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Nutritional Management of the Critically Ill Older Adult

A review of available evidence and an overview of recommendations for the nutritional management of the critically ill older adult.

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Introduction

Worldwide, there is a shift in the distribution of the population towards older ages. This shift is similarly being experienced in the Intensive Care Unit (ICU), with the median age of the entire ICU in some countries above 65 years (Flaatten et al. 2017). Older adults are commonly defined as persons aged 65 years or older, with geriatric medicine not specifically age defined but more frequently guided by the degree of morbidity (EUMS Definition). Nutrition therapy may play an important role in maintaining and optimising functional status and quality of life in critically ill older adults, with prolonged inadequate nutrition associated with poorer patient outcomes and greater economic burden for health care systems (Goates et al. 2016; Rasheed and Woods 2013; Volkert et al. 2019; Ha et al. 2010; Hegerova et al. 2015; Gentile et al. 2013). This narrative review aims to summarise available evidence and provide an overview of recommendations for the nutritional management of the critically ill older adult.

General Considerations for the Nutrition Management of the Older Adult in ICU

Important considerations relevant to the provision of nutrition therapy in the older adult are displayed in **Figure 1**. The majority of these considerations are interrelated and associated with higher morbidity and mortality (Guidet et al. 2018; Schefold et al. 2017; Lew et al. 2017; Shpata et al. 2015; Singer et al. 2019; Wells and Dumbrell 2006; Gomes et al. 2011; Gingrich et al. 2019), with malnutrition, obesity and sarcopenia discussed in more detail below.

Malnutrition

The detection and monitoring of malnutrition are of importance in this patient group, with estimates that malnutrition affects approximately 23% of hospitalised and 23-34% of critically ill older adults (Guigoz 2006; Sheean et al. 2013). The early identification and management of malnutrition are important, with malnutrition associated with adverse patient outcomes including longer hospital length of stay, functional decline, poor quality of life and higher mortality (Rasheed and Woods 2013; Gentile et al. 2013; Esmayel et al. 2013; Alzahrani and Alamri 2017; Liu et al. 2002). A limited number of studies have explored the sensitivity and specificity of malnutrition screening and diagnostic tools in older critically ill patients (Sheean et al. 2013; Tripathy and Mishra 2015). Due to the paucity of studies in this area, the latest 2019 European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines take a pragmatic approach, recommending that all patients (regardless of age) with an admission greater than 48 hours be considered at risk of malnutrition, but do not endorse use of a specific malnutrition screening or assessment tool (Singer et al. 2019). Until tools are appropriately validated in this population, local guidelines or the recent Global Leadership Initiative in Malnutrition (GLIM) criteria can be used to diagnose malnutrition.

Obesity

The prevalence of obesity (body mass index [BMI] >30kg/m2) is increasing in older adults, with a European study reporting an increase from 17.5% in 2005 to 19.2% in 2013 in individuals aged 50 years or older (Peralta et al. 2018). Both the ESPEN and the American Society for Parenteral and Enteral Nutrition/Society of Critical Care Medicine (ASPEN/SCCM) clinical guidelines make specific recommendations for the management of critically ill obese patients (**Table 1**) but are not specific to

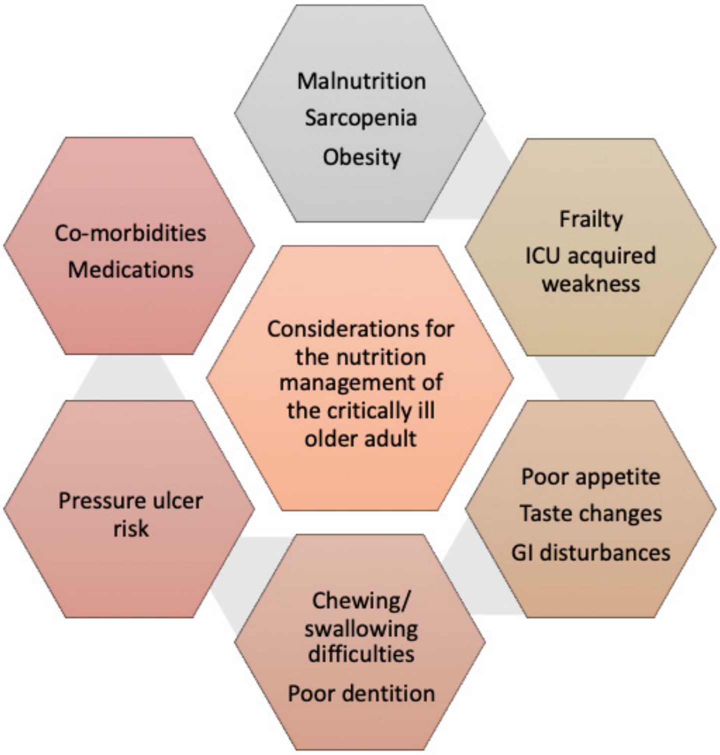

Figure 1. Considerations for the nutrition management of the critically ill older adult.
GI - gastrointestinal; ICU - Intensive Care Unit

Guideline	ESPEN (Singer et al. 2019)	ASPEN/SCCM (McClave et al. 2016)
Energy	Where possible, indirect calorimetry should be used to guide energy delivery **Day 1-3:** Aim <70% estimated or measured energy expenditure **After day 3:** • If using indirect calorimetry, progressively increase to 80-100% measured energy expenditure • If using predictive equations, aim <70% estimated energy expenditure for the first week	Where possible, indirect calorimetry should be used to guide energy delivery **Non-obese:** 25-30 kcal/kg/day **Obese:** • BMI 30-50 kg/m2: 11-14 kcal/kg actual body weight/day • BMI >50 kg/m2: 22-25 kcal/kg ideal body weight/day • If using indirect calorimetry, energy delivery should not exceed 65-70% of measured energy expenditure
Protein	**Non-obese:** 1.3 g/kg/day delivered progressively **Obese:** 1.3 g/kg adjusted body weight/day	**Non-obese:** 1.2-2.0 g/kg/day, and may be higher in burn or multi-trauma patients **Obese:** • BMI 30-40 kg/m2: 2.0 g/kg ideal body weight/day • BMI ≥ 40 kg/m2: up to 2.5 g/kg ideal body weight/day

ASPEN/SCCM: American Society for Parenteral and Enteral Nutrition/Society of Critical Care Medicine; BMI: Body Mass Index; ESPEN: European Society for Clinical Nutrition and Metabolism.

Table 1: General energy and protein recommendations for all Intensive Care Unit patients

the older obese adult.

A hypocaloric, high protein diet has been proposed for critically ill obese patients and is recommended in the ASPEN/SCCM guideline (McClave et al. 2016; Burge et al. 1994; Choban et al. 1997), but there is minimal evidence to support the use of this intervention in older obese patients. In a retrospective study, nitrogen balance and a range of clinical outcomes were explored in 33 older (≥ 60 years) and 41 younger (18-59 years) obese critically ill trauma patients prescribed hypocaloric, high-protein nutrition therapy (mean protein intake during nitrogen balance: 2.3 g/kg ideal body weight/day for both groups) (Dickerson et al. 2013). Mean nitrogen balance was comparable, with approximately half of patients in each group achieving nitrogen equilibrium or positive nitrogen balance. Clinical outcomes, including ICU length of stay and duration of mechanical ventilation, did not differ between groups (Dickerson et al. 2013). However, older patients had higher mean serum urea nitrogen concentrations (30 ± 14 mg/dL vs 20 ± 9 mg/dL, $p = 0.001$), although there were no signs of uraemia and no patients required continuous renal replacement therapy (Dickerson et al. 2013). This highlights that the use of high protein diets may be important for maintaining nitrogen equilibrium in the older obese adult, and that renal function should be carefully monitored when this nutrition intervention is delivered.

It is not clear whether there are benefits of implementing hypocaloric versus isocaloric regimens in the older obese critically ill adult. As energy requirements for obese individuals may be higher than recommended targets (Ridley et al. 2020a), and malnutrition and sarcopenia are key considerations in the older adult (which can co-exist with obesity), energy prescription should be carefully considered on an individual basis. The under-prescription of energy needs can result in significant underfeeding over time and this may be further compounded by the reported delay in the initiation of nutrition support in obese patients (Borel et al. 2014). Conversely, overfeeding has been associated with hyperglycaemia, hepatic steatosis (more likely to occur with parenteral nutrition) and increases in duration of mechanical ventilation which may be more pronounced in obese individuals (Dickerson 2020; Klein et al. 1998). The risks of both should be balanced with the goal of minimising muscle loss and maximising functional recovery.

Sarcopenia

Sarcopenia is generalised loss of skeletal muscle mass, strength and function, occurring primarily due to ageing, and secondary due to disease, inactivity and malnutrition (Cruz-Jentoft et al. 2019). Insulin resistance and anabolic resistance to protein intake (reduced sensitivity to amino acids, with higher quantities likely required to stimulate muscle protein synthesis) contribute to the increased risk of sarcopenia with ageing (Dickerson 2020; Breen & Phillips 2011). There is limited evidence investigating sarcopenia in critically ill patients due to the challenges of measuring both muscle mass and muscle strength in the ICU setting (Kizilarslanoglu et al. 2016). However recent observational studies have reported significantly lower muscularity at ICU admission in older (≥ 65years) versus younger patients using computed tomography (CT) image analysis (Paris et al. 2017; Lambell et al. 2020). Further, in older trauma patients admitted to the ICU, low CT muscle area was highly prevalent and independently associated with length of mechanical ventilation, ICU stay and mortality (Moisey et al. 2013). In non-ICU hospitalised patients, sarcopenia is associated with a range of poorer health outcomes, and in older hospitalised adults, those with sarcopenia on admission have been found to have higher hospital costs (up to a 5-fold increase) (Cruz-Jentoft et al. 2019; Antunes et al. 2017). Although not specific to older patients, three recent randomised controlled trials (RCTs) investigated nutritional interventions (high protein, high energy, and bolus feeding) aimed at attenuation of muscle wasting in the first few weeks of critical illness, with mixed findings (Ferrie et al. 2016; McNelly et al. 2020; Fetterplace et al. 2018). While the most appropriate nutrition interventions to limit detrimental changes in muscle health in critically illness (and specifically older adults) remains unclear, strategies such as early mobilisation and high protein intakes (see protein section) may be beneficial but need to be investigated (McKendry et al. 2020). Future studies are required to validate methods for assessing sarcopenia in the critically ill setting, and to determine the most appropriate nutrition intervention to prevent muscle loss and functional decline in critically ill older patients.

Nutritional Requirements for the Older Adult in ICU

Energy

The use of indirect calorimetry (and if not available, oxygen consumption [VO2] or carbon dioxide production [VCO2] measurements) is recommended to determine energy expenditure during critical illness and guide energy delivery where possible (Singer et al. 2019; McClave et al. 2016). In its absence, predictive equations are used. Predictive equation estimates commonly differ from indirect calorimetry measurements in critical illness, and this can be a greater issue at the extremes of age (Segadilha et al. 2017). In the older adult, changes in metabolism, decreases in fat and fat-free mass, medication use (such as the use of sedatives and analgesics in the ICU) and comorbidities likely contribute to this difficulty, as well as the use of predictive equations that were commonly developed and validated using populations with mean ages under 65 years (Walker and Heuberger 2009; Parker et al. 2017). Although various equations have been proposed for use in older critically ill adults (including the Mifflin–St Jeor and Harris-Benedict equations with applied stress factors) (Segadilha et al. 2017), there is no consensus on the most accurate and precise equation to use in this population.

Where the use of indirect calorimetry is not possible, **Table 1** summarises the current weight-based formula recommendations from key nutrition guidelines in critically ill patients. It should be noted that these recommendations are not specific to the older adult, with the ESPEN guideline on clinical nutrition and hydration in geriatrics recommending that approximately 30 kcal/kg/day is targeted (minimal requirements of 27 and 30 kcal/kg/day estimated during illness) for the older adult (Volkert et al. 2019).

Irrespective of the energy target selected, the latest ESPEN 2019 clinical practice guideline for critical illness recommends the progressive introduction of nutrition **(Table 1)**, due to findings of recent RCTs reporting no benefit (and in some cases harm) with target feeding early in ICU admission (Singer et al. 2019; Arabi et al. 2015; Rice et al. 2012; Casaer et al. 2011; Chapman et al. 2018). Hypocaloric nutrition, with adequate protein provision and progression to isocaloric nutrition where appropriate, has similarly been proposed for the older critically ill adult to avoid complications of overfeeding (McKendry et al. 2020)), nonetheless limited RCTs have been conducted to support this recommendation. Careful monitoring of energy provision is recommended in this patient group to avoid adverse outcomes associated with both under- and overfeeding.

Protein

Protein provision is thought to be important for maintaining functionality, decreasing the degree of ICU-acquired weakness and promoting recovery from illness, however the impact of protein intake on outcomes in critical illness is yet to be elucidated (Singer et al. 2019; Bauer et al. 2013; Preiser 2018). Protein intake recommendations in critical illness are summarised in

Table 1, however these are not specific to the older adult. For adults aged 65 years or older, 1.0–1.2 g/kg/day of protein is recommended in health, with increased quantities of 1.2-1.5 g/kg/day or higher recommended for older people with a severe illness in key position papers (Bauer et al. 2013; Deutz et al. 2014). In a recent review, protein intakes up to 2.5 g/kg/day have been proposed for critically ill older adults in severe catabolic states, such as patients with severe trauma and burns (McKendry et al. 2020).

In the stable non-critically ill patient, protein source (animal > vegetable protein), feeding pattern and timing of protein to exercise may play an important role in enhancing optimal protein synthesis (Bauer et al. 2013). Pulse-feeding (the inclusion of most protein at midday) (Bouillanne et al. 2013) and consuming high-quality protein immediately following exercise (Jordan et al. 2010; Esmarck et al. 2001) are some strategies that may be beneficial but require investigation in the stable critically ill older adult.

Fluid

For non-critically ill patients, 30-35 ml/kg/day of fluid is recommended for adults, nonetheless, this is a general recommendation that can vary significantly depending on factors including extra losses (e.g. drains) and extra input (e.g. intravenous drugs) (National Collaborating Centre for Acute Care, Queensland Health 2017). In the older adult (particularly frail and malnourished patients), fast and high volumes of fluid resuscitation may not be well tolerated with recommendations of providing less intravenous fluid (approximately 20-25 ml/kg/day) (NICE 2013). As with younger critically ill patients, fluid requirements are dependent on the clinical situation and should be individualised. When prescribing oral nutrition supplements, enteral and/or parenteral nutrition, fluid requirements should be considered and discussed with the medical team.

In the stable older adult, constipation is a common complaint which becomes more prevalent with ageing (Schuster et al. 2015). This in part can occur due to neurodegenerative changes in the enteric nervous system related to ageing and changes to rectal sensitivity and anal function (McCrea et al. 2008). Fluid intake should be considered when managing constipation in the ICU, with critical illness likely to increase the risk of constipation further for several reasons including the use of sedatives, opioid agents and changes in diet (de Azevedo and Machado 2013).

Considerations for the Ventilated Patient

Where nutrition targets cannot be achieved orally or in cases where swallowing is proven unsafe, artificial nutrition support should be considered (Singer et al. 2019). Post-pyloric enteral nutrition (or temporary parenteral nutrition where post-pyloric enteral nutrition is not possible) may be necessary in cases of severe dysphagia with a very high aspiration risk (Singer et al. 2019).

When commencing enteral nutrition, early commencement within 48 hours of ICU admission is recommended in key guidelines for critically ill adults (Singer et al. 2019; Burge et al. 1994; Heyland et al. 2003). Avoiding delays in the commencement of artificial nutrition support is important for at-risk patient groups, including malnourished and frail older adults. In all critically ill patients, enteral nutrition is the preferred and most common delivery route. However, when both oral and enteral nutrition are contraindicated, parenteral nutrition should be considered within three to seven days of ICU admission (Singer et al. 2019). Furthermore, as only approximately 50-60% of prescribed nutrition targets are usually delivered (Ridley et al. 2018), particular attention to energy and protein adequacy should be made as large deficits can quickly accumulate. This is an important consideration in this potentially vulnerable population that may have pre-existing malnutrition.

Another key consideration for patients receiving artificial nutrition support is refeeding syndrome, characterised by potentially fatal extreme fluid and electrolyte shifts (in particular, hypophosphatemia) (Mehanna et al. 2008; Aubry et al. 2018). Older adults, particularly malnourished elderly, are considered a high-risk population for developing refeeding syndrome due to the increased likelihood of comorbidities and reduced physiological reserves. Careful progressive introduction of artificial nutrition in all critically ill patients within the first week of ICU stay is recommended in the ESPEN 2019 guideline (**Table 1**) which is likely to assist in limiting the occurrence of refeeding syndrome (Singer et al. 2019). However, if refeeding syndrome is detected, detailed recommendations of management are outlined in the ESPEN 2019 guideline (Singer et al. 2019).

Considerations for the Non-Ventilated Patient in ICU

In the non-ventilated critically ill older adult, where possible, energy and protein targets should be met via oral diet and oral nutrition supplements (Singer et al. 2019). However, in practice this is challenging, with increasing evidence highlighting that energy intake is likely to be suboptimal, and frequently, under 60% of predicted requirements (Rowls et al. 2016; Peterson et al. 2010; Chapple et al. 2020). Refeeding syndrome risk should also remain a key consideration in patients consuming an oral diet, although the risk of occurrence is likely to be lower than in patients receiving artificial nutrition support.

The reasons contributing to suboptimal intake in the older adult are likely multifactorial and may include; decreased appetite, alterations in taste and smell, gastrointestinal factors (including delayed gastrointestinal motility, nausea, vomiting), physical barriers (including weakness, impaired vision) and psychological factors (including delirium), all of which may be heightened in the ageing population (Wells and Dumbrell 2006; 14, Naithani et al. 2008; Reid and Allard-Gould 2004; Bryczkowski et al. 2014; Ridley et al. 2020b). Post-extubation dysphagia is also a concern for the older critically ill patient, with a recent study reporting that 41.4% of 111 patients aged 65 years or older were found to have clinically significant dysphagia following liberation from mechanical ventilation (Regala et al. 2019).

For patients consuming an oral diet, oral nutrition supplementation should be strongly considered in this population (Singer et al. 2019; Singer 2019). Albeit not in the ICU, a double-blinded RCT of 652 malnourished hospitalised older adults (≥ 65 years), found that consumption of two high-protein supplements containing beta-hydroxy-beta-methylbutyrate (700 kcal and 40 g protein per day) from 72 hours of admission to 90 days post discharge compared to a placebo led to a lower 90-day mortality (4.8% vs 9.7%; relative risk 0.49, 95% confidence interval, 0.27 to 0.90; p = 0.018) and improved odds of better nutritional status at day-90 (Duetz et al. 2016). In addition to assisting in meeting energy and protein targets, oral nutrition supplements have also been reported to assist in optimising quality life, muscle function and decreasing the incidence of pressure ulcer development in acutely ill older adults (Ha et al. 2010; Bourdel-Marchasson et al. 2000; Gariballa & Forster 2007). Despite these findings, the prescription of oral nutrition supplements in non-ventilated ICU patients has been reported to be low (offered to <50% of patients consuming an inadequate diet) (Jarden et al. 2018). It is crucial that the oral intake of critically ill older adults is closely monitored and escalation to artificial nutrition support is considered when intake is inadequate.

The Post-ICU period

Nutrition support in the post-ICU period is likely to play an important role in recovery, but limited research exists in the area in general and specifically in older patients. In a study conducted in 32 patients in the post-ICU hospitalisation period (mean age 56 ± 18 years), nutrition intake was assessed second daily until day 28 or hospital discharge (Ridley et al. 2019). The median [interquartile range] energy and protein intake was 79% [41–108%] and 73% [44–98%], respectively, with intake lowest in patients receiving oral intake alone without oral nutrition supplements (median [interquartile range] energy and protein intake: 37% [21– 66%] and 48% [13–63%] of predicted requirements, respectively) (Ridley et al. 2019). No studies to our knowledge have assessed nutrition intake solely in older patients following ICU discharge, however studies in the acute care setting support the notion that intake may be suboptimal and that oral nutrition supplements should be prescribed and encouraged as discussed earlier (Ha et al. 2010; Bourdel-Marchasson et al. 2000; Gariballa and Forster 2007; Shahar et al. 2002; Young et al. 2018). In older adults, combined nutrition support and physiotherapy may also be beneficial for physical and muscle function as well as improving body composition (Hegerova et al. 2015; Fiatarone et al. 1994), but this needs to be explored in the ICU.

Conclusion

The physiological changes encountered with ageing present many complexities to consider when assessing and managing the nutrition needs of critically ill older adults. A thorough assessment of patients' pre-ICU condition ensures that potential nutritional risks are identified (e.g. risk of re-feeding syndrome and malnutrition) and that the nutritional management is appropriate for the individual. Following ICU discharge, adequate nutrition follow-up is likely to be important for supporting recovery and a return to premorbid function. With limited evidence available, critical care trials investigating nutrition therapy in the older adult would assist in guiding and enhancing nutrition care in this vulnerable population. ■

Key Points

- The median age of the entire ICU in some countries is above 65 years.
- Malnutrition affects approximately 23% of hospitalised and 23-34% of critically ill older adults.
- The prevalence of obesity is increasing in older adults.
- Careful monitoring of energy provision is recommended to avoid the development of refeeding syndrome and adverse outcomes associated with under- and overfeeding.
- The oral intake of critically ill older adults should be monitored closely and escalated to artificial nutrition support when intake is inadequate.
- In older adults, combined nutrition support and physiotherapy may be beneficial for physical and muscle function.

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