TLC) (Brugler et al, 2005). The ability of admission information to accurately reflect malnutrition-related complication risk is crucial to early initiation of restorative medical nutritional therapy (Brugler et al, 2005). New approaches exploring the link through nutrigenomics, proteomics, and metabolomics may provide insight into controlling age-related diseases by following a balanced diet intake (Fernandes, 2008). Table 15-3 provides a list of key nutrients for immunocompetence. Table 15-4 provides important factors to consider in critical illness. Table 15-5 lists nutritional implications in some specific conditions, and Table 15-6 lists virulence increased by iron supplementation.

TABLE 15-1 How the Immune System Works

The immune system is designed to provide protection from invading organisms, including bacteria and viruses, tumor cells, dirt, pollen, and other foreign material. Normally, barriers from the skin and linings of the lungs and gastrointestinal (GI) and reproductive tracts protect the underlying tissues from the outside environment. Whenever there is a breakdown in the protective lining, germs and other irritants can enter the body. The immune system is designed to conquer these foreign molecules by engulfing them or by destroying them with enzymes or other detoxifying means. In addition to fighting off these foreign invaders, the immune system has evolved to destroy abnormal cells (such as tumor cells) but occasionally reacts against the body's own normal tissues (autoimmunity).

Innate and Acquired Immunity

The two principal types of immune response, innate and adaptive (acquired) immunity, are distinguished from one another by both their speed and specificity. The innate immune system, present from birth, involves nonspecific responses that are the first line of defense against common infectious agents, including bacteria and viruses. This system is generally able to recognize foreign organisms but is unable to distinguish between particular invaders. Thus, an innate response does not require stimulation by sophisticated cell-to-cell interactions to remove bacteria or other foreign material and degrade it.

The more specific adaptive (acquired) immune system must be triggered by a specific virus, bacterium, or other foreign material, which stimulates lymphocytes to produce antibodies that can combat the foreign substance. At the next exposure, the preformed antibodies will allow the person to respond with an even stronger, more specific response known as *immunological memory*.

Cells of the Immune System

The immune system consists of white blood cells (WBCs, leukocytes), which are produced in the bone marrow and mature there or in the thymus and other lymphoid organs. Leukocytes circulate in the blood along with oxygen-carrying red blood cells. Under normal conditions, leukocytes leave the circulation and migrate into organs where germs can appear, including the skin, lungs, intestine, and reproductive tract. There, they can wait for infectious agents, or they can migrate back through the circulation to other organs.

(continued)

TABLE 15-1 How the Immune System Works *(continued)*

There are three major types of leukocytes. *Neutrophils* are the most plentiful and are the first line of defense; they contain an arsenal of preformed enzymes that are capable of destroying bacteria. In addition, they are phagocytic, and they engulf viruses, bacteria, or other foreign material, protecting the host from further damage. Neutrophils are very short-lived, often destroyed during the fight. *Monocytes* are leukocytes that migrate to tissues and mature into macrophages. Macrophages are phagocytic and can remove foreign material and parts of dead cells from the tissues. They contain enzymes that can destroy infectious material but live longer than neutrophils and do not tend to self-destruct as easily. The tissue macrophage in the liver is called the Kupffer cell. *Lymphocytes* are selective, specialized WBCs that combat specific infectious agents.

The two types of lymphocytes are B cells and T cells. *B cells* are responsible for humoral immunity in the body fluids (classically known as the humors); they release specialized, soluble protein antibodies into the blood and other body fluids. The antibodies recognize and bind to the surface of foreign substances (i.e., pathogens), immobilizing them and further labeling them as foreign so that they can be more readily taken up by phagocytic cells. *T cells*, in contrast, act directly on other cells rather than manufacturing antibodies. Because of this direct interaction with other cells, T cells are responsible for cellular immunity. They can be further divided into *helper T cells*, which recognize foreign invaders and stimulate immune responses from other cells, and *cytotoxic T cells*, which destroy infected cells. Some of these cells are extremely long-lived "memory cells," capable of remembering certain features on the foreign molecules so that, if the organism encounters that foreign molecule in the future, it can quickly stimulate a response.

Communication Between Immune Cells: Cytokines

One form of communication between immune cells is *direct cell-to-cell contact*, which can occur either as a loose, transient association or as a tighter, long-lasting encounter. Either way, cells must make physical contact with one another. In the second form of contact, cells release small proteins called *cytokines*, which bind to specific receptors on the surface of target cells.

Cytokines interact only with the appropriate target cell and not with surrounding cells. Although many of the effects of cytokines are local, they have been called the hormones of the immune system because they are transported by the circulating blood. Cytokines can affect the same cell that produced them, a neighboring cell, or a cell far away. They stimulate or dampen cell proliferation (replication), production of other cytokines, killing of damaged cells or tumor cells (cytotoxicity), and cell migration (chemotaxis). The latter response is controlled by a subset, chemokines. Just as there are cells that can stimulate or inhibit immune response, cytokines can regulate a variety of cell functions either positively or negatively. *Interleukin-6* is an important cytokine. Excessive production of proinflammatory cytokines or their production in the wrong biological context may lead to chronic inflammation and negative health consequences.

Gut Immunity

An extremely important function of the GI tract is its ability to regulate the flow of macromolecules between the environment and the host through a barrier mechanism. The GI immune response maintains critical pathways in the body. Gut-associated lymphoid tissue (GALT) is the dominant location for initiation of mucosal immune response and is dependent on fats, amino acids, and micronutrients. A healthy GI mucosal immune system provides barriers against systemic access for food antigens and microbes. Changes in the GALT immune response may contribute to intestinal dysfunction and susceptibility to postinjury gut-derived sepsis. Together with GALT and the neuroendocrine network, the intestinal epithelial barrier controls the equilibrium between tolerance and immunity to non–self-antigens (Fasano and Shea-Donohue, 2005). Because genetic and mucosal immunity strongly influence the composition and function of enteric bacteria, strategies are needed to correct dysfunctional microbiota in genetically susceptible individuals and to correct dysbiosis in many inflammatory disorders (Hansen et al, 2010).

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TABLE 15-2 Immunocompetence and Immunity Concerns

Almost all nutrients in the diet play a crucial role in maintaining an optimal immune response. Thus, deficient and excessive intakes can have negative consequences on immune status and susceptibility to a variety of pathogens. In addition, botanical and herbal products can be a concern. While Echinacea is used to reduce symptoms of the "common cold" or flu, there is a risk of hepatotoxicity, exacerbation of allergies or asthma, and even anaphylactic reactions. Garlic is also used to relieve cough, colds, and rhinitis but gastrointestinal disturbances, allergic reactions, or hypoglycemia can occur. Other agents, including angelica, German chamomile flower, ephedra, ginkgo, grape seed extract, licorice root, St. John's wort, kava-kava rhizome, peppermint, stinging nettle, and ginseng, may also have undesirable side effects (see Section 2).

Nutrition and dietary patterns have been shown to have direct impact on health of the population and of selected patient groups, related to a reduction of oxidative damage from free radical production (Berger, 2005). Insufficient intake of micronutrients occurs in people with eating disorders, in smokers (both active and passive), in individuals with chronic alcohol abuse, in patients who are immunocompromised or malnourished, during pregnancy and lactation, and in the elderly (Wintergerst et al, 2007; Happel and Nelson, 2005). Concerns are listed here.

Infants	Undernutrition in critical periods of gestation and neonatal maturation and during weaning impairs the development of a normal immune system. There is a high prevalence of micronutrient deficiencies and infectious diseases in infants in developing countries. Breastfed infants have lower morbidity and mortality due to diarrhea than those fed formula; human milk oligosaccharides protect against pathogens (Newburg et al, 2005).

(continued)

TABLE 15-2 Immunocompetence and Immunity Concerns *(continued)*

Young children	Risks and adverse functional and health outcomes may be associated with deficient and excessive intakes and nutrition status of iron, iodine, zinc, vitamins A and D, folate, vitamin B_{12}, and riboflavin in children. Altered growth and development, mental and neuromotor performance, immunocompetence, physical working capacity, and morbidity can result. Vitamin C and zinc may reduce the incidence and improve the outcome of pneumonia, malaria, and diarrhea infections, especially in developing countries (Wintergerst et al, 2005).
Older adults	Adults 65 years and older comprise the fastest-growing segment of the U.S. population. Older adults experience greater morbidity and mortality due to infection than do young adults (High et al, 2005). Nutritional factors can modify susceptibility to disease and promote healthy aging. Interleukin-6 (IL-6), a cytokine, is tightly controlled by hormonal feedback (estrogen, testosterone) that is lost in the aging process. Elevated IL-6 levels progressively increase and may promote tumorigenesis, osteoporosis, neurodegenerative diseases, and sarcopenia. Zinc is important for immune efficiency (innate and adaptive), antioxidant activity (superoxide dismutase), and cell differentiation (Mocchegiani et al, 2007).
	Use of a daily multivitamin/mineral supplement that contains 100% of the Dietary Reference Intakes (DRIs) may be encouraged.
Upper respiratory infections	The role of large doses of vitamin C to reduce duration or severity of cold symptoms has been inconclusive. Vitamin E supplementation may reduce the incidence of respiratory infections among the elderly. Echinacea or ginseng may also be modestly protective (Predy et al, 2005).
Immunocompromised persons (cancer, AIDS, tuberculosis)	Supplementation of vitamin C improves antimicrobial and natural killer cell activities, lymphocyte proliferation, chemotaxis, and delayed-type hypersensitivity (Wintergerst et al, 2005). Glutamine, arginine, fatty acids, and vitamin E provide some additional benefits for immunocompromised persons or patients who suffer from various infections but avoid excesses of arginine in septic patients. Chronic undernutrition and infection further weaken the immune response. Assessment of immunocompetence by available methods can identify individuals who are most in need of appropriate nutritional support to enhance host defense to infectious pathogens
Undernutrition	Iron and vitamin A deficiencies and protein–energy malnutrition are highly prevalent worldwide. Vitamin A and zinc play important roles in protecting individuals from severity in illnesses such as diarrhea and HIV infection. Zinc undernutrition or deficiency impairs cellular phagocytosis, natural killer cell activity, and the generation of oxidative burst (Wintergerst et al, 2005).
Overnutrition	Obesity caused by excess nutrition or excess storage of fats relative to energy expenditure is a form of malnutrition. Leptin is a cytokine-like immune regulator that has complex effects in both overnutrition and in the inflammatory response in malnutrition.
Surgical patients	Preoperative oral intake of immunonutrition containing omega-3 fatty acids, arginine, and nucleotides at home may prevent the risks of hospitalization and may lead to immunomodulating effects, which can improve nutritional status (see Section 14). Postsurgical or septic patients given branched-chain amino acids intravenously show improved immunity and improved outcomes (Calder, 2006).
Trauma	Sepsis and multiple organ failure have mortality rates of up to 80%. Vitamin C concentrations in the plasma and leukocytes rapidly decline during infections and stress (Wintergerst et al, 2005).

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TABLE 15-3 Nutritional and Host Factors in Immunity

Nutrient status is an important factor contributing to immune competence; undernutrition impairs the immune system, suppressing immune functions that are fundamental to host protection. Both macronutrients and micronutrients are essential. Protein is very important. Branched-chain amino acids (BCAAs) and other essential amino acids support synthesis of protein, RNA, and DNA in lymphocytes to respond to pathogens. Arginine and glutamine support a healthy gut and healing processes, but excesses are to be avoided. To prevent protein use for energy, sufficient carbohydrate intake is needed. Fats, especially omega-3 fatty acids, provide needed calories and support the immune system.

Vitamin A deficiency impairs both innate and adaptive immune responses to infection. Carotenoids such as beta-carotene, lycopene, and zeaxanthin protect the immune system. As a precursor of NAD+, the substrate for DNA repair, niacin contributes to genomic stability (Moccegiani et al, 2008). Antioxidant vitamins C and E counteract damage caused by reactive oxygen species and modulate immune cell function (Wintergerst et al, 2007). Excesses of vitamin E must be avoided as they can also be immunosuppressive. Vitamin D_3 regulates the differentiation, growth, and function of monocytes, dendritic cells, and T and B lymphocytes (Equils et al, 2006). Vitamins B_6, folate, B_{12}, C, and E support the Th1 cytokine-mediated immune response with sufficient production of proinflammatory cytokines (Wintergerst et al, 2007). Protection against macular degeneration has been noted with prescriptions that contain omega-3 fatty acids, lutein and zeaxanthin, vitamins C, E, beta-carotene, zinc and copper (Krishnadev et al, 2010).

Minerals and other substances also play an important role. Chromium can enhance the ability of white blood cells to respond to infection. Iron, as lactoferrin, deprives invading cells of their defense systems. Manganese can enhance natural killer cells and macrophage activity; CoQ10 is thought to do the same. Selenium deficiency may allow viruses to mutate into more dangerous pathogens. Selenium, copper, and zinc modulate immune cell function; they, along with iron, help to produce proinflammatory cytokines (Wintergerst et al, 2007). A summary of important factors is listed here.

Infectious Disease Determinants

- Environmental sanitation
- Microorganismic virulence
- Host immunity, including nutritional status
- Personal hygiene

Host-Resistance Factors

- Cell-mediated T cells
- Complement system
- Immunoglobulins, antibodies (B cells)
- Monocytes and dendritic cells
- Mucus and cilia on epithelial surfaces
- Oligosaccharides and other prebiotics
- Phagocytes (leukocytes, macrophages)
- Physical barriers (skin, mucous membranes)
- Probiotic bacteria

Immune System

- Bone marrow (B cells)
- GALT
- Luster patches in bronchioles
- Lymph nodes
- Peyer patches in gut
- Spleen
- Thymus gland (T cells)
- Tonsils

Nutrients of Immunocompetence

- **Macronutrients**
  - Arginine and glutamine
  - Dietary nucleotides (RNA)
  - Essential amino acids (especially BCAAs)
  - Linoleic acid (essential fatty acid)
  - Omega-3 fatty acids
- **Micronutrient Vitamins**
  - Vitamin A; carotenoids
  - Iron
  - Magnesium and CoQ10
  - Manganese
  - Folic acid, vitamin B_6, vitamin B_{12}
  - Niacin
  - Vitamin C
  - Vitamin D
  - Vitamin E
- **Micronutrient Minerals**
  - Chromium
  - Copper
  - Selenium
  - Zinc

Immunonutrition

- To provide immunonutrition, enteral feeding can be supplemented with arginine, glutamine, omega-3 polyunsaturated fatty acids (PUFAs), and nucleotides.
- Immunonutrition is a less invasive alternative to immunotherapy to lessen chronic inflammation.
- Excessive intravenous lipid can be deleterious due to the proinflammatory effects of omega-6 fatty acids. Omega-3 fatty acids are anti-inflammatory and, combined with medium-chain triglycerides and olive oil, they are more desirable (Grimble, 2005).
- Antioxidants, plant fibers, and live lactic acid bacteria are also important to boost the immune system and reduce inflammation (Bengmark, 2005).

(continued)

TABLE 15-3 Nutritional and Host Factors in Immunity *(continued)*

Nutrient–Nutrient Interactions, Excesses, and Immunocompetence

- Under most circumstances the systemic inflammatory response is beneficial to the host, improving the eventual outcome of injury or infection.
- Chronic, excessive inflammation may lead to cardiac, hepatic, and mitochondrial dysfunction.
- Excessive counterinflammation leads to immune depression; excesses of iron, zinc, vitamin E, and PUFA interfere with immunity, especially if given intravenously or intramuscularly.
- Excess calcium interferes with leukocyte function by displacing magnesium.
- Long-term parenteral nutrition reduces immune functions (Bengmark, 2005). Parenteral iron and zinc are to be used with great caution; central parenteral nutrition is contraindicated in septic patients.
- Associations for "zinc plus selenium and niacin" have a role in healthy immunity, especially in the aging process (Moccegiani et al, 2008).

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TABLE 15-4 Factors of Importance in Critical Care

Metabolic complications can occur from overfeeding critically ill patients. In general, current practice is to underfeed slightly rather than to overfeed: 20–25 kcal/kg actual body weight ABW is recommended; use 30% fat.

Indirect calorimetry (IC) remains the best method of determining a patient's energy needs. IC decreases complications from overfeeding and saves costs by reducing length of stay. Use a combination of prediction equations, clinical judgment, and monitoring of the appropriateness of the nutrition prescription.

- Harris–Benedict equation: using ABW or IBW in the calculation tends to underestimate energy needs (Campbell et al, 2005).
- Ireton–Jones formula: tends to overestimate the energy needs of mechanically ventilated patients (Campbell et al, 2005).

Maintain protein at approximately 1.5 g/kg. In critical illness, glutamine levels are much higher in the duodenal mucosa than during starvation; glutamine supplementation may be beneficial (De-Souza and Greene, 2005).

Arginine is a conditionally essential amino acid. It is a substrate for protein synthesis but can also be metabolized to various compounds, including nitric oxide, ornithine, and creatine phosphate, that are important for growth, wound healing, cardiovascular function, immune function, inflammatory responses, energy metabolism, urea cycle function, and other metabolic processes. Arginine supplementation improves outcomes with sepsis, wounds, ischemia-reperfusion injury, and burns.

The use of specific nutrients to modify immune, inflammatory, and metabolic processes offers the possibility for reducing morbidity following major surgery (Heys et al, 2005). Trace elements and antioxidant nutrients, especially selenium, are important for use in critical care and may reduce mortality (Heyland et al, 2005). Vitamin E levels tend to be low and may be supplemented accordingly. Use of omega-3 fatty acids is also important.

In general, enteral nutrition poses fewer risks than parenteral nutrition. Calories and protein that are delivered early by the enteral route have a significant effect on outcome in patients in critical care units; specific nutrients may also be needed to replace acute deficiencies brought on by specific injury or disease states (Wischmeyer and Heyland, 2010).

Control of hyperglycemia is very important to lessen infection and sepsis (Butler et al, 2005).

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TABLE 15-5 Infections and Febrile Conditions and Nutritional Implications

Emergence of new infectious diseases and old diseases with new properties may affect the whole world; severe acute respiratory syndrome and avian flu are examples.

Condition, Nutritional Acuity, Background	Nutritional Implications
Bacterial endocarditis, Level 3 Bacterial endocarditis is an infection (often *Streptococcus*) of the membrane lining the heart chambers, often occurring after rheumatic fever. It accounts for 2% of all cases of organic heart disease. Symptoms and signs include fever, chills, joint pain, lassitude, anorexia, weight loss, and malaise.	Restore patient's nutritional status to normal. Replenish electrolytes and fluids. Reduce edema, if present. Prevent heart failure, infections, anemia, embolism, and nephritis. Penicillin, erythromycin, and other antibiotics may be used; monitor for timing of meals and drugs. Use a high-energy and high-protein diet. If patient's appetite is poor, encourage intake of favorite foods. Ensure adequate intake of fluids, vitamins, and minerals, especially vitamins A and C. Antibiotic prophylaxis is generally needed before dental work.
Candidiasis, Level 2 *Candida albicans* is normally found in the mouth, feces, and vagina. Greater colonization occurs in debilitated persons in whom thrush or vaginitis or cutaneous lesions are common. Susceptible individuals are those with leukemias, those who are immunosuppressed or on long-term central parenteral nutrition, and those who are obese or have diabetes.	Prevent or treat systemic infections. Prevent endocarditis, emboli, splenomegaly, and other complications. Correct underlying conditions when possible. Ensure a diet high in quality proteins, fluid, and calories. Use regular meals and small, frequent snacks; avoid skipping meals or fasting. Increase vitamin and mineral intake from tolerated fruits and vegetables, especially for vitamins A and C. Nystatin or amphotericin B may be used; diarrhea, nausea, and stomach pain may occur. Synthetic antimicrobial peptides are under development for use in oral candidiasis.
***Clostridium difficile*–infection, Level 3** The common name is *Clostridium difficile*–associated disease (CDAD;) it is hard to treat. Suppression of gastric acid with proton pump inhibitor drugs such as Prilosec (omeprazole) or Nexium (esomeprazole) is associated with a 2–3 times increase in community-acquired CDAD. *C. difficile* causes one fourth of nosocomial antibiotic-associated diarrheas. The incidence is rising, with more colectomy and mortality.	Repeat antibiotics are indicated, either metronidazole or vancomycin. Tapering the dose after a 10-day course decreases the incidence of recurrences compared with abruptly stopping antibiotics. Long-term use of metronidazole may cause neurotoxicity. Vancomycin followed by rifaximin or immune therapy are treatments under study. Probiotics such as *Saccharomyces boulardii* may decrease recurrences when combined with high-dose vancomycin.
Chronic fatigue and immune dysfunction syndrome (CFIDS), Level 1 CFIDS is a serious health concern affecting more than 800,000 Americans of all ages, races, socioeconomic groups, and genders. CFIDS involves severe exhaustion, weakness, headaches, sore throat, tender lymph nodes, unrefreshing sleep, fever, muscle aches, inability to concentrate, and depression. Symptoms tend to mimic lupus or even cancer. Testing for viral load is helpful. There may be a link to Hodgkin disease or multiple sclerosis; patients may have neurally mediated hypotension.	Improve immunological status and prevent malnutrition. Lessen severity of symptoms. Avoid infections and stress to prevent recurrent attacks, where possible. Discourage use of high fat diets. Provide adequate protein (0.8–1 g/kg) and 35 kcal/kg. Include adequate vitamins, minerals, and antioxidant foods. Extra salt or fluids may be needed for hypotension. Fludrocortisone promotes sodium retention. Use analgesics for aches and pain. A multidisciplinary approach is beneficial. Traditional Chinese medicine has shown some merit in reducing sleeplessness and fatigue.
Encephalitis and Reye syndrome, Level 2 Encephalitis involves an inflammation of brain cells, usually by a virus such as measles, mumps, mononucleosis, or herpes simplex. If caused by the tsetse fly, it is known as *African sleeping sickness*. **Reye syndrome** is a disease of the brain and liver, affecting mostly children and teenagers after viral illness. Symptoms include headache, lethargy, nightmares, heavy vomiting; stupor and fatty liver; coma, double vision; hypoglycemia; multiple organ failure, or even death.	Ease symptoms. Allow natural defense system to work. Assist breathing with respirator if necessary. Control any pernicious vomiting. Tube feed if patient is comatose. A ketogenic diet may help when there are seizures. Otherwise, use a high-protein, high-calorie diet with a multivitamin–mineral supplement and extra fluids. If steroid therapy is used, monitor glucose, potassium, and nitrogen levels carefully; reduce sodium in foods if there is edema. Aspirin should be avoided.
Fever, Level 2 Fever is considered to be elevated body temperature >37.5–38.3°C (100–101°F). Fever (pyrexia) may be caused by acute (pneumonia, measles, flu, or chicken pox) or chronic causes (tuberculosis, hepatitis, or malaria). Disturbed thermoregulation is controlled by the hypothalamus. Prostaglandin E2 (PE2) is released from the arachidonic acid pathway and can help increase leukocyte, phagocyte, T cell and interferon activity. **Hyperpyrexia** is considered to be 41.5°C (106.7°F). **Fever of unknown origin (FUO)** involves illness for more than 3 weeks with a temperature higher than 101°F. Approximately 40% of FUO is from infections, 20% from cancer, 15% from connective tissue disease, and 25% from undetermined causes.	Meet increased nutrient needs caused by patient's hypermetabolic state, especially energy requirements. Each 1°F elevation causes a 7% increase in metabolic rate. Replace nitrogen losses. Replenish carbohydrate since liver stores last only 18–24 hours. Normalize electrolyte status, replace losses from perspiration, and facilitate toxin elimination through increased urine output. Prevent dehydration but avoid water intoxication. Treat anorexia, nausea, or vomiting. Adults need 30–40 kcal/kg/day; infants and children need additional calories as well. Monitor weight changes closely. Adults need 1.5–2 g protein/kg if temperature is high and chronic. If fever is acute, patient may prefer liquids. With longer duration, thiamin and vitamins A and C may be depleted, and a supplement may be used. Parenteral zinc or iron supplementation may significantly increase temperature in patients with recent injury or infection; avoid until fever improves. As treatment progresses, a diet with small, frequent feedings can be used. Offer preferred foods according to appetite, such as puddings, shakes, and soups.

(continued)

TABLE 15-5 Infections and Febrile Conditions and Nutritional Implications *(continued)*

Condition, Nutritional Acuity, Background	Nutritional Implications
	Take antipyretics/aspirin with food or milk and avoid alcoholic beverages. Take erythromycin with a full glass of water on an empty stomach to avoid sore mouth, nausea, or diarrhea. Penicillins should not be taken with acidic food or fluids such as fruit juice; so use adequate protein. Take tetracycline on an empty stomach with a full glass of water; avoid milk and dairy products for 2 hours before or after taking tetracycline. Avoid use in pregnancy and in children.
Herpes simplex, Level 1 Herpes simplex involves a viral infection of skin or mucous membranes (herpes simplex I for oral lesions, whereas herpes simplex II usually involves genital/anal area) with vesicular eruptions of repeated frequency. Oral lesions ("cold sores" or "fever blisters") are latent in the nerve cell ganglia of the trigeminal nerve and are triggered by stress. This virus is similar to the chicken pox virus. Testing includes polymerase chain reaction, herpes simplex virus test, and swollen lymph nodes. Herpetic outbreaks are common in HIV-positive and other immunocompromised patients.	Reduce inflammation and duration. Lessen recurrences and virulence. Reduce stress, febrile states, or further complications such as encephalitis or aseptic meningitis. Highlight relaxation and stress reduction techniques. Use high-quality protein and adequate calories. Increase intakes of vitamins A and C. Discuss relationship of nutrition to immune status. Take prescribed medication at first sign of an outbreak. Acyclovir (Zovirax), famciclovir (Famvir), and antiviral agents such as Valtrex are available; nausea, vomiting, or headaches may occur. If interferon is used, gastrointestinal (GI) distress, stomatitis, nausea and vomiting, abdominal pain, and diarrhea may be side effects. A herpes vaccine is being tested.
Herpes zoster (shingles), Level 1 Herpes zoster is an acute viral infection with vesicles, usually confined to a specific nerve tract, and neuralgic pain in the area of the affected nerve. It is a reactivation of the *Varicella* virus (chicken pox); severity correlates with age. Symptoms include pain along the affected nerve tract, fever, malaise, anorexia, and enlarged lymph nodes. Bacterial infection of the lesions, poor nutritional status, and risk of dehydration may occur if rehabilitation requires a long period. There is a comprehensive, sensitive assay that detects simultaneous HSV-1, HSV-2, varicella-zoster virus, human cytomegalovirus, and Epstein–Barr virus (EBV). The Zostavax vaccine is effective.	Facial nerves may be affected; alter diet as needed. Prevent further systemic infection; reduce fever. Correct or prevent malnutrition, constipation, and encephalitis. Hydrate adequately. Prevent or correct unplanned weight loss. Prevent or reduce severity of postherpetic neuralgia, which is a very painful complication. A balanced diet with frequent, small feedings may be needed. Increased fiber may be useful to correct constipation. Adequate vitamins E and B_{12} have been suggested for postherpetic neuralgia. Use adequate vitamins A and C. Acyclovir or famciclovir may shorten the duration and decrease pain. Monitor for GI distress, nausea and vomiting, or diarrhea. Valacyclovir is effective at facilitating healing lesions, reducing pain and postherpetic neuralgia. Narcotics and analgesics are needed to reduce pain. Capsaicin cream from hot peppers has proven to be useful for pain relief. Injecting lidocaine and prednisone directly into spinal column for pain relief of postshingles neuralgia has been tested. Oral prednisone may be used; alter sodium intake and monitor for glucose intolerance.
Infection, Levels 1–2 Infection results from successful invasion, establishment, and growth of microorganisms in a host. Responses involve general and antigen-specific immunological defense systems. In infectious processes, vitamin A is excreted in large amounts from the urine. Correct iron-deficiency anemia, but do not use excesses as microbes depend on iron for growth and proliferation. Iron is mostly protein bound as transferrin. Avoid parenteral or intravenous iron and zinc until fever is resolved.	Provide adequate nourishment to counteract hypermetabolic state. Support body's host defense system. Prevent or correct dehydration, hypoglycemia, complications, and anorexia. Replace nutrient losses (potassium, nitrogen, magnesium, phosphorus, and sulfur). Discuss role of nutrients in maintaining skin and mucous membrane integrity and preventing bacterial invasion and subsequent infections. Use a high-protein, high-calorie diet, rich in vitamins, minerals, and fluids. Needs increase up to 20% in mild infection, 20–40% in moderate, or 40–60% in septic conditions. Administration of antibiotics with or without food is specific to the type of drug used. Avoid caffeine, sodas, and fruit juices when taking penicillins. For tetracycline, avoid milk and dairy products 2 hours before and after taking drug. With amoxicillin (Augmentin), diarrhea, nausea, and vomiting may occur. Cephalosporins (e.g., Ceclor, Cephalexin, Duricef) may cause diarrhea, nausea and vomiting, sore mouth, hypokalemia, and vitamin K deficiency. Griseofulvin for fungal infections should be taken with a high-fat meal; dry mouth, nausea, and diarrhea are common effects. Ketoconazole (Nizoral) is used in fungal infections and should be taken with an acidic liquid such as orange juice; avoid taking ketoconazole within 2 hours of use of calcium or magnesium. Metronidazole (Flagyl) may cause nausea and vomiting, diarrhea, and anorexia; avoid alcoholic beverages.
Influenza (flu) and the common cold, Level 1 The common cold and influenza are the most common syndromes of infection in human beings. Influenza virus is transmitted by respiratory route, generally in the fall and winter months. Incubation is 1–4 days, with abrupt onset. Signs and symptoms include chills, fever for 3–5 days, malaise lasting 2–3 weeks, muscular aching, substernal soreness, nasal stuffiness, sore throat, some nausea, nonproductive cough, and headache. Annual vaccinations are suggested for high-risk populations, including elderly individuals and those individuals with pulmonary diseases. Low humidity, cold weather, or psychological stress may increase susceptibility. Adequate rest and hydration are essential. Discuss infection control.	Reduce fever and relieve symptoms. Chicken soup is actually useful by providing potassium and sodium, as well as fluid; it increases mucus flow. Prevent complications such as Reye syndrome, secondary bacterial infections (especially pneumonia), otitis media, and bronchitis. Promote bed rest, adequate hydration, and calorie intake. Replace fluid and electrolyte losses. Increase fluids from salty broths, juices, and other fluids. A high-energy and protein intake should be encouraged. Small meals and snacks may be better tolerated than three large meals. Adequate vitamins A and C, sodium, and potassium should be considered. Adequate zinc and low zinc status may be a risk factor for pneumonia in the elderly Barnett et al, 2010). Antibiotics may be needed if secondary bacterial infections occur; monitor for proper timing of administration with food and beverages. Amantadine or rimantadine may be helpful, especially in type A flu. Nausea, dry mouth, and constipation may occur. Avoid use of aspirin in children.

(continued)

TABLE 15-5 Infections and Febrile Conditions and Nutritional Implications *(continued)*

Condition, Nutritional Acuity, Background	Nutritional Implications
Meningitis, Level 1 Infection of the meninges causes inflammatory reactions, usually in the pia mater or arachnoid membranes. The condition may be viral or bacterial. Bacterial forms are more likely to be fatal if left untreated. Bacterial forms include *Listeria monocytogenes, Neisseria meningitidis, Haemophilus influenzae,* or *Streptococcus pneumoniae*. Meningitis can be caused by lung or ear infections or by a skull fracture. Symptoms and signs include headache, neck rigidity, fever, tachycardia, tachypnea, nausea and/or vomiting, disorientation, diplopia, altered consciousness, photophobia, petechial rash, irritability, malaise, seizure activity, and dehydration. Spinal tap or lumbar puncture is needed to assess cerebrospinal fluid. Meningitis could lead to septic shock, respiratory failure, or death. It most commonly affects children aged 1 month–2 years. Chronic meningitis can affect people with cancer or HIV/AIDS.	Prevent or correct weight loss. Force fluids but do not overhydrate, especially if there is cerebral edema. Prevent or correct constipation, fever, and other symptoms. Maintain intravenous feedings as appropriate; prevent overhydration. Progress diet, as possible, to high-calorie, high-protein intake. Unless contraindicated, provide 2–3 L of fluid. Adequate fiber will be beneficial to correct or prevent constipation. Gradually return to normal caloric intake for age. Ensure adequate intake of vitamins A and C from fruits, juices, and vegetables. In the long term, control obesity. Antibiotics (penicillin, ampicillin, and cephalosporin) may be used in bacterial forms or to prevent complications in viral forms; nausea, vomiting, and diarrhea can result. If corticosteroids are used, side effects may include nitrogen and calcium losses and sodium retention.
Mononucleosis, Level 1 Infectious mononucleosis is an acute disease caused by EBV; it causes gland swellings in the neck and elsewhere ("glandular fever"). It causes fatigue, malaise, headache, chills, and other symptoms such as sore throat, fever, abdominal pain, jaundice, stiff neck, chest pain, breathing difficulty, cough, and hepatitis. Incubation is 5–15 days. It is most common in those between ages 10 and 35 years. Lab work may include evaluation of increased cerebrospinal fluid pressure, EBV titer, uric acid, and liver enzymes. It is also useful to evaluate a serum agglutination test.	Use a high-protein, high-calorie diet. Use liquids when swallowing solid foods is difficult. Use small, frequent feedings to improve overall nutritional quality and quantity. Ensure adequate intakes of vitamins A and C, especially from fruits and vegetables. Modify food textures when swallowing is difficult. Emphasize importance of exercise in restoring lean body mass. Restore fluid balance. Replenish glucose stores. Spare protein. Restore lost weight. Reduce fever. Prevent complications such as myocarditis, hepatitis, and encephalitis. Acyclovir (Zovirax) may be useful in initial infection, preventing typical persistence; nausea, anorexia, and vomiting may occur. Other antibiotics may be needed for related infections.
Pelvic inflammatory disease (PID), Level 1 PID involves inflammation of the pelvic cavity, affecting the fallopian tubes (salpingitis) and ovaries (oophoritis) with acute pelvic and abdominal pain, low back pain, fever, purulent vaginal discharge, nausea and vomiting, urinary tract infection (UTI), diarrhea, maceration of the vulva, and leukocytosis. Long-term sequelae may include tubal infertility or chronic pelvic pain.	Promote good nutritional status to maintain weight and immunity. Increase hydration as tolerated. Lessen diarrhea, nausea, and vomiting. If nausea or vomiting is extensive, discuss need for small meals and consumption of fluids separately from meals. Provide diet as tolerated with small, frequent feedings until nausea and vomiting subside. Alter fiber and fluid, as needed. Increase energy and protein if needed to improve patient's nutritional status. Ensure adequate intake of all vitamins and minerals, especially vitamins A and C. Antibiotics may be used; quinolones, cephalosporins, metronidazole, and doxycycline may be prescribed. Analgesics are generally used to reduce pain; chronic use may cause GI distress.
Poliomyelitis, Level 1 A highly contagious enterovirus, poliomyelitis attacks the motor neurons of the brain stem and spinal cord; it may or may not cause paralysis. Polio is transmitted by personal contact, by eating contaminated food, or by drinking contaminated fluids. Polio is rare in areas where the vaccine is available, but there are risks in areas where the vaccine is not administered to all members of the population. Extra immunization may be needed for persons traveling to tropical areas. Symptoms and signs include headache, sore throat, fever, and neck and back pain. For breathing problems, a ventilator may be needed. Postpolio syndrome produces neuromuscular symptoms 25–30 years after attack; serious swallowing difficulties can ensue. Beware of possible choking or aspiration in the bulbar type of paralysis; patient may be unable to swallow. Provide adequate nourishment. Correct electrolyte imbalances.	For patient with acute paralysis, use a high-protein, high-calorie diet in liquid form. Use intravenous feeding and tube feeding when needed. Use vitamin supplements with 1–2 times the DRI; extra calcium and potassium may be needed to replace losses. As the treatment progresses, diet may be changed from a liquid to a solid diet as tolerated. A dysphagia diet may be useful, with varying levels of thickened liquids to enhance swallowing. Wean to oral diet as intake increases. Frequent high nutrient–density snacks are recommended. Instruct patient regarding how to puree or blend foods as needed, including how to add thickeners to liquids. Discuss appropriate recipes for high-energy and high-protein foods. Prevent complications of prolonged immobilization: renal stones, pressure ulcers, and negative N balance. Current antiviral drugs do not work; polio has no cure.

(continued)

TABLE 15-5 Infections and Febrile Conditions and Nutritional Implications *(continued)*

Condition, Nutritional Acuity, Background	Nutritional Implications
Rheumatic fever, Level 1 Rheumatic fever is an inflammatory condition affecting the connective tissues that causes joint pain, swelling, fever, rash, jerky movements (Sydenham chorea), facial grimacing, and carditis. It usually ensues 3 weeks after streptococcal infection. Lab work includes testing for serum antibodies to streptococci; albumin, transthyretin, and cholesterol may be decreased; erythrocyte sedimentation rate and white blood cell (WBC) level may be increased. Heart inflammation usually disappears but may cause permanent damage to the valves (especially the mitral valve), with a resulting heart murmur. Long-term effects are called rheumatic heart disease.	Use a full-liquid diet for acute rheumatic fever. As treatment progresses, gradually change diet, first to a soft diet, then to a regular diet. Restrict sodium intake if edema is present or if steroids are used. Increase intake of vitamin C, protein, and calories. Include adequate vitamin A as well. Reduce inflammation in joints and heart. Decrease physical activity and encourage rest while heart is inflamed. Recover lost weight. Reduce fluid retention, if present. Cure the infection and prevent its recurrence. Prevent complications such as bacterial endocarditis, atrial fibrillation, and heart failure. Explain increased need for calories and protein. Adequate rest, exercise, and nutrition are essential to prevent recurrence. Explain increased need for calories and protein. Adequate rest, exercise, and nutrition are essential to prevent recurrence. Restrict sodium if prednisone or adrenocorticotropic hormone is given for severe heart inflammation. Side effects include depletion of nitrogen, calcium, potassium, and hyperglycemia. Antibiotics are used. Monitor for specific side effects such as GI distress. Penicillin may be needed for 10 days. Lifelong use of antibiotics before surgery and dental work protects against bacterial invasion of heart valves. Aspirin or nonsteroidal anti-inflammatory drugs may be used to reduce joint pain and inflammation.
***Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus* (MRSA) infection, Level 1** *Staphylococcus aureus* is a gram-positive bacterium that developed resistance to the penicillin-derivative methicillin. MRSA emerged as a bacterium that became less susceptible to the actions of methicillin and thus developed the ability to colonize and cause life-threatening infections. *S. aureus* and MRSA population estimates are in the millions of persons.	MRSA colonization should be contained by infection control measures and not treated. Hand-washing technique is very important. The most potent anti-MRSA drug at the present time is daptomycin, especially to treat endocarditis.
Toxic shock syndrome (TSS), Level 1 TSS is an acute bacterial infection caused by *S. aureus* and most often is associated with prolonged use of tampons during menses. Symptoms include sudden onset of high fever, severe headache, red eyes, myalgia, vomiting, watery diarrhea, red rash on palms and soles (with desquamation), decreased circulation to fingers and toes, disorientation, peripheral edema, pulmonary edema, respiratory distress syndrome, and sudden hypotension progressing to shock. Anemia, kidney, liver, and muscle damage; septic shock; respiratory distress can occur. Monitor labs for increased levels of WBC, blood urea nitrogen, creatinine, bilirubin, liver enzymes, and creatine phosphokinase. Platelets may be decreased.	Increase fluid intake to 3 L daily, unless contraindicated. Discuss need for adequate fluid intake and small meals, especially with vomiting or nausea. Control diarrhea and vomiting. Improve well-being. Stabilize hydration and electrolyte balance. Prevent renal, heart, and lung problems and other complications. Antibiotics are required. Monitor for GI side effects. Determine how to administer specific drugs (such as with food, water, or milk).
Typhoid (enteric) fever, Level 2 Enteric fever includes typhoid and paratyphoid fever. It is a systemic infection caused by *Salmonella enterica,* and it is most common among travelers. This infectious fever is spread by contamination of food, water, or milk with *S. typhi* or *paratyphi*, which can come from sewage, flies, or faulty personal hygiene. The problem practically has been eradicated in areas of proper sanitary practices. Most infections are found in people who are in contact with carriers who have persistent gallbladder or UTIs. Incubation is 5–14 days. Symptoms include malaise, headache, cough, sore throat, "pea soup" diarrhea, constipation, rose spots, and splenomegaly. Lab work includes stool and urine for Widal test.	Reduce fever and prevent irritation. Replace nutrient losses from diarrhea. Replace tissue losses. Prevent complications such as intestinal hemorrhage or shock and pulmonary or cardiac side effects. Gradually add pectin and other fiber. Especially, include good dietary sources of vitamins A and C. Explain which foods are high-protein, high-calorie sources. Discuss how to prevent future reinfection. For patients with acute fever, use a diet of high-protein, high-calorie liquids. A low-residue diet may be needed temporarily. As treatment progresses, gradually add soft, bland foods. Try small, frequent feedings. First-line therapy is ceftriaxone, and fluoroquinolones can also be given. Monitor for GI distress. Preventive measures include educating travelers about hygiene precautions and vaccinations.

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TABLE 15-6 Virulence Increased by Iron

To successfully sustain an infection, nearly all bacteria, fungi, and protozoa require a continuous supply of host iron. Iron is a cofactor in oxidation–reduction reactions. Iron deficiency has opposing effects on infectious disease risk, decreasing susceptibility by restricting iron availability to pathogens, and increasing susceptibility by compromising cellular immunocompetence (Wander et al, 2009). Studies suggest that moderate iron deficiency protects against acute infection and may represent a nutritional adaptation to endemic infectious disease stress (Wander et al, 2009). Zinc and manganese may also play a role in host defense mechanisms.

Acid-fast and gram-positive bacteria	*Bacillus, Clostridium, Listeria, Mycobacterium, Staphylococcus, Streptococcus*
Fungi	*Candida, Cryptococcus, Histoplasma, Mucor, Pneumocystis, Rhizopus*
Gram-negative bacteria	*Campylobacter, Chlamydia, Escherichia, Klebsiella, Legionella, Proteus, Pseudomonas, Salmonella, Shigella, Vibrio, Yersinia*
Protozoa	*Entamoeba, Leishmania, Plasmodium, Toxoplasma, Trypanosoma*

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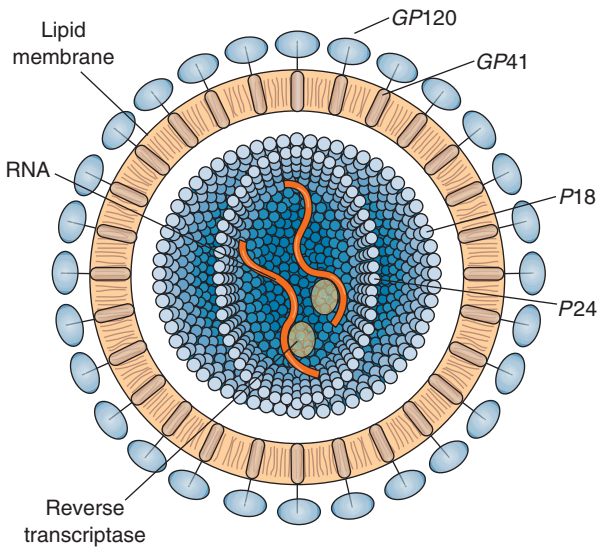
AIDS AND HIV INFECTION

NUTRITIONAL ACUITY RANKING: LEVEL 4



Adapted from: Porth CM. *Pathophysiology: Concepts of altered health states,* 5th ed. Philadelphia: Lippincott Williams & Wilkins, 1998.

DEFINITIONS AND BACKGROUND

The human immunodeficiency virus (HIV) infects T cells (CD4+) and macrophages. Levels of CD41 (helper) and CD81 (nonhelper) subsets of T cells are used to evaluate immunological competency. After levels have been identified, staging is identified to plan therapeutic interventions; see Table 15-7. Many people will develop acquired immunodeficiency syndrome (AIDS) after a decade, following an opportunistic infection or a decline in the immune system. Prognosis for AIDS ranges from 1 year, if not treated with antiretroviral therapy (ART), to 5 years, if treated.

HIV is not easily transmitted except by exchange of bodily fluids during sexual contact, by receipt of infected blood through a blood transfusion, by sharing contaminated needles with intravenous drug injection, or from an HIV-infected mother to neonate (children represent 15–20% of the affected population). Persons at high risk include homosexual and bisexual males, hemophiliacs, intravenous drug addicts, heterosexuals with multiple partners, and infants of HIV-positive mothers. Breastfeeding by HIV-infected mothers can result in HIV transmission to the infant, especially with mastitis. In some developing countries, the relative risk of HIV transmission may be less significant than malnutrition for the infant; risks and benefits must be weighed individually.

HIV infection involves multiple organs. It targets the immune system and impairs the ability to mount an adequate immune response. Malnutrition and its complications further impair the body; HIV often depletes nutritional status (Sztam et al, 2010). Immune reconstitution inflammatory syndrome develops in a substantial percentage of HIV-infected patients who have an underlying opportunistic infection and receive ART (Danaher et al, 2010). AIDS-related malignancies are another major complication.

TABLE 15-7 WHO Clinical Staging of HIV/AIDS for Adults and Adolescents

Clinical stage 1—Asymptomatic

Acute retroviral syndrome

Persistent generalized lymphadenopathy

Clinical stage 2

Angular cheilitis

Fungal nail infections of fingers

Herpes zoster

Moderate unexplained weight loss (<10% of body weight)

Papular pruritic eruptions

Recurrent oral ulcerations

Recurrent respiratory infections (sinusitis, bronchitis, otitis media, pharyngitis)

Seborrheic dermatitis

Clinical stage 3—Clinical signs

Acute necrotizing ulcerative stomatitis, gingivitis, or periodontitis

Oral candidiasis

Oral hairy leukoplakia

Pulmonary tuberculosis (TB) diagnosed in last 2 years

Severe infections (e.g., pneumonia, empyema, pyomyositis, bone/joint infection, meningitis, bacteremia)

Severe weight loss (>10% of body weight)

Unexplained chronic diarrhea >1 month

Unexplained persistent fever >1 month

Diagnostic test needed for: anemia (<8 g/dL), neutropenia (<500/mm^3), or thrombocytopenia (<50,000/mm^3) > 1 month

Clinical stage 4—Clinical signs

Chronic herpes simplex infection (orolabial, genital, or anorectal >1 month)

Central nervous system toxoplasmosis

Esophageal candidiasis

Extrapulmonary TB

HIV encephalopathy

HIV wasting syndrome

Kaposi sarcoma

Pneumocystis pneumonia

Recurrent severe or radiological bacterial pneumonia

Diagnostic testing needed for:

Candida of trachea, bronchi or lungs

Cryptosporidiosis

Cytomegalovirus infection (retinitis or of an organ other than liver, spleen, or lymph nodes)

Disseminated mycosis (e.g., histoplasmosis, coccidiomycosis, penicilliosis)

Disseminated non–tuberculous mycobacteria infection

Extrapulmonary cryptococcosis including meningitis

Invasive cervical carcinoma

Isosporiasis

Lymphoma (cerebral or B-cell non-Hodgkin)

Progressive multifocal leukoencephalopathy

Recurrent non-typhoidal salmonella septicemia

Visceral herpes simplex infection

Visceral leishmaniasis

Kaposi sarcoma and Hodgkin and non-Hodgkin lymphomas are the most common malignancies (Wood and Harrington, 2005).

HIV infections are considered pandemic, and AIDS has killed more than 25 million people, especially in the sub-Sahara. Worldwide, hepatitis B virus affects 370 million people, hepatitis C virus (HCV) affects 130 million, and HIV affects 40 million (Alter, 2006). Fortunately, ART has reduced mother-to-child transmission rates.

HIV infection requires lifelong, vigilant polypharmacy. Nutrition directly impacts immune-cell triggering and indirectly impacts DNA and protein synthesis in HIV progression. Decline in body cell mass and deficiencies in vitamins and minerals occur; some clinicians recommend a series of antioxidant supplements to augment cellular immunity. Because of the crucial role that nutrition plays throughout the course of HIV, medical nutrition therapy (MNT) is an integral part of disease management.

During starvation, there is generally a loss of adipose tissue with maintenance of lean body mass (LBM); in HIV/AIDS, there is loss of LBM (wasting) while maintaining body fat. *Wasting syndrome* is defined by the World Health Organization as the involuntary loss of at least 10% of body weight and is a common AIDS-defining diagnosis. Weight loss is an independent prognostic indicator of outcomes, including mortality. Weight loss, fatigue, anorexia, diarrhea, and low-grade fevers may occur. As long as an infection remains untreated, nutritional support regimens will meet needs with only limited success.

Body composition measures should be accurate, ideally taken prior to the initiation of ART. Bioelectrical impedance analysis is useful, whereas skinfold measurements tend to overestimate fat-free mass and underestimate fat mass. Fat redistribution is part of a syndrome known as *peripheral lipodystrophy* in patients receiving ART; they lose facial and extremity fat with redeposition into visceral and truncal adiposity. Abnormal fatty deposits are disfiguring and are found in the neck and dorsocervical area ("buffalo hump"). These changes can be accompanied by development of hyperlipidemia or diabetes.

Gastrointestinal (GI) complications are common. Weight loss is often multifactorial in etiology, and reduced oral intake is common. Malnutrition further compromises those who have tuberculosis (TB) or persistent diarrhea (Wanke, 2005). Nutritional supplements, dietary counseling, and use of specific nutrients such as vitamin D_3, are critically important (Villamor, 2006).

While central parenteral nutrition (CPN) is often indicated with HIV patients experiencing severe GI dysfunction, there is a concern over infection with the use of central venous catheters in patients with advanced HIV/AIDS. Medication interactions, coinfection with other infections and diseases, wasting, lipodystrophy, and other issues make individualized nutrition care plans extremely important

TABLE 15-8 Guidelines for Nutrition Therapy in HIV Management

I. High risk (see RD within 1 week)
- A. Poorly controlled diabetes mellitus
- B. Pregnancy (mother's nutrition; infant: artificial infant formula)
- C. Poor growth, lack of weight gain, or failure to thrive in pediatric patients
- D. 110% unintentional weight loss over 4–6 months
- E. 15% unintentional weight loss within 4 weeks or in conjunction with the following:
  1. Chronic oral (or esophageal) thrush
  2. Dental problems
  3. Dysphagia
  4. Chronic nausea or vomiting
  5. Chronic diarrhea
  6. Central nervous system (CNS) disease
  7. Intercurrent illness or active opportunistic infection
- F. Severe dysphagia
- G. Enteral or parenteral feedings
- H. Two or more medical comorbidities, or dialysis
- I. Complicated food–drug–nutrient interactions
- J. Severely dysfunctional psychosocial situation (especially in children)

II. Moderate risk (see RD within 1 month)
- A. Obesity
- B. Evidence for body fat redistribution
- C. Elevated cholesterol (1200 mg/dL) or triglycerides (1250 mg/dL) levels, or cholesterol level <100 mg/dL
- D. Osteoporosis
- E. Diabetes mellitus, controlled or new diagnosis
- F. Hypertension
- G. Evidence for hypervitaminoses or excessive supplement intake
- H. Inappropriate use of diet pills, laxatives, or other over-the-counter medications
- I. Substance abuse in the recovery phase
- J. Possible food—drug–nutrient interactions
- K. Food allergies and intolerance
- L. Single medical comorbidity
- M. Oral thrush
- N. Dental problems
- O. Chronic nausea or vomiting
- P. Chronic diarrhea
- Q. CNS disease resulting in a decrease in functional capacity
- R. Chronic pain other than oral/gastrointestinal tract source
- S. Eating disorder
- T. Evidence for sedentary lifestyle or excessive exercise regimen
- U. Unstable psychosocial situation (especially in children)

III. Low risk (see RD as needed)
- A. Stable weight
- B. Appropriate weight gain, growth, and weight-for-height in pediatric patients
- C. Adequate and balanced diet
- D. Normal levels of cholesterol, triglycerides, albumin, and glucose
- E. Stable HIV disease (with no active intercurrent infections)
- F. Regular exercise regimen
- G. Normal hepatic and renal function
- H. Psychosocial issues stable (especially in children)

Source: Hayes C et al. Integrating nutrition therapy into medical management of human immunodeficiency virus. Web site accessed February 5, 2010, at http://www.aidsetc.org/aidsetc?page=etres-display&resource=etres-175.

(American Dietetic Association, 2010). Although the incidence of most AIDS-defining opportunistic infections, including HIV wasting syndrome, has dramatically decreased since the introduction of ART, weight loss and wasting are still common in HIV-infected persons who use injected drugs; live below the federal poverty level; have a lower CD4 cell count or higher HIV viral load; or have diarrhea, nausea, or fever (Tang et al, 2005).

Work on an HIV vaccine is important. The International AIDS Vaccine Initiative has established a consortium to elucidate mechanisms of protection from such a vaccine (Koff et al, 2006). In addition, a new, inactivated mycobacterial vaccine may significantly reduce TB cases among HIV-positive individuals.

MNT for HIV/AIDS patients can reduce illness, hospital stays, and related medical costs. MNT helps the patient have an improved quality of life along with better CD4 counts and weight gain (American Dietetic Association, 2010). See Table 15-8 for guidelines on risk levels. The American Dietetic Association has recommended three MNT visits per year for adults with stage 1 HIV/AIDS; three to six visits per year for adults with stage 2 or 3 HIV/AIDS; and a minimum of five visits per year for children or adolescents with HIV/AIDS. Through the Ryan White Comprehensive AIDS Resources Emergency (CARE) Act, treatment is available even when other funds have been depleted.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: HIV-1 has a minimal genome of only nine genes, which encode 15 proteins; the virus depends on the human host for every aspect of its life cycle (Balakrishnan et al, 2009). Polymorphisms cause the 15% of variation in viral load between individuals during the asymptomatic phase of infection. Alleles of the HLA-B5701 gene and the HLA-C gene are affected.

Clinical/History

- Height
- Pre-illness weight
- Current weight
- Waist to hip ratio
- Body mass index (BMI)
- Skinfolds; fat-free mass (low?)
- Blood pressure (BP)
- Intake and output (I & O)
- Weight changes
- Swollen lymph nodes
- Rash
- Sore throat, headache
- Night sweats
- Dyspnea on exertion, rales, or rhonchi
- Nausea, vomiting
- Anorexia
- Temperature (fever, chills)
- Dysphagia, chewing problems
- Stomatitis
- Diarrhea
- Cyanosis, pneumonia
- Frequent viral or herpes infections
- Opportunistic infections (in AIDS)
- Stool tests for malabsorption
- Biopsies (lymph nodes, skin lesions)
- Dual-energy x-ray absorptiometry scan
- Bioelectrical impedance analysis

Lab Work

- Complete blood count with differential
- Platelets
- Cholesterol (Chol)
- Triglycerides (Trig) (increased)
- Glucose (Gluc)
- CD4 lymphocytes (active AIDS, <200 T cells)
- CD8 lymphocytes
- TLC
- Viral load
- Polymerase chain reaction for herpes virus
- P24 antigen
- Albumin (Alb) or transthyretin (decreased)
- C-reactive protein (CRP)
- Prealbumin:CRP ratio
- Aspartate aminotransferase (AST)
- Alanine aminotransferase (ALT)
- Bilirubin
- Prothrombin time (PT), international normalized ratio
- Hemoglobin and hematocrit (H & H) (decreased?)
- Ferritin (increased?)
- Creatine (Creat), blood urea nitrogen (BUN)
- Transferrin
- Lactose test
- Serum B_{12} and folate (decreased?)
- Schilling test
- Serum vitamin A
- Serum testosterone

SAMPLE NUTRITION CARE PROCESS STEPS

Increased Nutrient Needs

Assessment Data: Three-day food records. Input and output, weight loss, and medication records. Diagnosis of AIDS 3 years ago. Complaints of GI distress after meals.

Nutrition Diagnosis (PES): NI 5.1 Increased nutrient needs related to unintentional weight loss of 21% in 5 months as evidenced by weight only 80% of desirable BMI range.

Interventions:

Food-Nutrient Delivery.

ND 1.3 Specific foods (yogurt) 2 times daily.

ND 3.1.1 Commercial beverage 3 times daily.

Education:

E 1.1 Purpose of nutrition education: to explain importance of adequate nutrient intake and compliance with all medical/nutritional/emotional care.

Counseling:

C2.2 Goal setting—Gain 1–½ lb per week until ideal body weight (IBW) range is reached.

Coordination of Care:

RC 1.1 Team meeting—Discuss interventions with interdisciplinary team.

Monitoring and Evaluation: Weight records, fewer reports of GI distress and symptoms. Greatly improved intake on 3-day food records.

INTERVENTION

OBJECTIVES

- Improve nutrition-related immunity to prevent opportunistic infections, such as oral candidiasis; cirrhosis or hepatocellular carcinoma from chronic infection with hepatitis B or C; and other conditions such as immune reconstitution inflammatory syndrome.
- Enhance response to therapy through continuous counseling, nutritional alterations, and drug effectiveness monitoring. Follow guidelines according to levels of risk (see Table 15-8).
- Use 3-day food records rather than food frequencies (American Dietetic Association, 2010).
- Maintain body weight at 95–100% of usual body weight levels. LBM is especially affected; increased resting energy expenditure occurs (American Dietetic Association, 2010).
- Prevent weight loss from fever, poor intake with oral pain, infection, nausea, diarrhea, malabsorption, swallowing difficulties, effects of medications, inflammation, viral load, and lipodystrophy, and vomiting; offer early nutritional intervention (American Dietetic Association, 2010).
- Reduce mealtime fatigue to encourage better intake. Avoid unnecessary distractions and stresses.
- Lower the temperature when febrile.
- Manage altered GI function including diarrhea, malabsorption, vomiting, and HIV-induced enteropathy.
- If necessary, use CPN to prevent further weight loss and potential malnutrition. CPN will stop weight loss, but it will not prevent further immunodeficiency.
- Keep body well hydrated. Fluids are critical to prevent kidney stones and other complications.
- Support depleted levels of nutrients such as linoleic acid, selenium, and vitamin B_{12}.
- Counteract problems such as dysphagia, mouth pain, taste alterations (dysgeusia), or difficulty chewing. Alleviate nutritional effect of fatigue, anemia, anorexia, depression, and dyspnea. Optimize nutritional status.
- Maintain fat intake at prudent levels (30–35% total kcal) to maintain or achieve normal lipid levels.
- Alter dietary regimen if there is renal or hepatic impairment.
- Maintain honest discussions regarding use of alternative therapies such as herbs, special diets, and megavitamin therapy.

- Encourage physical activity, which has been shown to improve cardiopulmonary fitness and to reduce symptoms of depression (American Dietetic Association, 2010).
- Comply with food and water safety guidelines.

FOOD AND NUTRITION

- Maintain diet as appropriate for patient's condition; use a high-energy/high-protein diet with adequate nutritional supplements. Weight gain or maintenance is possible in patients with HIV infection and early stages of AIDS by use of oral liquid supplements.
- From 2–2.5 g protein/kg and 35–45 kcal/kg are needed. Fever and infection may further elevate need for these nutrients. Increase energy intake in cases of infection, fever, and pneumonia. Use indirect calorimetry when available; estimates are often incorrect (Frankenfield et al, 2005).
- Keep the body well hydrated. Estimate 35–40 cc/kg unless there is a reason to restrict fluids.
- Use TF, especially gastrostomy, if warranted. Low-lactose/low-fat TF products may need to be fed continuously to reduce gastroenteritis or reflux. CPN may be necessary if weight loss exceeds 20% of usual body weight.
- Increase use of omega-3 fatty acids and decrease saturated fat intake. There may be advantages to using a medium-chain triglyceride formula in the presence of AIDS-associated malabsorption (American Dietetic Association, 2010).
- Small, frequent feedings (6–9 times daily) are usually better tolerated but may be difficult to achieve given complex medication regimens.
- A general multivitamin–mineral supplement should be recommended, not to exceed 100% of the recommended dietary allowances (RDAs). Low serum micronutrient levels are common and have been associated with immune impairment, HIV disease progression, or mortality (Mehta and Fawzi, 2007). Use of vitamin A and beta-carotene may reduce some of the gut permeability and lessen watery diarrhea (American Dietetic Association, 2010). Vitamin K deficiency is common with antibiotic use.
- Use nutrient-dense snacks, such as pudding, if tolerated, nonacidic juices for sore mouth, ices made with tolerated juices, and sandwiches made with cold meat salads. Add protein powders and glucose polymers, if desired. Use oral supplements when needed.
- With bouts of diarrhea, use small meals and avoid extremes in temperatures; room temperature is often best. Avoid excesses of caffeine, alcohol, and fried and high-fat foods. Use soft cooked chicken, turkey, fish, and lean beef. Replace electrolytes with foods such as broth soups or Gatorade for sodium, potassium, magnesium, and chloride.
- If lactose intolerant, avoid milk and use a low-lactose diet.
- Sucrose and gluten may not be tolerated. Individualize as needed.
- Children present unique nutritional needs, further compounded by HIV infection; see Section 3.

Common Drugs Used and Potential Side Effects (see Table 15-9)

- Antiretroviral regimens are complicated and difficult. Because nonalcoholic fatty liver disease is a prominent feature induced by ART, hepatitis A and B virus vaccinations and close monitoring of liver parameters are suggested (Kahraman et al, 2006). Malabsorption can occur if antiretroviral agents are taken improperly with regard to meals or if they are taken with certain other drugs or herbal remedies. Suboptimal use of antiretrovirals because of noncompliance or malabsorption can result in viral resistance.
- Recombinant human growth hormone and growth hormone–releasing hormone are options for reducing visceral adipose tissue and coronary heart disease (Cofrancesco et al, 2009).

Herbs, Botanicals, and Supplements

- Ethical dilemmas may be presented by CAM use. HIV-infected patients often seek complementary therapies due to unsatisfactory side effects, high cost, nonavailability, or adverse effects of conventional medicines (Liu et al, 2005).
- CAM use is nearly 100% in the HIV-infected population, with half reporting daily use of a dietary supplement (especially vitamin C, vitamin E, and soy) as an adjunct to other treatments (Milan et al, 2008). However, there may be risks for herb–drug and herb–nutrient interactions. Many herbals may also interact with prophylactic medicines, such as antibiotics.
- Herbs and botanical supplements should not be used without discussing with the physician. Older, college-educated, or insured patients are more likely to disclose their CAM use to health care providers, and there is a need to find ways to discuss CAM between more patients and their providers (Liu et al, 2009).
- Licorice, capsaicin, astragalus, and burdock are not confirmed; large, rigorous trials are needed (Liu et al, 2005).
- Rosemary and marjoram have pentacyclic triterpenoic acids with anti-inflammatory, hepatoprotective, gastroprotective, antiulcer, anti-HIV, cardiovascular, hypolipidemic, antiatherosclerotic, and immunoregulatory effects. There would be no harm in seasoning foods with these herbs.
- Echinacea is not recommended as an antiviral agent. Do not use with warfarin or immunosuppressants.
- Garlic and St. John's wort may make saquinavir or indinavir less effective.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the role of nutrition in infection and immunity; patients should also decrease the use of drugs and cigarettes because of their effects on overall health status and immunocompetence. They should avoid sharing razors, toothbrushes, tweezers, nail clippers or piercing jewelry with others.

TABLE 15-9 Medications Used for HIV Infections and AIDS

Class and Purpose	Generic Name	Brand and Other Names	Nutritional Implications and Comments
Nucleoside reverse transcriptase inhibitors (NRTIs)—*faulty versions of building blocks that HIV needs to make more copies of itself; when HIV uses an NRTI instead of a normal building block, reproduction of the virus is stalled*			Can cause severe bone marrow depletion and anemia, altered taste, constipation, nausea, indigestion, or vomiting. Adequate folate and vitamin B_{12} may prevent toxicity. NRTIs can cause lactic acidosis, hypersensitivity reactions, neuropathies, pancreatitis, anemia, and neutropenia.
	Abacavir	Ziagen, ABC	Diarrhea may be a side effect. Malaise, fever, rash, and liver inflammation can occur.
	Abacavir, lamivudine	Epzicom	Diarrhea may be a side effect. Malaise, fever, rash, and liver inflammation can occur.
	Abacavir, lamivudine, zidovudine	Trizivir	Diarrhea may be a side effect. Malaise, fever, rash, and liver inflammation can occur.
	Adefovir	Hepsera, ADV, Preveon	Often used in chronic hepatitis B virus treatments. Has nephrotoxic potential. Nausea, diarrhea, and vomiting can occur.
	Aptivus	Tipranavir	For the adjunctive treatment of HIV-1 infections.
	Didanosine	Videx, ddI Videx EC	May cause liver toxicity in low-weight patients. Neuropathy and pancreatitis may result.
	Emtricitabine	Emtriva, FTC, Coviracil	Well tolerated. Anorexia and fatigue are side effects.
	Emtricitabine, tenofovir DF	Truvada	May cause diarrhea, nausea, and vomiting. Take with food.
	Lamivudine	Epivir, 3TC	May cause nausea and vomiting, pancreatitis, and depression. Avoid alcohol. Take without regard for meals.
	Lamivudine, zidovudine	Combivir	Headache, liver inflammation, and fatigue can occur. Take with meals.
	Stavudine	Zerit, d4 T	Severe anemia may occur. Avoid alcohol.
	Tenofovir DF	Viread, TDF	Gastrointestinal (GI) distress, hypophosphatemia, acute renal failure.
	Zalcitabine	Hivid, ddC	Can cause oral ulcers, nausea, vomiting, dry mouth, and neuropathy. Take on empty stomach. Avoid taking with antacids.
	Zidovudine	Retrovir, AZT, ZDV	Can cause severe bone marrow depletion and anemia, altered taste, constipation, nausea, indigestion, or vomiting. It works better in sequence with acyclovir. Adequate folate and vitamin B_{12} may prevent toxicity. Take with food.
Nonnucleoside reverse transcriptase inhibitors (NNRTIs)—*bind to and disable reverse transcriptase, a protein that HIV needs to make more copies of itself*			Nausea, vomiting, and diarrhea are common side effects. Liver inflammation may occur; avoid alcohol and St. John's wort. NNRTIs can cause rashes and hepatotoxicity.
	Delavirdine	Rescriptor, DLV	Monitor for abnormal liver enzymes. Headaches are common.
	Efavirenz, emtricitabine, and tenofovir DF	Atripla	Hyperlipidemia can occur. Contains two NRTIs and one NNRTI.
	Nevirapine	Viramune, NVP	Take with food or on an empty stomach; fever, headache, hepatitis, general fatigue, mouth sores, and rash can occur.
Protease inhibitors (PI)—*disable protease, a protein that HIV needs to make more copies of itself*			Associated with hyperlipidemia, hyperglycemia, GI symptoms, and body fat distribution abnormalities. Disguising their taste is important; add a small amount to cold foods such as ice cream, shakes, and fruit ices; thick sweet foods such as honey, jellies, and frozen juice; or small amounts of peanut butter, pudding, applesauce, or yogurt.
	Atazanavir	Reyataz	May cause a tendency to bleed. Take with food.
	Darunavir	Prezista	May cause GI distress.
	Fosamprenavir	Lexiva, FPV	May cause a tendency to bleed. Take without regard for meals.

(continued)

TABLE 15-9 Medications Used for HIV Infections and AIDS *(continued)*

Class and Purpose	Generic Name	Brand and Other Names	Nutritional Implications and Comments
	Indinavir	Crixivan, IDV	Best absorbed on an empty stomach or with a light, nonfat snack and increased fluids (but not skim milk, coffee, or tea), even juice if calories are needed. Nausea and vomiting, change in taste, and diarrhea can occur.
	Lopinavir/ ritonavir	Kaletra, LPV/r	Elevated lipid levels and GI distress may occur. Take with food. Abnormal mouth sensations are noted. Hyperglycemia can occur.
	Nelfinavir	Viracept, NFV	Take with food; flatulence, loose stools, or diarrhea can occur. Hyperglycemia may result.
	Ritonavir	Norvir, RTV	Take with a high-energy, high-fat meal. Side effects include weakness, diarrhea, nausea and vomiting, loss of appetite, abdominal pain, abnormal mouth sensations of burning or prickling, dyslipidemia, and coronary events.
	Saquinavir	Invirase	Best absorbed after a high-energy, high-fat meal; contains some lactose; may cause GI distress, diarrhea, or nausea.
	Tipranavir	Aptivus	May cause GI distress.
Entry inhibitors: **Integrase inhibitors—***stop HIV from inserting its own genetic code into the cell by slowing integrase, the chemical HIV needs to unlock the CD4 command center.*	**Raltegravir**	Isentress	
Entry inhibitors: **Fusion inhibitors—***prevent HIV entry into cells.*	**Enfuvirtide**	Fuzeon, T-20	Pneumonia has been one side effect. Take without regard for meals. Nausea, diarrhea, fatigue, and pancreatitis are possible side effects.
	Maraviroc	Selzentry	May cause GI distress.
Antineoplastic agents—*for Kaposi sarcoma*	**Adriamycin, bleomycin, vincristine**		Numerous side effects include nausea and vomiting, diarrhea, anorexia, stomatitis, and weight loss.
	Doxorubicin		Administer with riboflavin to decrease toxicity. Dry mouth, esophagitis, stomatitis, nausea, and vomiting are common.
Other medications—*to manage other side effects of HIV.*	**Acyclovir**	Zovirax	May cause headache, nausea, anorexia, sore throat, fatigue, altered taste, and diarrhea.
	Antidepressants	Zoloft, Wellbutrin, others	May be useful before interferon therapy if there is a history of depression.
	Antifungals	Amphotericin-B, clotrimazole, flucytosine, ketoconazole	May cause nausea and vomiting, diarrhea, weight loss, metallic taste, and GI distress.
	Antioxidants	Multivitamin–mineral supplement that meets 100% DRI levels	Antioxidant supplementation may decrease markers of oxidative stress. Selenium may enhance immune function by modulating cytokine production.
	Cidofovir	Vistide	A cytosine nucleotide analog for treatment of cytomegalovirus (CMV), herpes simplex, papilloma, and pox viruses.
	Corticosteroids	Prednisone, others	Sodium retention and potassium, calcium, and vitamin C depletion can occur; protein malnutrition can occur with extended use. Glucose intolerance also may result.
	Foscarnet	Foscavir	Used for CMV retinitis (used intravenously only) and may cause anorexia, nausea and vomiting, abdominal pain, and diarrhea.
	Ganciclovir	Cytovene	Approved for use with CMV. May cause diarrhea, fever, neuropathy, elevated blood urea nitrogen and creatinine levels, and hypoglycemia.

(continued)

TABLE 15-9 Medications Used for HIV Infections and AIDS *(continued)*

Class and Purpose	Generic Name	Brand and Other Names	Nutritional Implications and Comments
	Pancreatic enzymes	Various	May be used with malabsorption.
	Peginterferon-α plus ribavirin		Standard for hepatitis C virus/HIV coinfection. Flu-like symptoms, fatigue, weight loss, and depressive mood changes are frequent.
	Topical microbicides	Many microbicides are in development. Alkyl sulfate microbicides, such as sodium dodecyl sulfate agents	Proposed to break the chain of transmission by providing chemical, biological, and physical barriers to infection by blocking or inactivating pathogens at the mucosal surface.
	Trimethoprim–sulfamethoxazole	Bactrim, Septra	Used for *Pneumocystis carinii* pneumonia for 1 month; may cause hepatitis, azotemia, anorexia, stomatitis, and thrombocytopenia. Monitor carefully. Folate may be needed.
	Valganciclovir	Valcyte	Approved for CMV.
Appetite stimulants and anabolic steroids—*to improve appetite and intake*			Appetite stimulants and anabolic steroids lead to significant increase in body weight and fat-free mass.
	Dronabinol	Marijuana derivative	Takes 4–6 weeks to show effects; somnolence and impaired memory can occur.
	Megestrol acetate	Megace	Useful for stimulating appetite.
	Anabolic steroids: oxandrolone, nandrolone decanoate	Oxandrin	Synthetic testosterone (anabolic steroid) that promotes weight gain, linear growth in children, and increased muscle mass. Hepatic changes or tumors have been reported. Elevation of low-density lipoprotein can occur with prolonged use; this may have cardiovascular effects. Nutritional status and the quality of life can improve.

For more information, see the FDA Web site. Accessed February 6, 2010, at http://www.fda.gov/ForConsumers/ByAudience/ForWomen/FreePublications/ucm118597.htm#nucleo

- Patients and caregivers should report all weight loss, anorexia, and fever to doctor. Even a 5% weight loss in 6 months markedly increases the risk of death (Tang et al, 2005).
- Diet must be altered whenever necessary. Evaluation of nutrition assessment parameters on a regular basis requires a comprehensive process. Continuing contact with a dietitian is essential regarding alternative feeding methods, changes in medications, need for home-delivered meals, simplified menu planning, and treatment of GI side effects.
- Aversion to meat may be countered by use of cold protein foods such as cottage cheese, yogurt, skim milk, and cheeses.
- Education should address any decline in self-care abilities, as well as alternative therapies and consequences.
- Address the consequences of protease-inhibiting therapy, such as hyperlipidemia. Studies show that managing fat, alcohol, and fiber intakes and increasing exercise can be very beneficial (American Dietetic Association, 2010).
- Resistance and strengthening exercises should be maintained. Twenty minutes three times weekly is quite effective (American Dietetic Association, 2010; Cade et al, 2007).
- New mothers who are HIV positive will want to use formula or milk from a surrogate mother instead of breastfeeding.
- In the short term, nutrition counseling and oral supplements can achieve a substantial increase in energy intake. Importance of maintaining a balanced, nutritious diet should be addressed. Dietary patterns in HIV-positive individuals may be reflected in changes in BMI, CD4 counts, and viral load (Hendricks et al, 2008). Rest periods before and after meals are suggested.
- Patients are living longer because of ART therapy, and they may be susceptible to other age-related diseases (Gerrior and Neff, 2005). They should receive appropriate nutrition counseling to meet their individual needs. A new standard of care is also needed where malnourished patients may easily access nutritional therapies within HIV treatment (Sztam et al, 2010).
- Patients should be screened and treated for depression (Kacanek et al, 2010).
- Use of stress management and coping mechanisms will be important to maintain nutritional health (Tromble-Hoke et al, 2005). Massage therapy may also be beneficial.
- In home care, continuing education should be offered to caregivers to prevent transmission of the disease and to reduce other infections.

Patient Education—Food Safety

- Educate about food safety issues. Studies show that education helps to reduce the instances of foodborne illness in this vulnerable population (American Dietetic Association, 2010).
- Reducing infections is very important. Meticulous hand washing is essential because immune-compromised individuals are more susceptible to foodborne illness. Preparation and home delivery methods must also be scrupulously clean (American Dietetic Association, 2010).
- Tips include the following:
  - Separate raw meats from other raw foods such as fruits and vegetables.
  - Avoid cross-contamination from raw meats by storing and preparing raw meat so it does not come in contact with fruits, vegetables, and uncooked foods.
  - Use separate cutting boards and cooking utensils so that juices from raw meats are not allowed to contact uncooked foods.
  - Keep hot foods hot (>140°F) and cold foods cold (<40°F). Limit the amount of time that food is left at room temperature to prevent germs from growing in it.
  - Wash all fruits and vegetables with warm water and a soft bristle brush.
  - Thaw frozen meat or poultry in a refrigerator or under cold running water, not at room temperature.
  - Avoid raw fish or shellfish, unpasteurized juices or milk, and uncooked eggs (and dishes containing uncooked eggs).
- Exceptional hand-washing techniques should be used by all caregivers and by patient. Safe food-handling techniques are imperative to reduce exposure to *Cryptosporidia, Giardia,* and *Salmonella.*

For More Information

- AEGIS (AIDS Education Global Information System)
  http://www.aegis.com/
- AIDS Clinical Guidelines
  http://aidsinfo.nih.gov/Guidelines/
- AIDS Info
  http://www.aidsinfo.nih.gov
- American Foundation for AIDS Research
  http://www.amfar.org/
- Body: An AIDS and HIV Information Resource
  http://www.thebody.com/
- HIV InSite
  http://hivinsite.ucsf.edu/InSite
- International AIDS Vaccine Initiative
  http://www.iavi.org
- National AIDS Information Clearinghouse (NAIC)
  http://www.cdcnpin.org/

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BURNS (THERMAL INJURY)

NUTRITIONAL ACUITY RANKING: LEVEL 3 (MINOR), LEVEL 4 (MAJOR BURNS)

Adapted from: Fleisher GR, MD, Ludwig S, MD, Baskin MN, MD. *Atlas of Pediatric Emergency Medicine.* Philadelphia: Lippincott Williams & Wilkins, 2004.

DEFINITIONS AND BACKGROUND

Electrical, thermal, chemical, or radioactive agents can cause burns. Burns are the third leading cause of accidental death in the United States; 35% of burn victims are children. Unfortunately, a significant proportion of critically ill children admitted to pediatric intensive care units (ICUs) present with nutritional deficiencies; younger age, burn injury, and need for mechanical ventilation support are some factors that are associated with worse nutritional deficiencies (Mehta and Duggan, 2009).

With a first-degree burn, simple redness of epidermis occurs. In a second-degree burn, redness and blistering occur. In a third-degree burn, skin and tissue destruction occurs. The hypermetabolic response to burn injury is mediated by hugely increased levels of circulating catecholamines, prostaglandins, glucagon, and cortisol. This response causes profound skeletal muscle catabolism, immune deficiency, peripheral lipolysis, reduced bone mineralization, reduced linear growth, increased energy expenditure, and marked increase in metabolic rate. Local cytokines are released from inflammatory cells, attracting more to the affected area. Interleukin (IL)-1, IL-6, and tumor necrosis factor (TNF) are involved. Fever, evaporative losses, and infections may occur. Determination of total body surface area (TBSA) burned is often documented in the medical record by using charts such as the Lund-Browder chart, shown in Figure 15-3 (http://www.rch.org.au/clinicalguide/cpg.cfm?doc_id=5158).

Before the modern era of early enteral nutrition therapy, significant weight loss led to impaired wound healing, infectious morbidity, and increased mortality (Lee et al, 2005). Loss of 1 g of nitrogen equals a 30 g loss of LBM. Therefore, nitrogen balance becomes a matter of life and death in a major burn victim. Survival depends on medical treatment and early, effective nutritional support. Weight loss of up to 10% is acceptable; 40–50% shows great catabolism and hypermetabolism. Systemic inflammation, acute lung injury, and multiple organ failure (MOF) are common causes of mortality (Magnotti and Deitch, 2005).

Early institution of enteral feeding can attenuate the stress response, abate hypermetabolism, and improve patient outcome (Lee et al, 2005). Adding high doses of ascorbic acid (25 mg/mL) to resuscitation fluid during the first 24 hours after severe burns significantly reduces edema and severity of respiratory dysfunction.

Thermal injury produces a profound hypermetabolic and hypercatabolic stress response characterized by increased endogenous glucose production via gluconeogenesis and glycogenolysis, lipolysis, and proteolysis (Jeschke, 2009; Jeschke et al, 2005). Severity of thermal injury and presence of systemic infection increase risk for developing ischemic bowel disease. If the GI tract becomes nonfunctional, parenteral support may be needed.

Estimating the percentage of total body burned is important because total burn thickness affects metabolic rate more than body surface area. A 25–30% TBSA burn leads to systemic edema and catabolic responses. A 90% TBSA burn is usually fatal; 60% or more in an older person is also usually fatal. The Harris–Benedict equation (with or without activity and stress factors), the Mifflin–St. Jeor equation, the 1997 Ireton–Jones equation, and the Fick equation should not be considered for use in resting energy expenditure (REE) determination, as these equations do not have adequate prediction accuracy (American Dietetic Association, 2010). If a

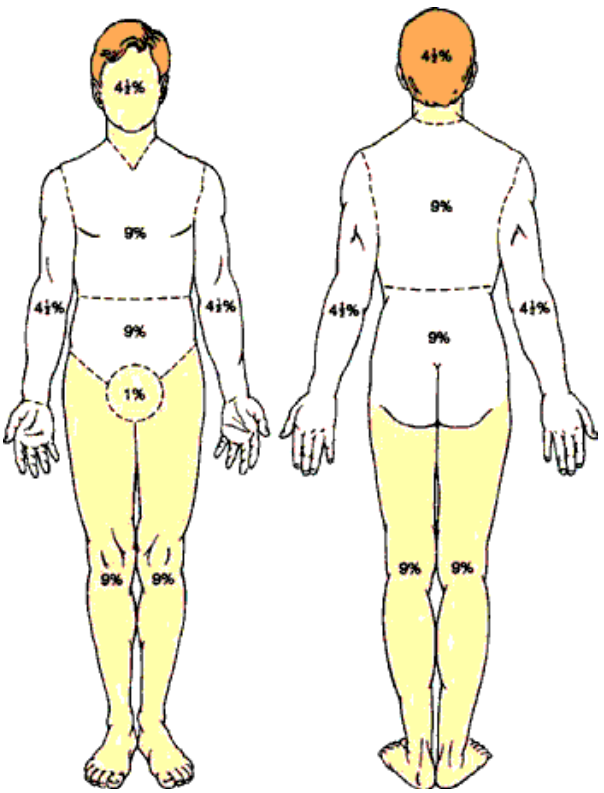

Figure 3. LifeART image copyright © 2010 Lippincott Williams & Wilkins. All rights reserved.

metabolic cart is not available, the following Penn State equation may be used for nonobese patients, where V is ventilation per minute (American Dietetic Association, 2010):

$$\text{PENN STATE EQUATION RMR} = \text{BMR}\,(0.85) + V_E\,(33) + T_{max(175)} - 6433.$$

The liver, with its metabolic, inflammatory, immune, and acute phase functions, plays a pivotal role in patient survival and recovery by modulating multiple pathways (Jeschke, 2009). Healing takes place in three stages: establishment of the epithelial barrier, scar tissue formation (dermal replacement), and contraction (shrinkage). Eschars cut off blood supply to an extremity or may impair breathing; they are often cut open in a surgical escharotomy. Bleeding occurs, but because the burn causing the eschar has destroyed the nerve endings in the skin, there is little pain. Hepatic acute phase proteins are strong predictors for postburn survival (Jeschke, 2009).

The burn patient is best cared for in a dedicated burn center where resuscitation and monitoring focus is on the pathophysiology of burns, inhalation injury, and edema management (Latenser, 2009). Most dietitians working in burn centers report having advanced training or education (Graves et al, 2009).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Burns are an injury and not genetic in origin.

Clinical/History

- Height
- Preburn weight
- Weight changes
- Daily weight (beware of heavy exudate, edema)
- BMI
- Diet history
- Measured energy expenditure (MEE)
- Percentage body burned
- Burn classification (first, second, third degree)
- Edema
- I & O
- BP
- Temperature
- Urine acetone, sugars
- Ability to chew
- Ability to swallow
- Hypovolemic shock = tachycardia, low BP, decreased urinary output

Lab Work

- Alb
- Prealbumin: CRP ratio
- CRP
- Transthyretin (decreased)
- BUN, Creat
- H & H
- Gluc (increased)
- AST (increased)
- Na^+ (decreased)
- Chloride
- K^+
- Total urinary N (TUN)
- Ca^{++}, Mg^{++}
- Partial pressure of carbon dioxide (pCO_2)
- Partial pressure of oxygen (pO_2)
- Transferrin
- Chol, Trig
- WBC, TLC
- Serum catecholamines (increased)
- Ceruloplasmin
- Alkaline phosphatase (Alk phos)
- N balance

SAMPLE NUTRITION CARE PROCESS STEPS

Unintentional Weight Loss

Assessment Data: Analysis of preferences, dislikes, and allergies; intake compared with measured or estimated requirements; confirmation of severity and extent of burn from medical record; recorded weights.

Nutrition Diagnosis (PES): NC-3.2 Unintentional weight loss related to inadequate intake after burns of 45% of upper extremities as evidenced by weight loss of 10 lb in past 14 days.

Intervention: Food-Nutrient Delivery—If needs cannot be met by oral route due to extent and severity of burn, patient will need nutrition therapy or feeding assistance. Eliminate distractions at mealtime and avoid lab work and painful procedures before meals. Educate family and nursing staff about not using empty-calorie foods or beverages and offering nutrient-dense beverages, especially with medication passes. Counsel about long-term nutritional implications, as appropriate.

Monitoring and Evaluation: Monitor and evaluate weights. Determine whether nutritional needs are being met. Anticipate 2–3 months total for optimal recovery time.

INTERVENTION

OBJECTIVES

- Restore fluid and electrolyte balance to prevent hypovolemic shock and to stabilize body temperature. Fluid resuscitation during the first 24–48 hours after injury remains a significant challenge (White and Renz, 2008).
- Prevent renal insufficiency or failure from decreased plasma volume, cardiac output, and excessive pigment overload from necrosis, toxins, or hemolysis. Exudate losses may be as high as 20–25% of total daily nitrogen losses.
- Promote wound healing and graft retention while minimizing loss of LBM (Lee et al, 2005). Close wound surface with grafts to reduce the likelihood of organ failure. Grafts may be autograft (own body) or from cultured keratinocytes.
- Provide early operative intervention and wound closure, metabolic interventions, early enteral nutrition, and intensive glucose control (Latenser, 2009).
- Anabolic steroid, glutamine, and glucose protocols (≤120 mg/dL) are widely used (Graves et al, 2009).
- Avoid weight losses greater than 10% of preburn weight. Minimize catabolism of protein tissues to avoid consequences of impaired immunity, decreased wound healing, decreased vigor and muscle strength, retarded synthesis of blood proteins and hemoglobin, and increased rates of infection.
- Use indirect calorimetry where possible. Patients require only small adjustment for physical activity levels; bedridden patients may need only 1.0–1.2 times the determined REE. Patients who are also malnourished benefit from a gradual increase in intake of 1.1–1.3 times the REE.
- Achieve positive nitrogen balance and minimize losses. Albumin therapy may be considered for the management

of ascites and volume resuscitation (Mendez et al, 2005). In children, growth must continue.
- Prevent ischemic gut, sepsis, and organ failure (Magnotti and Deitch, 2005). Prevent hypothermia and other complications.
- Reduce evaporative water losses, especially with occlusive wound dressings.
- Correct syndrome of inappropriate antidiuretic hormone, hypertonic dehydration, or overhydration.
- Relieve pain and alleviate problems such as postburn pruritus, deep venous thrombosis, peptic ulceration, or pressure ulcers.
- Manage psychosocial problems such as acute stress syndrome, depression, and posttraumatic stress syndrome, and reduce their effect on intake.
- Avoid overfeeding and minimize the negative consequences of hyperglycemia.
- Restore skin's protection to reduce infection. Sepsis is a major cause of mortality, often occurring 2–3 weeks after injury.

FOOD AND NUTRITION

- Immediately use intravenous fluids to replace deficits; prevent gastric distention and paralytic ileus. Prevent overhydration (Kattelmann et al, 2006). Add vitamin C (25 mg/mL) to promote healing.
- If hemodynamically stable with a functional GI tract, then EN is recommended over parenteral nutrition (PN) to lower sepsis and complication rates (American Dietetic Association, 2010; Chan and Chan, 2009). Start within a few hours to decrease the hypermetabolic response to injury (Magnotti and Dietch, 2005).
- A duodenal placement, especially in the early postburn phase, is superior to gastric feeding. Use specialty immunoenhanced products with peptides and glutamine to preserve gut function (De-Souza and Greene, 2005). Provide the feeding at a 45-degree angle, where possible, to reduce risks for pneumonia and aspiration; do not use blue dye to test for aspiration (American Dietetic Association, 2010).
- Protein intake should be from 2–3 times the RDA or 1.5–3 g/kg body weight; adjust for children. Add modular protein supplements as needed, especially glutamine. Leucine-supplemented nutrition is also very promising (De Bandt and Cynober, 2005).
- Use 20% protein, 50–60% carbohydrates (CHOs), and 20–30% fat (2–4% essential fatty acids and slight increase in omega-3 fatty acids). CHO may be given at rate of 5 mg/kg/min. Intravenous lipids can be given at 4 g/kg maximum in pediatric population.
- Gradually progress to oral diet when possible; use a high-calorie, high-protein diet with 5–6 small meals and snacks. Add CHO additives as needed. Suitable snacks may include peanut butter cookies, brownies, cake, shakes, pasteurized eggs in milkshakes or eggnog, protein in broths, and dextrins added to coffee. (See tips for adding protein and calories to the diet in Section 5).
- Supplemental glutamine granules with oral feeding or TF can abate glutamine depletion, promote protein synthesis, inhibit protein decomposition, improve wound healing, and reduce hospital stay (Peng et al, 2005).
- Provide adequate fluid intake: encourage intake of fruit juices (cranberry, grapefruit, prune, or orange juice) for adequate supplies of potassium. Water losses may be 10–12 times normal during first few weeks.
- Supplement diet with 5–10 times the RDA of vitamin C; 2 times the RDA of zinc sulfate; and 2–3 times the RDA of B-complex vitamins. Two times the RDA for vitamins A and D may be useful at first. Vitamins K and B_{12} may need to be given weekly; check serum levels as needed.
- For children, vitamins should be given at twice the RDA until recovery.
- Provide adequate copper (for collagen cross-linkage). Arginine (up to 2% of kilocalories) and carnitine also may be beneficial. Phosphorus should be added intravenously as potassium phosphate, enterally, or orally as Neutra-Phos.
- Essential fatty acids are included to reduce inflammation and promote wound healing. Omega-3 fatty acids help to promote a healthy balance of proteins in the body and to reduce inflammation.
- Administration of high-calorie total enteral nutrition in any highly septic phase should be avoided. Avoid large doses of linoleic acid, iron, and zinc, which can depress immunocompetence.
- Do not discontinue nutritional support because of watery diarrhea; this type of diarrhea is likely to occur for reasons other than CHO intolerance (Thakkar et al, 2005).

Common Drugs Used and Potential Side Effects

- See Table 15-10.

Herbs, Botanicals, and Supplements

- Herbs and botanical supplements should not be used without discussing with physician.
- Large amount of vitamin C supplements may be considered in severe burns because of increased requirements resulting from oxidative stress and wound healing; a 3-g dose/day may be needed to restore normal plasma ascorbate concentrations (Berger, 2009).
- Calendula may be used topically as an ointment or a tea. Gotu kola and bee resin (propolis) may also be useful. Aloe vera has some merit but should never be taken orally.
- Probiotic supplements containing *Lactobacillus acidophilus* can help restore GI and immune health.
- Vitamin E helps to promote healing; it may also be recommended for topical use. However, avoid excessive doses before any surgery.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Considering possible consequences of long-term immobilization (renal calculi, pneumonia, contractures, and pressure ulcers), increase activity as pain tolerance allows. Discuss importance of the balance between appetite, nutritional intake, and physical activity.

TABLE 15-10 Pharmacotherapy for Burns

Antimicrobial control, analgesia, sedation, and anxiety management are required for burn management. Given acutely and during rehabilitation, supportive therapy uses growth hormone, insulin and related proteins, oxandrolone, and propranolol.

Medication	Description
Anabolic steroids	Oral oxandrolone 0.1 mg/kg twice daily increases protein synthesis, lean body mass accretion, and muscle strength; improves serum visceral protein concentrations; promotes weight gain; and increases bone mineral content (Miller and Btaiche, 2008). Close monitoring of liver transaminase levels should be undertaken.
Analgesics	Pain medications may have some effect on gastrointestinal (GI) function and appetite.
Antacids	Used to prevent Curling ulcer. Cimetidine is also useful.
Antibiotic ointments	Early burn wound excision and complete coverage with autograft will reduce septic complications. Bacitracin may be used for first-degree burns, but other ointments (silver sulfadiazine, silver nitrate, mafenide, or povidone-iodine) may also be used. If Silvadene is used, nutrients may be leached out (i.e., sodium, copper, potassium, magnesium, calcium, and B-complex vitamins).
Antibiotics, oral	Oxacillin, mezlocillin, and gentamicin are used to treat infection.
Growth hormone	Growth hormones may be used to decrease the catabolic effect of burns.
Insulin	Used for stress-induced hyperglycemia.
Interferon-gamma or -alpha-2b	Used to decrease keloid formation. Dry mouth, stomatitis, nausea and vomiting, diarrhea, and abdominal pain may result.
Pain medicine	Prescription medications (acetaminophen with codeine, morphine, or meperidine) are used for severe burns.
Promotility agents (metoclopramide)	If the patient has gastroparesis or repeated high gastric residuals, a promotility agent may help increase GI transit and improve feeding tolerance.

From Miller JT, Btaiche IF. Oxandrolone in pediatric patients with severe thermal burn injury. *Ann Pharmacother*. 42:1310, 2008.

- Review the fact that fat is high in energy while low in volume. Fat is helpful in normalizing elimination; however, excesses may negatively affect immunocompetence.
- Explain that adequate intake of fiber is important.
- The family's attitude toward patient's dietary intake should be firm but understanding. A daily nutrient intake record may be a good way to track goals and to assess total intake. Discuss problems to monitor and report, such as fever or wound drainage.
- Offer a written care plan for home use.

Patient Education—Food Safety

- Educate about food safety, reducing risk of infection, and meticulous hand washing.
- Reinforce kitchen fire safety issues. Clean cooking surfaces to prevent food and grease buildup. Turn pan handles inward to avoid hot food spills. Avoid wearing loose clothing while cooking. Stay in the kitchen while cooking.
- Burn patients are more susceptible to minor illnesses, including foodborne illness. Tips include the following:
  - Separate raw meats from other raw foods such as fruits and vegetables.
  - Avoid cross-contamination from raw meats by storing and preparing raw meat so it does not come in contact with fruits, vegetables, and uncooked foods.
  - Use separate cutting boards and cooking utensils so that juices from raw meats are not allowed to contact uncooked foods.
  - Keep hot foods hot (>140°F) and cold foods cold (<40°F). Limit the amount of time that food is left at room temperature to prevent germs from growing in it.
  - Wash all fruits and vegetables with warm water and a soft bristle brush.
  - Thaw frozen meat or poultry in a refrigerator or under cold running water, not at room temperature
  - Avoid raw fish, shellfish, unpasteurized juices, and uncooked eggs (and dishes containing uncooked eggs).

For More Information

- American Burn Association
  http://www.ameriburn.org/
- Burn Care Foundation
  http://www.burnsurvivor.com/index.html
- Burn Prevention
  http://kidshealth.org/parent/firstaid_safe/sheets/burns_sheet.html
- Centers for Disease Control and Prevention (CDC) Emergency Treatment of Burns
  http://www.bt.cdc.gov/masscasualties/burns.asp
- Fire Safety
  http://www.nlm.nih.gov/medlineplus/firesafety.html
- Mayo Clinic
  http://www.mayoclinic.com/health/first-aid-burns/FA00022
- NIH—Burns
  http://www.nigms.nih.gov/Publications/Factsheet_Burns.htm
- National Library of Medicine—Burns
  http://www.nlm.nih.gov/medlineplus/burns.html

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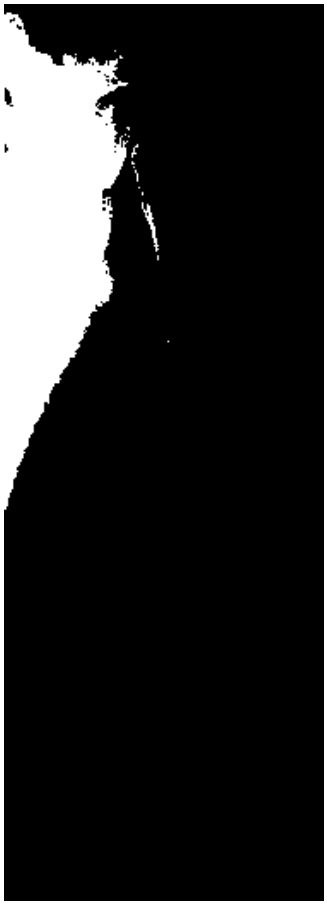
FRACTURES

NUTRITIONAL ACUITY RANKING: LEVEL 2



Adapted from: Koval KJ, MD and Zuckerman, JD, MD. *Atlas of Orthopaedic Surgery: A Multimeidal Reference.* Philadelphia: Lippincott Williams & Wilkins, 2004.

DEFINITIONS AND BACKGROUND

Stress fractures occur from prolonged stress on normal bones. Here, broken bones result from a physical force greater than stress that cannot be withstood. They are common in athletes, especially gymnasts, runners, and basketball or tennis players. *Simple (closed) fractures* involve bones that do not protrude. A *compound (open) fracture* allows bone to protrude. A *long-bone fracture* generally is an emergency and may be complicated by shock, wound infection, bleeding, or inadequate hydration; traction is used for internal immobilization. The most commonly broken bones are the collarbone (clavicle) and the bones of the wrist. In persons older than 75 years, the hip is more commonly broken.

A *complete fracture* has separated bone fragments complete, whereas they are still partially joined in an *incomplete fracture.* In *comminuted fractures,* the bones are split into multiple pieces. Orthopedic surgeons have elaborate nomenclature for the type of fracture, its location, and its geometric shape (transverse, oblique, spiral, and so on). After a break, edema of surrounding tissue causes discomfort, and muscle spasms occur to hold the bone in place.

Healing occurs in stages, starting with the *inflammation phase*; a blood clot (fracture hematoma) between the bone fragments, followed by new blood vessels with phagocytosis to remove dead tissue. Fibroblasts can then produce collagen fibers and new tissue. The second, *reparative stage* begins approximately 2 weeks after the fracture. In this stage, proteins produced by the osteoblasts and chondroblasts form new bone matrix (soft callus) from calcium hydroxyapatite crystals. This healing shows on a radiograph after approximately 4–6 weeks. The soft callus hardens forms into a hard callus over a 6- to 12-week period. In the third, *remodeling phase*, mature lamellar bone replaces the woven bone in the period of 3–18 months after the injury. Both osteoblasts and osteoclasts are involved.

Good nutrition is essential during all phases of healing. With multiple fractures, metabolic rate may increase by 20% or more for several weeks. Aggressive refeeding can decrease morbidity and mortality in malnourished patients (Bonjour, 2005).

Compression fractures involve weakened bones breaking from osteoporosis or from bone cancer. Incidence increases

after 60 years of age, especially in women. Osteoporosis is responsible for more than 1.5 million fractures annually, including more than 300,000 hip fractures; 700,000 vertebral fractures; 250,000 wrist fractures; and 300,000 fractures at other sites. Bone resorption markers at levels above the upper limit of the premenopausal range are associated with an increased risk of hip, vertebral, and nonvertebral fracture; the most sensitive markers include serum osteocalcin, bone-specific alkaline phosphatase, the N-terminal propeptide of type I collagen for bone formation, and the cross-linked C- (CTX) and N- (NTX) telopeptides of type I collagen for bone resorption (Garnero, 2008).

A *broken hip* includes fractures of the femur head (intracapsular), femur neck (extracapsular), and greater Hesser trochanter. Osteoporotic fractures lower one's quality of life. Up to 50% of women and 20% of men at the age of 50 years may have a fragility fracture in their remaining lifetimes (Earl et al, 2010). The most common risk factors for osteoporotic fracture are advanced age, low bone mineral density, and previous fracture as an adult (NAMS, 2010). Women with one hip fracture are at a fourfold greater risk of having a second one.

Maternal nutrition may have critical and far-reaching persistent consequences for offspring health; reduced maternal fat stores and low levels of circulating 25-hydroxyvitamin D in pregnancy are associated with reduced bone mass in the offspring (Earl et al, 2010). Low birth-weight and poor childhood growth are also linked to risk of hip fracture later in life (Cooper et al, 2006). Clearly, optimizing nutrition throughout life is protective. Deficiency in dietary proteins causes marked deterioration in bone mass, microarchitecture, and strength (Bonjour, 2005). Vitamin A in amounts greater than 5000 IU/day may increase the risk of hip fractures; intake should be limited to 100% RDA levels.

After hip fracture, aligning the bone through an open "reduction" with internal fixation (ORIF) may be necessary. In spinal fracture, vertebroplasty involves inserting glue (methylmethacrylate) into the center of the collapsed spinal vertebra to stabilize and strengthen the crushed bone. Here, adequate nutrition must be provided to heal and to reduce infectious processes. Sometimes the medical team uses electrical bone growth stimulation or osteostimulation to support bone recovery. Once healed, it is important to return to some level of physical activity if possible.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Bone density and family history can predict fracture risk (Cosman, 2005). Many genes are implicated. BMD candidate genes, ADAMTS18 (ADAM metallopeptidase with thrombospondin type 1 motif, 18) and TGFBR3 (transforming growth factor, beta receptor III) seem to predict bone density and risk for skeletal fracture (Xiong et al, 2009).

Clinical/History	Lab Work	
Height	Serum Ca^{++}	Prealbumin: CRP ratio
Weight (may need chair scales)	Urinary Ca^{++}	CRP
Weight changes	Mg^{++}	Gluc
BMI	BUN, Creat	WBC, TLC
Diet history	H & H	Total iron-binding capacity (TIBC)
I & O	Serum Fe	Alk phos (increased)
BP	N balance	Na^{+}, K^{+}
Temperature	Alb, transthyretin	

INTERVENTION

OBJECTIVES

- Support formation of bone matrix. Complete union may take 4–8 months.
- Supply adequate nutrition for collagen formation and calcium deposition.
- Prevent side effects of long-term immobilization, such as renal calculi, pressure ulcers, urinary tract infections, embolus, contractures, and neurovascular dysfunction.
- Use fluoridated water. Monitor bottled waters and well water, which are often not fluoridated.
- For long-bone fracture, meet energy needs, which are increased by 20–25%. Keep nearby joints as active as possible and prevent complications such as pressure ulcers, renal calculi, and effects from spinal anesthesia.

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Oral Food and Beverage Intake

Assessment Data: Diet history and intake records showing intake of <50% at most meals following hip fracture and ORIF. Weights not available at that time. Medications include morphine and heparin. Patient shows signs of depression and anorexia.

Nutrition Diagnosis (PES): NI-2.1 Inadequate oral food and beverage intake related to anorexia and depression as evidenced by food records showing <50% oral intake at most meals for past 5 days.

Intervention: Food-Nutrient Delivery—Consider use of tube feeding if oral intake continues to be low. Offer liquid nutritional supplements between meals to enhance protein and calorie intake. Educate patient and family about the importance of nutrition for healing. Counsel about ways to increase nutrient density without increasing the total amount of food consumed. Coordinate care with medical team for gradual increments of physical activity, which should help with depression and anorexia; review medications and determine whether morphine can be decreased to lessen sleepiness during the day.

Monitoring and Evaluation: Improved oral intake for total protein and calories. Gradual improvement in cognition and the ability to participate in physical activity. Decline in signs of depression.

FOOD AND NUTRITION

- Use a high-protein, high-energy diet; needs may increase as much as 20–25%.
- Use adequate levels of calcium, phosphorus, and vitamins D, C, and K. Encourage these nutrients to be taken in diet; if a supplement is used, avoid levels >100% RDA for vitamin A.
- Although the main source of dietary calcium is dairy products, calcium contained in mineral water is highly bioavailable and can provide another valuable source.
- Supply zinc for wound healing after surgical procedures.
- Prevent or correct fever, pneumonia, and possible embolism.
- Ensure adequate fluid intake to excrete calcium excesses.

Common Drugs Used and Potential Side Effects

- Pharmacological therapy can reduce the risk of fractures, but many patients take their medication incorrectly, stop it prematurely, or have malabsorption (Hamdy et al, 2010).
- Bisphosphonates (alendronate, risedronate, and ibandronate), selective estrogen-receptor modulators (raloxifene), parathyroid hormone, estrogens, and calcitonin may be necessary (NAMS, 2010). Parathyroid hormone (teriparatide) is an anabolic agent that stimulates new bone formation, repairs architectural defects, and improves bone density.
- Some drugs, such thiazolidinedione, anticonvulsants, and opioids, significantly reduce bone mineral density. Selective serotonin reuptake inhibitors may also have an undesirable effect on bone health; their use should be carefully monitored (Haney et al, 2010).
- Pain medications such as morphine or meperidine (Demerol) may cause vomiting, nausea, and constipation. When analgesics are needed, monitor for GI distress or bleeding.

Herbs, Botanicals, and Supplements

- Herbs and botanical supplements should not be used without discussing with the physician.
- Creatine supplementation, with and without resistance training, has the potential to influence bone biology; however, the longer-term effects of creatine supplementation are not known (Candow and Chilibeck, 2010).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Emphasize nutrition, especially adequate calcium, vitamin D, protein, and vitamin K (Earl et al, 2010).
- Encourage activity and the use of physical therapy after the healing has progressed. Use of oral supplements with resistance training can be very beneficial (Miller et al, 2006).
- Refer to appropriate agencies, such as home health, Visiting Nurses Association, or Meals-on-Wheels, as needed.
- All women should have a bone density test by the age of 65 years or at the time of early menopause.
- Discourage smoking. Smoking cigarettes hinders the healing of bones by decreasing collagen production and oxygen availability.
- Prevention focuses first on measures such as a balanced diet, adequate calcium and vitamin D intake, adequate exercise, smoking cessation, avoidance of excessive alcohol intake, and fall prevention (NAMS, 2010). Encourage frequent fish consumption, especially in winter, for vitamin D (Nakamura, 2006).

Patient Education—Food Safety

- Educate about basic food safety and hand washing.

For More Information

- American College of Physicians—Guidelines for Reducing Fractures
  http://www.annals.org/content/149/6/404.full
- Fracture Healing
  http://www.betterbones.com/bonefracture/speedhealing.aspx
- NIH—Medline
  http://www.nlm.nih.gov/medlineplus/ency/article/000001.htm
- Orthopedic Trauma Association
  http://www.hwbf.org/ota/bfc/
- Penn State University—Hershey Medical Center
  http://www.hmc.psu.edu/healthinfo/b/bonefracture.htm
- Web MD
  http://www.webmd.com/a-to-z-guides/understanding-fractures-basic-information
- WHO On-Line Risk Assessment Tool: FRAX
  http://www.shef.ac.uk/FRAX/

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INTESTINAL PARASITE INFECTIONS

NUTRITIONAL ACUITY RANKING: LEVEL 1

DEFINITIONS AND BACKGROUND

Intestinal parasite infections cause significant morbidity and mortality. These infections, especially from helminths and untreated water, represent major health problems that increase iron-deficiency anemia in developing countries (Alaofe et al, 2008). Protein–energy malnutrition causes immune deficiency, especially in developing countries. Newborns are especially vulnerable, where morbidity is often secondary to intestinal parasites (Steer, 2005). In addition, transmission of parasites is common in refugee or displacement camps. *Cryptosporidium parvum, Giardia lamblia, Entamoeba histolytica, Ascaris lumbricoides,* hookworm infection, *Schistosoma haematobium, S. mansoni* and *Strongyloides stercoralis* are important intestinal parasites that are common among children, the immunocompromised, and displaced populations (Gbakima et al, 2007). Infections caused by *Enterobius vermicularis, G. lamblia, Ancylostoma duodenale, Necator americanus,* and *E. histolytica* occur in the United States (see Table 15-11).

Mucin-secreting intestinal goblet cells are an important component of the innate defense system (Hasnain et al, 2010). Parasites modulate GI immunity, possibly by inhibiting migration of CD8α to the draining lymph nodes while increasing IL-6, TNF-α, and, in particular, IL-10 (Balic et al, 2009). Activation of the mucosal immune system of the GI tract results in altered intestinal physiology, which changes in intestinal motility and mucus production (Kahn and Collins, 2004). The protective immune response that develops following infection with intestinal parasites is characterized by increased numbers of $CD4^+$ T cells, granulocytes, and macrophages (Patel et al, 2009).

Toxoplasmosis is considered to be the third leading cause of death attributed to foodborne illness in the United States. More than 60 million men, women, and children in the United States carry the *Toxoplasma* parasite, but very few have symptoms because their healthy immune system usually keeps the parasite from causing illness. Washing vegetables thoroughly before eating them and cooking meat to the recommended temperatures are just a few ways to reduce risk of toxoplasmosis.

TABLE 15-11 Intestinal Parasites and Treatments

Parasite	Description and Treatment
Ancylostoma duodenale, Necator americanus (hookworms)	Cause blood loss, anemia, pica, and wasting. Finding eggs in the feces is diagnostic. Treatments include albendazole, mebendazole, pyrantel pamoate, iron supplementation, and blood transfusion. Preventive measures include wearing shoes and treating sewage.
Ascariasis (intestinal roundworms)	Common in warm or humid climates or when personal hygiene is inadequate. Adult worms live in the small intestine, with eggs that pass out in human feces. These eggs become infective within 2–3 weeks. When ingested by humans through fecally contaminated food or water, the eggs hatch and penetrate the intestines. Eventually, they reach the heart. Larvae mature within 2–3 months, and adult worms may live for 1 year or more. Hemorrhage can occur in lung tissue and cause pneumonitis. Vague abdominal discomfort can occur with small intestine involvement. Malnutrition can cause an imbalance in T-cell subpopulations that may lead to a defective T-cell maturation, thereby increasing susceptibility to parasitic infection (Di Pentima, 2009).
Enterobius vermicularis (pinworm)	Causes irritation and sleep disturbances. Diagnosis can be made using the "cellophane tape test." Treatment includes mebendazole and household sanitation.
Giardia	*Giardia intestinalis* is one of the most common intestinal parasites in the world, and it contributes to diarrhea, nutritional deficiencies, stunting, and cognitive impairment in children in developing regions (CDC, 2010). It causes nausea, vomiting, malabsorption, diarrhea, and weight loss. Stool ova and parasite studies are diagnostic. Treatment includes metronidazole. Sewage treatment, proper hand washing, and consumption of bottled water can be preventive.
Entamoeba histolytica	Can cause intestinal ulcerations, bloody diarrhea, weight loss, fever, gastrointestinal obstruction, and peritonitis. Amebas can cause abscesses in the liver that may rupture into the pleural space, peritoneum, or pericardium. Stool and serological assays, biopsy, barium studies, and liver imaging have diagnostic merit. Therapy includes luminal and tissue amebicides to attack both life-cycle stages. Metronidazole, chloroquine, and aspiration are treatments for liver abscess. Careful sanitation and use of peeled foods and bottled water are preventive.
Trichinella spiralis	*T. spiralis* is a roundworm that causes an acute infection (trichinosis) and is usually acquired by eating encysted larvae in raw or undercooked pork. Larvae mature and mate in the small intestine; larvae reaching striated muscle will encyst and live for years. Usual incubation is 5–15 days. The disorder has a 4% prevalence in the United States. Symptoms and signs include swelling of the upper eyelids, bleeding under the nails, skin rash, diarrhea, abdominal cramps, and malaise; later, low-grade fever, edema, sweating, dyspnea, cough, and muscle pain occur. In nonstriated muscle tissues such as the heart, brain, kidney, or lung, death can follow in 4–6 weeks, if untreated. Most symptoms disappear by the third month.

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CDC. Centers for Disease Control. Website accessed 10/16/10 at http://www.cdc.gov/ncidod/dpd/parasites/giardiasis/factsht_giardia.htm.

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Risks are more significant for individuals with AIDS and for pregnant women. Most intestinal protozoan infections can cause acute or chronic diarrhea in healthy individuals but may result in intractable, life-threatening illness in patients with immunosuppressive diseases such as AIDS (Escobedo et al, 2009). Vaccines or immunotherapies may be developed to treat these pathogens.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: The T-helper (Th) 2–type immune response causes infection-induced intestinal muscle hypercontractility and goblet cell hyperplasia (Kahn and Collins, 2004). The genetics of this form of immunity are under study.

Clinical/History

Height
Weight
BMI
Diet history
Temperature
I & O
BP

Lab Work

Stool examination
Positive skin and serological tests for eosinophilia and leukocytosis
Trichinosis—biopsy of skeletal muscle after fourth week (for larvae or cysts)
Alb, transthyretin
Prealbumin:CRP ratio
CRP
H & H
Serum Fe, ferritin
Transferrin
TIBC
Na^+, K^+, Cl^-
Ca^{++}, Mg^{++}
TLC, WBC
Gluc

SAMPLE NUTRITION CARE PROCESS STEPS

Altered GI Function

Assessment Data: Diet history and intake records showing normal intake of all macronutrients. History of (Hx) explosive diarrhea for the past month. Tested positive for *G. lamblia* after a camping trip where patient drank untreated water from a stream. Other family members tested negative.

Nutrition Diagnosis (PES): NC-1.4 Altered GI function related to infection with *Giardia* as evidenced by explosive diarrhea for the past month and no changes in usual dietary intake.

Intervention: Food-Nutrient Delivery—discuss options for decreasing fiber and tolerating medications while under treatment for *Giardia*. Educate patient and family about the importance of drinking only treated water while camping. Counsel about monitoring tolerance for fiber-rich foods when infection has resolved. Coordinate care with medical team for pharmacotherapy and any nutritional side effects.

Monitoring and Evaluation: Resolution of *Giardia* infection and diarrheal disease. No undesirable side effects from medications.

INTERVENTION

OBJECTIVES

- Differentiate symptoms and correctly identify condition as rapidly as possible; treat as needed.
- Treat infections and diarrhea.
- Prevent or correct malnutrition; prevent stunting and allow growth in children.
- Prevent blockage, inflammation, volvulus, and bowel perforation.
- Correct any complications such as anemia, pneumonia, and cardiac failure.
- Teach ways to prevent further infections.

FOOD AND NUTRITION

- Provide balanced intake of all macronutrients. Protein intake, especially lysine, is important. Adequate, but not excessive, iron and zinc are also useful.
- Encourage adequate intake of food sources of vitamins A and C, especially from fruits, juices, and vegetables. Vitamin E and selenium may be especially protective (Smith et al, 2005). Supplements with retinol may be used in some cases.
- Ensure an adequate fluid intake, especially with diarrheal losses. Replace electrolytes with broths and juices.
- With poor appetite, offer small, frequent meals and snacks to correct malnutrition or weight loss that is undesirable.
- Ensure safe food handling at all meals.

Common Drugs Used and Potential Side Effects

- The albendazole–praziquantel combined regimen is a useful single-dose therapy for **giardiasis** in children.
- Pyrantel pamoate (Povan) may be used for **ascariasis**. Rarely, vomiting or diarrhea may occur.
- For **trichinosis**, mebendazole or thiabendazole may be used. GI distress is a common side effect. Aspirin or analgesics may be needed for muscular pain.
- Corticosteroids such as prednisone are often used temporarily to reduce inflammation of the heart or brain.

Herbs, Botanicals, and Supplements

- Herbs and botanical supplements should not be used without discussing with the physician. Chincona, elecampane, golden seal, ipecac, and papaya are not proven through clinical trials.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the importance of personal hygiene in maintaining a sanitary environment and in preventing reinfestation.
- Children who play outside should always wash their hands before eating meals or snacks. Diarrhea caused by

parasites such as *Cryptosporidium* may be severe in malnourished or immunodeficient children; recovery is achieved only after sufficient nutritional repletion.
- Protozoa intestinal infection is still frequent in some marginalized populations; improvement in sanitation might decrease the prevalence of these diseases (Korkes et al, 2009). A mass campaign to educate about the role of sanitation in reducing intestinal parasite infection is recommended (Mehraj et al, 2008).

Patient Education—Food Safety

- Educate about food safety issues. Reducing new infection is very important. Meticulous hand washing is essential.
- Many of these parasites can be transmitted by food, water, soil, or person-to-person contact. Occasionally, helminthic roundworms, tapeworms, and flukes are transmitted in foods such as undercooked fish, crabs, and mollusks; undercooked meat; raw aquatic plants such as watercress; raw vegetables that have been contaminated by human or animal feces; and foods contaminated by food service workers with poor hygiene or working in unsanitary facilities.

For More Information

- CDC—An Ounce of Prevention
  http://www.cdc.gov/ounceofprevention/
- Index of Parasitic Diseases
  http://www.cdc.gov/ncidod/dpd/parasites/index.htm
- National Center for Emerging and Zoonotic Infectious Diseases
  http://www.cdc.gov/ncezid/index.html

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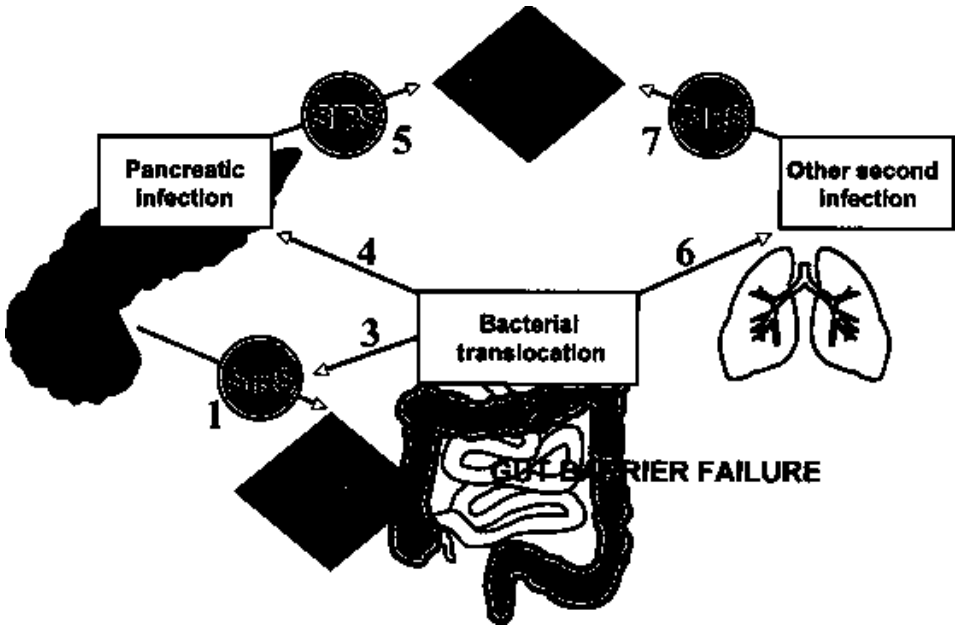
MULTIPLE ORGAN DYSFUNCTION SYNDROME

NUTRITIONAL ACUITY RANKING: LEVEL 4



Adapted from: Sherwood L. Gorbach, John G. Bartlett, et al. *Infectious Diseases.* Philadelphia: Lippincott Williams & Wilkins, 2004.

DEFINITIONS AND BACKGROUND

Multiple organ dysfunction syndrome (MODS) involves two or more systems in failure at the same time (e.g., renal, hepatic, cardiac, or respiratory). The condition is also called MOF.

Etiology may be from sepsis (gram-positive/negative bacteria, fungal or viral,) shock, hemorrhage, allergy, burns, or trauma. Conditions leading to MOF may also include unnecessary deep sedation, excessive blood glucose levels, prolonged immobilization, or corticosteroid use (de Jonge et al, 2009).

Cytokines are direct mediators. MODS is triggered by TNF-α and by a cytokine cascade with IL-6 and other ILs, platelets, endothelial cells, and leukocytes. Lactate level is often used as a prognostic indicator of problems with tissue perfusion. High baseline serum cortisol level is also a marker of severity and poor prognosis. Cortisol levels <20 g/dL in a highly stressed patient (with respiratory failure, hypotension) may diagnose adrenal insufficiency, which should be treated (Marik et al, 2005). Early aggressive resuscitation of critically ill patients limits or prevents progression to MODS.

Gut injury and impaired gut barrier function have a high impact on the development of MODS. Mucosal lesions and increased intestinal permeability cause translocation of bacteria and endotoxins and initiate a local or systemic inflammatory response syndrome (SIRS). There are sequential metabolic changes following induction of SIRS, with an elevation in REE from 4–21 days and loss of LBM. Some experts suggest use of the phrase "nutrition therapy" versus "nutrition support" to strengthen the role in attenuating this metabolic response, preventing oxidative stress, and modifying the immune response with the use of appropriate lipids, glutamine, arginine, and antioxidants. Indeed, the quality of nutrition therapy is more important than the quantity.

Specific nutrients to modify immune, inflammatory, and metabolic processes have been helpful (Heys et al, 2005). In critical illness, glutamine levels are much higher in the duodenal mucosa; glutamine supplementation may be beneficial (De-Souza and Greene, 2005). While arginine supplementation may improve outcomes, controversy continues surrounding its long-term use in septic patients. In general, immune-enhanced products do not decrease ICU length of stay or improve rates of recovery (American Dietetic Association, 2010).

Maintaining adequate tissue oxygenation and cellular nutrition are priorities. Trace elements, omega-3 fatty acids, and antioxidant nutrients, especially vitamin E and selenium, are important and may reduce mortality (Grimble, 2005; Heyland et al, 2005). Enteral nutrition provides the intestinal mucosa with nutrients, which reduces bacterial translocation and septic complications. There may be beneficial effects of immune-enhancing diets for MODS, especially after trauma or surgery. However, overall mortality remains high at 30–100%, especially if multiple organs are involved.

The treatment of MODS is complex. Treatment includes correction of ischemia through fluid resuscitation and mechanical ventilation; antibiotics; and stabilization of water, electrolyte, and acid–base imbalance. Stress hyperglycemia promotes the proinflammatory response, whereas insulin has the opposite effect; therefore, tight glycemic control is important.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: The development of techniques for measuring the expression level of all of a person's genes may make it possible to develop an injury scoring system based on the degree of gene activation related to having more infections and organ failure (Warren et al, 2009).

Clinical/History	Lab Work	
Height	Serum procalcitonin (PCT)	Lactic acid (elevated?)
Weight	BUN (often elevated)	Serum pH <7.35 (acidosis)
BMI	Creat (often elevated)	Alanine, pyruvate (retention?)
Dry weight	ALT, AST (elevated)	Serum cortisol
Weight changes	Alb, transthyretin	pCO_2, pO_2
Edema, ascites	Albumin:CRP ratio	Chol, Trig
Diet history	CRP	Glomerular filtration rate
Temperature	Na^+, K^+	TLC, WBC
I & O	Ca^{++}, Mg^{++}	H & H
BP	Cl^-	Serum Fe
Acute Physiology and Chronic Health Evaluation (APACHE)	Creatine kinase (CK)	TIBC
Injury Severity Score (ISS)	Phosphorus	Serum phosphorous
Ultrasonography	Gluc—serum, urine	Serum folate
Echocardiography	Serum insulin	Serum zinc
Electroencephalogram (EEG)		

INTERVENTION

OBJECTIVES

- Stabilize electrolyte and hemodynamic balances. Remove or control sources of organ dysfunction, such as bacterial translocation. Early identification and aggressive management of MODS is essential.
- Provide continuous administration of at least minimal enteral nutrition to prevent gut mucosa atrophy.
- In patients with a functional GI tract, enteral nutrition is preferred over parenteral nutrition (Casaer et al, 2008). Enteral or oral nutrition preserves the gut and immune system integrity.
- Support organs with appropriate substrate. "Immunonutrition" provides formulas supplemented with arginine, omega-3 fatty acids, ribonucleic acids, and glutamine; however, there is no clear evidence that these products promote faster recovery (American Dietetic Association, 2010).
- Control hyperglycemia to decrease infection and sepsis.

SAMPLE NUTRITION CARE PROCESS STEPS

Excessive Infusion of Parenteral Nutrition

Assessment Data: Patient in ICU for 3 days, on CPN with order changed Day 2 to provide CHO and lipid in excess of estimated requirements. Indirect calorimetry identifies needs as 1400 kcal/day; patient receiving 1800 kcal/day. Admitted with acute pancreatitis; now showing signs of heart and liver failure. Glucose >200 mg/dL; fever with temperature of 102° F.

Nutrition Diagnosis (PES): Excessive infusion of parenteral nutrition related to current CPN order as evidenced by solution providing 1800 kcal/day with CHO and lipid exceeding daily requirements.

Intervention: Food-Nutrient Delivery—Decrease CPN order to 1400 kcal/day; lipid calculated at 30% total calories and CHO calculated as 50% total kilocalories. Patient may benefit from jejunostomy instead of CPN because of MODS.

Coordinate care with medical team—discuss importance of not overfeeding CPN solution. Discuss merits of using jejunostomy feeding instead of parenteral feeding.

Monitoring and Evaluation: CPN order discontinued. Jejunostomy tube placed; new feeding order that meets needs of 1400 kcal and 50% CHO, 30% fat, and 20% protein with extra fluid. Glucose monitoring and use of insulin to bring levels back below 120 mg/dL. Patient tolerating jejunostomy. Fever gradually subsiding. Signs of improvement in MODS.

- Promote prompt and immediate responses to all changing parameters. Until organ dysfunction resolves, monitor weight, relevant laboratory parameters, and nutrient intake.
- Consider short- and long-term consequences of all actions (e.g., treatments must incorporate a consensus of opinions about which therapy precedes another).
- Manage complications such as anemia, gastric reflux, or delayed bowel motility.
- Promote wound healing if surgery is required. Prevent additional sepsis.
- Promote recovery and improved well-being.

FOOD AND NUTRITION

- If there is gastric reflux or delayed bowel motility, a nasoduodenal or jejunal feeding tube or feeding jejunostomy is required. Ensure that the formula is appropriate.
- The recommended energy intake is 20–30 kcal/kg/day with a protein intake of 1.2–1.5 g/kg/day (Casaer et al, 2008). Evaluate organ function and provide a correctly calculated feeding and product for patient's diagnosis and condition.
- Immunoenhanced or glutamine-enriched products used to preserve gut integrity do not necessarily speed rates of recovery or reduce time in ICUs (American Dietetic Association, 2010).
- Review current vitamin and mineral intakes; adjust according to changing needs. Antioxidants may play a role in supporting recovery.
- Avoid excesses of iron, zinc, polyunsaturated fatty acids (PUFAs), and linoleic acid—especially parenterally—because of their effects on the immune system.
- When possible, return to oral feeding to acquire the benefits of phytochemicals from whole foods.
- Patients requiring ventilator support may need a higher lipid content in their feeding, even with cardiac failure.

Common Drugs Used and Potential Side Effects

- Hypertonic saline solution is commonly used.
- Anti-inflammatory treatment is vital for intervention in severe infectious disease.
- All medications should be reviewed for potential drug–nutrient incompatibility and stability with formulas. Try to avoid inclusion of medications with EN products because of drug–nutrient interactions and because drugs may then be less available to the patient.
- Drug metabolism with the liver cytochrome P-450 (CYP450) system can result in drug toxicities, reduced pharmacological effect, and adverse drug reactions. Foods such as grapefruit, alcoholic beverages, teas, and herbs may inhibit or induce the activity of CYP3A4 (Flanagan, 2005).
- Review all vitamin and mineral supplements and enteral products to determine whether the potential of hypervitaminosis and mineral toxicities exists.
- Insulin may be required because of the hyperglycemia that occurs with stress.
- With continuous seizures, lorazepam or anticonvulsants may be needed. Weight and appetite changes are common if used long term.

Herbs, Botanicals, and Supplements

- Herbs and botanical supplements should not be used without discussing with the physician. Herbs often possess the ability to inhibit or induce the activity of CYP3A4.
- Chinese herbs for reducing inflammatory reaction are being studied.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- When possible, discuss implications of MODS in relation to nutritional support. Include a realistic assessment of potential for recovery and use of EN in the home setting, as discussed with the physician.
- Family should be included in discussions about nutritional support measures that are taken. As appropriate, prepare patient and family for home nutritional needs and total parenteral nutrition/EN/oral diet requirements.
- Alleviate fears associated with eating or nutritional support therapies.
- Discuss any signs or problems that should require professional intervention.

Patient Education—Food Safety

- Educate about food safety issues. Reducing more infection is very important.

- Meticulous hand washing is essential because immunocompromised individuals are more susceptible to minor illnesses, including foodborne illness.

For More Information

- eMedicine—MODS
  http://emedicine.medscape.com/article/169640-overview
- Merck—Shock
  http://www.merck.com/mmpe/sec06/ch067/ch067b.html

MULTIPLE ORGAN DYSFUNCTION SYNDROME—CITED REFERENCES

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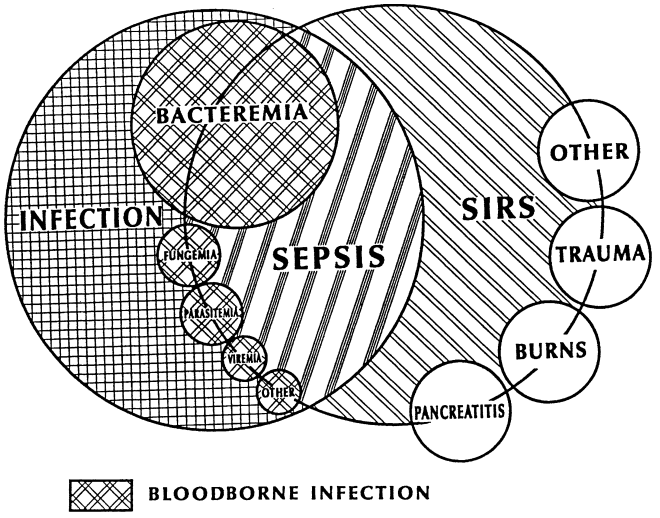
SEPSIS AND SYSTEMIC INFLAMMATORY RESPONSE SYNDROME

NUTRITIONAL ACUITY RANKING: LEVEL 4



Adapted from: Sherwood L. Gorbach, John G. Bartlett, et al. *Infectious Diseases.* Philadelphia: Lippincott Williams & Wilkins, 2004.

DEFINITIONS AND BACKGROUND

Sepsis involves a SIRS, with infection that has spread to other areas from its original site. Similar to the stress response, the inflammatory reaction is crucial for survival and is meant to be tailored to the stimulus and time (Elenkov et al, 2005). Sepsis may be a complication of vascular access devices or intravenous catheters and may be bacterial or fungal in origin. The most common sources of infection are lung and abdominal infections (Russell, 2008). The stages of sepsis are listed in Table 15-12.

Natural killer cells are a crucial component of the innate immune response to various viruses, fungi, parasites, and bacteria (Fauci et al, 2005). Systemic inflammation stimulates an acute-phase reaction and the stress response, mediated by the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system (Elenkov et al, 2005). GI tract dysmotility increases permeability of intestinal mucosa and bacterial translocation, contributing to sepsis and MODS (Ukleja, 2010). Synergistic effects of TNF-α, IL-1β, other cytokines, and nitric oxide are also implicated. In SIRS, reduced TNF production occurs; this is immunosuppression rather than an excessive inflammatory response (Cavaillon et al, 2005).

In sepsis, activated phagocytes release leukocytic endogenous mediators; hepatic uptake of amino acids and increased prostaglandin synthesis occur. Hormonal responses include increases in adrenocorticotropic hormone (ACTH), aldosterone, and catecholamines (with increased gluconeogenesis, glycolysis, proteolysis, and lipolysis). Decreased triiodothyronine (T3) cause tissue degradation and mobilized triglycerides.

Host defense peptides modulate inflammation (Bowdish and Hancock, 2005). While albumin, transthyretin, and transferrin have a transport role in the body, acute-phase proteins (CRP, α-acid glycoprotein, and α-trypsin) help with host defense. These parameters drop in sepsis independent of nutritional status; monitor all protein levels as markers of inflammation in this population.

Vitamin D_3 plays a role in immune activation of endothelial cells during gram-negative bacterial infections (Equils et al, 2006). It may enhance the innate immune response by induction of cathelicidin (LL-37), an endogenous antimicrobial peptide produced by macrophages and neutrophils (Jeng et al, 2009).

Enteral feeding is preferred over parenteral feeding, where catheter infection is a risk. A key issue in providing nutrition to critically ill patients is intolerance of enteral feeding as a result of impaired GI motility (Ukleja, 2010). Overfeeding sometimes increases sepsis.

TABLE 15-12 Stages of Sepsis

Definitions of the various stages of sepsis can be summarized as follows:

- Infection is a microbial phenomenon in which an inflammatory response to the presence of microorganisms or the invasion of normally sterile host tissue by these organisms is characteristic.
- Bacteremia is the presence of viable bacteria in the blood.
- Systemic inflammatory response syndrome (SIRS) may follow a variety of clinical insults, including infection, pancreatitis, ischemia, multiple trauma, tissue injury, hemorrhagic shock, or immune-mediated organ injury.
- Sepsis is a systemic response to infection. This is identical to SIRS, except that it must result from infection.
- Septic shock is sepsis with hypotension (systolic blood pressure <90 mm Hg or a reduction of 40 mm Hg from baseline) despite adequate fluid resuscitation. Concomitant organ dysfunction or perfusion abnormalities (e.g., lactic acidosis, oliguria, coma) are present in the absence of other known causes.
- Multiple organ dysfunction syndrome (MODS) is the presence of altered organ function in a patient who is acutely ill such that homeostasis cannot be maintained without intervention. Primary MODS is the direct result of a well-defined insult in which organ dysfunction occurs early and can be directly attributable to the insult itself. Secondary MODS develops as a consequence of a host response and is identified within the context of SIRS. The inflammatory response of the body to toxins and other components of microorganisms causes the clinical manifestations of sepsis.

Sepsis syndrome is recognized clinically by the presence of two or more of the following:

- Temperature >38°C or <36°C
- Heart rate >90 beats/min
- Respiratory rate >20 breaths/min or partial pressure of carbon dioxide in arterial gas <32 mm Hg
- White blood cell count >12,000 cells/μL, <4000 cells/μL, or >10% band forms

Adapted from: American College of Chest Physicians/Society of Critical Care Medicine Consensus Panel guidelines. Web site accessed February 11, 2010 at http://chestjournal.chestpubs.org/content/101/6/1644.abstract.

Management of septic shock requires an ABCDEF approach: Airway, Breathing, Circulation, Drugs, Evaluate, and Fix the source of sepsis (Russell, 2008). Improvements in the management of sepsis and MODS have resulted from improvements in critical care practices (Sullivan et al, 2005). Yet, the incidence of septic shock is increasing; mortality ranges from 30% to 70% (Russell, 2008). Severe sepsis leading to shock is still a common cause of death in critically ill patients.

Sepsis may involve the bloodstream from gram-negative or gram-positive bacteria. Diseases caused by group A *Streptococcus* include acute rheumatic fever, rheumatic heart disease, poststreptococcal glomerulonephritis, and invasive infections. Pathogenic *Escherichia coli* causes infections such as urinary tract infection and meningitis, which are prevalent (Kim et al, 2005). *Yersinia enterocolitis* can cause bacteremia or abdominal abscess, especially in states of iron overload. Neonatal sepsis is a major cause of death, especially in low birth-weight infants. In addition, while sepsis during pregnancy is uncommon, it is potentially fatal (Fernandez-Perez et al, 2005). In the elderly, poor immune response and poor functional status may be indicators of sepsis (Gavazzi et al, 2005).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

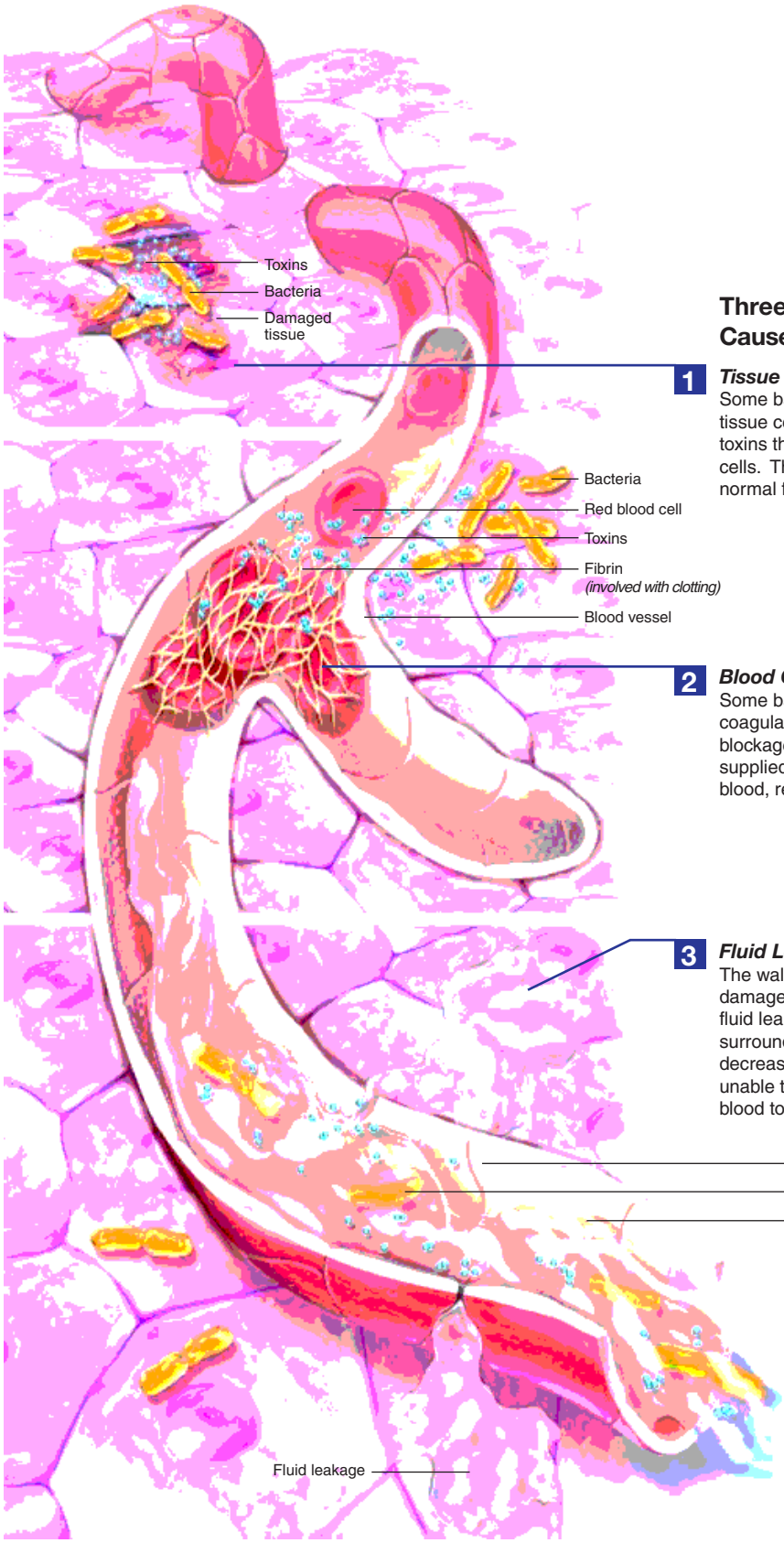
Genetic Markers: The genetics involved with various inflammatory responses to sepsis are being studied. A variety of polymorphisms may play a role in sepsis.

Clinical/History	Lab Work	
Height	Elevated WBC	Plasma lactate
Weight	Alb, transthyretin	Transferrin
BMI	Albumin: CRP ratio	Trig (increased)
Diet history	CRP	AST (increased)
I & O	Chol (decreased)	BUN, Creat
BP (hypotension?)	pO_2, pCO_2	Urinary urea nitrogen
Fever, chills	Gluc (altered)	Na^+, K^+
Fatigue, malaise	Decreased glucose tolerance?	Ca^{++}, Mg^{++}
Decreased urine output	Glucagon (increased)	Cl^-
Skin rash?	Serum insulin	H & H
Mild confusion	Plasma 25(OH)D—low?	Serum Fe
Catabolism of lean body mass		N balance
Tachycardia		T3 (decreased)
		5-Hydroxyindole acetic acid (5-HIAA) (increased)
		Phosphate (decreased)
		Osmolality

INTERVENTION

OBJECTIVES

- Prevent septic shock with increased cardiac output, tachycardia, low blood pressure, decreased renal output, and warm flushed skin. Support medical, goal-directed resuscitation of the septic patient and use of broad-spectrum antibiotic therapy within 1 hour of diagnosis of septic shock (Dellenger et al, 2008).
- Support the body's antimicrobial defense system and keep the environment as germ free as possible to prevent MODS. Use strict guidelines and protocols for insertion, care, and maintenance of any catheters and feeding tubes.
- Meet increased energy needs. Mild infection elevates resting energy expenditure between 15% and 40%; sepsis increases it by 40–70% and doubles nitrogen losses. Use indirect calorimetry whenever possible, and do not overfeed.



Three Ways Bacteria Cause Damage

Tissue Damage
Some bacteria may adhere to and invade tissue cells. Other bacteria may produce toxins that alter the chemical reactions in cells. This results in a disruption in the cells' normal function or causes the cell to die.

Blood Clots *(intravascular coagulation)*
Some bacterial toxins may cause blood to coagulate *(clot)* in small vessels, forming blockages. The tissue cells normally supplied by these vessels are deprived of blood, resulting in tissue damage.

Fluid Leakage from Vessel
The walls of small blood vessels may be damaged by bacterial toxins. This leads to fluid leakage from the vessel into the surrounding tissue. The fluid loss results in decreases blood pressure, and the heart is unable to pump an adequate amount of blood to the vital organs.

Asset provided by Anatomical Chart Co.

SAMPLE NUTRITION CARE PROCESS STEPS

Increased Nutrient Needs

Assessment Data: Nursing home resident with urosepsis; fever with temperature 101°F; albumin 2.4 g/dL; requires feeding assistance; hip replacement surgery 1 month ago.

Nutrition Diagnosis (PES): NI 5.1 Increased nutrient needs for protein related to urosepsis and recent surgery as evidenced by albumin 2.4 g/dL and intake <50% of dairy-meat items at meals.

Intervention

Food-Nutrient Delivery—ND 3.1.1 Commercial high-protein beverage

Education E 2.1 Adding protein powder, 30 mL BID for increased protein

Counseling C2.2 Goal setting—meet protein needs daily (1.5 g/kg)

Coordination of Care RC 1.1 Team meeting—nursing to focus on better intake of dairy and meat items on trays.

Monitoring and Evaluation: Improved oral intake of protein sources from dairy products, meat group choices, and protein powder; 75–100% at meals. Meeting daily protein needs of 1.5 g/kg. Resolution of urosepsis. Wound healing continues.

- Promote tissue repair and wound healing. Protein turnover is often 30–50% higher than normal.
- Treat nausea, vomiting, and anorexia.
- Prevent or treat metabolic derangements such as hyperglycemia, glycosuria, hyperosmolar/nonketotic coma, electrolyte abnormalities (e.g., decreased potassium, decreased phosphate, elevated chloride), osmotic diarrhea, and fluid overload. Glycemic control, targeting a blood glucose <150 mg/dL after initial stabilization (Dellenger et al, 2008).
- Correct anemia, which prevents tissue oxygenation. Target a hemoglobin level of 7–9 g/dL (Dellenger et al, 2008). Prevent or manage stress ulcers and upper GI bleeding.

FOOD AND NUTRITION

- Protein should be provided in levels of 1.5–2.0 g/kg daily. Branched-chain amino acids (BCAAs) are useful for energy because they do not need to be metabolized to glucose.
- Provide calories at 30–35 kcal/kg. Monitor daily actual intake.
- Enteral nutrition should be initiated within 48 hours of injury or admission and average intake actually delivered within the first week should be **at least** 60–70% of total estimated energy requirements as determined by patient assessment (American Dietetic Association, 2010).
- When patient can eat, soft diet and liquids of high nutrient and energy value are beneficial.
- Vitamins A, C, D, K, thiamin, and folic acid may become depleted with infection. Urinary excretion of phosphorus, potassium, magnesium, zinc, and chromium also occur; monitor for signs of malnutrition. Replace in feedings or diet as appropriate.
- Include omega-3 fatty acids (Babcock et al, 2005). Inclusion of fish oil in parenteral nutrition provided to septic ICU patients increases plasma eicosapentaenoic acid, modifies inflammatory cytokine concentrations, improves gas exchange, and shortens the length of hospital stay (Barbosa et al, 2010).
- Monitor fluid requirements and intake carefully to excrete wastes properly.
- If tube feeding is needed, there are no benefits for using immune-enhancing formulas (American Dietetic Association, 2010).

Common Drugs Used and Potential Side Effects

- Antibiotics are used for bacterial sepsis; monitor for side effects and GI distress.
- Activated protein C, a vitamin K–dependent serine protease, is an anticoagulant that is also cytoprotective and has anti-inflammatory role for use in septic shock (Russell, 2008).
- Antiseptic-impregnated catheters, such as those with minocycline–rifampicin or chlorhexidine/silver sulfadiazine, may be needed to reduce catheter-related sepsis.
- Insulin may be needed for hyperglycemia; glucose control is important.
- Iron and zinc are bacterial nutrients; omit them in CPN solutions in septic patients.
- Prevent upper GI bleeding by using H2 blockers or proton pump inhibitors (Dellenger et al, 2008).
- Steroids may be used. Greater nitrogen depletion and hyperglycemia, sodium retention, and potassium losses can occur. Monitor carefully. Corticosteroid therapy induces potentially detrimental hyperglycemia in septic shock (COIITSS Study Investigators, 2010).

Herbs, Botanicals, and Supplements

- Herbs and botanical supplements should not be used without discussing with physician.
- Optimal vitamin D is important for innate immunity in the setting of sepsis (Jeng et al, 2009).
- Fish oil may play an important role in reducing the hospital length of stay in septic patients (Barbosa et al, 2010).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Use of aseptic techniques for feedings and meals will be essential.
- Need for a well-managed convalescence and gradual refeeding process will be needed to support patient's resistance and immunity. Terminate the cycle of infection, malnutrition, reinfection, and further protein–energy malnutrition.

Patient Education—Food Safety

- Educate about food safety issues. Reducing infections is very important.

- Meticulous hand washing is essential; immunocompromised individuals are more susceptible to minor illnesses, including foodborne illness.

For More Information

- JAMA—Sepsis Page
  http://jama.ama-assn.org/cgi/reprint/301/23/2516.pdf
- MEDLINE—Sepsis
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SEPSIS AND SYSTEMIC INFLAMMATORY RESPONSE—CITED REFERENCES

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TRAUMA

NUTRITIONAL ACUITY RANKING: LEVEL 3

DEFINITIONS AND BACKGROUND

Physical trauma is caused by major injury or accidents; 50% are from traffic accidents. Trauma is the third leading cause of death and the number one killer of people younger than 45 years (Compton and Rhee, 2005). Multiple traumas involve at least two injuries. Long-bone fractures, pelvic or vertebral fractures, and damage to body cavities (head, thorax, or abdomen) generally are involved. The first assessment by emergency medical technicians involves airway, breathing, and circulation (A-B-C), followed by disability and exposure (D-E). For a neurological disability evaluation, clinicians use the Glasgow Coma Scale (GCS) to determine the level of consciousness; see Table 15-13.

Metabolic changes may include increased oxygen consumption and energy expenditure; increased secretion of ACTH, cortisol, epinephrine, norepinephrine, insulin, and growth hormone; and decreased total T3 levels (Jakob and Stanga, 2010). Reperfusion injury, a potential life-threatening disorder, is an acute inflammatory response after periods of ischemia resulting from trauma (Zhang et al, 2006). The heart and brain are the organs most affected.

The first 60 minutes, or the "golden hour" after trauma, may involve early deaths from severe brain or spinal cord injuries. Days later, death may occur from subdural or epidural hematoma. Late deaths may occur after several weeks. Therefore, nutritional support is an integral part of the management of trauma victims. Skeletal muscle is a major protein source for catabolism; BCAAs are cannibalized (Laviano et al, 2005). Nitrogen excretion increases after injury, peaks after 7 days, and eventually stabilizes. Insulin has been shown to increase synthesis and decrease degradation of skeletal muscle protein when amino acids are provided intravenously. Malnutrition caused by hypercatabolism and hypermetabolism parallels the severity of illness (Wooley et al, 2005).

Trauma is best managed by emergency department or critical care teams. Most countries have adopted measures known as Advanced Trauma Life Support (ATLS). In this process, teams address the most life-threatening issues first.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Trauma is not genetic in origin, but individuals respond to trauma while using their innate and acquired immune systems accordingly.

Clinical/History

Height
Weight before trauma
Weight after trauma
Percentage weight change
Resting energy expenditure (indirect calorimetry)
BMI
Diet history
Temperature
I & O
BP
ISS
GCS
Respiratory rate
Arteriography
Radiographs, computed tomography

Lab Work

Alb, transthyretin (monitor fluid levels)
Albumin:CRP ratio
CRP
Na^+, K^+
Ca^{++}, Mg^{++}
Cl^-
H & H
Serum Fe
TLC
WBC
Serum lactate
Chol, Trig
Phosphorus
BUN, Creat
Gluc (increased?)
Creatine phosphokinase (increased)
pCO_2, pO_2
Bilirubin, AST (increased)
Serum amino acids
N balance

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Oral Food and Beverage Intake

Assessment Data: Car accident victim; closed head injury and comatose. Indirect calorimetry measures REE at 1800 kcal.

Nutrition Diagnosis (PES): Inadequate oral food and beverage intake related to inability to eat orally as evidenced by comatose state and ventilator dependency.

Intervention: Food-Nutrient Delivery—Initiate enteral tube feeding at slow rate, gradually increasing to meet needs of 1800 kcal/24 hours. Avoid overfeeding and monitor hydration status carefully.

Coordinate care with medical team to follow progress.

Monitoring and Evaluation: Tube feeding tolerance: glucose, BUN, other lab values; hydration without excess.

INTERVENTION

OBJECTIVES

- Assess and monitor extent of injury and resulting problems. Restore hemodynamic and metabolic functions and acid–base and fluid balance.
- Prevent infection, respiratory failure, shock, sepsis, and reperfusion injury.
- Determine GI function; provide nutrients in the most effective mode. Use the gut if possible. Enteral nutrition is more efficacious and poses lower risks than parenteral nutrition; it reduces infection rates and shortens hospital length of stay (American Dietetic Association, 2010).
- Decrease nitrogen losses; promote nitrogen balance. Glutamine and arginine may be indicated.
- Meet elevated energy requirements (up by 20–45%). Spare proteins and LBM.
- Prevent overfeeding with respiratory distress from increased carbon dioxide production.
- Determine and monitor fluid requirements and balance. Do not overhydrate; persistent positive fluid balance in older surgical patients prolongs mechanical ventilation (Epstein and Peerless, 2006).
- Promote healing and rapid recovery.

TABLE 15-13 Glasgow Coma Scale (GCS)

The GCS is a neurological scale for recording the conscious state of a person, for initial and subsequent assessments. A patient is assessed against the criteria of the scale, and the resulting points give patient a score between 3 (indicating deep unconsciousness) and either 14 (original scale) or 15 (the more widely used modified or revised scale). The scale comprises three tests: eye, verbal, and motor responses. The three values are considered separately, as well as their sum. The lowest possible GCS score (the sum) is 3 (deep coma or death), whereas the highest score is 15 (fully awake person). The lower the score, the worse the prognosis.

Key: Severe, with GCS ≤ 8
Moderate, GCS 9–2
Minor, GCS ≥ 13

	Glasgow Coma Scale					
	1	2	3	4	5	6
Eyes	Does not open eyes	Opens eyes in response to painful stimuli	Opens eyes in response to voice	Opens eyes spontaneously	N/A	N/A
Verbal	Makes no sounds	Incomprehensible sounds	Utters inappropriate words	Confused, disoriented	Oriented, converses normally	N/A
Motor	Makes no movements	Extension to painful stimuli (decerebrate response)	Abnormal flexion to painful stimuli (decorticate response)	Flexion/withdrawal to painful stimuli	Localizes painful stimuli	Obeys commands

From Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet*. 2:81, 1974.

- Treat ileus, fistula, glucose abnormalities, and other complications such as venous thromboembolism (VTE). VTE causes major morbidity in adults after trauma and occurs in up to 50% of patients without prophylaxis (Hanson et al, 2010).
- Promote rehabilitation.
- Correct anorexia and depression; improve the quality of life.

FOOD AND NUTRITION

- **Day 1: Immediately**—Intravenous feedings are given for fluid resuscitation for approximately 24 hours until stable. Life support measures and careful monitoring are required.
- **Days 2–5: Transition Phase**—Assess changing status. Implement nutrition by the most effective means, dictated by injury location and extent. Controversy exists regarding the optimal nutrition regimen; therefore, individualize for each patient (Thompson and Fuhrman, 2005). When goals are not achieved enterally, early PN use may be associated with a greater risk of nosocomial infection and worse clinical outcomes (Sena et al, 2008). Initiation of enteral feedings within 24–48 hours of injury or admission to ICU generally reduces infectious complications (Kattelmann et al, 2006). Feed patients in the semirecumbent rather than supine position to reduce aspiration pneumonia and formula reflux (Kattelmann et al, 2006). Provide adequate energy and nutrients: 35–45 kcal/kg and 1.5–2 g protein/kg. Advance feeding rate over several days; gastrostomy may be useful in head/neck trauma. Actual delivery of 14–18 kcal/kg/day or 60–70% of goal is associated with improved outcomes, whereas greater intake may not be beneficial (Kattelmann et al, 2006). Blue food coloring should not be used to detect aspiration with enteral feedings (American Dietetic Association, 2010).
- **Days 5–10: Adaptive Phase**—Use products with glutamine, arginine, and high percentage of BCAAs; include lipids. Osmolarity should be monitored to be close to 300 mOsm. In general, 25 kcal/kg/d is an acceptable and achievable target intake, but patients with trauma may require almost twice as much energy during the acute phase of their illness. Provide 1.5–2 g protein/kg. CHOs should be given as 5 mg/kg/min. A diet providing 50% CHO, 15% protein, and 35% fat should be adequate. A slight increase in vitamin–mineral intake should be addressed, with vitamins A, B-complex, and C in particular. Avoid large doses of iron and zinc.
- **Day 11 Onward: Rehabilitative Phase**—Patient can be weaned to oral diet, if possible, and off the ventilator support. Liquid to regular diets are usually tolerated at this time.

Common Drugs Used and Potential Side Effects

- Albumin therapy is considered for trauma, hypovolemia, shock, hypoalbuminemia, and volume resuscitation (Mendez et al, 2005).
- Analgesics may have an effect on nutritional status. Evaluate individually. Lidocaine can be used to alleviate neuropathic pain.
- Antibiotics generally are used to reduce bacterial infection. Monitor for GI distress and side effects.
- Barbiturates, used for closed head injury, will decrease metabolic rate.
- Intensive insulin therapy and the use of a continuous glucose sensor may be used for hyperglycemia (Mraovic, 2009).
- Promotility agents may reduce gastric residual volume in tube-fed patients (Kattelmann et al, 2006).

Herbs, Botanicals, and Supplements

- Herbs and botanical supplements should not be used without discussing with the physician.
- Capsaicin and resveratrol have been used for some patients to decrease inflammation after trauma.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Need for specific nutrients should be discussed, according to the mode tolerated.
- Rehabilitation should progress according to individual requirements and injury sites, side effects, and complications.

Patient Education—Food Safety

- Educate about food safety issues. Reducing infections is very important. Meticulous hand washing is essential because immunocompromised individuals are more susceptible to minor illnesses, including foodborne illness.

For More Information

- Medscape—Trauma
  http://emedicine.medscape.com/trauma
- Trauma
  http://www.trauma.org/

TRAUMA—CITED REFERENCES

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