Pulmonary Disorders

CHIEF ASSESSMENT FACTORS

- Altered Respirations
- Anorexia
- Blood Gases: Partial Pressure of Oxygen (pO₂); Partial Pressure of Carbon Dioxide (pCO₂)
- Clubbing of Nail Beds
- Confusion, Somnolence
- Cough, Especially with Chest Pain
- Cyanosis of Lips, Nail Beds
- Dizziness
- Elevated Blood Pressure (BP)
- Engorged Eye Veins
- Fever or Chills
- Flaring Nostrils; Red, Swollen Nose
- Hemoptysis (Coughing Up Blood)
- Hoarseness
- Orthopnea, Tachypnea
- Pain (Chest, Abdominal)
- Pallor; Ashen or Gray Coloring
- Poor Exercise or Activity Tolerance
- Rapid Breathing, Excessive Perspiration
- Restlessness, Irritability
- Shortness of Breath (Dyspnea)
- Stridor (Crowing Sound on Inhalation)
- Wheezing (Whistling, Musical Sound from Obstructed Airways)
resveratrol, in apples, onions, oranges, berries, and red wine support lung health (Arts and Hollman, 2005; Donnelly et al, 2004; Neuhouser, 2004). Vitamin D helps to maintain healthy lung function (Wright, 2005b). Vitamin E helps to stave off upper respiratory infections; 200 IU daily gives better response to vaccines for diseases such as flu, ear infections, pneumonia, bronchitis, sinusitis, and other pathological conditions (Meydani et al, 2004). Almonds, mango, sunflower seeds, vegetable oils, and whole grains are good sources.

Table 5-1 lists factors that contribute to malnutrition with pulmonary disease.

Omega-3 fatty acids can calm inflamed airways; include salmon, respiratory quotients (RQs) tuna, mackerel, walnuts, and flaxseed oil more often. Table 5-2 lists the RQs for fats, protein, and carbohydrates (CHO). In general, it is assumed that fats decrease CO₂ output more than CHO.

**TABLE 5-1 Causes of Malnutrition in Patients with Pulmonary Disease**

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerophagia and rapid breathing</td>
</tr>
<tr>
<td>Anemia (low oxygen-carrying capacity)</td>
</tr>
<tr>
<td>Anorexia of chronic illness</td>
</tr>
<tr>
<td>Cellular hypoxia</td>
</tr>
<tr>
<td>Chronic debility</td>
</tr>
<tr>
<td>Decreased lung immunity</td>
</tr>
<tr>
<td>Decreased lung surfactant and elasticity</td>
</tr>
<tr>
<td>Depression, anxiety with anorexia</td>
</tr>
<tr>
<td>Difficulty in eating with continuous dyspnea</td>
</tr>
<tr>
<td>Fever</td>
</tr>
<tr>
<td>Gastric hypomotility</td>
</tr>
<tr>
<td>Hypermetabolism, as in chronic obstructive pulmonary disease (COPD)</td>
</tr>
<tr>
<td>Increased mechanical work of breathing</td>
</tr>
<tr>
<td>Increased workload of the heart</td>
</tr>
<tr>
<td>Inflammation</td>
</tr>
<tr>
<td>Lung cancer</td>
</tr>
<tr>
<td>Malabsorption, as in cystic fibrosis</td>
</tr>
<tr>
<td>Medications causing nausea and anorexia</td>
</tr>
<tr>
<td>Pneumonia</td>
</tr>
<tr>
<td>Polypharmacy</td>
</tr>
<tr>
<td>Poor respiratory muscle strength and endurance</td>
</tr>
<tr>
<td>Restricted diet</td>
</tr>
<tr>
<td>Right-sided heart failure</td>
</tr>
<tr>
<td>Vitamin deficiency, leading to poor epithelial integrity and weak lung muscles</td>
</tr>
</tbody>
</table>

**TABLE 5-2 Respiratory Quotient (RQ) and Nutrients**

<table>
<thead>
<tr>
<th>RQ</th>
<th>Nutrient</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>RQ from fat</td>
</tr>
<tr>
<td>0.8</td>
<td>RQ from protein</td>
</tr>
<tr>
<td>1.0</td>
<td>RQ from carbohydrates (CHO)</td>
</tr>
</tbody>
</table>

Pulmonary surfactant is a complex and highly active material composed of lipids and proteins that is found in the fluid lining the alveolar surface of the lungs. It protects the lungs from injuries and infections caused by inhaled particles and micro-organisms (Wright, 2005a). The role for surfactant was first studied in premature infants with respiratory distress syndrome (RDS), which is now routinely treated with an exogenous replacement (Stevens et al, 2004). Biochemical surfactant abnormalities have been described in asthma, bronchiolitis, chronic obstructive pulmonary disease, lung transplantation; infectious and suppurative lung diseases (cystic fibrosis [CF], pneumonia;) adult RDS, pulmonary edema, chronic lung disease of prematurity, interstitial lung diseases. Surfactant replacement therapy has been tested with positive outcomes. In acute respiratory syndrome, exogenous surfactant does not improve survival, but patients who received surfactant had a greater improvement in gas exchange during 24-hour treatment (Spragg et al, 2004).

The evidence for the role of diet in pulmonary disease is clear: Intake of fruit, fish, antioxidant vitamins, fatty acids, sodium or magnesium, helps to alleviate symptoms of asthma and Chronic obstructive pulmonary disease. Because antioxidant nutrients are positively corrected with lung function, vitamin C, vitamin E, beta-carotene, and selenium are important. Flavonoids, such as quercetin and

**TABLE 5-1 Causes of Malnutrition in Patients with Pulmonary Disease**

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerophagia and rapid breathing</td>
</tr>
<tr>
<td>Anemia (low oxygen-carrying capacity)</td>
</tr>
<tr>
<td>Anorexia of chronic illness</td>
</tr>
<tr>
<td>Cellular hypoxia</td>
</tr>
<tr>
<td>Chronic debility</td>
</tr>
<tr>
<td>Decreased lung immunity</td>
</tr>
<tr>
<td>Decreased lung surfactant and elasticity</td>
</tr>
<tr>
<td>Depression, anxiety with anorexia</td>
</tr>
<tr>
<td>Difficulty in eating with continuous dyspnea</td>
</tr>
<tr>
<td>Fever</td>
</tr>
<tr>
<td>Gastric hypomotility</td>
</tr>
<tr>
<td>Hypermetabolism, as in chronic obstructive pulmonary disease (COPD)</td>
</tr>
<tr>
<td>Increased mechanical work of breathing</td>
</tr>
<tr>
<td>Increased workload of the heart</td>
</tr>
<tr>
<td>Inflammation</td>
</tr>
<tr>
<td>Lung cancer</td>
</tr>
<tr>
<td>Malabsorption, as in cystic fibrosis</td>
</tr>
<tr>
<td>Medications causing nausea and anorexia</td>
</tr>
<tr>
<td>Pneumonia</td>
</tr>
<tr>
<td>Polypharmacy</td>
</tr>
<tr>
<td>Poor respiratory muscle strength and endurance</td>
</tr>
<tr>
<td>Restricted diet</td>
</tr>
<tr>
<td>Right-sided heart failure</td>
</tr>
<tr>
<td>Vitamin deficiency, leading to poor epithelial integrity and weak lung muscles</td>
</tr>
</tbody>
</table>

**NOTE. Death in patients with COPD is typically due to acute respiratory failure, pneumonia, lung cancer, cardiac disease, or pulmonary embolism.**

ASTHMA

NUTRITIONAL ACUITY RANKING: LEVEL 1

Between 10 and 15 million Americans are affected by asthma, including about 5% of children. Asthma seems to be inherited in two thirds of cases. Two main types of bronchial asthma are recognized: allergic (extrinsic) and nonallergic (intrinsic or infectious). Exercise-induced bronchospasm is much less common.

Children who are exposed to second-hand smoke may have chronic cough or symptoms of asthma. Chronic poor control can lead to a serious condition, status asthmaticus, which generally requires hospitalization and can be life threatening. Brittle asthma is a rare form of asthma with repeated attacks; food intolerance is common. Many infants with wheezing have transient conditions that resolve. The common cold virus and rhinovirus (RV) are major triggers; this pattern continues for adults with allergic asthma (Tan, 2005).

Breastfeeding provides immunological protection when the infant's immune system is immature and a modest protective effect against wheeze in early childhood (Kim et al, 2009; Oddy et al, 2004). Longer duration of breastfeeding seems to be more protective. Supplementation of maternal diet with fish oil is associated with altered neonatal immune responses to allergens (Devereux, 2009). Reduced maternal

DEFINITIONS AND BACKGROUND

Bronchial asthma involves paroxysmal dyspnea accompanied by wheezing and is caused by spasm of the bronchial tubes or swelling of their mucous membranes. Bronchial asthma differs from wheezing caused by cardiac failure (cardiac asthma), in which an x-ray shows fluid in the lung. Asthma involves inflammation of the lining of the airways, obstruction, and increased sensitivity of the airways. Table 5-3 provides a checklist for signs and symptoms of asthma.

![Image of bronchi](image)

**TABLE 5-3 Early Warning Signs of Asthma**

<table>
<thead>
<tr>
<th>Head/eyes</th>
<th>Glassy eyes; dark circles; watery eyes; headache; feverish; pale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nose</td>
<td>Stuffy nose; runny nose; sneezing</td>
</tr>
<tr>
<td>Mouth/throat</td>
<td>Chin or throat itches; change in sputum; dry mouth; funny feeling in chest</td>
</tr>
<tr>
<td>Chest/lungs</td>
<td>Fast heartbeat; coughing; changes in breathing; downward trend in peak flow numbers</td>
</tr>
<tr>
<td>Behavior/mood</td>
<td>Easily upset or irritable; weak; slowing down; feeling sad; more quiet, excited or restless than usual; desire to be alone; insomnia</td>
</tr>
<tr>
<td>Exercise tolerance</td>
<td>Poor tolerance for exercise; sweaty; easy fatigue</td>
</tr>
</tbody>
</table>

intake of vitamins D and E, zinc during pregnancy seems to be associated with increased asthma and wheezing outcomes in children up to the age of 5 years (Devereux, 2009).

Nutritional status is important for healthy lungs. Intravenous treatment with multiple nutrients may be of considerable benefit; pulmonary function improves progressively with longer treatment (Schrader, 2004). Diet affects the pathophysiology of asthma by altered immune or antioxidant activity with consequent effects on airway inflammation. Maternal intake of vitamins D and E and zinc can modify fetal lung development (Devereux, 2009). Low serum vitamin D has been shown to be a marker for severity of childhood asthma (Brehm et al, 2009).

Overall, dietary modification may help patients manage their asthma and their overall health. A multidisciplinary approach is required to move forward and understand the complexity of the interaction of dietary factors and asthma (Kim et al, 2009). Obesity and overweight may lead to less-effective therapy from inhaled corticosteroid treatments (Sutherland et al, 2009). While there is currently no conclusive evidence about the role of specific nutrients, food types, or dietary patterns past early childhood on asthma prevalence (Kim et al, 2009) Table 5-4 lists various nutrients and their potential effects on asthma.

### TABLE 5-4 Nutrients and Their Potential Mechanisms in Asthma

<table>
<thead>
<tr>
<th>Nutrient(s)</th>
<th>Activity and Potential Mechanisms of Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamins A (carotenoids), C, and E</td>
<td>Antioxidants for protection against endogenous and exogenous oxidant inflammation</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Prostaglandin inhibition (Harik-Kahn et al, 2004)</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Vitamin D modulates T-cell responses (Devereux, 2009)</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Membrane stabilization, inhibition of immunoglobulin E (IgE) production. Modulation of T-cell responses (Devereux, 2009)</td>
</tr>
<tr>
<td>Flavones and flavonoids</td>
<td>Antioxidants; mast cell stabilization</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Smooth muscle relaxation, mast cell stabilization (Schrad, 2004)</td>
</tr>
<tr>
<td>Selenium</td>
<td>Antioxidant cofactor in glutathione peroxidase</td>
</tr>
<tr>
<td>Copper, zinc</td>
<td>Antioxidant cofactors in superoxide dismutase. Zinc modulates T-cell responses (Devereux, 2009)</td>
</tr>
<tr>
<td>Omega-3 fatty acids</td>
<td>Leukotriene substitution, stabilization of inflammatory cell membranes (Wong, 2005). PUFA modulate T-cell responses (Devereux, 2009)</td>
</tr>
<tr>
<td>Omega-6 polyunsaturated/trans fatty acids</td>
<td>Increased eicosanoid production (Nagel and Linseisen, 2005)</td>
</tr>
<tr>
<td>Sodium</td>
<td>Increased smooth muscle contraction; reductions can increase airway responsiveness (Nickleborough and Gotshall, 2004)</td>
</tr>
</tbody>
</table>

### CLINICAL INDICATORS

#### Genetic Markers:
Tobacco smoke and genetic susceptibility are risk factors for wheezing and asthma (Sadeghnejad et al, 2008). Interleukin 6 (IL6) IL6 receptor (IL6R), and IL13 are candidate genes. Maternal diet plays an epigenetic role by sensitizing fetal airways to respond abnormally to environmental insults (Devereux, 2009; Kim et al, 2009). In addition, beta2-adrenergic receptor (beta2AR) gene polymorphisms are associated with asthma in different racial or ethnic populations.

#### Clinical/History
- Height
- Weight
- Body mass index (BMI)
- BP
- Hypotension?
- Temperature
- Intake and output (I & O)
- Spirometry test
- GERD?
- Respiratory distress
- Audible wheezing
- Decreased breath sounds

#### Lab Work
- Tachycardia
- Cyanosis
- Anxiety
- Pulmonary edema
- Dehydration
- Hard and dry cough
- Distended neck veins
- Food or sulfite allergies?
- Skin testing
- pCO₂, pO₂
- Glucose (Gluc)
- Albumin (Alb)
- Hemoglobin and hematocrit (H & H)
- Serum Fe, ferritin
- Transferrin
- Serum vitamin D₃
- Serum lipids
- Uric acid
- Bilirubin
- Ca²⁺, Mg²⁺
- Cholesterol (Chol)
- Triglycerides (Trig)
- C-reactive protein (CRP)

### INTERVENTION

#### OBJECTIVES
- Prevent distention of stomach from large meals, resulting in distress, GERD, or aggravation of asthma.
- Prevent lung infection and inflammation. Promote improved resistance against infections.
- For allergic asthma, identify and control allergens in the environment.
- Promote adequate hydration to liquefy secretions.
- Optimize nutritional status. Sufficient vitamins C, B₆, D, and E, selenium and magnesium are important. Reduce intake of oleic acid, but increase omega-3 fatty acids if tolerated.
- Encourage a health maintenance program, including physical activity where possible.
- Caffeine relaxes muscles and opens the airways; 2–3 cups of coffee daily may be useful in adults.
SAMPLE NUTRITION CARE PROCESS STEPS

**Overweight**

**Assessment Data:** BMI >90%tile for age; complaints of heartburn and GERD after meals; asthma triggered by allergies; diet hx showing frequent intake of high sugary snacks between meals.

**Nutrition Diagnoses (PES):** Overweight related to excessive intake of energy as CHO with asthma as evidenced by BMI >90%tile for age, GERD, and diet hx revealing intake of high CHO snacks throughout the day.

**Interventions:** Education about the role of weight management and asthma; review of any known food allergies; discussion about appropriate energy intake for age and activity; counseling about alternative snacks with a mix of protein-CHO-fats.

**Monitoring and Evaluation:** BMI closer to desirable range; fewer complaints of GERD; better tolerance of drug therapy for asthmatic episodes; improved quality of intake for meals and snacks.

---

**FOOD AND NUTRITION**

- Infants should be exclusively breastfed to reduce the risk of asthma in susceptible families.
- Provide balanced, small meals that are nutrient dense (high-quality protein, vitamins, and minerals), to reduce risk of infections.
- Lose weight by following a lower energy intake if needed (Oddy et al, 2004; Sutherland et al, 2009).
- Encourage extra fluids unless contraindicated. Theobromine in cocoa tends to increase blood flow to the brain and to reduce coughing; use often.
- Use less sodium (Mickleborough and Gotshall, 2004).
- Highlight foods rich in vitamins A and C, magnesium, and zinc. Use more broccoli, grapefruit, oranges, sweet peppers, kiwi, tomato juice, and cauliflower for vitamin C.
- Quercetin in apples, pears, onions, oranges, and berries should be encouraged (5 or more servings per week). Other nutrients that support immunocompetence should be included.
- Omit specific food allergens for children if identified: as milk, eggs, seafood, tree nuts, peanuts, fish, wheat or soy. For adults, tree nuts, peanuts, fish and shellfish allergies tend to persist.
- Sulfites salicylates may aggravate asthma in 5% of this population, especially adults with severe disease. Sulfite-containing foods or beverages should be avoided.
- Salicylate sensitivity is common in 5–20% of asthmatics who are hypersensitive to aspirin. Many fruits and some vegetables contain salicylates.
- If fish is tolerated, consumption of fish two to three times weekly may help reduce leukotriene synthesis (Wong, 2005). If nuts are tolerated, include selenium from Brazil nuts and vitamin E from most nuts.
- Omega-3 fatty acids from fish oils, walnuts, and flaxseed have been suggested. Some studies suggest that EPA is more useful than DHA (Mickleborough et al, 2009) whereas others suggest the opposite (Weldon et al, 2007). The evidence is not yet clear.
- Saturated fatty acids (SFAs) and oleic acid (from margarine) may contribute to clinical onset of asthma; limit their use (Nagel and Linseisen, 2005).

---

**Common Drugs Used and Potential Side Effects**

- An airway renin–angiotensin system is triggered by release of mast-cell renin; ANG II is a critical factor for new therapeutic targets in the management of airway disease (Kano et al, 2008; Reid et al, 2007).
- See Table 5-5.

**Herbs, Botanicals, and Supplements**

- Many patients with asthma use alternative therapies. Antioxidant and natural anti-inflammatory and immunomodulatory remedies may prove beneficial.
- In China, a combination of three herbal extracts (ASHMI) may be used in anti-asthma intervention (Wen et al, 2005). Seaweed may be used to treat asthma in Vietnamese and oriental cultures (Dang and Hoang, 2004).
- Dietary fatty acids such as gamma linolenic acid (GLA; borage oil) modulate endogenous inflammatory mediators without side effects (Ziboh et al, 2004).
- Ephedra (ma huang) is an effective bronchodilator, but it increases BP significantly. Problems with blood glucose, arrhythmias, increased heart rate, and central nervous system (CNS) stimulation can also occur. The Food and Drug Administration (FDA) has removed it from the market, but some forms are still available.
- Stinging nettle, licorice, gingko, and anise have not shown efficacy; side effects must be evaluated.
- St. John’s wort can inhibit theophylline’s effectiveness.

---

**NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT**

- Mild, chronic asthma can be a warning; if untreated, it can lead to an acute exacerbation.
- Waiting to introduce solids to an infant does not necessarily protect against onset of asthma and allergy (Zutavern et al, 2004).
- Early multivitamin–mineral supplementation may trigger asthma in susceptible children; the exact reasons are not clear (Milner et al, 2004). A healthy, nutrient-dense diet should be consumed instead.
- All medications should be taken as directed by the physician. An emergency pack should be carried at all times containing a rescue inhaler and, if needed, epinephrine injection device and a chewable antihistamine tablet.
- Work with the patient/family to avoid precipitating triggers. Reduce exposure to triggers such as pet dander, food allergens, second-hand smoke. Discuss exercise, rest, and nutrition.
- Massage therapy enhances relaxation, decreases anxiety, and promotes better lung function.
TABLE 5-5 Medications Used in Asthma

<table>
<thead>
<tr>
<th>Medication</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics</td>
<td>Long-term use can cause diarrhea and other problems. Penicillin should not be taken with fruit juices.</td>
</tr>
<tr>
<td>Anticholinergics (Atrovent, Combivent)</td>
<td>Quick-relief asthma medications. Dry mouth is common side effect.</td>
</tr>
<tr>
<td>Beta-agonists (metaproterenol, albuterol; levosalbuterol; salbutamol)</td>
<td>Relaxes smooth muscle around airways. Side effects include shakiness, rapid heart rate, nervousness and elevated glucose. Metaproterenol (Metaprel, Alupent) may alter taste and cause nausea or vomiting. Albuterol (Ventolin, Proventil) may have cardiac side effects or may cause nausea or diarrhea.</td>
</tr>
<tr>
<td>Bronchodilators: theophylline (Theo-Dur, Slo-Bid, Slo-Phyllin, Theolair, Uniphyl)</td>
<td>No longer first choice of asthma medication. Nausea, vomiting, and sleeplessness can be a problem. Theophylline metabolism is affected by protein and CHO availability; avoid extreme changes in protein and CHO intake. Because it is a methylxanthine, avoid extreme changes in usual intakes of caffeine-containing foods. Theophylline depresses levels of vitamin B6. In addition, lipid levels (cholesterol, HDL, and LDL) are higher in children who take theophylline.</td>
</tr>
<tr>
<td>Corticosteroids (methylprednisolone [Medrol], Deltason, Draped, Prelone)</td>
<td>Many side effects such as fluid retention, low serum potassium, GI distress, retaining excess sodium, causing hyperglycemia, and other problems. Monitor carefully, especially if needed over a long period of time. AeroBid contains an anti-inflammatory steroid and is inhaled; it may cause nausea, vomiting, or diarrhea. Bone mineral density is often decreased after long-term use of inhaled corticosteroids.</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>May be required for emergencies. Intravenous (IV) administration of epinephrine results in a prolonged increase in resting energy expenditure (REE) as measured by respiratory quotient (RQ); fuel for this is increased CHO oxidation.</td>
</tr>
<tr>
<td>Expectorants</td>
<td>Potassium iodide may affect existing thyroid problems.</td>
</tr>
<tr>
<td>Long-term control medications</td>
<td>Anti-immunoglobulin E: Reduces histamine release; may be useful with allergic form of asthma. Combination therapy (Advair): Combining an inhaled corticosteroid and a long-lasting beta-,agonist seems to provide consistent relief for people with asthma. Intal (cromolyn) and Tilade (nedocromil) are inhaled medications useful for asthma triggered by cold weather, exercise, and allergies. Inhaled nasal steroids: Aerobid (flunisolide), Azmacort (triamcinolone), Flont (fluticasone), Pulmicort (budesonide), and Qvar (beclomethasone HFA). These prevent inflammation and reduce swelling inside airways; they also reduce mucus production. Leukotriene modifiers: Accolate, Singulair, Zyflo. These relax the smooth muscle around the airways and reduce inflammation. Serevent (salmeterol xinafoate), Advair (fluticasone propionate and salmeterol inhalation powder), and Foradil or Tubuhaler Aerolizer (formoterol fumarate); these medications can worsen asthma or cause death. Formoterol may deplete potassium levels and cause heart palpitations.</td>
</tr>
<tr>
<td>Omega-3 fatty acid supplements</td>
<td>Omega-3 fatty acid supplements may decrease inflammation and improve lung function in adults with asthma, but there is no conclusive evidence. Omega-6 fatty acids tend to increase inflammation and worsen respiratory function.</td>
</tr>
</tbody>
</table>

Patient Education—Foodborne Illness

- Careful food handling will be important. Hand washing is key as well.

For More Information

- Allergy and Asthma Advocate http://www.aaaai.org/
- Allergy and Asthma Network—Mothers of Asthmatics http://www.aana.org/
- Asthma and Allergy http://allergy.healthcenteronline.com/allergyasthamabasics/
- National Asthma Center http://www.nationaljewish.org/healthinfo/conditions/asthma/index.aspx
- National Asthma Education and Prevention Program (NAEPP) http://aspe.hhs.gov/sp/asthma/

Asthma—Cited References


**SECTION 5 • PULMONARY DISORDERS**

**BRONCHIECTASIS**

**NUTRITIONAL ACUITY RANKING: LEVEL 1**

**DEFINITIONS AND BACKGROUND**

Bronchiectasis (BX) is an irreversible widening of portions of the bronchi resulting from damage to the bronchial wall with chronic dilation. It may be present with recurrent bronchitis or pneumonia. The most common acquired cause is acute respiratory illness in patients with COPD. Other causes include measles, whooping cough, tuberculosis (TB), fungal infection, inhaled object, lung tumor, CF, ciliary dyskinesia, immunoglobulin deficiency syndromes, rheumatoid arthritis, ulcerative colitis, human immunodeficiency virus (HIV) infection, and heroin abuse.

BX secondary to primary immunodeficiency in childhood is not always progressive; it is possible to slow or prevent disease progression with appropriate treatment (Haidopoulou et al, 2009). In non-CF BX, airway obstruction deteriorates over time; precaution must be taken to prevent significant morbidity and mortality (Twiss et al, 2006).

Relapse can be controlled with antibiotics, chest physiotherapy, inhaled bronchodilators, proper hydration, and good nutrition. Surgical resection or bilateral lung transplantation may be an option for improving quality of life that has few complications.

**ASSESSMENT, MONITORING, AND EVALUATION**

**CLINICAL INDICATORS**

| Genetic Markers: Congenital BX usually affects infants and children related to problems with lung development in a fetus but is not genetic in origin. |
| **Clinical/History** | **Chest high-resolution computed tomography (HRCT)** | **Early morning paroxysmal cough** | **Decreased breath sounds** | **Weight loss, anorexia** |
| Height | Weight | BMI | Weight loss? | Diet history | BP | I & O |
| **Unintentional Weight Loss** |
| **Assessment Data:** Fever, anorexia, fatigue, chronic cough with purulent sputum, weight loss of 15 lb in past 2 months. |
| **Nutrition Diagnoses (PES):** Unintentional weight loss related to fever, fatigue and poor appetite as evidenced by loss of 15 lb in 2 months. |
| **Interventions:** Food and nutrient enhancement through nutrient-dense, energy-rich foods and beverages. Education about recipes and beverages to replace weight that are easy to prepare and consume. |
| **Monitoring and Evaluation:** Regain of lost weight; improved appetite; more stable BMI. |

**SAMPLE NUTRITION CARE PROCESS STEPS**

**OBJECTIVES**

- Promote recovery and prevent relapse of symptoms.
- Prevent lung collapse or atelectasis.
- Avoid fatigue associated with mealtimes.
- Prevent or correct dehydration.
- Improve weight status, when necessary.
- Reduce fever and inflammation.
- Support lung function with higher antioxidant intake.
- Prepare patient for surgery if needed.
FOOD AND NUTRITION

- Use a diet with 1.0–1.25 g protein/kg and sufficient calories to meet elevated metabolic requirements appropriate for age and sex.
- Small, frequent feedings may be better tolerated.
- Fluid intake of 2–3 L daily may be offered, unless contraindicated.
- Intravenous fat emulsions may be indicated (eicosanoids are inflammatory modulators, and thromboxanes and leukotrienes tend to be potent mediators of inflammation). Omega-3 fatty acids should be enhanced in the oral diet by including salmon, tuna, sardines, walnuts, and flaxseed. Supplements may also be useful.
- Adequate antioxidant use with vitamins C and E and selenium may be beneficial. Ensure adequate potassium intake, depending on medications used.

Common Drugs Used and Potential Side Effects

- Antibiotics are used if the condition is bacterial. Aerosol administration of high-dose tobramycin in non-CF bronchiectatic patients is safe (Drobnic et al, 2005).
- Expectorants help bring up the mucus. Mucus thinners help make it easier to cough.
- Bronchodilators help open up the airways and corticosteroids help reduce airway swelling and inflammation. Monitor side effects according to the specific drugs used.

Herbs, Botanicals, and Supplements

No clinical trials have proven efficacy for use of herbs or botanicals in BX.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss the role of nutrition in health and recovery; emphasize quality proteins and nutrient-dense foods, especially if the patient is anorexic.
- A flu shot or pneumonia shot may be needed annually.
- Emphasize fluid intake, perhaps juices or calorie-containing beverages instead of water.
- Discuss desirable sources of fatty acids, such as omega-3 foods.

Patient Education—Foodborne Illness

- Careful food handling will be important. Hand washing is key as well.

For More Information

- Bronchiectasis http://www.lung.ca/diseases/bronchiectasis.html

BRONCHIECTASIS—CITED REFERENCES


BRONCHITIS (ACUTE)

NUTRITIONAL ACUITY RANKING: LEVEL 1

DEFINITIONS AND BACKGROUND

Bronchitis is caused by inflammation of the air passages. Acute bronchitis is an acute respiratory infection that is manifested by cough and sputum production that lasts for no more than 3 weeks (Braman, 2006). The acute form may follow a cold or other upper respiratory infection, producing hemoptysis, sore throat, nasal discharge, slight fever, cough, and back and muscle pain. Causes include Mycoplasma pneumoniae, Chlamydia, or exposure to strong acids, ammonia, or chlorine fumes, air pollution ozone, or nitrogen dioxide. The chronic form from cigarette smoking and air pollution can produce breathing difficulty, wheezing, blueness, fits of coughing, and sputum production. (See Chronic Obstructive Pulmonary Disease entry.)

Risks for acute bronchitis are much higher in smokers. Mental patients and homeless persons tend to smoke more than other individuals and are at higher risk for acute bronchitis (Himelhoch et al, 2004; Snyder and Eisner, 2004). In addition, smoking has negative consequences for maternal health as well as fetal health during pregnancy; the risk of bronchitis is 15 times higher for smokers than for nonsmokers (Roelands et al, 2009).
ASSESSMENT, MONITORING, AND EVALUATION

• Provide adequate amounts of vitamins C and E, selenium, and potassium.
• Increase the intake of fluids (2–3 L), unless contraindicated.
• Appropriate fatty acid intake may be beneficial to reduce inflammation.
• A low energy intake may be needed after the acute phase to promote weight loss, improve BMI, and promote a healthier level of respiratory functioning (Canoy et al, 2004).

Common Drugs Used and Potential Side Effects

• Bronchodilators can cause gastric irritation. They should be taken with milk, food, or an antacid.
• Theophylline can be toxic if a diet high in CHO and low in protein is used. Avoid large amounts of stimulant beverages, namely, coffee, tea, cocoa, and cola, unless the physician permits.
• Use of antibiotics for the treatment of acute bronchitis is not justified (Braman, 2006).

Herbs, Botanicals, and Supplements

• No clinical trials have proven efficacy for eucalyptus, mullein, horehound, stinging nettle, or marshmallow.
• Belladonna leaf and root are respiratory antispasmodic agents. They should not be used with tricyclic antidepressants, some antihistamines, phenothiazines, or quinidine. Sedation, dry mouth, and difficult urination may occur.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

• Explain to patient that adequate hydration is one of the best ways to liquefy secretions.
• Maintain body weight within a healthy range.
• Promote healthy diet that includes a balance of nutrients, with anti-oxidant-rich foods.

Patient Education—Foodborne Illness

• Careful food handling will be important. Hand washing is key as well.

For More Information

• Medline—Bronchitis
• Web-MD—Bronchitis
  http://www.webmd.com/a-to-z-guides/acute-bronchitis-topic-overview

BRONCHITIS—CITED REFERENCES

DEFINITIONS AND BACKGROUND

Chronic obstructive pulmonary disease (COPD) may result from a history of emphysema, asthma, or chronic bronchitis with persistent lower airway obstruction. COPD is the fourth leading cause of death in the United States. Smoking is the most common cause. According to the Centers for Disease Control and Prevention (CDC), approximately 440,000 persons die each year of a cigarette smoking—attributable illness in the United States. Nonsmoking causes of COPD include alpha-1 antitrypsin deficiency, connective tissue diseases, HIV infection, and some metabolic disorders.

COPD is associated with muscular impairment, nutritional depletion, and systemic inflammation. Symptoms and signs of COPD include dyspnea on exertion, frequent hypoxemia, decreased forced expiratory volume in 1 second (FEV₁), and destruction of the alveolar capillary bed. In COPD, total air quantity is blown out much sooner. COPD is a leading cause of death in the United States.

Chronic bronchitis (“blue bloater”) patients have inflamed bronchial tubes, excess mucus production, chronic cough (for 3 months each year), SOB, and no weight loss. Cardiac enlargement with failure is common.

Emphysema (“pink puffer”) patients have weight loss and thinness without heart failure. It is characterized by tissue destruction, distention, and destruction of pulmonary air spaces by smoking and air pollution. Wheezing, SOB, and chronic mild cough result. Nutritional depletion is significantly greater in patients who have emphysema than in those who have chronic bronchitis. Serious weight loss occurs from anorexia, secondary to significant SOB and gastrointestinal (GI) distress. Malnutrition, tissue wasting, and oxidative stress play a role.

Approximately 75% of patients with COPD suffer from weight loss, where chronic mouth breathing, dyspnea, aerophagia, certain medications, and depression often act in concert. Low body weight or recent weight loss and, in particular, depleted lean body mass (LBM) in patients with COPD are predictors of mortality, outcomes after acute exacerbations, hospital admission rates, and need for mechanical ventilation (Mallampalli, 2004). Risk of respiratory mortality is high.

Elevated resting and activity-related energy expenditure, reduced dietary intake relative to resting energy expenditure, accelerated negative nitrogen balance, medication effects, and an elevated systemic inflammatory response contribute to weight loss (Mallampalli, 2004).
Nutritional supplementation may have a role in the management of COPD when provided as part of an integrated rehabilitation program incorporating a structured exercise component.

The pathological mechanisms of COPD involve neutrophil granulocytes, cytotoxic T cells, macrophages, and mast cells (Ekberg-Jansson et al., 2005). Interventions aimed at controlling cytokine production may be required to reverse cachexia. Starvation, as in anorexia nervosa, can cause emphysema, even without smoking (Coxson et al., 2004).

Recommendations for fats, CHO, proteins, and water must be individualized. For patients with acute exacerbations of COPD in the intensive care unit (ICU), serum total protein is associated with hospital mortality; therefore, protein intake must be carefully monitored (Yang et al., 2004).

Nutritional support is a mainstay of the comprehensive therapeutic approach to patients with COPD because of progressive malnutrition, due to reduced energy intake, increased energy expenditure, and impaired anabolism (Anker et al., 2009).

Fruit and vegetable intake is important and protective. Foods such as meats, vegetables, and coffee may be more bland to the patient than he or she remembers; recognition of this may be important in planning meals.
prepare, and consume food to meet nutritional needs; impairment with activities of daily living is common (ADA, 2009).

FOOD AND NUTRITION

- A high-protein/high-calorie diet is necessary to correct malnutrition. Use 1.2–1.7 g protein/kg and sufficient kilocalories for anabolism (start with 30–35 kcal/kg, depending on current weight). Use BMI and weight change to assess weight status, body composition, and calorie needs (ADA, 2009).
- A diet without tough or stringy foods and an antireflux regimen are useful. Gas-forming vegetables may cause discomfort for some patients.
- Increased use of omega-3 fatty acids in foods such as salmon, haddock, mackerel, tuna, and other fish sources may be beneficial (ADA, 2009; Romieu et al, 2005).
- Encourage a diet that meets Recommended Dietary Allowances for antioxidant vitamins A, C, and E (ADA, 2009). To enrich the diet with antioxidants, use more citrus fruits, whole grains, and nuts. There is a protective effect of fruit and possibly vitamin E.
- Fluid intake should be high, especially if the patient is febrile. Use 1 mL/kcal as a general rule. For discomfort, consume liquids between meals to increase ability to consume nutrient-dense foods at mealtimes.
- Limit salt intake. Too much sodium can cause fluid retention or peripheral edema, which may interfere with breathing.
- Fiber should be increased gradually, perhaps through use of psyllium, crushed bran, prune juice, or extra fruits and vegetables.
- Use small, concentrated feedings at frequent intervals to lessen fatigue. For example, eggnogs and shakes may be helpful between meals.
- Morning may be the best meal of the day for many patients with COPD. See Tables 5-6 and 5-7 for ways to add extra protein or calories to the diet.
- Parenteral nutrition (PN) is reserved for patients in whom malabsorption has been documented where enteral nutrition has failed (Anker et al, 2009).

Common Drugs Used and Potential Side Effects

- Bronchodilators (Atrovent, Theo-Dur, etc.) are used to liquefy secretions, treat infections, and dilate the bronchi. They can cause gastric irritation and ulceration.
- Antibiotics, steroids, expectorants, antihistamines, diuretics, anticholinergics, and other drugs may be used. Monitor side effects accordingly.
- Oral or parenteral corticosteroids significantly reduce treatment failure and the need for additional medical treatment; adverse drug reactions may occur (Wood-Baker et al, 2005).

Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of mullein, camu-camu, licorice, red pepper, peppermint, or eucalyptus.
- Ephedra (ma huang) is an effective bronchodilator, but it increases BP significantly. Avoid taking with digoxin, hypoglycemic agents for diabetes, monoamine oxidase inhibitor (MAOI) antidepressants, antihypertensive medications, oxytocin, theophylline, caffeine, and dexamethasone steroids. Problems with BP, blood glucose, arrhythmias, increased heart rate, and CNS stimulation can occur.
- Vitamin D supplementation may be beneficial to prevent upper respiratory infections (Ginde et al, 2009).

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Early detection, prevention, and early treatment of involuntary weight loss means putting more emphasis on dietary change (Brug et al, 2004; Weekes et al, 2009). Explain how to concentrate protein and calories in five to six small meals a day rather than three large ones.
- To conserve energy while preparing meals at home, choose foods that are easy to prepare. Try having the main meal early in the day to have more energy later.

### TABLE 5-6 Tips for Adding Calories to a Diet

<table>
<thead>
<tr>
<th>Food</th>
<th>Tip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fats</td>
<td>Butter or margarine, cream, sour cream, gravies, salad dressings, and shortening. Mix butter into hot foods such as soups and vegetables, mashed potatoes, cooked cereals, and rice. Serve hot bread with lots of melted butter. Mayonnaise can be added to salads or sandwiches. Sour cream or yogurt can be used on vegetables such as potatoes, beans, carrots, and squash. Try sour cream or yogurt in gravy or salad dressings for fruit. Whipping cream has 80 kcal per tablespoon; add it to pies, fruits, pudding, hot chocolate, gelatin, eggnog, and other desserts. Fry the entree (e.g., chicken, meat, fish) and sauté vegetables in butter or oil.</td>
</tr>
<tr>
<td>Sweets</td>
<td>Spread jelly or honey on toast or cereal; mix honey in tea. Add marshmallows to hot chocolate.</td>
</tr>
<tr>
<td>Snacks</td>
<td>Have snacks ready to eat, such as nuts, dried fruits, candy, buttered popcorn, crackers and cheese, granola, ice cream, and popsicles.</td>
</tr>
<tr>
<td>Beverages</td>
<td>Drink milk shakes with lots of ice cream added; these will be high in calories and protein. Use sugar-sweetened beverages such as carbonated beverages, coffees with whipped cream and sugar, and sugar-sweetened ades.</td>
</tr>
</tbody>
</table>
TABLE 5-7  Tips for Adding Protein to a Diet*

<table>
<thead>
<tr>
<th>Food</th>
<th>Tip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meats and meat substitutes</td>
<td>Add diced or ground meat to soups and casseroles. Serve a chef salad with cheese, ham, turkey, and sliced egg. Peanut butter can be spread on crackers, apples, celery, pears, and bananas. Nuts are a good snack with both fat and protein.</td>
</tr>
<tr>
<td>Dairy products</td>
<td>Add milk powder to hot or cold cereals, scrambled eggs, mashed potatoes, soups, gravies, ground meats (e.g., meat patties, meatballs, meatloaf), caserole dishes, and baked goods. Use milk or half and half instead of water when making soups, cereals, instant puddings, cocoa, and canned soups. Add grated cheese or cheese chunks to souces, vegetables, soups, caserole, hot crab dip, and mashed potatoes. Add extra cheese to pizza. Use yogourt as a fruit dip, or add yogourt to sauces and gravies.</td>
</tr>
<tr>
<td>Milk powder</td>
<td>Add skim milk powder to the regular amount of milk used in recipes or for a beverage. For double-strength milk, add 1 cup of dry milk powder to 1 quart of fluid milk, let it sit overnight for 286 kcals and 15 g of protein.</td>
</tr>
<tr>
<td>Beverages</td>
<td>Add protein powder to casseroles, soups, sauces, gravies, milkshakes, and eggnogs. One scoop may have 4 or 5 g of protein, depending on the brand. Some do not stir in as well as others; some dissolve better in hot foods. Buy instant breakfast mixes and use them instead of milk with meals or as snacks; one 8-oz glass provides 280 kcal. Formula products that are high in protein may be useful as supplements with or between meals or with medication pass in an institution.</td>
</tr>
<tr>
<td>Desserts</td>
<td>Choose dessert recipes that contain egg such as sponge or angel food cake, egg custard, bread pudding, and rice pudding.</td>
</tr>
</tbody>
</table>

*Protein can be added to many foods without having to increase the number of foods eaten.

Encourage slow eating and rest periods before and after meals.
- Encourage the patient to make small, attractive meals.
- Explain that excessively hot or cold foods may cause coughing spells for some individuals.
- Limit fluid intake with meals to decrease early satiety and subsequent decreased food intake.
- Schedule treatments to mobilize mucus (postural drainage, aerosol treatment) 1 hour before and after meals to prevent nausea.
- Improve physical conditioning with planned exercises, especially strengthening exercises and dancing. Consumption of an oral supplement may be beneficial to support exercise.
- If using oxygen, be sure the cannula is worn during and after meals. Eating and digestion require energy and oxygen.
- Maintain a relaxed atmosphere to make meals enjoyable.
- Promote good oral hygiene; periodontal disease is common.
- MNT should be coordinated with the team of clinical professionals to integrate rehabilitative elements into a system of patient self-management and regular exercise (ADA, 2009).

**Patient Education—Foodborne Illness**

- Careful food handling will be important. Hand washing is key as well.

**For More Information**
- AARC—COPD  
- American Thoracic Society  
- National Emphysema Treatment Trial (Nett)  
- Stages of COPD  
- Your Lung Health  

**CHRONIC OBSTRUCTIVE PULMONARY DISEASE—CITED REFERENCES**

CHYLOTHORAX

NUTRITIONAL ACUITY RANKING: LEVEL 2–4

DEFINITIONS AND BACKGROUND

Chylothorax involves accumulation of clear lymph (chyle) in the pleural or thoracic space. It may be spontaneous or caused by amyloidosis, congenital chylothorax, coronary artery bypass grafting (CABG), violent vomiting, lymphoma, thoracic cage compression after cardiopulmonary resuscitation (CPR), thoracic duct trauma or surgery, sarcoidosis, or TB. Chylothorax is caused by surgical procedures in about half of all cases (Maldonado et al, 2009).

Chylous effusions look like milk. Since chyle represents direct absorption of fat from the small intestine lacteals, it is rich in triglycerides. Management of chylothorax may include use of total parenteral nutrition (TPN), low-fat enteral nutrition, thoracentesis to remove the chylous fluid, or surgical ligation of the thoracic duct (Suddaby and Schiller, 2004).

In the congenital form, breast milk and/or regular infant feeding formula should be used before proceeding to medium-chain triglyceride (MCT)–rich formula. Surgery may be considered if conservative management fails. Surgery is needed in the care of small babies with massive chylothorax, such as daily output exceeding 50 mL/kg per day (Cleveland et al, 2009).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Congenital chylothorax is the leading cause of pleural effusion in newborns but is not genetic in origin.

<table>
<thead>
<tr>
<th>Clinical/History</th>
<th>Dyspnea</th>
<th>TLC (decreased)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>Tachypnea</td>
<td>Decreased breath sounds</td>
</tr>
<tr>
<td>Weight</td>
<td>Decreased</td>
<td>Gluc Ca++, Mg ++</td>
</tr>
<tr>
<td>BMI</td>
<td>Chol</td>
<td>Na+, K+</td>
</tr>
<tr>
<td>Weight changes</td>
<td>Trig</td>
<td>CRP</td>
</tr>
<tr>
<td>Temperature</td>
<td>Lab Work</td>
<td>BUN, creatinine (Creat)</td>
</tr>
<tr>
<td>I &amp; O</td>
<td>Alb, transthyretin</td>
<td>pCO2, pO2</td>
</tr>
<tr>
<td>Lung x-ray</td>
<td>Chol</td>
<td></td>
</tr>
<tr>
<td>Pleural fluid analysis for triglyceride</td>
<td>Trig</td>
<td></td>
</tr>
<tr>
<td>&gt;110 mg/dL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTERVENTION

OBJECTIVES

- Offer continuous chest-tube drainage to decrease pleural chyle.

- Drainage of chyle from the chest or abdomen results in rapid weight loss and profound cachexia. Lesser consequences of a nutritional or immunological nature from drainage (e.g., sepsis, protein–calorie malnutrition, decreased lymphocytes).

- Replace fat, protein, and micronutrient losses from exudates.

- Achieve a positive nitrogen balance.

- Support involvement of a surgical nutrition support team, which is associated with better patient management and a reduction in inappropriate TPN orders (Saalwachter et al, 2004).

FOOD AND NUTRITION

- Decrease enteral fat intake for patients who are tube fed. For patients who are fed orally, reduce total fat intake until condition is resolved; also for these patients, a low-fat diet may be used alone or with an elemental product.

- Some patients may be able to tolerate a low long-chain fatty acid formula given as a tube feeding (TF) (Cormack et al, 2004).

- For patients without sepsis, TPN may be indicated; care is needed to avoid aggravating the condition.

- Replace exudate losses of nutrients such as vitamin A and zinc. Check serum levels and replace with higher levels of the recommended intakes if necessary.

Common Drugs Used and Potential Side Effects

- Octreotide (Sandostatin) may be given as conservative medical management (Page-Brown et al, 2006; Suver et al, 2004). Nausea, vomiting, abdominal pain, diarrhea, and flatulence can occur. Use with the low-fat diet to decrease GI side effects.
• Medications are given, as appropriate, for the etiology. Monitor side effects accordingly, especially in conditions such as TB or cancer in which numerous side effects are created from drug therapies.
• Bronchodilators may be used. Some nausea and vomiting may occur.

Herbs, Botanicals, and Supplements
• No clinical trials have proven efficacy for use of herbs or botanicals in chylothorax.

For More Information
• Emedicine
http://www.emedicine.com/med/topic381.htm
• Medscape
http://emedicine.medscape.com/article/172527-overview

CHYLOTHORAX—CITED REFERENCES

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT
• Discuss the importance of adequate nutrition in recovery.
• Discuss interventions that are appropriate for the conditions and diagnoses involved.

Patient Education—Foodborne Illness
• Careful food handling will be important. Hand washing is key as well.

COR PULMONALE
NUTRITIONAL ACUITY RANKING: LEVEL 2–4

DEFINITIONS AND BACKGROUND
Acute cor pulmonale (right ventricular failure) occurs when relevant increases in pulmonary vascular resistance overwhelm compensatory mechanisms. Cor pulmonale may be acute, subacute, or chronic. The acute form is generally caused by acute respiratory failure (RF) or pulmonary embolism. A heart disease that follows disease of the lung (such as end-stage emphysema, silicosis), chronic cor pulmonale creates hypertrophy and eventual failure.

The body secretes B-type natriuretic peptide (BNP) from the cardiac ventricles in response to ventricular stretch and pressure overload; this counteracts vasoconstriction that occurs as a compensatory mechanism (Prahash and Lynch, 2004).

Long-term exposure to combustion-related fine particulate air pollution is a risk factor. Pulmonary hypertension (PH) and cor pulmonale may affect patients with COPD or CF. Children who have Prader-Willi syndrome may also experience obesity-related cor pulmonale (Stevenson et al, 2004).

ASSESSMENT, MONITORING, AND EVALUATION

Genetic Markers: Genes important in early lung development are also important in determining adult risk for COPD and its consequences (Bush, 2008). Glucocorticoid resistance may be related to cytokines, excessive activation of the transcription factor activator protein 1, reduced histone deacetylase-2 (HDAC2) expression, and increased P-glycoprotein-mediated drug efflux (Barnes and Adcock, 2009).

Clinical/History
Height
Weight
BMI
Obesity?

Diet history
Clinic report
I & O
Edema of feet, ankles
Blood Pressure
Chest x-ray
Echocardiography
BP (hypertension?)
INTERVENTION
OBJECTIVES

- Improve the patient’s capacity to eat meals without straining the diaphragm.
- Correct malnourished status but avoid weight gain that stresses the heart.
- Reduce or prevent fluid retention and edema to lessen cardiac workload.
- Prevent additional damage to cardiac and respiratory tissues.
- Improve energy levels and stamina. Oxygen may be needed, even at mealtimes.
- Support adequate lung function with higher antioxidant intake.

FOOD AND NUTRITION

- Recommend small, frequent meals or oral supplements rather than three large meals (Anker et al, 2006).
- Use a nutrient-dense diet with concentrated protein sources. Double-strength milk, foods with milk powder added to them, high-calorie supplements, and addition of extra gravies or sauces to meals are useful when quantity of food must be kept minimal because of dyspnea.
- Restrict sodium or adjust fluid restriction as needed.
- Use foods that reduce likelihood of gastric irritation and reflux. For example, use low-acidic fruits, vegetables, and juices.
- Provide adequate potassium and magnesium intake with the Dietary Approaches to Stop Hypertension (DASH) diet.
- Include adequate levels of vitamins C, D, and E and selenium for antioxidant properties (Barnes and Adcock, 2009).
- Control CHO if needed. Insulin resistance is also common (Zamanian et al, 2009).
- Oral nutritional supplements or TF enables nutritional intake to be maintained or increased when usual intake is inadequate (Anker et al, 2006).

Common Drugs Used and Potential Side Effects

- Bosentan or sildenafil may be given by mouth
- Calcium channel blockers and anticoagulants may be used. Monitor specific medicines for side effects.
- Thiazide diuretics can cause potassium depletion.
- Anabolic pharmacotherapy has the potential to improve nutritional status and function (Anker et al, 2006).
- To reverse glucocorticoid resistance, vitamin D may restore interleukin-10 response and use of antioxidants may be recommended (Barnes and Adcock, 2009).

Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of herbs or botanicals in cor pulmonale.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Plan small, attractive meals that are nutrient dense. If fluid and sodium must be limited, provide tips.
- Recommend snacks that are nutrient dense and protein-rich but do not provide excessive sodium.
- Emphasize the importance of eating slowly to reduce SOB.
- Weight loss may be needed (Olson and Zwillich, 2005).
- Monitor heart murmurs in children to identify potential risks or need for surgery. If untreated, cor pulmonale can lead to right-sided heart failure and death.

Patient Education—Foodborne Illness

- Careful food handling will be important. Hand washing is key as well.

For More Information

- Medline
- Merck Manual
  http://www.merck.com/mmpe/sec07/ch074/ch074c.html

SAMPLE NUTRITION CARE PROCESS STEPS

Excessive Sodium Intake

Assessment Data: Diet history revealing intake of 8–10 g sodium daily, low intake of potassium, calcium and magnesium; ankle and foot edema; SOB.

Nutrition Diagnoses (PES): Excessive sodium intake related to dietary habits and long-term hypertension as evidenced by BP 212/100, elevated BNP, and dietary intake low in potassium, calcium and magnesium.

Interventions: Offer DASH diet education and alter diet to enhance fruits and vegetables and low-fat dairy products. Monitor sodium intake and offer alternatives for recipes and menu planning. Counsel about dining out and traveling. Evaluate medications for nutritional side effects.

Monitoring and Evaluation: Improved BP and fewer incidents of SOB; alleviation of edema. Improved BNP levels and fewer signs of heart failure.
COR PULMONALE—CITED REFERENCES

Anker SD, et al. ESPEN Guidelines on Enteral Nutrition: cardiology and pul-
Barnes PJ, Adcock IM. Glucocorticoid resistance in inflammatory diseases.

118:948, 2005.
Prahash A, Lynch T. B-type natriuretic peptide: a diagnostic, prognostic, and
Stevenson DA, et al. Unexpected death and critical illness in Prader-Willi

CYSTIC FIBROSIS

NUTRITIONAL ACUITY RANKING: LEVEL 3

Lungs
Increased mucus and infections lead to lung destruction.

Liver
Small bile ducts become obstructed and impede digestion. Liver function is
disrupted in about 5% of patients.

Pancreas
Ductal occlusion prevents digestive enzymes from being available for digestion.

Small intestine
Thick stool may obstruct the intestines. About 10% of newborns with cystic fibrosis
require surgery.

Reproductive tract
About 95% of males are infertile due to the absence of mature sperm. Females may be infertile
because of a mucus plug that impedes sperm transport into the uterus.

Skin
Malfunctioning sweat glands secrete sodium chloride.

118:948, 2005.
Prahash A, Lynch T. B-type natriuretic peptide: a diagnostic, prognostic, and
Stevenson DA, et al. Unexpected death and critical illness in Prader-Willi
DEFINITIONS AND BACKGROUND

CF is a life-limiting, autosomal recessive inherited disease characterized by thick mucus and frequent pulmonary infections. There is general dysfunction of mucus-producing exocrine glands; high levels of sodium and chloride in the saliva, tears, and sweat; and highly viscous secretions in the pancreas, bronchi, bile ducts, and small intestine. Meconium ileus is a classic sign in newborn infants with CF; it is thicker than usual and passes more slowly.

CF affects approximately 30,000 children and adults in the United States. About one in 3200 Caucasians is affected; 2–5% of Caucasians carry the CF gene. The majority of CF patients have been diagnosed by age 3, but about 10% are not diagnosed until age 18 or older. The median life expectancy for CF patients is 33 years.

The CFTR system controls the efflux of physiologically important anions, such as glutathione (GSH) and bicarbonate, as well as chloride (Hudson, 2004). Interleukin-8 and cytokines also play a role in CF (Augarten et al, 2004). Anti-inflammatory and antioxidant treatments are recommended, including use of omega-3 fatty acids and selenium (Innes et al, 2007). Foods rich in lecithin, choline, betaine, and DHA can safely be recommended to reduce the effects of oxidative stress in CF.

The percentage of CF children who are malnourished varies; weight-based indicators greatly underestimate the extent. A link has been established between the degree of malnutrition and the severity of the disease. Inadequate intake, malabsorption, and increased energy requirements are common. Careful follow-up, better knowledge of energy requirements, dietary counseling, and nutritional intervention help optimize the growth of these patients.

A major goal is to maintain a good nutritional status because it improves long-term survival. Early diagnosis of CF and aggressive nutritional therapy are important to prevent growth failure and malnutrition (Farrell et al, 2005). When appropriate, lung transplantation may be considered.

Pancreatic insufficiency occurs in 80–90% of CF patients; 85% show growth retardation. Intestinal malabsorption is severe in virtually all people who have CF. Deficiency of pancreatic enzymes, bicarbonate deficiency, abnormalities of bile salts and mucosal transport, and anatomical structural changes are relevant. Appropriate pancreatic replacement therapy, combined with pharmacotherapy to address increased acidity of the intestines, achieves near-normal absorption in many patients.

Decreased bone density and increased risk of fractures are seen in patients with CF. Nutrition problems, hypogonadism, inactivity, corticosteroid use, and cytokines may contribute to the low bone mass. Treatment may include calcium, vitamin D₃, vitamin K, bisphosphonates, and exercise.

Diabetes may also occur in persons with CF (more commonly in older individuals), reflecting impairment of beta-cell function, which is probably genetically determined. Onset of CF-related diabetes (CFRD) is often associated with a decline in health and nutritional status. Energy requirements may be higher than usual for patients with CF. Microvascular complications are common in CFRD; microalbuminuria is a sensitive indicator of progression to diabetic nephropathy in non-CF diabetes, but it is less sensitive for CF patients (Dobson et al, 2005).

Some patients are diagnosed in adulthood; patients diagnosed as adults differ distinctly from long-term CF survivors diagnosed as children (Nick and Rodman, 2005). While respiratory symptoms are not as severe and prognosis is more favorable, pancreatitis is more common (Nick and Rodman, 2005).

Progressive pulmonary disease associated with chronic bacterial infection and inflammation is the major cause of morbidity and mortality; CRP and IgG levels are indicators of severity (Levy et al, 2007). With anemia from chronic inflammation, treat the underlying inflammation rather than using supplemental iron (Fischer et al, 2007). Overall, patients with CF who receive optimal nutrition have better growth, maintain better nutritional reserves, and have better pulmonary function than patients with CF who have poor nutrition (Hart et al, 2004). Metabolic and immunological response to infection and the increased work of breathing escalate calorie requirements.

Research supports the potential benefits of gene therapy; compacted DNA is used to get healthy genes into CF cells. Lung transplantation may be needed. Other treatments include use of antibiotics for infections and inhaled medicines to open the airways. Because no single strategy works for every patient, close monitoring of growth, symptoms, and changes in respiratory status must occur. The American Dietetic Association recommends a minimum of 4 MNT visits for patients who have CF.

ASSessment, monitorinG, AND evaluAtion

CLINICAL INDICATORS

Genetic Markers: CF is genetic, inherited when both parents are carriers of the CF gene. There are hundreds of gene mutations, so each person’s symptoms will be unique. The CF transmembrane conductance regulator (CFTR) is an important molecule for chloride that affects sodium transport, fluid, and ion management. CFTR is also expressed in the neurons of the human spinal cord.

Clinical/History

Height, weight
Growth chart for height and weight
BMI
Diet history
Foul smelling stools
pH
Chest x-ray or CT scan
Pulmonary function test
DEXA scan

Lab Work

Pilocarpine iontophoresis sweat test (>60 mEq/L)
PCO₂, PO₂
Chol, Trig
Na⁺, K⁺, Cl⁻, Alb

H & H
Serum Fe, ferritin
Pancreatic enzymes (amylase, lipase)
White blood cell count (WBC)
Prothrombin time (PT)
International normalized ratio (INR)
Serum vitamin K
Correct edema, diarrhea, anemia, azotorrhea, and steatorrhea. 

Promote adequate bone mass, as serum levels of vitamins D and K may be low (Grey et al, 2008).

Provide essential fatty acids in a tolerated form. Reduce arachidonic acid use to lessen inflammatory cascade. Include omega-3 fatty acids and antioxidants such as selenium and vitamins C and E. Vitamin E may be especially important for improving cognitive function (Koscik et al, 2004).

Promote adequate bone mass, as serum levels of vitamins D and K may be low (Grey et al, 2008).

Correct edema, diarrhea, anemia, azotorrhea, and steatorrhea.

**TABLE 5-8** Nutritional Management for Cystic Fibrosis (CF)

<table>
<thead>
<tr>
<th>Nutritional Management</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine care</td>
<td>Within desired BMI</td>
</tr>
<tr>
<td>Anticipatory guidance</td>
<td>At 90–95% desired BMI</td>
</tr>
<tr>
<td>Supportive intervention</td>
<td>At 85–90% desired BMI</td>
</tr>
<tr>
<td>Rehabilitative care</td>
<td>At 75–85% desired BMI</td>
</tr>
<tr>
<td>Resuscitative or palliative care</td>
<td>Below 75% desired BMI</td>
</tr>
</tbody>
</table>

- Prevent progressive pulmonary disease or complications such as glucose intolerance, intestinal obstruction, cirrhosis, and pancreatic or cardiac diseases.
- Improve lung function outcomes from better nutrition and fewer chronic infections (McPhail et al, 2008).

**FOOD AND NUTRITION**

- Energy expenditure may be as high as 199% of predicted in CF patients. CF patients may need to be given 120–150% more calories than for age-matched and gender-matched controls; this may mean 3000–4000 kcal for teens.
- Design the plan for 45–65% CHO and 20–30% fat. For persons with acute disease, starch and fat will not be well tolerated unless adequate levels of pancreatic enzymes are provided. Calorie intake should be about 150 kcal/kg for children and 200 kcal/kg for infants. Specific interventions for increasing total energy intake in CF patients are the role of the dietitian (Powers et al, 2004). Many supplements are available at little or no cost to the patient.
- Manage glucose levels if CF diabetes mellitus (CFDM) develops. Intensive insulin therapy and CHO counting will be important.
- Protein should be 10–35% of total calories. This may translate into 4 g/kg for infants, 3 g/kg for children, 2 g/kg for teens, and 1.5 g/kg for adults.
- Increase fat:CHO ratio with respiratory distress. Special respiratory formulas may be useful during those times, or use of MCTs and safflower oil may be beneficial. Be sure to time intake according to the use and type of pancreatic enzymes.
- Encourage intake of omega-3 fatty acids (DHA and EPA), selenium, betaine, and choline to reduce inflammation and enhance immunity.
- Supplement the diet with two times the normal RDAs for fat-soluble vitamins A, D, and E (use water-miscible sources such as “ADEKS” brand).
- Replace vitamin K as needed; check levels regularly. Either 1 mg or 5 mg doses of vitamin K will help replenish low levels (Drury et al, 2008).
- Use extra riboflavin if there is cheilosis; include the other B-complex vitamins and vitamin C at recommended levels.
- Be sure that iron, zinc, copper, selenium intakes meet recommended levels.
- Use liberal amounts of salt to replace perspiration losses.
- Lactose intolerance is common. Omit milk during periods of diarrhea if lactose intolerance persists.
- Intolerance for gas-forming foods and concentrated sweets may occur; alter dietary plans accordingly.

**SAMPLE NUTRITION CARE PROCESS STEPS**

<table>
<thead>
<tr>
<th>Nutrition Care Process Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Poor Nutritional Quality of Life</strong></td>
</tr>
<tr>
<td><strong>Assessment Data:</strong></td>
</tr>
<tr>
<td><strong>Nutrition Diagnoses (PES):</strong></td>
</tr>
<tr>
<td><strong>Interventions:</strong></td>
</tr>
<tr>
<td><strong>Monitoring and Evaluation:</strong></td>
</tr>
</tbody>
</table>
• Soft foods may be useful if chewing causes fatigue.
• Fluid intake should be liberal unless contraindicated.
• Use of turmeric and cumin in foods may be beneficial for CF patients (Berger et al, 2005). Research is ongoing to determine overall practicality of uses.
• Infants can tolerate most formulas (may need 24 kcal/oz) and commercial products that include some MCT oil. Do not add pancreatic enzymes to formula because desired amounts may not be totally consumed or enzymes may block the opening of the nipple.
• Nocturnal TF may be appropriate with growth failure. With reflux, a gastrostomy feeding tube may be well tolerated (Oliver et al, 2004). PN is not recommended due to high risk of infection.

Common Drugs Used and Potential Side Effects

• Growth hormone may be used to bring onset of puberty in prepubescent children who have CF (Vanderwel and Hardin, 2006).
• New aerosol treatments show promise. See Table 5-9 for alternative therapies.

Herbs, Botanicals, and Supplements

• Interesting studies suggest that curcumin may directly stimulate CFTR Cl− channels (Berger et al, 2005). Use of turmeric and cumin in foods served to this population may have therapeutic benefits.
• Dietary supplement use is prevalent among CF children. Identify use of nonprescribed supplements because of unknown effects on growth and development and the potential for adverse drug interactions (Ball et al, 2005).

The individual with CF should work with the CF nutritionist to maintain a healthy diet before considering adding herbal therapies. Each label on any supplement should be read carefully; some ingredients that can be toxic to people with CF.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

• Diet must be periodically reevaluated to reflect growth and disease process.
• New foods may be introduced gradually.
• A behavioral and nutrition intervention can be used with children to enhance weight and height velocities (Powers et al, 2005).
• To liquefy secretions, adequate fluid intake should be ensured. Discuss signs of dehydration and how to prevent or correct.
• Bronchopulmonary drainage, three times daily, may be required. Plan meals to be 1 hour before or after therapy.
• Ensure that all foods and beverages are nutrient dense.
• As needed, discuss issues related to fertility (most males with CF are infertile, but females are not).
• In adults with CF, 40% have glucose intolerance. Discuss how to manage diabetes in those cases.
• Discuss reimbursement issues for TFs and pumps.
• Depression is common and should be adequately managed (Quittner et al, 2008). Hypnosis may be useful in reducing pain from frequent intravenous injections or other treatments.

Patient Education—Foodborne Illness

• Careful food handling will be important. Hand washing is key as well.

<table>
<thead>
<tr>
<th>TABLE 5-9 Medications Used in Cystic Fibrosis (CF) and Potential Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medication</strong></td>
</tr>
<tr>
<td>Aerosolized antibiotics</td>
</tr>
<tr>
<td>Antibiotics</td>
</tr>
<tr>
<td>Azithromycin</td>
</tr>
<tr>
<td>Bisphosphonates</td>
</tr>
<tr>
<td>Bronchodilators</td>
</tr>
<tr>
<td>Glutathione (GSH)</td>
</tr>
<tr>
<td>L-arginine</td>
</tr>
<tr>
<td>Mucolytics</td>
</tr>
<tr>
<td>Pancreatic enzymes (pancrelipase)</td>
</tr>
<tr>
<td>Pulmozyme</td>
</tr>
<tr>
<td>Ursodeoxycholic acid</td>
</tr>
</tbody>
</table>

NOTE. The need to take up to 40–60 pills daily is common in CF.
INTERSTITIAL LUNG DISEASE

INTERSTITIAL LUNG DISEASE

NUTRITIONAL ACUITY RANKING: LEVEL 1–2

DEFINITIONS AND BACKGROUND

Interstitial lung disease (ILD) is a general term that includes a variety of chronic lung disorders, sometimes also known as “interstitial pulmonary fibrosis.” In ILD, the lung tissue is damaged; the walls of the air sacs in the lung become inflamed; and, finally, scarring (fibrosis) occurs in the interstitium (tissue between the air sacs). The lung becomes stiff.

Although the histologic patterns of ILD in children and adults share similar features, important differences exist in etiology, clinical manifestations, and outcome (Young et al, 2008). Causes of adult ILD include environmental exposure to inorganic dust (such as silica) or organic dust (such as animal or bacterial proteins); exposure to gases, fumes, or poisons; or medical conditions such as sarcoidosis, scleroderma, rheumatic arthritis, and lupus. Agricultural workers also can be affected, with moldy hay causing allergic reactions in a disorder known as Farmer’s Lung.

Breathlessness during exercise and dry cough can be the first symptoms. Other symptoms vary in severity. Further testing is usually recommended to identify the specific type

of ILD a person has; some have known causes and some have unknown causes (idiopathic). The course of these diseases is unpredictable.

Some ILDs improve with medication if treated when inflammation occurs. Inflammation of these parts of the lung may heal or may lead to permanent scarring of the lung tissue. Fibrosis results in scarring and permanent loss of that tissue’s ability to transport oxygen. The level of disability that a person experiences depends on the amount of scarring of the tissue. Oxygen may be needed; some patients need it all of the time, and others need it only during sleep and exercise.

A pulmonary rehabilitation program is often recommended for education, exercise conditioning, breathing retraining, energy-saving techniques, respiratory therapy, nutritional counseling, and psychosocial support. Lung transplantation has become an option for some patients.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

**Genetic Markers:** Prevalence of ILDs is low in children. A total of 10–16% may be familial, with mutations in surfactant proteins or the SFTPC and ABCA3 gene (Nogee, 2006).

<table>
<thead>
<tr>
<th>Clinical/History</th>
<th>Lab Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height, weight</td>
<td>pCO₂, pO₂</td>
</tr>
<tr>
<td>Growth chart for</td>
<td>Chol, Trig</td>
</tr>
<tr>
<td>height and weight</td>
<td>Na⁺, K⁺, Cl⁻</td>
</tr>
<tr>
<td>BMI</td>
<td>Alb</td>
</tr>
<tr>
<td>Diet history</td>
<td>H &amp; H</td>
</tr>
<tr>
<td>Fecal fat study</td>
<td>Serum Fe</td>
</tr>
<tr>
<td>pH</td>
<td>WBC count</td>
</tr>
<tr>
<td>Bronchoalveolar</td>
<td>PT or INR</td>
</tr>
<tr>
<td>lavage (BAL)</td>
<td>Gluc</td>
</tr>
<tr>
<td>Lung biopsy</td>
<td>Ca ++, Mg ++</td>
</tr>
</tbody>
</table>

**Common Drugs Used and Potential Side Effects**

- Oral prednisone or methylprednisone is frequently the first medication used to help decrease inflammation.
- Cyclophosphamide (Cytoxan) may be used if steroid therapy fails or if it is not possible. It reduces inflammation by killing some inflammatory cells and suppressing their function. Response to therapy may require up to 6 months or longer. In some cases, a combination of prednisone and cyclophosphamide is used with good results. Side effects include GI irritation, bladder inflammation, bone marrow suppression, infection, and blood disorders.
- Azathioprine (Imuran) is used if there are problems tolerating the side effects of the above medications. It is not as effective as cyclophosphamide, but side effects are more tolerable. Side effects include fever, skin rash, GI irritation, and blood disorders.
- Interferon has been tested in clinical trials with some promising results.

**Herbs, Botanicals, and Supplements**

- Herbs and botanicals should not be used for ILD because there are no controlled trials to prove efficacy.

INTERVENTION

**OBJECTIVES**

- Early identification and aggressive treatment are needed to lessen inflammation and prevent further lung damage.
- Remove the source of the problem, if known.
- Lessen the effect of complications.
- Maintain nutritional immunity as far as possible. Improve poor status.
- Provide nutritional repletion before surgery, if surgery is scheduled.

**FOOD AND NUTRITION**

- If not contraindicated, offer 3–3.5 L fluid daily to liquefy secretions and to help lower temperature.
- A high-calorie, soft diet is recommended, especially if oxygen is used. Frequent, small meals may be beneficial.
- Discuss how to make mealtimes relaxed, especially if oxygen is required at the same time. Plan for longer mealtimes accordingly.
- A multivitamin–mineral supplement may be beneficial, especially for vitamins A, C, and E. Vitamin E reduces the extent of pulmonary damage in some types of ILD (Card et al, 2003).
- Ensure adequate potassium intake, as from fruits and juices.
- When possible, add more fiber to prevent constipation.
- TF at night may be beneficial if intake is poor during the day. A gastrostomy or transpyloric feeding tube may be desirable.

**SAMPLE NUTRITION CARE PROCESS STEPS**

**Underweight**

**Assessment Data:** Poor dietary intake, underweight for height.

**Nutrition Diagnoses (PES):** Underweight (NC 3.1) related to inadequate energy intake as evidenced by low percentile height, weight 30%tile on growth chart and estimated intake approximately 500 calories below estimated needs.

**Interventions:** Enhance intake through adding protein and calories to casseroles and foods served. Educate about nutrient density and increasing calories. Counsel with tips about eating slowly and frequently.

**Monitoring and Evaluation:** Weight gain closer to desired BMI; improved intake of energy and nutrients.
NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

• Discuss how a balanced diet supports overall immunity and health status. Teach principles of the Food Guide Pyramid and the Dietary Guidelines.
• Teach how to incorporate antioxidants and related nutrients in the diet, especially if energy intake is low because of poor appetite.
• Influenza vaccine and pneumococcal pneumonia vaccine are both recommended for people with ILD.
• Rehabilitation and education programs may help some people. Local support groups have benefited people with ILD and their family members and friends.

Patient Education—Foodborne Illness

• Careful food handling will be important. Hand washing is key as well.

PNEUMONIA

NUTRITIONAL ACUITY RANKING: LEVEL 1–2

DEFINITIONS AND BACKGROUND

Pneumonia involves acute inflammation of the alveolar spaces of the lung. Lung tissue is consolidated as alveoli fill with exudate, usually after a cold or the flu. To protect against pneumonia, dental and oral health care are important. Dental plaque germs may be inhaled and may lead to onset of pneumonia; regular tooth brushing, flossing, and dental check-ups are recommended (El-Solh et al, 2004).

A productive cough that is painful and incessant (generally with green/yellow sputum that progresses to pink, brown, or rust color) may be indicative. Pneumonia may be classified as community acquired, hospital acquired, or atypical. Table 5-10 describes the common types of pneumonia. The most common form is community-acquired pneumococcal pneumonia. With treatment, most types of bacterial pneumonia can be cured within 1–2 weeks; viral pneumonia may last longer. Mycoplasmal pneumonia resolves in 4–6 weeks. Before antibiotics, pneumonia caused many deaths in elderly individuals; it now ranks sixth among causes of death in the United States.

People at high risk for pneumonia include the elderly; the very young; those with COPD, diabetes mellitus, congestive heart failure, sickle cell anemia, AIDS, or asthma; and people undergoing cancer therapy or organ transplantation. Nursing home residents have chronic medical conditions that gradually lead to “decompensation” in functional status, nutritional status, and pulmonary clearance. Elderly patients with low body weight and hypoalbuminemia are more likely to die from pneumonia than healthy patients.

Inflammation may cause low serum albumin levels in many pneumonia patients. GSH is the primary antioxidant that lines alveolar space; selenium, vitamins E and C may be beneficial. However, supplementation alone will not prevent pneumonia in well-nourished older individuals (Merchant et al, 2004).

Enteral feeding provides nutrients for patients who require endotracheal tubes and mechanical ventilation. There is a presumed increase in the risk of ventilator-associated pneumonia (VAP) with TF, but this is not always true.

Pneumonia due to immune system suppression and membrane damage induced by oxidative stress suggest that sufficient fatty acid intake may be useful in the nutritional repletion of such patients with pneumonia. The American Dietetic Association previously recommended 3 MNT visits for persons who have pneumonia.

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Genes that have inflammatory molecules such as tumor necrosis factor, interleukin-10, and angiotensin-converting enzyme may play a role in susceptibility to pneumonia. Population studies are needed.

Clinical/History  BMI       Chills, fever
Height        L & O (102–106°F),
Weight        Diet history  delirium
               BP  Pleuritic pain

For More Information

• Children’s Interstitial Lung Disease
• Interstitial Lung Disease Program
  http://www.nationaljewish.org/4k.html
• Medicine Net
  http://www.musicnet.com/interstitial_lung_disease/article.htm

INTERSTITIAL LUNG DISEASE—CITED REFERENCES


If not contraindicated, offer 3 L or more of fluid daily to liquefy secretions and to help lower elevated temperature.

Progress, as tolerated, to a high-calorie diet. If overweight, allow normal calorie intake for age and sex.

Early enteral nutrition, properly administered, can decrease upper GI intolerance and nosocomial pneumonia (Kompan et al, 2004).

Frequent, small meals and a soft diet may be tolerated better.

A multivitamin–mineral supplement may be beneficial, especially including selenium and vitamins E and C. Vitamin A is needed to keep mucous membranes healthy.

**TABLE 5-10 Types of Pneumonia**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergic</td>
<td>From sensitivity to dust or pollen.</td>
</tr>
<tr>
<td>Aspiration</td>
<td>From swallowing a foreign substance. The gastric volume predisposing to aspiration is larger than 30 mL. (Kalinoski and Kirsch, 2004). Just a few hours with “nothing by mouth” helps prepare for surgery because risk of aspiration is lower than previously believed. Ventilator-associated pneumonia, a common and serious complication in critically ill patients who require a ventilator, results from pneumonia occurring &gt;48 hours after endotracheal intubation (Parker and Heyland, 2004). It is caused by microaspiration of contaminated oropharyngeal or gastrointestinal secretions into the airways (Parker and Heyland, 2004).</td>
</tr>
<tr>
<td>Bacterial</td>
<td>From bacteria normally present in mouth/throat. Quick onset with high fever and rapid breathing. Several bacteria may be relevant. <em>Streptococcus pneumoniae</em> causes about 25% of bacterial types. <em>Mycoplasma</em> causes walking pneumonia, notorious for sore throat and headache in addition to the usual symptoms; causes about 20% of all kinds of pneumonia. When pneumonia is due to pertussis (whooping cough), long coughing spells, turning blue from lack of air, and making a classic “whoop” sound when trying to take a breath will occur. <em>Haemophilus influenzae</em> type b (Hib) is America’s most common cause of bacterial meningitis; it is also an agent of pneumonia.</td>
</tr>
<tr>
<td>Chemical</td>
<td>From accidental inhalation of toxic fumes and chemicals, often in the workplace or when using cleaning agents such as bleach in a closed space.</td>
</tr>
<tr>
<td>Healthcare-associated pneumonia</td>
<td>Pneumonia in any patient who has been hospitalized in an acute care hospital for 2 or more days within the past 90 days; residents of a nursing home or long-term care facility; recipients of recent intravenous antibiotic therapy, chemotherapy, or wound care within the past 30 days; or patients who have attended a dialysis clinic.</td>
</tr>
<tr>
<td>Hypostatic</td>
<td>In bedridden persons, usually elderly individuals. Caused by a fungus, primarily in AIDS patients.</td>
</tr>
<tr>
<td>Viral</td>
<td>More common; leads to about 50% of pneumonia cases. Symptoms appear more gradually; less severe than bacterial form. Wheezing is common in this type. Adenoviral infections often affect infants and young children. Other viruses that can cause pneumonia include rhinovirus, influenza, respiratory syncytial virus, and parainfluenza virus (croup).</td>
</tr>
</tbody>
</table>

**INTERVENTION**

**OBJECTIVES**

- Prevent or correct dehydration.
- Relieve breathing difficulty and discomfort. Oxygenate all tissues.
- Prevent weight loss from a hypermetabolic state.
- Support diet with adequate antioxidants and nutrient-dense foods.
- Avoid additional infections; prevent sepsis and multiple organ dysfunction syndrome.
- In convalescent stage, avoid constipation.

**FOOD AND NUTRITION**

- If not contraindicated, offer 3 L or more of fluid daily to liquefy secretions and to help lower elevated temperature.
- Progress, as tolerated, to a high-calorie diet. If overweight, allow normal calorie intake for age and sex.
- Early enteral nutrition, properly administered, can decrease upper GI intolerance and nosocomial pneumonia (Kompan et al, 2004).
- Frequent, small meals and a soft diet may be tolerated better.
- A multivitamin–mineral supplement may be beneficial, especially including selenium and vitamins E and C. Vitamin A is needed to keep mucous membranes healthy.

**SAMPLE NUTRITION CARE PROCESS STEPS**

**Inadequate Fluid Intake**

**Assessment Data:** Dehydration, rapid breathing, poor skin turgor, I & O records.

**Nutrition Diagnoses (PES):** Inadequate fluid intake related to fever of 103°F and pneumonia as evidenced by signs of dehydration and low I & O.

**Interventions:** Encourage intake of fluids at all meals and between meals as well. Keep water or a beverage on hand within easy reach.

**Monitoring and Evaluation:** Improved I & O records; reduction of fever; normal skin turgor.
When possible, add more fiber to prevent constipation.
Ensure adequate potassium intake, as from fruits and juices.

Common Drugs Used and Potential Side Effects

- A 7-day course of low-dose hydrocortisone infusion speeds recovery from community-acquired pneumonia (CAP) and prevents complications due to sepsis (Confalonieri et al, 2005).
- Antibiotics, such as clarithromycin (Biaxin), are used in bacterial pneumonia. Nausea, diarrhea, and abdominal pain can occur.
- Telithromycin (Ketek) is used for the treatment of infections caused by bronchitis, bacterial sinusitis, and CAP.
- Analgesics are used to reduce pain and antipyretics are used to lessen fever.
- Cephalosporins are often useful for nursing home-acquired pneumonia (Muder et al, 2004). Cefotibiprole may be used against MRSA, Enterococcus faecalis, Enterobacteriaceae, and Pseudomonas aeruginosa.

Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of herbs or botanicals, such as echinacea, honeysuckle, garlic, dandelion, astragalus, and baikal skullcap in pneumonia patients.
- Vaccines are now also given against the pneumococcus organism (PCV), a common cause of bacterial pneumonia. Although the polysaccharide pneumococcal vaccine (PPV) does not prevent CAP, it might still improve outcomes in those who develop pneumonia (Johnstone et al, 2007).
- Flu vaccines are recommended for individuals with chronic illnesses such as heart and lung disorders, including asthma. Premature infants may need protection against respiratory syncytial virus (RSV). Individuals who have HIV infection may need protection against Pneumocystis carinii.
- Protect people who have pneumonia from others who have respiratory tract infections, such as the common cold.

Patient Education—Foodborne Illness

- Careful food handling will be important.
- Hand washing is key as well, especially after sneezing and coughing and before eating.

For More Information

- American Lung Association—Pneumonia
  http://www.lungusa.org/diseases/lungpneumonia.html
- KidsHealth
  http://kidshealth.org/kid/ill_injure/sick/pneumonia.html
- Medicine Net
  http://www.medicinenet.com/pneumonia/article.htm

PNEUMONIA—CITED REFERENCES


PULMONARY EMBOLISM

NUTRITIONAL ACUITY RANKING: LEVEL 1–2

DEFINITIONS AND BACKGROUND

A pulmonary embolism is caused by a partial or complete occlusion of a pulmonary artery from a blood clot from another part of the body that has found its way to the lung. The condition can be life-threatening. Sudden, sharp substernal pain, SOB, cyanosis, pallor, faintness, fever, hypotension, and wheezing can occur, sometimes followed by right heart failure. Approximately 10% of patients suffer some form of tissue death or pulmonary infarction.

Venous thrombosis most often starts in the calf veins and moves on to the lung. Thrombosis in the veins is triggered by venostasis, hypercoagulability, and vessel wall inflammation (the Virchow triad).
Common causes include recent surgery, fractures, immobility, burns, obesity, chemotherapy, old age, heart failure, polycythemia, ulcerative colitis, homocystinemia, and even pregnancy. It is actually one of the primary concerns during pregnancy (Stone and Morris, 2005). Hormone replacement therapy (HRT) is no longer recommended for women after menopause because of the increased risk for pulmonary embolism (Hillman et al, 2004).

Massive pulmonary embolism causes hypotension, with a systolic arterial pressure less than 90 mm Hg; mortality ranges from 30% to 60%. Nonmassive pulmonary embolism presents with systolic arterial pressure greater than or equal to 90 mm Hg and is much more common. Oxygen therapy is always initiated, and fibrinolytic therapy is the primary mode of treatment.

Interesting studies have been conducted to evaluate the role of diet on embolism. In the Iowa cohort study of older women, greater intake of alcohol was associated with a lower risk of incident thromboembolism; no associations were seen with “Western” or “Prudent” dietary patterns, fruit, vegetables, dairy, meat, refined grains, whole grains, regular soda, vitamins E, vitamin B6, vitamin B12, folate, omega-3 fatty acids, or saturated fat (Lutsey et al, 2009). In the Longitudinal Investigation of Thromboembolism Etiology study, greater intake of fish, fruit, and vegetables were noted as beneficial (Steffen et al, 2007). Clearly, more research is needed.

**ASSESSMENT, MONITORING, AND EVALUATION**

**INTERVENTION**

**OBJECTIVES**

- Prevent right-sided heart failure, atelectasis, and bleeding.
- Stabilize PT and INR if warfarin (Coumadin) is used.
- Maintain lung function through higher antioxidant intake.
- Normalize body temperature where there is fever.
- Replenish nutrients depleted by respiratory distress.
- Oxygenate tissues.
- Eliminate edema when present.

**FOOD AND NUTRITION**

- Use a regular or high-calorie diet; use a low-sodium diet for patients with edema.
- Increase fluid intake as tolerated.
- Control vitamin K in diet when PT cannot be stabilized.
- Small meals may be needed.

**SAMPLE NUTRITION CARE PROCESS STEPS**

**Involuntary Weight Loss**

**Assessment Data:** Poor oral intake and weight loss of 15 lb in 6 months; swallowing difficulty; decreased appetite and frequent coughing during meals.

**Nutrition Diagnoses (PES):** Involuntary weight loss related to poor oral intake, coughing at meals and swallowing difficulty as evidenced by 15 lb weight loss in 6 months.

**Interventions:**

- ND 4.5 Patient to use oxygen via nasal cannula during meals to assist with breathing and swallowing to improve energy levels.
- E2.2 Basic education tips on managing discomfort related to SOB by using—five to six small meals throughout the day that are easily prepared; consume main meal early in the day; drink fluids between meals; add protein and calories into meal items.
- RC2.2 Refer to local meals on wheels program for home-delivered meals 5 days per week.

**Monitoring and Evaluation:** Improvement in oral intake and weight status; fewer complaints of fatigue at mealtime; better appetite.
• Provide sufficient antioxidants such as vitamins C and E and selenium. A diet including more plant foods, alcohol, and fish and less red and processed meat may be suggested (Lutsey et al., 2009; Steffen et al., 2007).

**Common Drugs Used and Potential Side Effects**

• Rivaroxaban is a novel oral direct factor Xa inhibitor for prophylaxis in total knee and hip replacements, with few side effects and low potential for drug–food interactions (Chen and Lam, 2009). Liver enzymes should be checked during use.

• Heparin slows down clot progression and reduces risk of further clots. Warfarin (Coumadin) increases clotting times by thinning the blood. If problems in stabilizing the PT exist, controlled vitamin K may be needed. Use stable amounts of green leafy vegetables and fish.

• Fibrinolytic therapy is a primary treatment. Alteplase is generally infused over several hours. Tissue plasminogen activator (tPA) is also available for thrombolysis.

• Estrogen-containing contraceptives and hormone replacements may promote an embolism in susceptible women. Close medical monitoring is advised.

**Herbs, Botanicals, and Supplements**

• No clinical trials have proven efficacy for use of herbs or botanicals in pulmonary embolism.

**NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT**

• Explain sources of vitamin K in the diet. Therapy often continues for 3–6 months.

• Individuals on long airline flights should try to obtain some physical activity to prevent embolism.

**Patient Education—Foodborne Illness**

• Careful food handling will be important. Hand washing is key as well.

**For More Information**

- Emedicine
- Mayo Clinic
- Web MD

**PULMONARY EMBOLISM—CITED REFERENCES**


---

**RESPIRATORY DISTRESS SYNDROME**

**NUTRITIONAL ACUITY RANKING: LEVEL 3–4**

**DEFINITIONS AND BACKGROUND**

RDS may occur as part of systemic inflammatory response syndrome (SIRS), affecting approximately 70% of patients in the ICU. Acute respiratory distress syndrome (ARDS) develops within 24–48 hours in patients who have sepsis or who are critically ill, in shock, or severely injured. Other causes include infectious pneumonia, aspiration of food into the lung, several blood transfusions, pulmonary embolism, chest injury, burns, near drowning, cardiopulmonary bypass surgery, pancreatitis, overdose of drugs such as heroin, methadone, or aspirin.

ARDS has three pathologic stages: exudative, proliferative, and fibrotic. Patients often have pulmonary edema but have normal left atrial and pulmonary venous pressures.

In infants, RDS occurs in premature or low birth weight babies as hyaline membrane disease. Such babies are often born to mothers who have diabetes. Surfactant treatment may be of significant benefit in newborn infants with respiratory compromise (Finer, 2004).
One of the most common causes of ARDS in adults is sepsis. Here, a high-fat diet or formula with EPA may be beneficial. In ARDS, an overwhelming inflammatory response damages the endothelial-alveolar units, reducing oxygen diffusion and increasing pulmonary workload (Singer and Shapiro, 2009). Specialized enteral formulas may be beneficial adjunctive therapy by reducing lung inflammation and improving oxygenation (Malik and Zaloga, 2010; Priestley and Helfaer, 2004).

Indirect calorimetry (IC) accurately estimates a patient’s energy expenditure; this helps the health care team when there is weaning failure.

**ASSessment, Monitoring, AND Evaluation**

**Genetic Markers:** ARDS may have a relationship with tumor necrosis factor-α (TNFα), interleukin-b (IL-b), interleukin 10 (IL-10), and soluble intercellular adhesion molecule 1 (sICAM-1).

**Clinical/History**

<table>
<thead>
<tr>
<th>Height</th>
<th>Weight</th>
<th>BMI</th>
<th>Growth profile</th>
<th>Diet history</th>
<th>IC</th>
<th>I &amp; O</th>
<th>BP</th>
<th>Temperature</th>
<th>RQ</th>
</tr>
</thead>
</table>

**Lab Work**

- Complete blood count (CBC)
- Low blood pH (acidic)
- H & H
- Serum Fe, ferritin
- Transferrin
- pCO₂, pO₂
- Transthyretin
- Na⁺, K⁺, Ca²⁺, Mg²⁺
- Serum phosphorus
- BUN, Creat

**SAMPLE NUTRITION CARE PROCESS STEPS**

**Excessive Enteral Nutrition**

**Assessment Data:** Ventilator dependency for acute respiratory distress, ICU admission, inability to consume oral food and beverages, IC indicates energy needs as 1400 kcals/d; current TF order for 2000 kcals

**Nutrition Diagnoses (PES):** Excessive enteral nutrition related to overfeeding with order for 2000 kcals as evidenced by IC results suggesting 1400 kcals as sufficient.

**Interventions:** Nutrition prescription should change to match energy needs. Educate nutrition support team about results of IC (1400 kcals vs. current order for 2000 kcals). Suggest immuno-modulating diet (IMD) formula supplemented with fructo-oligosaccharides (FO).

**Monitoring and Evaluation:** Improved arterial blood gases; enteral nutrition formula tolerated; able to gradually wean from ventilator.

**INTERVENTION**

**OBJECTIVES**

- Identify the cause and remove the ongoing insult. Promote rapid recovery and oxygenation of tissues; support ventilator management.
- Prevent relapse. Avoid secondary insults through aggressive immune surveillance, complete nutrition, and adequate oxygen delivery.
- Counteract side effects of medications as ordered.
- Replace essential fatty acids, carnitine, and other nutrients.
- Prevent malnutrition, which depresses CNS output for ventilatory drive. Starvation decreases the desire to breathe, causing an abnormal breathing pattern, pneumonia, and atelectasis. Muscle mass (including diaphragm) varies with body weight, and refeeding may take 2–3 weeks.
- Prevent overfeeding (hepatic dysfunction, fatty liver, and CO₂ overproduction) and underfeeding (morbidity, mortality, and decreased response to therapy). Avoid refeeding syndrome.
- Prevent fluid overload.
- Support lung function, which is found to be better with higher antioxidant intake levels (Singer et al, 2006).
- An IMD that is supplemented with FO improves the outcome of medical ICU patients with SIRS/sepsis and ARDS (Marik and Zaloga, 2010).

**FOOD AND NUTRITION**

- Provide parenteral fluids and oxygen as needed.
- Progress, when possible, to oral feedings. Use TPN only if GI tract is nonfunctional. TPN-induced changes in CO₂ production occur if overfed (Plurad et al, 2009).
- For calories, use 30–35 kcal/kg. Nonprotein calories should come from 50% glucose and 50% lipid.
- Increased fat may be required to normalize the RQ. Fat also adds extra energy intake and palatability to the diet.
- Ensure adequate provision of EFA. Low linoleic acid status in critically ill RDS infants may require IVs with a fat emulsion added.
- Increase intake of omega-3 fatty acids, especially EPA and GLA (Singer et al, 2006). Enteral administration of fish oil, antioxidants and arginine improves oxygenation and clinical outcomes (Singer and Shapiro, 2009). Provide vitamins C and E and selenium at slightly higher than RDA levels, and fat-soluble vitamins in water-miscible form if necessary.
- Inositol supplementation promotes survival of premature infants with RDS (Howlett and Ohlsson, 2003).

**Common Drugs Used and Potential Side Effects**

- Heparin or warfarin (Coumadin) may be used as a blood thinner.
• Ventilator-dependent surgical patients receiving oxandrolone have prolonged courses of mechanical ventilation; oxandrolone may enhance collagen deposition and fibrosis in the later stages of ARDS and thus delay recovery (Bulger et al, 2004).

**Herbs, Botanicals, and Supplements**

• Use of n-3 PUFA targets the inflammatory response in ARDS (Singer and Shapiro, 2009).

**NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT**

- Discuss the role of fat intake on respiratory requirements. Fat decreases CO₂ production.
- Small, frequent feedings may be beneficial.
- Tight glucose control is needed.
- Prone positioning, especially for meals, is recommended.

**Patient Education—Foodborne Illness**

• Careful food handling will be important. Hand washing is key as well.

**RESPIRATORY FAILURE AND VENTILATOR DEPENDENCY**

**NUTRITIONAL ACUITY RANKING: LEVEL 4**

Absence of respirations, with confusion or unresponsiveness and failure of pulmonary gas exchange mechanism. Chronic pulmonary disease or an acute injury can cause ARF, which requires mechanical ventilation.

**TABLE 5-11 Causes of Respiratory Failure**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway obstruction</td>
<td>Chronic bronchitis, emphysema, bronchiectasis, cystic fibrosis, asthma, broncholithiasis, inhaled particles, subglottic stenosis, tumor, laryngeal edema</td>
</tr>
<tr>
<td>Poor breathing</td>
<td>Obesity, sleep apnea, drug intoxication, trauma, hypothyroidism</td>
</tr>
<tr>
<td>Neuromuscular disease</td>
<td>Myasthenia gravis, muscular dystrophy, polio, Guillain–Barré syndrome, botulism, polymyositis, stroke, amyotrophic lateral sclerosis, spinal cord injury</td>
</tr>
<tr>
<td>Abnormality of lung tissue</td>
<td>Acute respiratory distress, drug reaction, pulmonary fibrosis, fibrous alveolitis, widespread tumors, radiation therapy, sarcoidosis, burns</td>
</tr>
<tr>
<td>Abnormality of chest wall</td>
<td>Kyphoscoliosis, chest wound</td>
</tr>
</tbody>
</table>

**For More Information**

- Acute Respiratory Distress Clinical Network http://www.ardsnet.org/
- ARDS Support http://www.ards.org/

**RESPIRATORY DISTRESS SYNDROME—CITED REFERENCES**


---


**DEFINITIONS AND BACKGROUND**

RF involves ineffective gas exchange across the lungs by the respiratory system. Arterial blood gases should be used to determine the presence of RF and Table 5-11 lists common causes. Acute respiratory failure (ARF) involves sudden
Mechanical ventilation can be delivered with a plastic tube inserted through the nose or mouth into the trachea. A tracheostomy is safer and more comfortable for long-term ventilation for either pure oxygen or a mixture of oxygen and air.

Anabolic and catabolic hormones, muscle work, and nutritional status affect skeletal muscle mass and muscle strength. Substrate plus muscle work help to stimulate protein synthesis. Randomized controlled trials comparing early aggressive use of enteral nutrition with delayed, less-aggressive use of enteral nutrition suggest that providing early, aggressive enteral nutrition promotes improved clinical outcomes (Stapleton et al, 2007). In starvation, respiratory muscles are catabolized to meet energy needs; refeeding helps ventilatory response. Enteral feedings started within 24–48 hours may reduce length of time on a ventilator.

Daily screening of ventilator patients is recommended, followed by trials of spontaneous breathing. The process of weaning takes a few days and requires proper refeeding. Table 5-12 identifies ventilator-dependency feeding stages. The length of ventilator dependency time relates to energy and CHO intake. Aggressive immune surveillance, nutritional support, and fluid management are critical (Michaels, 2004).

Older patients are more at risk for RF and may be harder to wean (Sevransky and Haponik, 2003). Attention must be paid to factors such as electrolytes, infections, anemia, heart failure, medications, or hypothyroidism (Datta and Scalise, 2004). Use of an evidence-based nutrition support protocol improves the likelihood of meeting nutritional requirements (Mackenzie et al, 2005). Patients with RF often have 30% or higher increase in oxygen requirements. Too much oxygen can be damaging, though, so careful monitoring is needed. Lung function is found to be better with higher PaO2. 1–4 weeks muscles that are working harder; minimize CO2 production. Be careful not to overfeed. Check prealbumin levels and monitor fatigue. Get a Speech evaluation for swallowing. Assess for gastrostomy if needed.

Assessment, Monitoring, and Evaluation

Genetic Markers: Mutations in the ABCA3 transporter have been associated with childhood respiratory disease; there is a role for surfactant, a mixture of phospholipids, cholesterol, and hydrophobic proteins (Fitzgerald et al, 2007; Shulenin et al, 2004).

Clinical/History

<table>
<thead>
<tr>
<th>Stage</th>
<th>Objectives and Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubation/Acute Phase</td>
<td>Replenish muscle glycogen stores and reverse catabolism. Enteral nutrition by day 3; parenteral by day 7 if GI tract not functioning.</td>
</tr>
<tr>
<td>Preweaning</td>
<td>Maintain positive nitrogen balance, improve visceral protein stores, improve lean body mass, and promote weight gain. Evaluate albumin or prealbumin levels.</td>
</tr>
<tr>
<td>Weaning 1–4 weeks</td>
<td>Provide energy substrates to cover needs of respiratory muscles that are working harder; minimize CO2 production. Be careful not to overfeed. Check prealbumin levels and monitor fatigue. Get a Speech evaluation for swallowing. Assess for gastrostomy if needed.</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>Maintain nutrient needs despite anorexia or dysphagia; support anabolism. Maintain enteral nutrition at night until oral intake meets needs. If aspiration risk remains, continue gastrostomy.</td>
</tr>
</tbody>
</table>


Sample Nutrition Care Process Steps

Excessive CHO Intake

Assessment Data: IC indicates need for 1675 kcals daily. TF provides 65% CHO, 20% lipid, 15% protein; 2300 kcals total. ARF with ventilator dependency post motor vehicle accident. BMI 24. Serum glucose levels 350, 250, 301 on 3 days.

Nutrition Diagnoses (PES): Excessive CHO intake related to high CHO and energy content of TF formula as evidenced by ventilator dependency, elevated CO2 levels, and inability to wean.

Interventions: Evaluate enteral needs and select TF product that has less CHO. Calculate energy, protein, and fluid needs with a new product and provide rate and amount using continuous drip equal to 1675 kcals daily. Monitor use of insulin and adjust according to serum glucose levels.

Monitoring and Evaluation: Gradual weaning from ventilator dependency. Improved blood gases and lower CO2 production. Weight maintenance; BMI remaining at 24. Serum glucose within acceptable range.
INTERVENTION

OBJECTIVES

- Promote normalized nutritional intake despite hypermetabolic status of the patient and the prohibition of oral intake due to endotracheal tubes.
- Oxygenate tissues and relieve breathlessness; decrease CO₂ production.
- Monitor sensations of hunger when patients are unable to communicate their hunger and thirst.
- Prevent respiratory muscle dysfunction by ensuring that the patient is properly nourished.
- Provide intensive metabolic support with insulin therapy, an appropriate blood glucose target, nutrition risk assessment, early or combined enteral nutrition and PN, and close nutritional monitoring (Mechanick and Chiolero, 2008).
- Counteract hypotension caused by positive-pressure ventilation, acidosis, or both.
- Provide nutritional substrates that will maintain surfactant production and LBM. Achieve or maintain weight; note that not all patients are malnourished.
- Prevent atelectasis, pulmonary infection, sepsis, glucose or lipid intolerance, multiple organ dysfunction syndrome, and aspiration.
- Alleviate GI complications, which are a concern with mechanical ventilation. Hypomotility and diarrhea are common.
- Protocol-driven weaning reduces use of mechanical ventilation (Dries et al., 2004; Graham and Kirbey, 2006). Adjust goals as appropriate.
- Maintain flexible approaches to patient requirements. Nutritional supplements containing selenium, vitamins, and antioxidants may provide needed support to shift from catabolic to anabolic, reduce free radicals, and quiet inflammation (Meltzer and Moitra, 2008).

FOOD AND NUTRITION

- Begin nourishing the patient as soon as possible to wean the patient from the ventilator. Start a TF of low osmolality slowly to avoid gastric retention or diarrhea. Advance gradually and use continuous administrations unless contraindicated. Do not add blue food coloring to feedings to detect aspirate in tracheal secretions (Kattelman et al., 2006).
- Ambulatory adults need about 30 kcal/kg daily. In ICU, the goal of 20–25 kcal/kg is sought; if it cannot be met, then combined enteral and PN should be considered to reduce the risk of complications and longer length of stay (Scurlock and Mechanick, 2008).
- Increased needs occur from labored breathing; monitor using IC. Use of specialty products such as Pulmocare or Respalar may be recommended, but they are not always necessary. Include 2% of total fat as essential fatty acids with some omega-3 fatty acids.
- While hypermetabolism and malnutrition are common, there is no need for supplemental PN to increase caloric delivery in the early phase of critical illness (Stapleton et al., 2007). Monitor TPN carefully for complications such as pneumonia, refeeding syndrome from high-calorie loading, and increased CO₂ production.
- Patients with pulmonary edema should have their sodium intake reduced if needed. Include adequate protein in the diet to prevent additional fluid retention from lowered colloidal osmotic pressure.
- Supplement diet with a multivitamin supplement. Include antioxidant-rich foods for vitamins E, selenium, carotenoids, and vitamin C. Phosphorus and magnesium may be needed if stores are depleted.

Common Drugs Used and Potential Side Effects

- Bronchodilators, antibiotics, diuretics, or corticosteroids may be needed. Monitor side effects.
- For diarrhea, treatment depends on the cause. For *Clostridium difficile* infection, antibacterial therapy should be discontinued, if possible, and treatment with oral metronidazole should be initiated (Mutlu et al., 2005).

Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of herbs or botanicals in RF.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- A daily calorie count may be needed to assess the patient’s nutritional status.
- The greatest danger in using enteral nutrition is aspiration. Low-osmolarity products are essential, as well as elevation of the head of the bed.
- Discuss early satiety, bloating, fatigue, dyspnea as related to food or TF intake.
- Delivery of enteral nutrition in patients receiving mechanical ventilation is interrupted by practices required for the care of these patients (O’Meara et al, 2008). Discharge planning for the ventilator patient to return home is ideal.

Patient Education—Foodborne Illness

- Careful food handling will be important. Hand washing is key as well.

For More Information

- Merck Manual—Respiratory Failure
  http://www.merck.com/mmhe/sec04/ch055/ch055a.html
- Medicine Net
- Respiratory Failure
  http://www.med-help.net/AcuteRespiratoryFailure.html
RESPIRATORY FAILURE AND VENTILATOR DEPENDENCY—CITED REFERENCES


SARCOIDOSIS

NUTRITIONAL ACUITY RANKING: LEVEL 1–2

DEFINITIONS AND BACKGROUND

Sarcoidosis is a disease of undetermined origin with tiny patches of inflammation (granulomas) occurring in almost any organ. Pulmonary effects are most common. It develops most often between ages 20 years and 40 years, more often among women than men, and more commonly among Swedes, Danes, and African Americans. Sarcoidosis is more common among nonsmokers than among smokers.

In children, renal impairment of sarcoidosis usually is caused by either hypercalcemia leading to nephrocalcinosis or interstitial nephritis with or without granulomatia (Thumfart et al, 2005). Lofgren’s syndrome is a classic set of signs and symptoms involving fever, enlarged lymph nodes, arthritis in the ankles, or erythema nodosum. Overall, prognosis is good for most cases, and most sarcoidosis subsides on its own within 3 years. In 10% of cases, the condition becomes chronic. Sarcoidosis leads to organ damage in about one third of the people diagnosed; the lungs, heart, or brain may be affected.

Hypercalcemia can occur in patients with granulomatous disorders such as sarcoidosis, often related to high serum 1,25-dihydroxyvitamin D (OHD) concentrations (Falk et al, 2007). Endogenous antioxidant defense is significantly reduced, and oxidative stress underlies the pathology of this disease (Boots et al, 2009).

ASSessment, monitoring, and evaluation

Clinical/History BMI BP

Height Weight

Weight Diet history

Genetic Markers: Sarcoidosis CD4+ T cells are primarily responsible for the systemic responses. The 1-alpha-hydroxylase gene affects alveolar macrophages and disturbances in calcium metabolism.

CLINICAL INDICATORS

Genetic Markers: Sarcoidosis CD4+ T cells are primarily responsible for the systemic responses. The 1-alpha-hydroxylase gene affects alveolar macrophages and disturbances in calcium metabolism.
**INTERVENTION**

**OBJECTIVES**

- Reduce heart failure, BX, and related problems.
- Correct weight loss, anorexia, fever, and abdominal pain.
- Improve ability to breathe and eat normally.
- Prevent further deterioration of organ functions with any and all affected organ systems.
- Prevent or correct fluid retention.

**Tender red lumps on shins or ankles**

**Lupus pernio**

**Granulomas**

**Enlarged liver or spleen**

**Uveitis**

**SOB, cough**

**Night sweats**

**Bone or joint pain**

**Anorexia, weakness, aching joints**

**Abdominal pain, lymphadenopathy**

**Bone cysts in hands and feet**

**PH cor pulmonale**

**Clubbing of fingers, hypoxemia**

**Iritis, glaucoma, blindness**

**Chest pain, even heart failure**

**Chest x-ray biopsy**

**Gallium scan**

**TB test (rule out tuberculosis)**

**Pulmonary function tests**

**Lab Work**

**H & H (anemia common)**

**Serum Fe, ferritin Alb (decreased)**

**CRP (elevated)**

**Alkaline phosphatase (Alk phos)**

**Nitrogen (N) balance**

**Transferrin Globulin**

**Ca²⁺ (increased)**

**Ca²⁺ in urine (increased?)**

**Serum vitamin D₃**

**Na⁺, K⁺, Mg⁺⁺**

**Uric acid (increased)**

**PO₄ Kveim test**

**Erythrocyte sedimentation rate (ESR)**

- High levels of calcium may accumulate in the blood and urine. Monitor for related nausea, anorexia, vomiting, thirst, excessive urination, or renal failure.

**FOOD AND NUTRITION**

- Restrict salt if necessary for heart failure or for use of corticosteroids. A 2- to 3-g sodium diet may be beneficial.
- Use a diet containing adequate to high potassium (unless medications are used).
- Patients might benefit from antioxidants such as quercetin (Boots et al, 2009). More fruits and vegetables should be consumed.

**Common Drugs Used and Potential Side Effects**

- Prednisone is used to suppress severe symptoms such as SOB. Watch electrolytes, nitrogen balance, and other changes. Treatment may require several years.
- Methotrexate works best for treating sarcoidosis that affects lungs, eyes, skin, or joints. Folic acid depletion can occur (Low et al, 2008).
- Calcium-chelating agents may be used if hypercalcemia persists.
- Sarcoid granulomatous interstitial nephritis may respond to infliximab therapy (Thumfart et al, 2005). The drug seems to work against elevated TNF.
- For pain or fever, nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen may help.

**Herbs, Botanicals, and Supplements**

- No clinical trials have proven efficacy for use of herbs or botanicals in sarcoidosis.

**NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT**

- If the patient is using steroids, antacids could also be taken to reduce GI side effects. Check with the doctor.
- Discuss the role of diet in maintaining immunocompetence and in improving tolerance for other therapies.
- Follow regarding calcium and vitamin D supplements to avoid prolonged hypercalcemia and hypercalciuria. If needed, avoid intake of fish oils and excessive sun exposure.

**Patient Education—Foodborne Illness**

- Careful food handling will be important. Hand washing is key as well.

**For More Information**

SLEEP APNEA

NUTRITIONAL ACUITY RANKING: LEVEL 2–3

Sleep apnea may develop in any patient who has an endocrine disorder or is receiving certain hormonal therapies. Increases in habitual sleep duration is associated with elevations in CRP and IL-6 while reduced sleep duration is associated with elevated TNFα levels; activation of pro-inflammatory pathways may represent a mechanism by which extreme sleep habits affect health (Patel et al, 2009). IL-6, TNFα, and insulin levels are elevated in sleep apnea independently of obesity; visceral fat is the primary parameter linked with sleep apnea (Vgontzas, 2008).

Effective assessment and management of OSA may lead to a reduction in insulin resistance and hypertension as well as other markers of vascular risk in patients with metabolic syndrome (Yee et al, 2004). Untreated severe OSA results in elevated CRP levels and cardiovascular risks. Clinicians should be aware. Both atherosclerosis and OSA are associated with endothelial dysfunction; increased CRP, interleukin-6, fibrinogen, and plasminogen activator inhibitor; and reduced fibrinolytic activity. OSA has also been associated with enhanced platelet activity and aggregation and leukocyte adhesion on endothelial cells (Parish and Somers, 2004).

Obstructive sleep–disordered (OSD) breathing is common in children (3–12% of children snore); mild sleep apnea affects 1–10% of children (Chan et al, 2004). Risk factors of children who are more at risk for OSA are physical abnormalities of the face or skull, cerebral palsy, muscular dystrophy, Down syndrome, sickle cell disease, obesity, and mouth breathing. Consequences of untreated OSA include failure to thrive, enuresis, attention-deficit disorder, behavior problems, poor academic performance, and cardiopulmonary disease (Chan et al, 2004). Sleep deprivation and sleep apnea may even be related to some sudden infant death syndrome (SIDS) cases; upper airway obstruction and depressed arousability from sleep may contribute (Franco et al, 2004).

Treatment includes the use of continuous positive airway pressure (CPAP), weight loss in obese children, or adenotonsillectomy. Use of a CPAP device can be worn while sleeping. This device works to keep the airway open by continuously blowing air through the nasal passages at a high pressure. CPAP may help medically treated patients with heart failure and other cardiovascular conditions. In addition, some dental appliances may reposition the tongue or lower jaw so that the airway remains open while the patient sleeps, thus preventing the apnea. Surgical treatments may

DEFINITIONS AND BACKGROUND

Approximately 4% of middle-aged men and 2% of middle-aged women suffer from obstructive sleep apnea (OSA). OSA affects 12–18 million Americans and is associated with irritability, excessive daytime sleepiness, an inability to concentrate, depression, morning headaches, and decreased job performance in adults. Untreated sleep apnea also can increase an individual’s risk of heart attack, high BP, diabetes, stroke, and automobile accidents. OSA is often undiagnosed and is a major contributing factor in the development of essential hypertension.

Sleep apnea occurs in both genders and in all ages, weights, and ethnicities. Certain risk factors are associated with a higher incidence, such as excess weight or obesity (BMI >25); family history of sleep apnea; male sex; large neck (greater than 17 inches in men, greater than 16 inches in women); recessed chin; physical abnormality in the nose, throat, or upper airway structure; older age; smoking; use of alcohol or sleeping pills; ethnicity (African Americans, Pacific Islanders, and Hispanics seem to be at an increased risk); and snoring.
also be done, such as septoplasty, tonsillectomy, uvulopalatopharyngoplasty (UPPP, also known as UP3), and laser-assisted uvulopalatopharyngoplasty (LAUP).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: IL-6, TNFα, and insulin levels are elevated in sleep apnea.

Clinical/History

| Height | Weight | BMI | Abdominal adiposity? | PCOS? | Diet history | BP | Chest x-ray | Polysomnography (sleep study) | Hypopnea (less than normal breath) | Apnea–hypopnea index (AHI) | Respiratory disturbance index (RDI) | Epworth Sleepiness Scale (ESS) | Lab Work | Gluc | Serum insulin | CBC | H & H (anemia common) | Serum Fe, ferritin | CRP | Homocysteine Alb, transthyretin Ca++, Mg++, Na+, K+ | pCO2, pO2 |
|--------|--------|-----|----------------------|-------|--------------|----|-------------|-------------------------------|---------------------------------|-------------------------------|-------------------------------|-----------------------------|----------|-----|-------------|-----|----------------|-----------------------|-----|----------------|------------------------|----------|

INTERVENTION

OBJECTIVES

- If obese, weight loss will be beneficial. Obesity is associated with comorbidities such as PH, hypoventilation, and sleep apnea that may lead to disability or death (Poirier et al, 2009).
- In children with sleep apnea and failure to thrive, medical or surgical treatments may help to alleviate the problem so catch-up growth can occur. These children may have reduced upper airway muscle tone, evident mostly during REM sleep stages (Eckert et al, 2009).
- Lessen insulin resistance, where possible.
- Manage other medical and health complications that are present in the individual; cardiovascular disease, hypertension, or metabolic syndrome may coexist with OSA.

FOOD AND NUTRITION

- Lower energy intake to promote weight loss of 1–1.5 lb weekly if possible.
- Alter diet plan if needed to manage diabetes, sickle cell anemia, or other underlying conditions.
- The DASH diet or a calorie-controlled diet may be useful.

SAMPLE NUTRITION CARE PROCESS STEPS

Obesity and Metabolic Syndrome

Assessment Data: Divorced male, age 45, BMI 31, chronic hypertension, central adiposity, hx of sleep apnea with snoring, HDL 40, LDL 210, diet hx shows eating away from home six to eight times weekly, no cooking skills or interest, drinks two to three alcoholic beverages daily.

Nutrition Diagnoses (PES): Obesity related to excessive intake of energy-dense foods as evidenced by BMI 31, hypertension, sleep apnea, and central adiposity (waist 46)." Referral go to Sleep Disorder Clinic if interested.

Monitoring and Evaluation: Meal and food choices; improvement in BMI, BP, lipids; less problem with snoring and sleep apnea. Participation in Sleep Disorder Clinic evaluation.

Common Drugs Used and Potential Side Effects

- OSA can be induced, unmasked, or exacerbated by the effects of sedative, analgesic, and anesthetic agents (Jain and Dhand, 2004). Sleeping agents are not generally recommended.
- Treatment of depression or mood disorders may be needed. In patients who are on chronic neuroleptic drugs for schizophrenia, weight management will be very important.

Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of herbs or botanicals in sleep apnea.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Typically, patients diagnosed with sleep apnea are advised to avoid tobacco, alcohol, sedatives, and medications that relax the airway and/or reduce respiratory function.
- Regular exercise and weight reduction can help some patients with mild or moderate sleep apnea minimize their symptoms.
- Sleep apnea sufferers are advised to avoid sleeping on their back, if possible. Using pillows and other devices that help the patient sleep in a side position may help.
- The relationship of OSA with hypertension, stroke, and cardiovascular disease should be discussed.
- Help with obesity if needed, especially central adiposity (Schwartz et al, 2008).
- Patients who have cough, OSA, rhinosinusitis, and esophageal reflux clustered together can be categorized as having CORE syndrome (Arter et al, 2004).
THORACIC EMPYEMA

NUTRITIONAL ACUITY RANKING: LEVEL 2

DEFINITIONS AND BACKGROUND

Thoracic empyema involves accumulation of pus in the pleural cavity, sometimes as a complication of pneumonia. Complications may include septic shock, multiple organ failure, cardiac insufficiency, and end-stage renal failure. A chest tube may be placed (thoracentesis) to drain the infection.

In diaphragmatic injury, empyema is a rare but serious complication that can lead to prolonged hospital or ICU lengths of stay; gastric trauma is often associated (Bramparas et al, 2009). Use of prophylactic antibiotics may be prescribed.

An increase in the incidence of thoracic empyema in children has been noted, and the causative pathogen is often unknown (Saglani et al, 2005). Staphylococcus aureus is a common micro-organism isolated from the bacterial cultures, as is Mycobacterium tuberculosis (Ozel et al, 2004). With an increasing incidence of S. aureus, particularly MRSA, the use of video-assisted thoracoscopic surgery (VATS) results in a decreased duration of fever and length of hospitalization (Schultz et al, 2004).

ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: Most empyema is from pneumonia or trauma. The noted virulence of invasive pneumococcal disease (IPD) after the initiation of vaccine has led to speculation about antibiotic resistance in some individuals.

SAMPLE NUTRITION CARE PROCESS STEPS

Inadequate Oral Food and Beverage Intake

Assessment Data: Chronic cough and chest pain, fatigue and anorexia with weight loss of 12 lb in past month. Fever 102°F for past 3 days.

Nutrition Diagnoses (PES): Inadequate oral food and beverage intake related to anorexia, fever, tachycardia, chronic cough and chest pain from thoracic empyema as evidenced by weight loss of 12 lb in past month.

Interventions: Educate about simple, nutrient and energy-dense meals and snacks. Counsel about ways to lessen fatigue with mealtime preparation. Coordinate care with home-delivered meals or shopping assistance when discharged.

Monitoring and Evaluation: Improved oral food and beverage intake as per patient food diary and weight gain of 5 lb in 3 weeks after returning home. Fewer complaints of anorexia or poor nutrition quality of life.
INTERVENTION

OBJECTIVES

• Lessen fatigue; promote improved well-being.
• Reduce fever. Prevent sepsis, organ failure, and other complications.
• Correct weight loss.
• Control and reduce anorexia.
• Support the capacity for wound healing if surgery is needed.

FOOD AND NUTRITION

• Provide diet as ordered. Patient may need high-calorie/high-protein foods served at frequent intervals.
• Two or more liters of fluid may be needed daily, unless contraindicated.
• Meals should be served in an attractive manner to stimulate appetite.
• A multivitamin–mineral supplement may be useful.

Common Drugs Used and Potential Side Effects

• Antibiotics such as streptokinase are common (Cameron and Davies, 2004). Monitor side effects accordingly.
• Monitor effects of other medications as prescribed.

Herbs, Botanicals, and Supplements

• No clinical trials have proven efficacy for use of herbs or botanicals in thoracic empyema.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

• Discuss the role of nutrition in illness and recovery, especially as it relates to immunocompetence.
• With family, discuss signs to observe for future problems or relapses.

Patient Education—Foodborne Illness

• Careful food handling will be important. Hand washing is key as well.

For More Information

• Empyema
• NIH—Empyema
• Thoracic Empyema

THORACIC EMPYEMA—CITED REFERENCES


TRANSPLANTATION, LUNG

NUTRITIONAL ACUITY RANKING: LEVEL 3–4

DEFINITIONS AND BACKGROUND

Lung transplantation (LTX) is an accepted treatment for end-stage pulmonary parenchymal and vascular diseases. LTX is a well-tolerated, effective therapy for RF with interstitial lung disease, CF or COPD. The International Society for Heart and Lung Transplantation and the Cystic Fibrosis Foundation have uniform guidelines for transplantation candidate selection. Over 13,000 LTXs have occurred worldwide (Tynan and Hasse, 2004).

Proper nutrition plays a key role in preparing for LTX. Therefore, the LTX dietitian plays an important role and meets with the patient for an initial interview. Weight and weight history, foods typically eaten, and appetite are reviewed. Being at ideal body weight range for height helps assure good physical condition for pretransplantation pulmonary rehabilitation and for the transplantation itself. Certain patients with advanced pulmonary disease are unable to eat enough to maintain ideal body weight because of increased metabolic demands and breathlessness with eating. In such situations, it may be recommended that a percutaneous endoscopic gastrostomy (PEG) feeding tube be placed.

Proper nutrition is critical to maximize the chances of a successful transplantation. Occasionally, listing for transplantation will be delayed until the patient’s nutritional status improves. LBM depletion may be associated with more severe hypoxemia, reduced walking distance, and a higher mortality. Both undernutrition and obesity should be carefully managed before surgery. Diabetes is a common problem after LTX in CF patients even though quality of life is dramatically improved (Hadjiliadis, 2007).

As with other types of transplantations, graft–host resistance and sepsis are the major concerns after LTX. Infections are the most common cause of morbidity and mortality in LTX recipients. Immunosuppressive therapy with glucocorticoids contributes to protein degradation.
Nitrogen balance after LTX is negative because of high glucocorticoid requirements; aggressive nutritional intervention and increased nitrogen intake are needed to reduce protein losses in these patients. Chronic infection (bronchiolitis obliterans syndrome) is the most common cause of death after transplantation (Quattrucci et al, 2005).

SAMPLE NUTRITION CARE PROCESS STEPS

**Inadequate Protein Intake**

**Assessment Data:** BMI 18, recent weight loss of 20 lb, lung failure with planned Tx surgery, low serum albumin.

**Nutrition Diagnoses (PES):** Inadequate protein intake related to loss of LBM and insufficient oral intake as evidenced by albumin 2.1 and diet history showing low meat and milk consumption.

**Interventions:** Enhance meals by adding dry milk powder to recipes such as mashed potatoes and casseroles; offer puddings, eggnog and oral supplements between meals; add protein powder scoops to milkshakes or soups. Educate patient and family about the importance of protein for maintaining LBM and wound healing.

**Monitoring and Evaluation:** Improved intake of protein-rich foods. Successful wound healing after surgery. Improvement in weight and BMI over several months.

---

**ASSESSMENT, MONITORING, AND EVALUATION**

**OBJECTIVES**

**Preoperative**
- Because nutritional depletion in LTX candidates is highly prevalent, it should be precisely assessed both before and after LTX. Attempts should be made to increase LBM and reverse cachexia and vitamin and mineral deficiencies before LTX.
- Prepare for a surgical procedure. Most patients will require sodium or fluid restrictions; monitor serum potassium as well.
- Allow for mild weight loss with a planned diet if the patient is obese and has time to do this.

**Postoperative**
- Prevent infection, surgical complications, organ rejection, and organ failure.
- Promote wound healing.
- Support ideal body weight and LBM maintenance.
- Reduce protein losses, support nitrogen balance, and correct hypoalbuminemia.

---

**ASSESSMENT**

**Clinical/History**
- Height
- Weight
- BMI
- Weight changes
- Diet history
- RQ
- Ventilator support
- I & O

**Lab Work**
- Alb, transthyretin
- CRP
- Transferrin
- Chol, Trig
- H & H
- Serum Fe, ferritin
- Gluc
- BUN, Creat
- Na⁺, K⁺
- Ca²⁺, Mg²⁺
- PO₄
- AST, ALT
- TLC
- CRP
- pCO₂, pO₂

---

**GENETIC MARKERS**

Organ transplant researchers are increasingly using microarrays to identify specific patterns of gene expression that predict and characterize acute and chronic rejection. Increased expression of genes involved in inflammation, apoptosis, and T-cell activation and proliferation may play a role in organ rejection (Lande et al, 2007).

**FOOD AND NUTRITION**

**Preoperative**
- Prepare patient nutritionally to alleviate malnutrition in advance (Inouye et al, 2004). Home enteral or PN may be useful.
- Promote adequate intake of kcal (25–30 kcal/kg) and protein (1 g/kg body weight).
- Manage coexisting problems such as diabetes, heart disease, and hypertension with an appropriate diet such as the DASH diet.

**Postoperative**
- Return to oral intake by 48–72 hours postoperatively, when possible. Limit simple CHO when there are signs of hyperglycemia (Tynan and Hasse, 2004).
- Promote adequate intake of kcal (30–35 kcal/kg) and protein of 1.3–1.5 g/kg body weight (Tynan and Hasse, 2004). Use high nitrogen TF when needed, but do not overfeed, and monitor for needed changes in electrolytes according to lab values. Discontinue TF when intake meets >60% of estimated needs (Tynan and Hasse, 2004).
- Parenteral solutions may be used if the gut is nonfunctioning (Tynan and Hasse, 2004).
- Calorie-dense options should be considered if fluid restriction is required. Use caution with high-caloric loads because of RQ; maintain sufficient fat intake to prevent excess CO₂ production from a high-CHO intake.
- Restrict sodium and potassium if needed to improve cardiac or renal status.
Reduce energy intake and increase activity if weight gain or diabetes occurs after long-term corticosteroid use (Tynan and Hasse, 2004).

Prevent osteoporosis by using adequate calcium and vitamin D. Provide sufficient magnesium and vitamins to heal and promote adequate nutritional status.

Common Drugs Used and Potential Side Effects

- Using tacrolimus as primary immunosuppressant for lung transplant recipient results in comparable survival and reduction in acute rejection episodes when compared with cyclosporine (Fan et al, 2009). See Table 5-13 for more information.

Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of herbs or botanicals after LTX.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Discuss appropriate calorie and protein levels. Protein helps to heal after surgery.
- Drink plenty of water until restriction is prescribed.
- Decreased saturated fat and cholesterol intakes may be useful to decrease cardiac risks and to prevent unwanted weight gain, which is common. Read food labels and monitor portions carefully. Choose condiments such as mustard rather than mayonnaise or salad dressing. Choose healthy cooking methods. Instead of frying, try baking, grilling, broiling, or steaming foods; instead of oil, use nonstick, fat-free spray or sauces.
- Adequate fiber (from fresh fruits, vegetables, and whole grains) is important.
- A gradual return to activity will be important.
- Eat a minimum amount of salt, processed foods, and snacks. Use herbs and spices to add flavor instead of salt.
- Avoid alcohol and do not use drugs that are not prescribed.

Preventing infection is very important after transplantation surgery. Hand washing is critically important.

Careful food handling will be important.

For More Information

- Cystic Fibrosis—Transplantation http://www.cff.org/treatments/LungTransplantation/
- International Society for Heart and Lung Transplantation http://www.isHLT.org/
- Organ Procurement and Transplantation Network http://www.optn.org/
- Transplant Terms http://www.transplantliving.org/Community/glossary.aspx
- Trans Web http://www.transweb.org/
TUBERCULOSIS

NUTRITIONAL ACUITY RANKING: LEVEL 1–2

**DEFINITIONS AND BACKGROUND**

TB is caused by a tubercle bacillus (*Mycobacterium tuberculosis*) invading the lungs and setting up an inflammatory process. Healing occurs with a calcification of the tubercular cavity. TB causes loss of appetite, constant fatigue, tissue wasting, exhaustion, hemoptysis, cough lasting 3 weeks or longer with occasional blood-tinged sputum, fever or chills, profuse night sweats, and weight loss. The acute form resembles pneumonia; the chronic form causes low-grade fever.

Nearly one third of the world’s population is infected with *M. tuberculosis* (Pai et al, 2006). More than 9 million new cases were reported in 2007, many of them in Africa. An increase in TB in the United States may be related to inadequate compliance with prescribed drug therapy or to recently acquired or reactivated latent infections. Among U.S. born citizens, non-Hispanic African American, Mexican Americans, and individuals living in poverty have the highest risk for TB (Bennett et al, 2008). Immunocompromised persons are more vulnerable to the effects of TB, especially those persons who have HIV infection. Hypermetabolism appears to play a role in the wasting process in patients infected with both HIV and TB. HIV infection is associated with a significant downregulation of whole-body protein flux, adding to the nutritional decline if TB is also present (Paton et al, 2003).

Vitamin D signaling within macrophages enables them to respond to and kill *Mycobacterium tuberculosis* organisms (Bikle, 2008; Shapira et al, 2009). This is an intracrine–autocrine–paracrine system for vitamin D that is just being recognized (Adams et al, 2007).

Active TB begins in the lungs but often spreads through the bloodstream as extrapulmonary TB. Fatigue, abdominal tenderness, painful urination, headache, SOB, arthritis-like symptoms, kidney damage, and pain in the spine and bones can occur. TB meningitis is a very dangerous complication, especially for the elderly.

Many TB patients have early, unplanned readmission and often need assistance with activities of daily living. They may have drug complications, the need to use a nonstandard drug regimen, and other illnesses. With a high prevalence of malnutrition, a relatively low utilization rate of nutritional services, and the potential effect of adverse reactions to therapeutic drugs, careful attention is needed for this patient population.
ASSESSMENT, MONITORING, AND EVALUATION

CLINICAL INDICATORS

Genetic Markers: It is suspected that TB has connections with allergy. There are higher levels of specific IgE, interleukin (IL)-6, and interferon (IFN) gamma to different inhalant allergens in TB patients; successful treatment lowers these levels (Ellertsen, 2009). In addition, polymorphisms in the gene that encodes the vitamin D receptor (VDR) influence host response to Mycobacterium tuberculosis (Roth et al, 2004).

Bioconversion of 25-hydroxyvitamin D₃ (25D₃) into bioactive 1,25D₃, leading to VDR activation and antimicrobial activity against intracellular TB (Kruitzik et al, 2008).

Clinical/History

<table>
<thead>
<tr>
<th>Test</th>
<th>Biopsy or sputum test for M. tuberculosis</th>
<th>Temperature, fever or chills</th>
<th>Night sweats</th>
<th>Anorexia</th>
<th>Spinal tap for polymerase chain reaction (PCR)</th>
<th>I &amp; O</th>
<th>Alb, transthyretin</th>
<th>CRP</th>
<th>RBP</th>
<th>TLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet history</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mantoux skin test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QuantiFERON®, TB Gold test (QFT-G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSPOT® TB test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest x-rays (irregular white areas on dark background)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronchoscopy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood-tinged sputum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lab Work

<table>
<thead>
<tr>
<th>Test</th>
<th>Lymphopenia?</th>
<th>H &amp; H</th>
<th>Serum Fe, ferritin</th>
<th>Normocytic anemia?</th>
<th>Serum pyridoxine</th>
<th>N balance</th>
<th>Chol (decreased)</th>
<th>Na⁺, K⁺, Ca⁺⁺, Mg++</th>
<th>Serum folate</th>
<th>Transferrin</th>
<th>BUN, Creat</th>
<th>Liver function tests (from medication use)</th>
</tr>
</thead>
</table>

INTERVENTION

OBJECTIVES

- Maintain or prevent losses in weight. Reduce fever. The basal metabolic rate is 20–30% above normal to counteract fever of 102°F or higher.
- Normalize serum calcium and vitamin D₃ levels; either hypocalcemia or hypercalcemia may occur.
- TB often coincides with nutritional deficiencies; micronutrient supplementation may improve the outcome in patients undergoing TB treatment (Villamor et al, 2008).

Involuntary Weight Loss

Assessment Data: Analysis of estimated oral intake below estimated needs.

Nutrition Diagnosis (PES): Involuntary weight loss related to insufficient intake and frequent coughing spells, medication-related GI symptoms as evidenced by 15-lb weight loss since TB diagnosis months ago.

Intervention: Food and nutrient delivery with careful timing of meals and snacks in relation to medication administration and coughing episodes. Small, frequent meals and oral supplements.

Monitoring and Evaluation: Monitor and evaluate changes in intake and weight; tolerance for medications; and nutritional quality of life.

Common Drugs Used and Potential Side Effects

- Replace nutrient losses from lung hemorrhage, if present.
- Promote healing of the cavity.
- Counteract neuritis from isoniazid (INH) therapy, when used.
- Stimulate appetite, which is generally poor.
- Prevent dehydration.
- Prevent lung inflammation, infections, and complications.

Food and Nutrition

- Use a well-balanced diet containing liberal amounts of protein and adequate calories. It may be useful to calculate needs as 35–45 kcal/kg if weight loss has been significant.
- Use adequate fluids (35 cc/kg) unless otherwise contraindicated.
- Add more omega-3 fatty acids; they may improve food intake, restore normal eating patterns, and prevent body weight loss (Ramos et al, 2004).
- Ensure that the diet provides sufficient levels of calcium and vitamin D.
- Iron and vitamin C are needed for proper hemoglobin formation and wound healing.
- B-complex vitamins, especially vitamin B₆, are needed to counteract INH therapy.
- Use supplemental vitamin A as carotene as it is poorly converted.
- Alcohol should not be used as a calorie replacement or appetite enhancer.

FOOD AND NUTRITION

- Use a well-balanced diet containing liberal amounts of protein and adequate calories. It may be useful to calculate needs as 35–45 kcal/kg if weight loss has been significant.
- Use adequate fluids (35 cc/kg) unless otherwise contraindicated.
- Add more omega-3 fatty acids; they may improve food intake, restore normal eating patterns, and prevent body weight loss (Ramos et al, 2004).
- Ensure that the diet provides sufficient levels of calcium and vitamin D.
- Iron and vitamin C are needed for proper hemoglobin formation and wound healing.
- B-complex vitamins, especially vitamin B₆, are needed to counteract INH therapy.
- Use supplemental vitamin A as carotene as it is poorly converted.
- Alcohol should not be used as a calorie replacement or appetite enhancer.

Common Drugs Used and Potential Side Effects

- Current anti-TB chemotherapies, although effective, are associated with side effects and are limited in treating drug-resistant strands (Shapira et al, 2009).
- See Table 5-14 for more drug therapies.
Herbs, Botanicals, and Supplements

- No clinical trials have proven efficacy for use of eucalyptus, echinacea, garlic, licorice, honeysuckle, or forsythia in TB management.
- Deficiencies of multiple micronutrients (MMN) are common in developing countries or where TB is common; outcomes are better using MMN than when providing just one to two micronutrients (Allen et al, 2009). Vitamins D, E, and selenium are supplements that should be highlighted.

NUTRITION EDUCATION, COUNSELING, CARE MANAGEMENT

- Add protein powders or nonfat dry milk to beverages, casseroles, soups, and desserts to increase protein and calcium intake, unless contraindicated for other medical reasons.
- Encourage preparation of small, appetizing meals. Plan rest periods before and after meals.
- Discuss tips for managing anxiety related to weight loss, night sweats, loss of strength, high fever, and abnormal chest x-rays.
- Discuss communicability of TB. Family members and those living in proximity should have x-rays and other tests. About 5% of exposures result in TB within 1 year; others may be dormant until another condition sets in such as HIV infection, diabetes, or leukemia.
- Promote adequate rehabilitation if the patient is an alcoholic.
- Promote as much quality of life as possible; this is often overlooked (Marra et al, 2004).

A TB vaccine is available. The BCG (bacille Calmette-Guérin) vaccine for TB disease is not widely used in the United States, but it is often used in other countries where TB is common.

Patient Education—Foodborne Illness

- Careful food handling will be important. Foodservice employees who are exposed to those at risk for active TB should be tested regularly. People are at risk and may need to be tested if they:
  - Have symptoms of active TB disease
  - Have been exposed to someone (family member, friend, or coworker) who has active TB
  - Have HIV infection, diabetes, or chronic kidney failure
  - Take steroids or other immune-suppressing drugs for chronic medical conditions
  - Live or work in a homeless shelter, prison, hospital, nursing home, or other group setting
  - Have recently moved from a region with active TB (Africa, Asia, the Caribbean, Eastern Europe, and Latin America).
- When preparing food:
  - Separate raw meat from cooked or ready-to-eat foods. Do not use the same chopping board or the same knife for preparing raw meat and cooked or ready-to-eat foods.
  - Do not handle either raw or cooked foods without washing hands in between.
  - Do not place cooked meat back on the same plate or surface it was on before it was cooked.
  - All foods from poultry should be cooked thoroughly, including eggs. Egg yolks should not be runny or liquid. Because influenza viruses are destroyed by heat,

### TABLE 5-14 Medications Used for Tuberculosis (TB)

<table>
<thead>
<tr>
<th>Medication</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aminosalicylic acid</td>
<td>Interferes with vitamin B₁₂ and folate absorption. Nausea and vomiting are common.</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>Chemotherapy can increase serum calcium levels.</td>
</tr>
<tr>
<td>Ethionamide (Trecator-SC)</td>
<td>Requires a vitamin B₆ supplement. It may cause anorexia, metallic taste, nausea, vomiting, diarrhea, weight loss, and hypoglycemia.</td>
</tr>
<tr>
<td>Ethambutol (Myambutol)</td>
<td>May cause GI distress, nausea, or anorexia. It should not be used longer than 2 months because it can harm the eyes.</td>
</tr>
<tr>
<td>Immunotherapy</td>
<td>According to the Centers for Disease Control and Prevention (2004): TB disease is a potential adverse reaction from treatment with tumor necrosis factor-alpha (TNF-α) antagonists infliximab (Remicade), etanercept (Enbrel), and adalimumab (Humira). These products block TNF-α, an inflammatory cytokine, and are approved for treating rheumatoid arthritis and other selected autoimmune diseases. Blocking TNF-α can allow TB disease to emerge from latent Mycobacterium tuberculosis infection. Health care providers should take steps to prevent TB in immunocompromised patients and remain vigilant for TB as a cause of unexplained fever.</td>
</tr>
<tr>
<td>Isoniazid (INH)</td>
<td>May cause neuritis by depleting vitamin B₁₂; usual dose is 300 mg INH with 50 mg pyridoxine. Bad taste can be disguised in pureed fruit or jam to make it palatable, especially for pediatric patients. Niacin, calcium, and vitamin B₁₂ are also depleted. Nausea, jaundice, vomiting, stomach cramping, and dry mouth are common. INH must be taken for 9 months to eradicate the condition completely.</td>
</tr>
<tr>
<td>Pyrazinamide (PZA)</td>
<td>May cause anorexia, nausea, and vomiting. It can be hepatotoxic.</td>
</tr>
<tr>
<td>Rifampin (Rifadin, Rimactane)</td>
<td>Has side effects such as anorexia and GI distress.</td>
</tr>
<tr>
<td>Streptomycin</td>
<td>One of the first drugs used to treat TB. It is given by injection. Use of longer than 3 months can affect balance and hearing.</td>
</tr>
</tbody>
</table>

NOTE. Therapy always involves two or more drugs because of the long-term treatment period required.
the cooking temperature for poultry meat should reach 70°C (158°F).

- Wash egg shells in soapy water before handling and cooking, and wash hands afterwards.
- Do not use raw or soft-boiled eggs in foods that will not be cooked.
- After handling raw poultry or eggs, wash hands and all surfaces and utensils thoroughly with soap and water.
- Do not eat uncooked or undercooked poultry or poultry products, including food with uncooked poultry blood.

For More Information

- CDC
  http://www.cdc.gov/tb/links/default.htm
- JAMA—Patient page for TB
- Joint HIV/TB Interventions
  http://www.who.int/hiv/topics/tb/tuberculosis/en/
- Lung Association of Canada
  http://www.lung.ca/diseases-maladies/tuberculosis-tuberculose_e.php
- National Tuberculosis Curriculum Consortium
  http://ntcc.ucsd.edu/
- National TB Center
  http://www.nationaltbcenter.edu/
- NIH—Medline
- Travelers Health Website
  http://www.cdc.gov/travel
- World Health Organization
  http://www.who.int/tb/en/

TUBERCULOSIS—CITED REFERENCES

Ellertsen IJ. Allergic sensitization in tuberculosis patients at the time of diagnosis and following chemotherapy. BMC Infect Dis. 9:100, 2009.