Adult Nutrition Assessment Tutorial

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Abstract

This tutorial presents a systematic approach to nutrition assessment based on a modern appreciation for the contributions of inflammation that serve as the foundation for newly proposed consensus definitions for malnutrition syndromes. Practical indicators of malnutrition and inflammation have been selected to guide diagnosis that include medical/surgical history and clinical diagnosis, clinical signs and physical examination, anthropometric data, laboratories, dietary assessment, and functional outcomes. Knowledge of systematic nutrition assessment and appropriate diagnosis of malnutrition will help to guide proper interventions and expected outcomes. (*JPEN J Parenter Enteral Nutr.* 2012;36:267-274)

Keywords

administration; adult; nutrition assessment

There is growing understanding that varying degrees of acute or chronic inflammation are key factors in the pathophysiology of disease or injury-associated malnutrition.[1-4] It has also become clear that historic nutrition assessment indicators such as serum albumin and prealbumin are dramatically affected by inflammatory response. Appropriate diagnosis of malnutrition will help to guide proper interventions and expected outcomes. Unfortunately, malnutrition is often unrecognized or misdiagnosed by health practitioners.[5] Proper diagnosis requires fundamental knowledge of assessment methods. This tutorial draws on a more comprehensive chapter by these same authors in the 3rd edition of the *A.S.P.E.N. Adult Nutrition Support Core Curriculum*.[6] A systematic approach to nutrition assessment will be described that incorporates a modern appreciation for the contributions of inflammation that serve as the basis for the new consensus definitions for malnutrition syndromes proposed by an International Guideline Committee convened under the auspices of the American Society for Parenteral and Enteral Nutrition and the European Society for Clinical Nutrition and Metabolism.[4] A more detailed review of application of these assessment concepts to the critical care setting is presented elsewhere.[7]

Malnutrition Syndromes and Their Assessment

The proposed syndromes[4] include starvation-associated malnutrition, when there is chronic starvation without inflammation (eg, anorexia nervosa [case study 1] or major depression with lack of interest in eating); chronic disease-associated malnutrition, when inflammation is chronic and of mild to moderate degree (eg, organ failure [case study 2], pancreatic cancer, rheumatoid arthritis, or sarcopenic obesity [case study 3]); and acute disease or injury-associated malnutrition, when inflammation is acute and of severe degree (eg, major infection, burns, trauma [case study 4], or closed head injury). Depending on the circumstances, it can be appropriate to diagnose a patient with 1 or more of these syndromes, and as the clinical course evolves, patients may change from one syndrome to another.

No single clinical or laboratory parameter can be recommended as an indicator of comprehensive nutrition status, so data must be collected from a variety of domains. A systematic approach to assessment is therefore detailed below to guide diagnosis using indicators of malnutrition and inflammation that include medical/surgical history and clinical diagnosis, clinical signs and physical examination, anthropometric data, laboratory indicators, dietary assessment, and functional outcomes (Table 1). Clinically relevant micronutrient deficiencies may be detected in association with any of the malnutrition syndromes, but a more detailed discussion of their assessment is beyond the scope of this focused tutorial.

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Table 1. Systematic Approach to Nutrition Assessment

- ***History and clinical diagnosis*** can be a helpful guide to raise suspicion for the presence of inflammation and malnutrition
- ***Clinical signs and physical examination***
  - Clinical indicators of inflammation may include fever or hypothermia as well as other nonspecific signs of systemic inflammatory response such as tachycardia
  - Physical examination can reveal signs of edema, weight gain/loss, and specific nutrient deficiencies.
- ***Anthropometric data***
  - Weight loss and underweight status are well-validated indicators of malnutrition. Height, weight, skin-folds, circumferences, and other assessments of body composition are helpful
- ***Laboratory indicators*** of inflammatory response and possible protein malnutrition (serum albumin, prealbumin) should be interpreted with caution. Other useful laboratory indicators of inflammation can include elevated C-reactive protein, white blood cell count, and glucose. Negative nitrogen balance and elevated resting energy expenditure may also be used to support the presence of systemic inflammatory response.
- ***Dietary data*** may be obtained in practical fashion using a modified diet history and/or 24-hour recall.
- ***Functional outcomes*** such as strength and physical performance may also be tested as additional supportive findings

Adapted with permission from *A.S.P.E.N. Adult Nutrition Support Core Curriculum*, 3rd ed.

Medical/Surgical History and Clinical Diagnosis

Knowledge of the medical/surgical history and clinical diagnoses is particularly helpful in raising concern for inflammation and malnutrition in a given patient. Weight loss is perhaps the best validated nutrition assessment parameter.[8,9] It is also often a sign of underlying disease or inflammatory condition. Ascertain the degree and duration of weight loss to appreciate its clinical significance. For example, a moderate loss of 10% of body weight over the preceding 6 months is notable, whereas a severe loss of 30% of body weight over the same duration is life-threatening. Weight loss history is often unavailable or unreliable,[10] so it is important to query the patient as well as the medical records, family, and caregivers as indicated.

Patients are admitted to the hospital with conditions, injuries, or complications that may in turn be associated with an acute inflammatory response. Examples of conditions often characterized by severe acute inflammatory response include critical illness, major infection/sepsis, adult respiratory distress syndrome, systemic inflammatory response syndrome, severe burns, major abdominal surgery, multitrauma, and closed head injury. A great variety of other conditions or diseases are more typically associated with a chronic inflammatory response that is mild to moderate in severity (Table 2). Note that acute inflammatory events may frequently be superimposed on those with chronic conditions; for example, a patient with chronic obstructive pulmonary disease is admitted to the hospital with pneumonia and acute respiratory failure. It is also important to recognize those medical/surgical conditions or chronic diseases that place one at greater risk to become malnourished. Such conditions or diseases may contribute to malnutrition by increasing nutrition requirements or compromising intake or assimilation (Table 2).

Nutrition assessment also includes a thorough review of medications. Practitioners should have knowledge of the potential drug-nutrient interactions of medications that they prescribe. Drugs may promote anorexia or interfere with the absorption, metabolism, and excretion of nutrients. Foods and nutrients can in turn modify drug absorption, metabolism, and excretion.

Clinical Signs and Physical Examination

Fever, hypothermia, and tachycardia are nonspecific clinical indicators of inflammation. The nutrition-oriented physical examination should be attentive to edema as well as findings consistent with weight gain/loss and specific nutrient deficiencies. The knowledgeable practitioner will give careful examination to those parts of the body where high cell turnover occurs (eg, hair, skin, mouth, tongue) as they are the most likely to manifest observable signs of nutrition deficiencies. Physical findings of weight loss associated with mobilization of muscle and subcutaneous fat should not be missed. When appreciable edema is present, weight loss and reduction in body cell mass may not be readily appreciated.

Anthropometric Data

Obtaining repeated body weight measurements over time is recommended to monitor weight change trends because reliance on self-reported weights or other sources of data may prove unreliable. Patients who can stand should be weighed in a consistent manner without overgarments or shoes. Those who cannot stand may require use of a chair or bed scales. Appropriate calibration of scales and staff training in their use are essential to secure valid measurements. Height should ideally be measured in a standing position without shoes using a

Table 2. Association of Medical/Surgical Conditions and Chronic Diseases With Nutrition Risk and/or Inflammatory Response

- Look for medical or surgical conditions or chronic disease that can place one at nutrition risk secondary to increased requirements, or compromised intake or assimilation such as critical illness, severe burns, major abdominal surgery, multitrauma, closed head injury, previous gastrointestinal surgery, severe gastrointestinal hemorrhage, enterocutaneous fistula, gastrointestinal obstruction, mesenteric ischemia, severe acute pancreatitis, chronic pancreatitis, inflammatory bowel disease, celiac disease, bacterial overgrowth, solid or hematologic malignancy, bone marrow transplant, acquired immune deficiency syndrome, and organ failure/transplant (kidney, liver, heart, lung, or gut).
- A number of conditions or diseases are often characterized by severe acute inflammatory response, including critical illness, major infection/sepsis, adult respiratory distress syndrome, systemic inflammatory response syndrome, severe burns, major abdominal surgery, multitrauma, and closed head injury.
- Many conditions or diseases are more typically associated with mild to moderate chronic inflammatory response. Examples include cardiovascular disease, congestive heart failure, cystic fibrosis, inflammatory bowel disease, celiac disease, chronic pancreatitis, rheumatoid arthritis, solid tumors, hematologic malignancies, sarcopenic obesity, diabetes mellitus, metabolic syndrome, cerebrovascular accident, neuromuscular disease, dementia, organ failure/transplant (kidney, liver, heart, lung, or gut), periodontal disease, pressure wounds, and chronic obstructive pulmonary disease. Note that acute exacerbations, infections, or other complications may superimpose acute inflammatory response on such conditions or diseases.
- Examples of starvation-associated conditions that generally have little or no inflammatory component include anorexia nervosa or compromised intake in the setting of major depression.

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wall-mounted stadiometer. For those adults who cannot safely stand, height can be estimated by doubling the arm span measurement (from the patient's sternal notch to the end of the longest finger). Height can also be estimated in frail older persons from measurement of knee height using a caliper device.[11]

It is useful to standardize body weight for height, but available reference tables require subjective assessment of frame size and offer limited reference data for many relevant population groups, including older persons.[12,13] The body mass index (BMI), defined as weight (kg)/height (m^2), offers a simple measure of body size that also provides an indirect measure of body fatness. The National Institutes of Health–proposed cut points for BMI in adults are as follows: BMI <18.5 = underweight, BMI 18.5–24.9 = desirable, BMI 25.0–29.9 = overweight, and BMI ≥30 = obese.[14,15] The Centers for Medicare and Medicaid Services in its quality indicators system has defined a higher BMI range as desirable for persons 65 years of age and older (BMI ≥23 and <30).[16]

Classical anthropometric measurements, including skinfolds and circumferences, can be quite helpful, but routine application in patient care settings has been limited because appropriate training is needed to achieve acceptable practitioner reliability. The National Health and Nutrition Examination Study (NHANES) III Anthropometric Procedures Video[17] is available to those who would like to learn these methods.

Body composition assessment methodologies include bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DEXA), computed tomography (CT), and magnetic resonance imaging (MRI). Portability issues limit the practical bedside utility of all except BIA. The imaging technologies have become the state of the art for precise assessments of muscle mass, and recent findings suggest that it may be possible to take advantage of CT or MRI studies that are being done for other clinical purposes to evaluate musculature.[18]

Laboratory Indicators

Laboratory findings must be appropriately used in combination with other assessments to diagnose a malnutrition syndrome. Additional evidence suggesting insufficient energy intake, nonvolitional weight loss, loss of muscle mass, loss of subcutaneous fat, fluid accumulation, or diminished functional status is warranted to make a diagnosis. It is useful to obtain serum albumin or prealbumin in any patient with a suspected malnutrition syndrome, but these proteins must be interpreted with caution because they lack specificity and sensitivity as indicators of nutrition status.[1,2] Because serum albumin and prealbumin may be reduced by the systemic response to injury, disease, or inflammation, those patients with low serum albumin or prealbumin may or may not prove to be malnourished when evaluated by systematic nutrition assessment. To help discern whether inflammation is present, one can measure the positive acute-phase reactant, C-reactive protein.[19,20] If C-reactive protein is increased and serum albumin or prealbumin decreased, then inflammation is likely to be a contributing factor. Because it is recognized that C-reactive protein also suffers sensitivity and specificity limitations, trends over the clinical course are often helpful. Research findings suggest that cytokines, particularly interleukin-6, may also offer promise as indicators of inflammatory status.[21,22] Additional nonspecific indicators often associated with inflammatory response include leukocytosis and hyperglycemia. Further tests that may be obtained to clarify the presence of inflammatory response include 24-hour urine urea nitrogen and indirect

calorimetry. In the setting of severe acute systemic inflammatory response, negative nitrogen balance and elevated resting energy expenditure are expected.

Dietary Assessment

Inadequate or imbalanced food or nutrient intakes may be detected by dietary assessment. Commonly used methods in patient care settings include the 24-hour recall and modified diet history. Resources for diet history components include the patient, medical records, family, and caregivers. A modified diet history queries types and frequencies of intake of foods. It is important to specifically address dietary practices and use of nutrition supplements. Because patients will often present with acute medical events superimposed on chronic health conditions, it is not unusual for them to have had compromised dietary intakes and malnutrition for extended periods prior to assessment. It is imperative that this not be overlooked so that appropriate intervention may be undertaken.

Assessment must continue when parenteral or enteral feedings are initiated because it is important to monitor how much of the ordered formula is actually being administered to and received by the patient. It is especially common for enteral feedings to be interrupted or held for procedures, tolerance issues, feeding tube displacements, and other events. Patients may therefore be appreciably underfed for protracted periods.[23] Once a patient is being transitioned to oral feedings, it is important to monitor amounts of food and/or supplements consumed as well as patient tolerance. This takes on particular relevance because anorexia is typically associated with ongoing inflammatory response. It is also not unusual for patients to suffer multiple missed or delayed meals for tests or procedures.

Functional Outcomes

Detectable declines in strength and physical performance will result from the loss of muscle mass and function that accompany advanced malnutrition syndromes. The most practical measure for clinical assessment is handgrip strength using a simple handgrip dynamometer. Physical performance batteries that include measures such as timed gait, chair stands, and stair steps are sometimes used in the comprehensive assessment of integrated functions in frail older persons.

Nutrient deficiencies and impairment of organ system functions often contribute to the overall functional decline observed in malnutrition syndromes. Improved wound-healing parameters and restored responsiveness to recall antigens by delayed hypersensitivity testing[24,25] may also be used as functional outcome measures to demonstrate improvements with nutrition interventions, although it must be appreciated that these are multivariable outcomes for which nutrition is but one variable.

Conclusion

This tutorial has introduced a new approach to understanding malnutrition syndromes in adults and has highlighted practical assessment methodology for use in diagnosing these syndromes. The lack of any single clinical or laboratory measure that provides a comprehensive assessment of nutrition status requires a systematic approach that gathers information from medical/surgical history and clinical diagnosis, clinical signs and physical examination, anthropometric data, laboratory indicators, dietary assessment, and functional outcomes.

Case Scenarios

These scenarios illustrate a systematic approach to nutrition assessment to facilitate diagnosis of the appropriate malnutrition syndrome. Information is gathered from medical/surgical history and clinical diagnosis, clinical signs and physical examination, anthropometric data, laboratory indicators, dietary assessment, and functional outcomes. The cases have been adapted with permission from *A.S.P.E.N. Adult Nutrition Support Core Curriculum*, 3rd edition.[6]

1. Anorexia Nervosa

Question: What malnutrition syndrome would you anticipate in a patient who presents with anorexia nervosa and how would you confirm this?

Scenario: A 26-year-old woman was admitted to the hospital with a diagnosis of anorexia nervosa and a longstanding history of restrictive eating behavior without purging. She had lost one-third of her body weight over 6 months. Upon admission, the patient was 5′6″ (167.6 cm) in height and weighed 82 pounds (37.2 kg) with a BMI of 13.2 kg/m^2. Her resting heart rate was 50 beats per minute. She was afebrile. Laboratory values included the following: C-reactive protein, 0.7 mg/dL; white blood cell count, 6200 /mm^3; serum albumin, 4.0 g/dL; prealbumin, 25 mg/dL; and fasting blood glucose, 75 mg/dL. She exhibited generalized loss of muscle and subcutaneous fat. Other physical findings included lanugo hairs. Marked underweight status was evident, with weight loss of 42 pounds (19.1 kg) over 6 months. Mid-arm muscle circumference measurement was below the fifth percentile.

Answer: Malnutrition syndrome: starvation-associated malnutrition.

1. History and clinical diagnosis: Anorexia nervosa is consistent with starvation without a significant inflammatory component.
2. Clinical signs/physical examination: Consistent with severe malnutrition without inflammatory response.
3. Anthropometric data: Weight loss, underweight status, and mid-arm muscle circumference consistent with severe malnutrition.

4. Laboratory indicators: Do not suggest active inflammation.
5. Dietary intake: Severely compromised for months.
6. Functional outcomes: Would be likely to have diminished grip strength and physical performance.

Suggested malnutrition coding: International Classification of Diseases, Ninth Revision (ICD-9) other severe protein calorie malnutrition (PCM) *–262*.0, severe malnutrition in the context of environmental or social circumstances.

√ Evidence of reduced dietary intake
√ Unintended weight loss
√ Reduced grip strength
√ Physical exam with loss of muscle and subcutaneous fat

Intervention: Resuscitate patient cautiously to avoid refeeding syndrome

Rationale: Resuscitation should begin with decreased macronutrients to reduce risk of complications

Close monitoring is indicated because refeeding concerns in the resuscitation of the severely malnourished may include fluid retention and falling potassium, phosphate, and magnesium. In the setting of pure starvation, it is feasible to resuscitate individuals from even life-threatening malnutrition with appropriate nutrition intervention. In the absence of inflammation, serum albumin and prealbumin will often remain normal or near normal unless malnutrition is quite advanced.

2. Cirrhosis With Portal Hypertension and Ascites

Question. What malnutrition syndrome would you anticipate in a patient who presents with cirrhosis with portal hypertension and ascites and how would you confirm this?

Scenario. A 52-year-old man presented for a follow-up clinic appointment with an established history of cirrhosis and portal hypertension in the setting of long-term ethanol abuse. He had gained 10 pounds (4.5 kg) over the prior 2 weeks and exhibited massive ascites. Additional findings included mild encephalopathy (grade 1) with poor concentration, asterixis, and scleral icterus. A family member reported that his food intake had been severely compromised for weeks. At presentation, the patient was 5′8″ (172.7 cm) in height and weighed 161 pounds (73.0 kg) (usual weight, ~150 pounds, 68.0 kg). He was afebrile. Laboratories included total bilirubin, 3.8 mg/dL; aspartate aminotransferase, 96 IU/L; alanine aminotransferase, 111 U/L; alkaline phosphatase, 162 IU/L; serum albumin, 1.7 g/dL; prothrombin time, 18 seconds; white blood cells, 3700/mm^3; C-reactive protein, 27 mg/L; prealbumin, 6.8 mg/dL; hemoglobin, 8 g/dL; hematocrit, 32%; and fasting glucose, 107 mg/dL. Physical findings were notable for ascites and extensive loss of muscle and subcutaneous fat.

Answer: Clinical malnutrition syndrome: chronic disease-associated malnutrition.

1. History and clinical diagnosis: Cirrhosis is consistent with malnutrition and chronic inflammation of mild to moderate degree.
2. Clinical signs/physical examination: Consistent with malnutrition in setting of chronic liver disease/cirrhosis.
3. Anthropometric data: Ascites and weight gain mask true underweight status and loss of body cell mass. Other body composition measures may demonstrate loss of muscle.
4. Laboratory indicators: Consistent with cirrhosis and cannot be reliably interpreted to support malnutrition or inflammation.
5. Dietary intake: Severely compromised for weeks.
6. Functional outcomes: Would be likely to have diminished grip strength and physical performance.

Suggested malnutrition coding: ICD-9 other severe PCM–262.0, severe malnutrition in the context of chronic illness.

√ Evidence of reduced dietary intake
√ Unintended weight loss masked by ascites
√ Reduced grip strength
√ Physical exam with loss of muscle and subcutaneous fat

Intervention: Promote adequate caloric intake with balanced macronutrients and sodium-restricted diet May benefit from protein-energy supplements.

Rationale: Serum albumin and prealbumin levels are decreased by liver failure and so serve as poor indicators of nutrition status in this setting. Elevated C-reactive protein levels have been described in patients with hepatic encephalopathy. It has been suggested that they may represent the inflammatory response to subclinical infection. In this patient, malnutrition is identified on the basis of clinical diagnosis, history of compromised intake, and physical findings. Chronic inflammation is consistent with the clinical diagnosis and may not be revealed by available laboratory indicators. Mild encephalopathy is generally not an indication for severe protein restriction.

3. Obesity in a Frail Older Person/Sarcopenic Obesity

Question: What malnutrition syndrome would you anticipate in an older patient who presents to your clinic with obesity and frailty and how would you confirm this?

Scenario: A 70-year-old woman presented for a follow-up clinic appointment with longstanding obesity and metabolic syndrome. She had been receiving medications that included a statin, a diabetes oral agent, and a nonsteroidal anti-inflammatory for her hypercholesterolemia, diabetes mellitus, and painful destructive joint disease of the knees, respectively. Her chief complaint was worsening limitations in function that included

compromised mobility. She lived in her own home and was effectively housebound. She reported limited financial resources and difficulty obtaining regular meals. She indicated that she may have lost some 10–20 pounds (4.5–9.0 kg) over the past 6 months without trying to lose weight. An adult daughter accompanied the patient and reported that she checked on her mother once a week and dropped off some meals during those visits but noted that the meals were frequently left in the refrigerator, uneaten, unless she stayed and ate with her mother. Upon evaluation, her height was 5′2″ (157.5 cm) and weight was 200 lbs (90.7 kg) (BMI 37 kg/m^2). Prior records confirmed a 20-lb (9.0 kg) weight loss compared with her last visit a year before. She was afebrile with blood pressure 135/85 mm Hg and pulse 72. Laboratories included fasting glucose, 130 mg/dL; HbA_1c, 7.0%; cholesterol, 180 mg/dL; high-density lipoprotein (HDL) cholesterol, 45 mg/dL; triglycerides, 125 mg/dL; serum albumin, 4.1 g/dL; white blood cells, 5100/mm^3; and C-reactive protein, 48 mg/L. Physical examination revealed truncal adiposity with waist circumference of 96 cm. She had difficulty arising from a chair and ambulating with evidence of generalized loss of strength and knee discomfort.

Answer: Clinical malnutrition syndrome: chronic disease-associated malnutrition.

1. History and clinical diagnosis: Longstanding obesity and metabolic syndrome with compromise in dietary intake and weight loss are consistent with malnutrition and chronic inflammation of a mild to moderate degree. A clinical diagnosis of sarcopenic obesity is suspected.
2. Clinical signs/physical examination: Consistent with obesity and limitations in mobility associated with painful destructive joint disease of the knees and loss of strength.
3. Anthropometric data: BMI and waist circumference are consistent with obesity. Loss of muscle mass will be difficult to appreciate by simple anthropometric measures in this patient. Other body composition measures such as DEXA, CT, and MRI may be used to demonstrate loss of muscle and to confirm the diagnosis of sarcopenic obesity.
4. Laboratory indicators: Fasting glucose and HbA_1c are consistent with diabetes mellitus, lipid profile is consistent with statin-controlled hypercholesterolemia, and the elevated C-reactive protein is typical of the inflammation observed with obesity.
5. Dietary intake: Compromised secondary to homebound status, isolation, and limited resources. It will be appropriate to confirm poor quality diet with diet recall or history.
6. Functional outcomes: A physical performance test battery will be helpful to confirm the degree of functional impairment. Assessment of strength measures may also be useful.

Suggested malnutrition coding: ICD-9 other mild/moderate PCM–262.0, mild/moderate malnutrition in the context of chronic illness.

- √ Evidence of reduced dietary intake
- √ Unintended weight loss
- √ Reduced grip strength may be difficult to appreciate, but the patient has other observed functional limitations.
- √ Loss of muscle mass can be confirmed by imaging methodology and will be difficult to detect by physical exam.

Intervention: Encourage diabetic diet regimen with regular high-quality meals and snacks. In view of her malnutrition and lipid profile on statin therapy, there is little indication to be overly restrictive of cholesterol or fat while her malnutrition is addressed. Supplement a daily multivitamin with minerals. Promote strength and flexibility training to improve function and mobility. Consider consultations to social services, dietitian, Agency on Aging, Meals on Wheels, physical therapy, and orthopedic surgery. Encourage family engagement. If available, consider evaluation by comprehensive geriatric assessment and endocrine/diabetes management teams. Knee replacement surgery may be a consideration once malnutrition and other concerns are suitably addressed.

Rationale: In an older person with obesity and frailty, an emphasis on promoting strength and flexibility rather than weight loss may be most appropriate. Prior to embarking on any weight loss intervention, this patient's malnutrition must be addressed. Weight loss intervention remains controversial in older persons, although improvements in metabolic syndrome parameters, inflammatory status, and function have been described for selected cohorts. In this particular patient, once she has been stabilized, modest weight reduction would offer potential benefits to her obesity-related comorbidities as well as decrease her risks for possible elective knee replacement surgery. Malnutrition is in this case identified on the basis of clinical history of compromised intake and nonvolitional weight loss. Compromised strength and function provide additional supporting data. Chronic inflammation is consistent with the clinical diagnoses and elevated C-reactive protein. Obesity is a major risk factor for destructive joint disease of the knees. Moderate weight loss has been found to reduce disability for obese individuals with knee osteoarthritis. Sarcopenic obesity is characterized by muscle loss in the setting of obesity and is common among obese older persons and those obese persons with significant disease burden or injury. Dropout of α-motor neurons, changes in anabolic hormones, and malnutrition may be contributing factors, but inflammation-promoted erosion of muscle mass, as well as the synergy of physical inactivity, increased adiposity, and accumulated disease burden, is likely important as well.

4. Multiple Trauma Victim

Question: What malnutrition syndrome would you anticipate in a multiple trauma victim early in his or her course and how would you confirm this?

Scenario: A 38-year-old man suffered multitrauma secondary to a motor vehicle accident. His injuries included ruptured spleen, grade III liver laceration, left femur fracture, and bilateral pulmonary contusions. His status was post–damage control celiotomy, splenectomy, and packing of the liver. He was transferred to the trauma intensive care unit on a ventilator where he continued to be resuscitated. Clinical and laboratory criteria for systemic inflammatory response syndrome (SIRS) include temperature >38°C or <36°C, heart rate >90, respiratory rate >20, white blood cell count >12K/mm^3 and pCO_2 <32 mm Hg. Postsurgery day 2 of admission, this patient had temperature 39°C, heart rate 98 beats per min, respiratory rate 26 breaths per minute, white blood cell count 25K/mm^3, and pCO_2 28 mm Hg. He was markedly edematous with weight gain of 15 lbs (6.8 kg) above his usual body weight. His open abdomen was dressed. Additional laboratories consistent with active inflammation included C-reactive protein, 45 mg/dL; serum albumin, 2.6 g/dL; prealbumin, 11.0 mg/dL; and glucose, 220 mg/dL. He had an increased metabolic rate by indirect calorimetry with a resting energy expenditure of 3000 kcal. Dietary intake was anticipated to be compromised for a week or greater. He was reported to have been well nourished with suitable dietary intake prior to his injury.

Answer: Malnutrition syndrome: high risk for acute disease or injury-associated malnutrition.

1. History and clinical diagnosis: Multiple trauma is consistent with severe acute systemic inflammatory response and high nutrition risk.
2. Clinical signs/physical examination: Consistent with severe acute inflammatory response.
3. Anthropometric data: Body weight gain consistent with appreciable edema.
4. Laboratory indicators: Supportive of presence of severe acute inflammation.
5. Dietary intake: At risk for extended duration of compromise.
6. Functional outcomes: Grip strength and physical performance testing is not feasible in an acutely injured and sedated patient.

Suggested malnutrition coding: High risk to develop *ICD-9* other severe PCM–262.0; severe malnutrition in the context of acute injury.

- √ At risk for reduced dietary intake
- √ Marked edema will mask weight loss, but at high risk for loss of muscle
- √ Grip strength not feasible
- √ Difficult to appreciate loss of muscle and subcutaneous fat by physical exam

Intervention: Enteral feedings were initiated within 24 hours of admission.

Rationale: Signs of severe acute systemic inflammatory response are caused by hormonal, metabolic, and immunological mediators that include cytokines. Nutrition intervention is intended to support vital immune system, wound healing, and organ system functions to help the patient through this phase of acute inflammatory response. Trauma victims are often not malnourished at baseline but are at risk to become severely malnourished due to acute metabolic dysregulation and associated catabolism. In addition, those with severe injury may be unable to eat for extended periods. Even with aggressive nutrition support, during this acute phase, such patients will likely remain in negative nitrogen balance and have low serum albumin and prealbumin due to the robust proinflammatory state.

Glossary

Acute-phase reactants: Secretory liver proteins in which plasma concentrations increase (positive acute-phase reactants) or decrease (negative acute-phase reactants) in response to injury, infection, or other inflammatory disorders.
Anthropometry: Measurements of the weight, size, and proportions of the human body.
Body mass index: Weight in kg/height in m^2.
Dietary assessment: A comprehensive evaluation of dietary intake used to characterize dietary patterns or food or nutrient intakes.
Negative nitrogen balance: Increased rate of protein breakdown compared with protein synthesis so that nitrogen excretion exceeds nitrogen intake.
Resting energy expenditure: A measurement of resting metabolic rate extrapolated to 24 hours to estimate the energy expended in activities to sustain normal bodily functions and homeostasis.
Systemic inflammatory response: A systemic response to a condition that provokes an acute inflammatory reaction indicated by the presence of 2 or more of a group of symptoms that include leukocytosis, fever, tachycardia, and tachypnea.

Further Reading

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