

# Management of the Gastrointestinal Tract and Nutrition in the Geriatric Surgical Patient



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## KEYWORDS

• Geriatric patient • Malnutrition • Nutrition • Surgery

## KEY POINTS

- Elderly people experience physiologic changes in the gut and in every organ system, which predisposes them to impaired nutrition and associated increased risk factors.
- When the normal processes of aging is compounded by illness, the propensity to cause a pathologic state of malnutrition increases.
- Surgical nutrition support in the critical care setting aims to identify those at nutritional risk and to support nutritional needs in the direction of recovery; new evidence has arisen for use of certain nutrients as therapeutic agents because they are thought to contribute to the healing process and may be conditionally deficient in stress related to disease processes.
- It is important that health care providers follow evidenced-based recommendations for the provision of adequate nutrients and address the individual needs of every patient.

## INTRODUCTION

Increased age leads to the loss of cells in the myenteric plexus<sup>1</sup> and decreased gastric emptying, possibly associated with reduced nitric oxide concentrations.<sup>1</sup> Satiety is affected by a reduction in the endogenous-opioid-mediated feeding drive and by altered neurotransmitter signaling in brain hunger and satiety centers.<sup>1</sup> There is an enhanced secretion of cholecystokinin that inhibits gastric emptying and increases satiety.<sup>1</sup> The functions of ghrelin and glucagonlike peptide are also modified.<sup>1</sup> Slowing of gastric emptying prolongs satiety.<sup>2</sup> Because of the delay in gastric emptying associated with normal aging, elderly patients often are recommended liquid diets that are high in calories and protein.<sup>1</sup> Therefore, the changes in appetite and satiety are

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multiple and include both central and peripheral factors that are impacted by aging, and many of these changes continue to be poorly understood.<sup>2</sup>

Because of the above factors, age is considered a nonmodifiable risk factor involving surgical outcome. This statement is modulated by the effect of physiologic age versus chronologic age,<sup>3</sup> which is often expressed in clinical practice as the perceived condition of the patient with respect to what the clinician would expect for their specific biological age. Objective measures exist for biological age, such as the concept of frailty,<sup>4</sup> which has been defined recently as the presence of 4 of 6 of the following factors associated with the prediction of 6-month mortality: Mini-Cog score of 3 or less, albumin level of 3.3 mg/dL or less, more than 1 fall in the last 6 months, hematocrit level less than 35%, dependency with at least one activity of daily living, and the presence of at least 3 comorbidities.<sup>5</sup> Frailty assessment is currently recommended in the routine preoperative assessment of the elderly patient and has been associated with an increased surgical risk among several procedures and in diverse prospective cohorts.<sup>6–8</sup>

It is important to understand the uniqueness of the aging patient to achieve the best surgical outcome by applying necessary screening criteria and using risk-modifying interventions to address their special perioperative needs. The elderly are a segment of the population significantly increasing in numbers. The US Census Bureau estimates that old-age dependency will approach youth dependency in 2030 and will actually surpass it in 2060.<sup>9</sup> The “baby boomers” are currently 50 to 65 years of age and with the current life expectancy will cause a significantly larger portion of the population to be elderly.<sup>9</sup> The number of elderly patients in the United States is expected to double in the next 25 years.<sup>10</sup>

The nutritional status of the elderly surgical patient has been found to be of paramount importance in the prediction of surgical risk.<sup>8</sup> Furthermore, nutritional interventions are purported to alter this risk when applied appropriately.<sup>8</sup> In addition, the postoperative elderly individual is at a greater risk of malnutrition development and subsequent health and quality of life deterioration than a younger person.<sup>11</sup> This review discusses the importance of optimizing the outcome of the geriatric surgical patient through proper nutritional assessment and delivery of adequate nutrition via the gastrointestinal tract.

## BACKGROUND

It is estimated that more than 50% of surgical procedures are performed on individuals older than 65 years and that one-half of all individuals older than 65 will require some type of operative procedure.<sup>12</sup> In 2010, more than one-third of all surgical operations were performed on patients 65 years of age and older.<sup>13</sup> As noted above, the number of elderly individuals is steadily increasing, and the population census estimates that more than 20% of individuals in the United States will be elderly by 2025.<sup>9</sup>

Because the number of elderly patients is increasing and the nutrition aspect of their care is likely a modifiable risk factor for improved outcome, it is important for medical providers to be well versed in identifying potential or existing nutritional problems in their patient. In addition, health care providers must be skilled at appropriately identifying risk factors for malnutrition and creating care plans to implement appropriate nutritional support and treatment proactively.

Malnutrition has been associated with increased postoperative complications,<sup>14–16</sup> perioperative mortality,<sup>17,18</sup> increased hospital length of stay,<sup>17</sup> decreased longevity,<sup>11</sup> and quality of life<sup>11</sup> in elderly patients with various disease conditions. Sadly, the

prevalence of malnutrition in hospital and nursing home settings has been reported to be more than 40% to 50%.<sup>19</sup> It is, therefore, not uncommon for elderly patients to present for surgical consultation with some degree of malnutrition or cachexia.<sup>8,20</sup> Thus, it is imperative for the preoperative planning and surgical treatment plan to involve an overall nutritional assessment.<sup>8</sup> If the patient is severely malnourished, the decision to proceed with surgery may need to be delayed, as the risks of an adverse outcome may outweigh the benefits of surgical intervention.<sup>8</sup>

## RISK FACTORS FOR MALNUTRITION IN THE ELDERLY

Medical or surgical illness impairing the function of the gastrointestinal tract is clearly a pathologic state causing a predisposition to malnutrition. Physical factors limiting eating ability<sup>21</sup> or interest in food may become pathologic states predisposing one to malnutrition. Such factors include poor dentition, swallowing dysfunction, poor vision,<sup>21</sup> and a weakened ability to secure or prepare food.<sup>22</sup> Social isolation may itself be a disease state because elderly individuals are inclined to eat less when they eat alone. Poor economic conditions lead to malnutrition because of food insecurity.<sup>23</sup> If an elderly person needs assistance with activities of daily living and help is not available, the individual will also be predisposed to malnutrition. Bereavement in the elderly may be a pathologic state because some elderly individuals may not recover fast enough after loss of a loved one without accruing long-term decline in their level of functioning.

Other psychological or pathologic diseases more common in the elderly are often associated with malnutrition states. For example, elderly individuals are predisposed to depression,<sup>1</sup> and the presentation may be subtle and missed by routine general assessment. Depression often leads to less eating and to malnourishment.<sup>1</sup> Dementia has been associated with malnourishment, although it is unclear whether malnourishment most often leads to decline in mental capacity or whether the lack of nourishment is a manifestation of dementia.<sup>1</sup>

Since the risks of neoplasia increases with age, a greater proportion of the elderly population has a neoplastic disease.<sup>8</sup> The cancer site itself (eg, gastric, esophageal) is associated with specific challenges to nutrition. Both surgical patients and patients receiving chemotherapy or radiotherapy may have better outcome when well nourished.<sup>8</sup> Patients who have undergone surgery for their disease are at greater risk for complications when they are malnourished and are at increased risk to remain malnourished postoperatively. The gastrointestinal system may be compromised by a surgical site complication and may have altered gastrointestinal physiology because of either their pre-existing gastric motility issues related to their age or a newly altered anatomy.

### ***Biological Changes of the Gastrointestinal Tract***

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Age-related changes in the gastrointestinal tract are often impacted by concomitant pathologic factors or disease processes such as diabetes, pancreatitis, liver disease, and malignancy.<sup>24</sup> It may be difficult to discern whether the gastrointestinal dysfunction is the result of their aging or disease.

Dysphagia, gastrointestinal reflux, and constipation often are a result of neurodegeneration of the aging enteric nervous system.<sup>24,25</sup> In rodent studies, caloric reduction is found to prevent neuronal loss, proposing that diet alone may influence the aging gut.<sup>24,26</sup> Esophageal and gastric motility are impacted as a result of the reduction of neurons in the mesenteric plexus in older people<sup>24,27</sup>; however, the small intestine seems to be unaffected.<sup>24,28</sup> As we age, signal transduction pathways and cellular

mechanisms that control smooth muscle contraction can influence the colonic motility, which may lead to constipation.<sup>24,29</sup>

A reduction in gastric acid secretions occurs with increasing age.<sup>24</sup> Chronic gastritis leads to hypochlorhydria and, as a consequence, proton pump inhibitors are frequently used for prolonged periods in older people, which causes suppressed acid secretion.<sup>24</sup> This decline in acid secretion predisposes the gut to small bowel bacterial overgrowth.<sup>24,30</sup> Bacterial overgrowth has been associated with weight loss and reduced intake of micronutrients.<sup>24,31</sup>

Structural changes of the pancreas are evident with the aging process.<sup>24,32</sup> Chymotrypsin and bicarbonate concentration in pancreatic juice have all been found to decrease with aging.<sup>24,33</sup> Others have reported that there is little evidence of reduced pancreatic secretion with age-independent factors such as disease and drugs.<sup>24,34</sup> With age, the liver decreases in size and blood flow, but microscopic changes seem to be subtle.<sup>24,35</sup> Aging mice studies have found that changes in the expression of genes in the liver are involved in inflammation, cellular stress, and fibrosis.<sup>24,36</sup> Limiting calories in mice seemed to reverse age-related changes<sup>24,37</sup> implying that such restrictions may affect changes that occur with aging. Age has also been found to be associated with a decline in the number of villi and crypts, loss of villi and enterocyte height, and decline in mucosal surface.<sup>24</sup> However, a clear association between intestinal morphology and nutrient uptake with aging has yet to be shown.<sup>24,38</sup>

## MALNUTRITION STATES AS THEY RELATE TO AGING

Pathologic protein-energy malnutrition usually arises when there are disease states superimposed on normal aging. Certain undernutrition syndromes may be clinically apparent and consistent with the patient's presenting diagnosis. **Table 1**<sup>1,39,40</sup> depicts such presentations. These are distinct entities, but they are not mutually exclusive.

## ASSESSING NUTRITIONAL RISK IN THE GERIATRIC SURGICAL PATIENT

### *History, Physical Examination, and Supporting Laboratory Results*

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The first step in the assessment of the patient's nutritional status is a thorough history and physical examination. Classifying a patient as being well nourished based on a cursory examination of weight or body mass index (BMI) and a serum albumin level is incomplete and often incorrect.<sup>16</sup> Supporting laboratory investigations are important but should be used with caution. For example, a low albumin or prealbumin level may be caused by malnutrition, but it can also be a marker of inflammation and catabolism in disease.<sup>16</sup> A malnourished patient may have a normal serum albumin level, or, conversely, a well-nourished patient may have a low serum albumin level. Furthermore, in high-acuity states, catabolism may simply be an adaptive response to acute illness, which may again illicit a low serum albumin level, which is clearly not reflective of their nutritional state.<sup>16,41,42</sup>

A history and physical examination should capture some basic information. One should evaluate the patient's history for recent unexplained weight loss. Medical history such as depression, dementia, neurologic disease, chronic infections, gastrointestinal disorders including reflux, malignancy, and neurologic, endocrine, and end-organ disease should be collected. Surgical history of gastrointestinal reconstruction (ie, intestinal resection, gastric bypass) is also important to note. Furthermore, special attention to common problems in the elderly is warranted.<sup>43</sup> In general, depression is the most common cause of malnutrition<sup>43</sup> in the elderly followed by malignancy. Routine assessment for signs and symptoms of depression

<b>Undernutrition Syndrome</b>	<b>Case Presentation</b>	<b>Pathophysiology</b>
Anorexia	79 y-old Mrs X reports that she just does not feel like eating. Her favorite foods are no longer enticing. She reports that this began after the death of her husband a year ago. She cries as she reports this to you.	Anorexia is a decrease in appetite. Older adults are more predisposed. Depression is a frequent cause. <sup>1</sup> Other causes include drug side effects, dementia, and illness. <sup>1</sup> Anorexia may be related to gastrointestinal changes, hormonal changes, and sensory changes. <sup>1</sup> Differentiate from unable to eat because of dysphagia, food insecurity, denture problems, or other potentially reversible causes.
Cachexia	55 y-old Mr Y is a known patient with pancreatic cancer. He has unresectable disease and is receiving chemoradiotherapy. He reports a drop of 20 kg in 3 mo. He appears muscle wasted, emaciated, frail, and has reduced hair. He complains of fatigue, anorexia, early satiety, taste and smell disturbance, and nausea.	Cachexia is characterized by profound loss (up to 80%) of adipose tissue and skeletal muscle mass, which is associated with hematologic derangements and asthenia. <sup>39</sup> It is a complex syndrome characterized by inflammation and altered metabolism <sup>39</sup> and is associated with metabolic disease, cancer, acquired immunodeficiency syndrome, or end-stage organ disease.
Sarcopenia	75-y-old Mr Z is said to be shrinking, he has smaller muscles and feels generally weaker than 5 y prior. Otherwise, he is in good health, he has just had a routine medical checkup that came out normal.	Sarcopenia is the loss of muscle mass accompanied by decreased strength that is associated with age. <sup>40</sup> It is related to reductions in androgenic hormones, insulin resistance, decreased physical activity, and reduced protein intake. <sup>40</sup> It is accompanied by weakness and may lead to functional disability and falls if severe. <sup>40</sup>

Data from Refs. <sup>1,39,40</sup>

are extremely important.<sup>44</sup> In addition, a thorough physical examination of the skin, hair, oral mucosa, and tongue may provide critical information about the hydration and nutrition status of the geriatric patient.<sup>45</sup>

### **Calculation of Nutritional Risk**

The American Society for Parenteral and Enteral Nutrition and the American Diabetes Association have recently recommended a standardized set of diagnostic criteria to be used to identify and document adult malnutrition. If the patient has 2 of the following, he or she has malnutrition: insufficient energy intake, recent weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid

accumulation, and diminished functional status as measured by hand grip strength.<sup>16</sup> The hand strength test with a dynamometer has the strongest correlation with muscle mass and nutritional status among physical function assessments. It is logical to presume that in the quick assessment of a hospitalized patient with many pressing health and management issues, the above assessment may be limited because of relative physician expertise, and reproducibility may be compromised by competing factors such as hydration status.

Determining a patient's risk for malnutrition would be key during the preoperative visit to plan and optimize supportive measures accordingly.<sup>17,46</sup> The Malnutrition Screening Tool (MST) is a quick and easy tool to help determine this risk, as it asks 2 simple questions: "Have you been eating poorly because of a decreased appetite?" and "Have you lost weight recently without trying?," and it is accurate when compared with the standard Subjective Global Assessment.<sup>17</sup> The MST is reliable and sensitive and may be used to screen patients for the need for further nutritional assessment. One must elicit reasons for difficulty eating. These reasons may have medical treatments available if recognized, such as dysphagia, poorly fitting dentures, intention tremor, or rigidity.

Additional tools are also available for conducting nutritional assessments. The Short Nutritional Assessment Questionnaire is similar to the MST; it is validated and practical.<sup>47,48</sup> The Mini Nutritional assessment (MNA) has the advantage that it is designed for use in the elderly population.<sup>49</sup> It can also detect malnutrition when BMI and albumin levels are within normal ranges. The MNA has a brief screening assessment that can identify an at-risk patient, and a full or complete MNA can be completed in 10 to 15 minutes.<sup>49</sup> However, the presence of comorbidities may be considered in addition to the MNA result.<sup>19</sup> The MNA is widely cited as a screening tool and is validated in an acutely hospitalized patient.<sup>49</sup> It can be used for follow-up to determine the effect of an intervention.<sup>49</sup> The forms for these screening tools are widely available on the internet<sup>49</sup> and in the American Diabetes Association pocket guide to nutritional assessment.<sup>50</sup> It is advised that some form of nutritional screening be done and that the method used is documented for future reference and to ensure that appropriate follow-up, such as dietician consultation, is conducted.

In addition to clinically recognizable nutritional deficiency syndromes, a clinician often predicts or forms an opinion on the degree of surgical risk just by visiting the patient for the first time. The opinion is usually that the patient looks well for his age or looks fragile for his age.<sup>3</sup> However, this assessment may not be a sufficient valuation of surgical risk. Instead, the Portsmouth Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (P-POSSUM) score may be calculated. It is obtained by entering 12 widely available physiologic parameters into an equation and can be modified using basic intraoperative parameters, which can be done using online calculators.<sup>51</sup> The result is a percentage risk of morbidity or mortality at 30 days. This score is validated for use in general surgery patients and is also available for risk-adjusted analysis.<sup>52</sup> There are limitations when using this score in healthy subjects, as it may be grossly overestimated even after the P-POSSUM adjustment.<sup>52</sup>

Calculating nutritional risk using unfiltered laboratory assessments may be misleading in elderly surgical patients. A more accurate choice would be the Geriatric Nutritional Index Score.<sup>53</sup> This score incorporates weight, a surrogate for height, and serum albumin level in the nutritional risk assessment of acute elderly hospitalized patients. This score has been found to be accurate in establishing the risk of complications and death associated with elderly patients' nutritional status.<sup>53</sup> Because the usual weight and height of the patient are not always known or easily measurable

for an elderly individual because of decreased mobility or poor memory, height and usual weight are not used. Instead the calculation is based on knee height, ideal weight (as calculated by the Lorentz equation), and serum albumin level entered into a simple equation. The score thresholds correlate with a 5% and 10% weight loss and albumin thresholds of 38, 35, and 30 and predict mortality and complication-ridden survival at 6 months.<sup>53</sup> In addition, BMI less than 19, albumin level less than 3.0, and weight loss in excess of 5%<sup>17</sup> and 10%<sup>41</sup> are known predictors of poor survival. BMI less than 18.5 in an adult<sup>54</sup> and less than 20 in an older adult are independent predictors of mortality in intensive care unit patients.<sup>55</sup> Laboratory measurements of prealbumin, transferrin, and retinol-binding protein levels can assess for acute starvation, but no value should stand alone.<sup>41</sup>

An association has been described between higher BMI and surviving critical illness,<sup>54</sup> but this assertion requires further research.<sup>56</sup> There is additional evidence that overweight and mildly obese elderly individuals have longer survival rates in general.<sup>1,57,58</sup> As data continue to accrue, it may be found that overweight elderly individuals have better odds of surviving an intensive care unit stay. Therefore, weight loss in an elderly patient should be an individually based decision, which carefully considers expected quality of life changes in association with the patient's comorbidities.

### ***Promoting Dietary Intake and Setting Reasonable Goals***

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Elderly individuals should receive special attention regarding the status of their overall process of eating and digestion. Simple factors such as poor dentition or mal-fitting dentures may impact their ability to consume a meal. Difficulty swallowing may lead to silent aspiration or fear of consuming certain foods. The frequency and severity of gastrointestinal upsets, bowel movement patterns, or constipation may impact food choices or volume.<sup>43</sup> A preemptive understanding of the possible challenges to maintain an appropriate diet in an acutely hospitalized individual may help caregivers ensure the appropriate intake during hospitalization. An effort should be made to know whether the patient has true food intolerances,<sup>57</sup> food preferences, or specific food dislikes such that the caregiver team may provide adequate and effective nutrition for the patient.

Restrictive diets in this population are cautioned against because they have been associated with increased risk of malnutrition.<sup>57</sup> Recommendations to suit chronic diseases should involve monitoring and continual management instead of strict exclusions<sup>57</sup> (ie, measure effects of sweets on glycemia and institute appropriate insulin protocol instead of cutting out all concentrated sweets). It is also important to not remove all salt from hypertensive geriatric patients' diets,<sup>57</sup> because of the palatability of food and the dizziness and fall risk of hypovolemic patients who may also be prescribed diuretics.

Multiple comorbidities are common in elderly individuals; thus, they are often prescribed multiple medications to treat these diseases. It is difficult to separate whether polypharmacy worsens malnutrition or whether these 2 occurrences coexist in the vulnerable population of the elderly, with or without medical morbidity, and social deprivation factors like food insecurity.<sup>23,44</sup> It should be noted, however, that medications have common side effects that may be easily overlooked, such as dyspepsia or gastrointestinal intolerance. Furthermore, certain commonly prescribed medications have side effects affecting nutritional status such as anorexia, early satiety, reduced ability to eat, dysphagia, constipation, and diarrhea. If an elderly patient is feeling off balance because of medication-induced dizziness, nausea, or myalgias, it is also reasonable to believe that he or she would eat less. In addition, in elderly patients

who take multiple medications (often up to 10 or more), possible side effects may be difficult to identify and may be superimposed by drug interactions.<sup>44</sup> A thorough review of symptoms may help capture missed gastrointestinal disturbances or side effects of medications in an elderly individual.

It is important that recent weight loss is identified and quantified when possible during the preoperative visit.<sup>16</sup> Availability of serial weight measurements are preferred, as they may reflect a trend that may more readily identify malnutrition. Once recognized, malnutrition or weight loss should be communicated to all health care professionals involved in the patient's care. In addition, weight should be plotted against estimated weight for age and height on an available weight chart, because the number alone may be misinterpreted by clinicians, and those whose number is less than 80% of expected weight may be considered underweight. Treating physicians should be cognizant that even if a proper diet is instituted and successful, weight gain in the elderly is slower compared with their younger counterparts.

### ***The Provision of Nutrients to Elderly Critically Ill Surgical Patients***

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#### ***Overview of nutrient delivery***

When an elderly patient requires tube feedings or total parenteral nutrition, the clinical care provider must evaluate all factors involved with providing adequate nutrition for their patient. This evaluation entails the assessment of their basal and total energy expenditure, type of and amount of calories needed to achieve goal calories, and the delivering of other necessary vitamins and adjuncts. One must also consider the method of delivery (enteral vs parenteral) and patient-specific access (central vs peripheral total parenteral nutrition, gastric vs postpyloric or jejunal) and complications associated with each of these. Continuous assessment is needed to ensure that the individual is neither overfed nor underfed.

The provision of calories by artificial means is often necessary in critically ill surgical patients. The enteral route is preferred whenever possible, via nasogastric tube, gastrostomy, or jejunostomy, as clinically applicable. Precautions should be taken to avoid aspiration, as elderly individuals are generally at increased risk. When indicated, enteral nutrition should be started 1 to 2 days after admission. If illness is not expected to last longer than 3 to 5 days in a well-nourished individual or 5 to 7 days in a poorly nourished individual, artificial nutrition, whether enteral or parenteral, may be unnecessary. The provision of calories sufficient to meet caloric needs is calculated based on height, weight, activity, and nature of stress. The provision of nutrients is titrated clinically.

In the case that an elderly individual is suspected to have low oral intake, especially while acutely hospitalized, a search for the reason of poor intake should ensue. For individuals admitted without a gastrointestinal complaint, current dysphagia and previous insult to the cricopharyngeal mechanism are worth ruling out. Disorders that affect the cricopharyngeal mechanism of swallowing are many and include neurologic disorders such as previous stroke, Parkinsonism, esophageal motility disorders, gastroesophageal reflux, and mechanical obstruction caused by cancer or something else. Patients may present because of recurrent episodes of aspiration, which raises the suspicion for disorders affecting swallowing or cough reflex.<sup>59</sup> For individuals found to have decreased oral intake because of mechanical difficulties associated with a medical condition and who are determined to be malnourished or at risk of malnourishment after nutritional assessment, the placement of a percutaneous endoscopic gastrostomy must be entertained. Proper discussion should be done with the patient and the family to come to that decision, and it is preferable that it be for individuals with moderate-to-good prognosis.



### **Nutrient requirements**

The most accurate method to calculate the basal energy expenditure is the Harris-Benedict equation, which is based on height, weight, gender, and age. For an initial estimate of total energy expenditure, one must multiply by the appropriate activity factor of the patient and by the appropriate stress factor.<sup>60</sup> Therefore, careful assessment must be made of the mitigating factors for nutritional requirement, such as sepsis, fever, inflammation, surgical trauma, or traumatic long bone fractures, which would factor into increased stress.

As a general rule, an individual should receive 25 kcal/kg/d in an unstressed situation. One then must multiply this amount by the activity and stress factors to estimate requirements in a hospitalized patient.<sup>61</sup> Protein requirements are also increased by stress and are thus important to counteract the loss of lean muscle mass in a postoperative patient. Counteracting the loss of lean muscle mass may be especially important in the elderly. There are no specific protein recommendations for artificial nutrition supplied to the elderly, but 0.8 g/kg/d is the current recommendation for adults and is increased with stress and protein losing conditions.<sup>61</sup> In patients with end-stage renal disease on dialysis, greater than the usual dose of protein is recommended. Patients on continuous renal replacement therapy should receive 2.5 times the usual amount of protein.<sup>62,63</sup> In patients with end-stage renal disease not on dialysis, the normal amount for an unstressed patient is recommended. Patients with renal disease should receive less to none of certain trace elements. Patients with liver disease should receive about the usual amount of protein.<sup>63</sup> A patient with liver-related encephalopathy that is refractory to medical management may benefit from branched-chain amino acids.<sup>62,63</sup>

Micronutrients are slowly being recognized as therapies, as they may be conditionally essential in conditions of disease, such as arginine and glutamine.<sup>64</sup> Furthermore, selenium, a trace element with antioxidant properties, has shown potential for a direct therapeutic effect when given in doses beyond the recommended daily values.<sup>61,64,65</sup> The use of micronutrients as therapy is an active avenue of research. Not enough is known about trace element status in the elderly to make recommendations for this age group.<sup>66</sup> Ergogenic diets have not been studied sufficiently in the elderly to make recommendations.<sup>67</sup> Biological mechanisms at the cellular level are being evaluated to perhaps detect the effect of micronutrients on aging and to detect the effect of nutritional interventions.<sup>68</sup>

Clinicians must be aware of the possibility of symptomatic micronutrient deficiency states developing in patients, especially in those individuals who are predisposed because of chronic malnutrition. However, deficiency states usually do not develop because of body stores when patients are on artificial nutrition for less than 3 months.<sup>69</sup> Patients with certain diseases are more likely to have deficiency in certain nutrients, such as zinc in cases of increased gastrointestinal loss,<sup>69</sup> but despite its reported positive effect on healing, it is not recommended in excess.<sup>64</sup> Although iron is deficient in critical illness and is needed for erythropoiesis, there are theoretic concerns over its safety, including the association with sepsis and an altered redox potential in the cells. In addition, iron supplementation has not been proven to prevent the need for transfusion.<sup>70</sup>

### **Type of formulation**

Different formulations for enteral feeding exist. Patients with normal to near-normal digesting ability can receive polymeric feedings. Patients with malabsorption syndromes require elemental or predigested feedings. Fiber supplemented feedings are contraindicated before full resuscitation and restoration of hemodynamic stability

and in patients who have dysmotility or who are predisposed to bowel ischemia.<sup>62</sup> Soluble fiber may be indicated in patients without a contraindication who have diarrhea.<sup>62,64</sup> A combination of antioxidant vitamins and trace minerals is recommended in both enteral and parenteral regimens. The exact composition of micronutrients is under debate because of manufacturing limitations and the absence of recommendations for dosage, specifically determined for elderly critically ill surgical patients.

Immune-modulating enteral formulations have been shown to be beneficial in surgical critically ill patients.<sup>11,62</sup> These formulations contain arginine, glutamine, nucleic acids, omega 3 fatty acids, and vitamin antioxidants. There is some evidence that immune-modulating formulations should not be given to patients who are already severely septic.<sup>62</sup> There is also evidence for enteral glutamine alone in burn, trauma, and mixed critically ill patients.<sup>62</sup> Patients with acute respiratory distress syndrome should be placed on anti-inflammatory lipid formulations.<sup>62</sup> There is some evidence for the use of probiotics in patients with major abdominal surgeries, transplants, and severe trauma, but no general recommendation can be made.<sup>62</sup> Intravenous lipid emulsions seem to help in sepsis and in preventing end-organ failure in this setting, whereas enteral fish oils are still under study.<sup>61</sup> No specific high-level recommendations are made regarding indications and recommended doses for individual micronutrients in artificial nutrition for critical care patients and for the elderly subgroup.

### ***Glycemic control***

The institution of feeding in a critically ill patient may have a negative effect on glycemic control. The maintenance of normoglycemia must be maintained in all patients, including those receiving artificial nutrition.<sup>62</sup> Special attention must be given to times of stoppage of feeding for procedures and changes in rate of feeding to prevent variations in glycemia and episodes of hypoglycemia. Overfeeding should be avoided. Hyperglycemia in critically ill patients is associated with an increased risk of infections, length of stay, dependence on organ support, and overall mortality.<sup>71</sup> Hyperglycemia is detrimental to immune functions and promotes infection<sup>72</sup>; furthermore, it is theorized that maintenance of normoglycemia may help reverse the systemic inflammatory immune response. The amalgamation of the largest clinical trial proposes that strictest control of hyperglycemia without causing episodes of hypoglycemia is associated with the best outcome.<sup>73</sup> Although the initial value and trend of glycemia may of prognostic value,<sup>74</sup> there is sufficient evidence to believe that achieving and maintaining normoglycemia is of significant benefit to outcome in a critically ill elderly hospitalized patient.<sup>75</sup> The authors suggest that a sliding scale of intravenous insulin be instituted, perhaps similar to the modified Yale protocol, with special guidance at the time of instituting and stopping feedings and validated at every institution for safety.

For diabetic elderly individuals, the same percentage of carbohydrates in artificial nutrition may be used or slightly less at 30% to 40% of the total caloric requirements, instead of the usual 50% of total requirements. Use of oral antihyperglycemic drugs is discouraged because of the risk of hypoglycemia. Metformin use is discouraged because it increases the risk of lactic acidosis in septic patients and in those who receive intravenous contrast. Control of glycemia in diabetics on parenteral nutrition may require more than their usual amount of insulin.<sup>41</sup>

### ***Common vitamin deficiencies***

Because of impaired processes necessary for production of vitamin D in aging adults and because deficiency is associated with depression, cognitive impairment, and

increased risk of fractures, adequate vitamin D intake is recommended. The recommended dietary allowance (RDA) of vitamin D for adults through age 70 years is 600 IU with the recommended dietary allowance increasing to 800 IU after age 71. Patients who are institutionalized are at particular risk for vitamin D deficiency because of poor exposure to sunlight. Vitamin D is not sufficiently studied for use in intensive care,<sup>76</sup> although acute cases of symptomatic bone loss caused by vitamin D deficiency associated with parenteral nutrition are reported.<sup>69</sup>

Patients at risk for vitamin B12 deficiency because of previous gastric surgery or gastric disease or those who have neurologic, psychological, and hematologic disturbances determined to be caused by vitamin B12 should be supplemented with oral B12 at a 1000 µg/d. Because of extensive physiologic stores, vitamin B12 deficiency will not set in clinically for a few years after absorption ceases, so replacement only becomes important in long-term states of deficiency such as surgical gastrectomies or pernicious anemia, or when a deficiency state is otherwise diagnosed if suspected.

If it is deemed that an elderly individual may be unable to achieve micronutrient recommended requirements because of poor intake, it may be prudent to prescribe a multivitamin. However, the National Institutes of Health Census in 2006 did not find sufficient evidence to recommend for or against routine prescription of a multivitamin to elderly individuals.

## **GENERAL IN-HOSPITAL RECOMMENDATIONS FOR NUTRITION OF ELDERLY SURGICAL PATIENTS**

### ***General Recommendations***

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- Every patient should receive at least a brief nutritional assessment<sup>41</sup> at admission<sup>16</sup> in accordance with hospital policy and useful to allied health staff. The assessment performed should be documented in the medical chart and the nutritional status continually communicated to treating physicians as more information is available.<sup>41</sup> If the patient is malnourished or at risk of malnourishment according to the initial screening tools (MST, the Short Nutritional Assessment Questionnaire, MNA) or according to the assessment of his or her physician, formal dietary assessment should be initiated.
- When an elderly surgical patient is prescribed a diet, every effort should be made by the caring physician, nurse, and allied health professionals to ensure that the diet prescribed is provided to and successfully received by the patient. Any issues with access<sup>21</sup> and palatability should be reported to the caring team, and a search for alternatives should occur. This search requires attention to possible physical limitations of the elderly individual.<sup>41</sup>
- Hospitalized patients should be assessed regularly for medical signs of nutritional intolerance such as nausea, vomiting, pain, difficulty chewing or swallowing, impaired bowel function, and physical signs of intolerance on physical and abdominal examination.

### ***Continued Assessment***

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- After the initial nutritional assessment, if the patient is at increased risk for malnutrition, further specialized testing will occur by consulted allied health care professionals. The information and recommendations ensuing should be discussed with the team, including the attending physician.<sup>16</sup>
- Any nutritional intervention should be monitored for efficacy and modified as needed.

- The patient's bowel movements should be managed consistently.<sup>77</sup> For instance, if the patient takes a laxative at home, this should not be withdrawn for longer than necessary after surgery, and one should not wait for the development of constipation. If a patient is given a medication that can cause constipation, the appropriate kind and strength of prophylactic laxative should be added and tailored to the individual patient's bowel pattern and response to medication. If a patient gets diarrhea, other than the usual medical intervention and workup, efforts should be made to modify the diet to decrease the problem without withdrawing nutrition, when possible. If the patient is expected to have nausea because of his medical or surgical treatment, protocols immediately available at the bedside should address the symptoms targeting immediate relief and then triggering a formal evaluation.

### **Enteral Nutrition**

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- Tolerance to the method of nutrition must be assessed.<sup>77</sup> Decisions for nutrition are important medical decisions that are often life changing and should be discussed with the elderly person involved and his family when appropriate. An elderly person may have increased issues with tolerance to the nutritional method of access chosen and many opt out of it altogether. It is important to define goals of care.<sup>62</sup>
- The type of nutrition provided should be chosen mindfully. No specific recommendation exists for the elderly, but the closest to physiologic may be wise unless contraindicated, for example, fiber-rich enteral nutrition.<sup>77</sup> The proportion of calories to be supplied as carbohydrates, proteins, and fat in parenteral nutrition should be standard and may be approached regularly to respond to the patient's clinical course by the nutritionist and the clinical team.
- The provision of micronutrients must be considered for every patient, including the amount necessary, whether certain micronutrients may be beneficial in excess amounts, and the avoidance of toxic levels by adjusting for comorbid conditions. If nutrition is enteral, it is suggested that the whole requirement for micronutrient is provided even if less-than-usual calories are provided.
- Monitoring of electrolyte imbalances is done as appropriate to the clinical condition of the patient<sup>77</sup> and more aggressively if the patient is at risk for refeeding syndrome.
- Fluid balance is important in an elderly individual.<sup>77</sup> Large shifts in fluid status are discouraged. Special attention should be given for underlying pathologies, such as heart failure. The elderly's kidney concentrating capacity is less than that of a young adult, so adequate amounts of water should be considered. The amount of fluid given with nutrition may be limited by the necessary medical restriction of fluids in certain elderly individuals.
- The risk of aspiration is larger in elderly individuals,<sup>77</sup> so precautions must be assiduously followed.
- The interference with drug absorption is possible, and previous control may be altered by the new provision of nutrition. Monitoring should occur as clinically indicated; for example, monitoring of anticoagulant levels should be considered.
- The clinician must be aware of the possibility of malabsorption syndromes. The specific history and clinical course will guide appropriate workup and intervention.
- Glycemic goals must be defined,<sup>77</sup> and changes appropriate in magnitude to the clinical situation should be instituted to shift smoothly toward euglycemia.

- Elderly should be assessed regularly for the ability to return to an oral diet.<sup>77</sup> Perceived readiness should prompt a monitored trial of oral diet.

### ***Parenteral Nutrition***

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- The clinician must be mindful of complications of vascular access (ie, central line sepsis) and monitor accordingly. Regular follow-up should be done to ensure the supply of an adequate amount of nutrients without metabolic consequences (ie, liver failure).
- Elderly individuals may exhibit early sepsis differently than younger adults.
- Fluid, electrolyte, and micronutrient supplementation should be tailored clinically the individual.
- Glycemic goals must be defined, and changes appropriate in magnitude to the clinical situation should be instituted to shift smoothly toward euglycemia.
- Elderly should be regularly assessed for the ability to return to an oral diet. Perceived readiness should prompt a monitored trial of oral diet.

### ***The Relationship of Drugs and Nutrition***

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- The hospitalization period may serve to optimize the patient's medications, to observe for wanted effects, and to control for unwanted ones. Consultation should be considered when a medication is suspected to cause harm but treats an active clinical condition.
- Consider STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment) criteria for medications that seem to be producing significant side-effects that can impact nutritional status. For example, opioids can be replaced with acetaminophen if the pain is not severe.
- Especially when new medications are started, it is advisable to monitor for side effects that can affect dietary intake.

### ***Discharge Planning***

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- On discharge planning, it is wise to flag a patient who is nutritionally at risk or who has received in-house nutritional interventions, such that nutritional assessment for undernutrition may not be missed on follow-up visits.<sup>16,41</sup> A patient may have food insecurity that is unmasked because of new dietary restrictions that are prescribed or related to the consequences of surgical disease or chronic hospitalization. A worsened nutritional status may lead to a spiral of clinical deterioration.
- For individuals who may be discharged on enteral and parenteral nutrition, early arrangements should be made for professional home care and adequate follow-up.

In general, it is important that the clinical care team identify problems that can be quickly remedied to ensure adequate nutritional intake. It would also be wise to emulate the patient's nutritional habits from home if those were working for the patient, such as home cooking to be brought in by family. In addition, ensuring a comfortable environment for eating and the exact amount of help necessary to allow the patient autonomy of eating when possible would help to improve the patient's intake. For every kind of nutrition provided, whether oral, enteral, or parenteral, special care must be taken to monitor for the complications common in the elderly population.

## **SUMMARY**

Elderly people experience physiologic changes in the gut and in every organ system, which predisposes them to impaired nutrition and associated increased risk factors.

When the normal processes of aging is compounded by illness, the propensity to cause a pathologic state of malnutrition increases. Surgical nutrition support in the critical care setting aims to identify those at nutritional risk and to support nutritional needs in the direction of recovery. New evidence has arisen for use of certain nutrients as therapeutic agents because they are thought to contribute to the healing process and may be conditionally deficient in stress related to disease processes. Nutritional support is critical to the successful surgical outcome in the geriatric surgical population. It is important that health care providers follow evidenced-based recommendations for the provision of adequate nutrients and address the individual needs of every patient.

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