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Abstract

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Background: Nutrition interventions for hospitalized patients can provide meaningful benefit on patient recovery outcome, length of hospital admission, and overall healthcare costs. Preventing and treating malnutrition is one aspect of optimizing patient outcomes following a prolonged clinical course, including stays in the intensive care unit (ICU).

Purpose: This literature review aims to address how nutrition status can be maximized for a patient's post intensive care unit clinical course. While early enteral nutrition (EN) when appropriate is accepted as optimal care, there is little standardization for removal of devices to provide artificially administered nutrition and hydration (AANH).

Methods: A comprehensive literature review was conducted using PubMed and Google Scholar, using the search terms post extubation dysphagia, malnutrition, post ICU rehab, post ICU nutrition, ICU nutrition, feeding tube in the ICU, post extubation rehab phase, and dysphagia and feeding tube. Inclusion criteria were studies that were published in 2018 or later. Systematic reviews, case studies and research prior to 2018 was excluded unless it was needed to provide appropriate historical background or context for discussion.

Conclusions: In order to best time the removal of artificially administered nutrition and hydration devices to optimize patient rehabilitation and minimize determinate outcomes related to malnutrition, further research is warranted. Research should focus on assessing outcoming randomized control trials, with defined malnutrition criteria across institutions.

Key Words: post extubation dysphagia, post ICU rehabilitation, nasoenteric feeding tube use, malnutrition interventions, nutrition status, malnutrition.

Introduction

As health care providers and healthcare systems strive to improve patient outcomes, more attention is being paid to the type of care provided, including the holistic approach that an interdisciplinary care team can provide. Within that approach, clinical nutrition can provide meaningful benefits on patient recovery outcomes, length of hospital admissions and healthcare costs.[1,2] As more attention is given to a comprehensive approach, nutrition care is one aspect to examine. Adequate nutrition, or conversely, malnutrition is an impactful, and at times modifiable, aspect of clinical care.[3-5]

Nutrition interventions are a necessity of clinical care, especially within the setting of a prolonged clinical course. Furthermore, intubation and prolonged nil per mouth (NPO) periods can prohibit an individual from adequate oral intake for prolonged periods of time and require support with artificially administered nutrition and hydration (AANH). Aside from inadequate oral intake, other medical complications can arise from prolonged intubations and critical illness.[4,6]

As medical advances have allowed more patients to survive critical illness, significant disability can remain following a critical illness; and there are ongoing improvements to be made in how to best optimize a patient's outcome with post intensive care (ICU) rehabilitation, requiring an interdisciplinary care team to provide a holistic, comprehensive approach. Related specifically to malnutrition, the question of how nutrition status can be maximized for a patient's post intensive care unit clinical course remains ongoing.

In order to determine the best time to remove AANH devices to optimize patient rehabilitation and minimize detrimental outcomes related to malnutrition risks, this literature review will first provide a brief historical review of diagnosing malnutrition, the impact of malnutrition on patient outcomes, and also the role of AANH in an ICU setting. The current literature surrounding nutrition support usage in the usage of nutrition support in the ICU setting will be presented, followed by the prevalence and evaluation of post extubation dysphagia, and then treating malnutrition during the post-ICU rehabilitation phase. Conclusions and recommendations are presented as well.

Methods

A comprehensive literature review was conducted using two search engines: PubMed and Google Scholar. The following search terms were utilized: post extubation dysphagia, malnutrition, post ICU rehab, post ICU nutrition, ICU nutrition, feeding tube in the ICU, post extubation rehab phase, and dysphagia and feeding tube. Inclusion criteria were studies that were published in 2018 or later. Systematic reviews and case studies were overall omitted unless needed to provide appropriate historical background. Furthermore, some studies published before 2018 are included to provide sufficient context for discussion. Of note, much of the literature from 2020 and beyond was observational due to the unique challenges associated with a worldwide pandemic. As discussed in the background section below, malnutrition lacks a worldwide definition for diagnosis, and great variance exists in the literature. For the purpose of this literature review, a standardized malnutrition criteria was not required to be included in the literature review section.

Background + Literature Review

Historical background, Malnutrition

Worldwide, there are a number of different assessment and diagnostic tools used for evaluation of malnutrition. While albumin is largely accepted as an inappropriate marker of nutrition status, it is still seen today in clinical practice. Albumin is a known acute phase response protein, and may misrepresent nutrition status for a critically ill patient.[7] Overall weight loss, BMI, and oversimplification of oral intake as meals per day have also lost favor as accurate indicators of nutrition status. Variance in body composition and frames, and variance in meal size, quality, and content will substantially impact the effects of compromised protein and energy intake. In the last one to two decades, four diagnostic tools have become accepted as the preferred diagnostic tools for assessing malnutrition.[8]

- ☐ Subjective Global Assessment (SGA): still widely used today, validated as a strong predictor of malnutrition related outcomes.[9]
- ☐ Mini Nutritional Assessment (MNA): used to quickly identify patients at high risk for malnutrition. Short form and full assessment have both high specificity and high sensitivity.[10,11]
- ☐ Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition malnutrition consensus characteristics (AND + ASPEN): While widely used in the United States, the diagnostic criteria and assessment tool established needs to be analyzed internationally.[12]
- ☐ Global Leadership Initiative on Malnutrition criteria (GLIM): This approach appears promising, and Theilla et. al has preliminary data to indicate this is an effective method, with proposals in progress to fully validate this approach.[13]

Table 1. Malnutrition Diagnostic Tools and Criteria

Assessment Tool name:	**Assessment components:**	**Severity Determination:**	**Validated:**	**Special Notes:**
SGA	Weight change, dietary intake, gastrointestinal symptoms, functional capacity, impact of patient's disease in relation to nutrition requirements; physical exam to assess for loss of subcutaneous fat, muscle wasting, edema, and/or ascites	Scoring → categorize: A, well nourished B, moderately malnourished, or suspected of being C, severely malnourished	Yes	
MNA	Decline in intake x 3 months, weight loss x 3 months, mobility, psychological	Severity: >24, no malnutrition	Yes	If identified as at risk on short form

	stress or acute stress x 3 months, neuropsychological problems, body mass index or calf circumference.	17-24 at risk for malnutrition <17 malnutrition		assessment, move to more in depth assessment
AND + ASPEN	Inadequate energy intake, weight loss, subcutaneous fat loss, muscle loss, localized or generalized fluid retention, and decreased functional capacity as measured by hand grip strength.	Must meet at least two criteria. The degree of malnutrition and the etiology of it are built into the parameters of the diagnostic criteria	Yes, need to expand populations	
GLIM	Weight loss, low body mass index, reduced muscle mass. Parameters within these determine degree of malnutrition.		In progress	
**Some criteria contain subjective measurements, such as degree of subcutaneous fat loss + muscle loss, may be dependent on provider training.*				

Malnutrition on clinical outcomes

The inclusion criteria for diagnosing malnutrition varies among providers and healthcare systems; therefore, without a gold standard for diagnosing malnutrition, it is difficult to directly compare malnutrition rates among studies. However, using the broad diagnosis, it is evident that malnutrition impacts multiple patient outcomes indicators, including differences on 30 day readmission rates, all cause mortality, and overall length of hospital days.[1,13] Hiller et al. found that mean length of stay doubled for malnourished patients, over 40% were hospitalized for greater than 7 days compared to rate of 14% in the well nourished population, and malnourished patients were over three times more likely to be be readmitted in within 30 days, and over five times more likely to have a fatal outcome.[2] In another retrospective review, Hudson et al. found statistically significant differences between malnourished and well nourished adults for total length of stay and 30 day readmission rates, although not at such staggering differences.[14] It is important to highlight that both studies included patients from general medical floors beyond the intensive care unit, and neither study assessed the role of aggressive nutrition interventions via AANH on patient outcomes.

Hiura et al. confirmed these trends to be true for patients specifically admitted to the ICU. The 13 percent of patients diagnosed with severe malnutrition were found to have significantly longer overall hospital length of stays, increasing from 8 days on average for a well nourished patient to an average of 18 days for a patient meeting severe malnutrition criteria. Total ICU length of stays also doubled, increasing from 3 to 7 days, and the rate of in hospital mortality also increased; 30 day readmission rates were not addressed.[15]

The incidence of malnutrition in the ICU varies widely between studies, and the variance may be attributed to the diagnostic tools used, and/or the subjective aspects of some malnutrition assessment options. For example, Barcus utilized mean upper arm circumference and dietary intake sufficiency to determine that over 60% of ICU patients met moderate and/or severe malnutrition criteria.[16] Conversely, Lew et al. summarized data from 20 studies prior to 2016, and found that rates of malnutrition in the ICU population ranged from 38 to 78%.[6] In the case of severe COVID19 illness, 100% of all study participants were diagnosed with malnutrition by the end of their ICU admission.[17] If not present at admit, the risk for malnutrition increases as the total number of days in the ICU increases.

Energy + Protein Intake in the ICU

Best practices for preventing, minimizing and treating malnutrition in the ICU population remains in progress. ASPEN provides updated nutrition support guidelines for AANH in the ICU setting. Within these guidelines, it is essential to highlight that much of the recommendations are based on consensus and expert opinions (good practice statements) due to insufficient randomized, controlled trials, or observational studies.[4] For the purpose of this literature review, a few key components are summarized here.

Based on low or very low quality evidence, the guidelines recommend AANH via enteral nutrition be initiated within 24-48 hours of admission for the critically ill patient unable to maintain adequate volitional intake. Moreover, EN initiation into the stomach is reasonable, unless infusion needs to be diverted lower into the GI tract due to high risk for aspiration or intolerance to gastric EN, based on moderate to high quality evidence. However, the guidelines do not clarify size or type of tube (example of using a 8-12 french tube that can be advanced into the small intestine or more comfortable with long term use versus a 14-16 french which may less prone to clogging and be used for decompression if needed), instead deferring to the preferred practices of individual healthcare systems.[4]

Accurately quantifying energy and protein deficits achieved during, and preceding, mechanical intubation, is difficult due to a multitude of factors, including variance of institutional practices, frequent stoppages of enteral formula and nurse reported formula intake, bias in reporting 24 hour diet recalls, and lack of standardization for estimating energy and protein needs. For example, Yeh et al found that in over 200 patients requiring at least 72 hours of mechanical ventilation, those experiencing a less severe degree of energy and protein deficit had an increased likelihood of discharging home compared to those with a substantial energy and protein deficit (6000 kcal, 300 grams protein in total while receiving enteral nutrition). The degree, or absence of malnutrition, was not considered for in the findings, and the underlying etiology of the significant deficits was not determined in this study.[18] However, guidance regarding individualized nutrition therapy directed by a multidisciplinary care team is correlated with a decrease in ICU length of stay days.[19]

Following mechanical intubation, oral intake often remains inadequate for a prolonged period of time. Peterson et al., determined that the oral intake of 50 adult patients over a seven day period following intubation was largely inadequate overall, based on data collected from a 24 hour diet recall. Following extubation, nearly half of the population never averaged meeting more than 75% of their estimated daily energy and protein requirements over the week, regardless of their age, nutritional status, severity of illness, location in the hospital, ICU and hospital length of stay, and days on mechanical ventilation. Furthermore, 15 out of 22 diagnosed with malnutrition never consumed more than 75% of their estimated energy and protein needs on any given day during the observation period. Numerous barriers may prevent patients from achieving adequate intake, and patients may suffer from one, or multiple, including residual pain, delays in orders for diet resumption or overly strict diets, post extubation dysphagia, procedures, appetite changes, and/or mentation issues.[20]

Post extubation dysphagia

Post extubation dysphagia (PED) remains a relevant complication of a prolonged critical illness. Multiple factors impact a person's risk for PED, including increasing age, compromised baseline functional status, severity of disease at admission, and comorbidities. Duration of intubation and trauma with intubation may also have a pertinent role in the risk for PED.[21] Furthermore, individuals at risk for nutrition related complications may also be at higher risk for PED .[22]

The role of post extubation dysphagia is thought to largely impact intake following mechanical ventilation. In some ICU's, more than 50 percent of the population remains nil by mouth due to PED, with an average time of five days to an oral diet for all patients requiring mechanical ventilation. Overall, a longer intubation was directly correlated with a longer duration until an oral diet was safely resumed.[23] Individuals that failed a bedside evaluation were nearly three times more likely to have ongoing AANH reliance via a feeding tube (type not specified).[24]

There are quick, bedside evaluation modalities that are reliable in determining PED if a fluoroscopic video swallow evaluation is not feasible.[25] However, the research surrounding the rates of PED occurrence and associated complications fails to address the role of nutrition status, and nutrition related complications; there is often little to no information regarding the presence of nasoenteral feeding tubes in the patient population being evaluated, or this is an exclusion criteria.

Post ICU malnutrition

Attention and care should be paid to the impact of malnutrition on the post ICU rehabilitation phase. For patients admitted to the ICU with severe COVID-19 requiring intubation, inadequate intake and malnutrition remained during hospitalization following transfer out of the ICU.[26] Compromised nutritional status remained at the three month marker following extubation for over half of the patients meeting study criteria.[27] This decline in nutrition status and congruent functional capacity appears to improve over many months of rehab based interventions, with nearly full recovery of nutrition status by the 12 month marker.[28]

Following extubation, a comprehensive and daily swallowing and oral care program in the hospital is an effective option to minimize complications of PED, ultimately decreasing the total number of days until resumption of oral feeding and occurrence of aspiration pneumonia.[22] An effective and comprehensive swallow and oral care program is best approached by a multidisciplinary care team to optimize outcomes, and should address safe swallowing education, salivary gland massage, swallowing exercises, and general oral care.[29,30] However, Nagano et al., determined that tongue strength indicators were most closely correlated with an individual's ability to consume adequate energy and protein during the initial post ICU phase.[31]

Lastly, the impact of a nasoenteric feeding tube (FT) on dysphagia and subsequent aspiration risk should be considered. Patients may be reliant on AANH following extubation in lieu of the ability for safe oral intake, to supplement oral intake volumes, or as an intervention for pre-existing comorbidities. In a group of 15 older participants, Prior et al. found that there was an increase in airway penetration aspiration and pharyngeal residual with the presence of small bore nasal FT. Increased residual in the valleculae, and an increase in transit time was demonstrated with both large and small bore nasal FT.[32] However, the sample size is small and all participants were healthy when assessed. Wang et al., also found similar results, but for individuals recovering from a stroke that had a 14 french nasogastric FT in place for two months. The levels of pharyngeal residual and pharyngeal transit time both improved following removal of the FT, and the risk of penetration aspiration also significantly decreased.[33]

There are multiple ways to diagnose malnutrition, whether at admission or throughout an individual's hospitalization. Malnutrition is linked to worse outcomes including increases in length of hospital stay, risk for 30 day readmission, and mortality. Malnutrition, comorbidities, PED, and the post ICU phase appear to be closely related and impactful on a person's clinical course. A multidisciplinary team approach to diagnosing malnutrition and PED can help identify risk factors and provide appropriate interventions to optimize patient outcomes during and following the post ICU phase.

Discussion + Analysis

Based on the literature, malnutrition, PED, and clinical outcomes are closely related, although the degree, mechanism and prevalence is unclear. PED appears widespread and clinically relevant, and may be underreported. As patients remain NPO due to PED, the likelihood of prolonged inadequate energy and protein intake increases, with a resultant decrease in the nutritional status of patient's in their post ICU phase.

It appears imperative that assessments and interventions begin during the ICU phase of a clinical course, and continue into the post-ICU phase. A multidisciplinary care team can approach the multiple facets of patient care, although guidelines are based on best practices and expert recommendations due to an insufficient amount of evidenced based literature. Cost, staffing shortages, and expertise may pose barriers to a multidisciplinary care team approach in providing patient care. Furthermore, underlying comorbidities and complications related to critical illness necessitate individualized interventions under the parameters of overarching guidelines.

In a review by Moisey et al., nutrition rehabilitation following critical illness was identified as an "underrecognized, and underappreciated area in critical care rehabilitation and research". The role of AANH to optimize rehabilitation, and prevention of early FT removal in patients experiencing PED remain an area to further explore appropriate and effective interventions.[34] Personalized nutrition therapy should be prescribed and monitored following critical illness as part of a holistic rehabilitation plan to help promote a patient's return to their baseline.[33.]

While optimizing a patient's nutrition status may be achieved through AANH, there is limited data suggesting that continued reliance on a nasoenteric FT may hinder progress, and worsen dysphagia and related complications. Collecting adequate data on patient progression is difficult for a myriad of reasons. Temporary nasal tubes are reported to be uncomfortable, unwieldy, and may hinder normal swallowing physiology.[24] Properly securing with a nasal bridle requires a trained healthcare professional to place, and can cause injury or discomfort should the patient attempt to self remove the FT or have the device pulled on.[35] Furthermore, preferred practices for AANH device removal, diet advancement, and multidisciplinary care involvement may be influenced by an individual provider's education and experience, and hospital and organization policies, among other potential factors.[4,18]

The literature remains limited at best, for each individual aspect contributing to a person's outcome following critical illness. It is essential to highlight, though, that none of these exist independently and without impact from the other aspects when applied to a patient's courses and outcomes. Malnutrition, dysphagia, readmission rates, provider preferences, etc, co-exist in every patient scenario. This is evident in the literature presented, given the majority compiled from retrospective studies. Clinical nutrition requires a highly individualized approach, and the numerous factors that must be analyzed, including age, body weight, nutrition status, functional capacity, weight loss, actual versus estimated energy needs, and underlying disease states, make a randomized control trial difficult to implement with a sufficient sample size that encompasses the variety of factors that impact an individual's clinical course in the ICU. While this makes creation of a randomized control trial difficult, it also makes replication difficult also.

As healthcare systems and healthcare providers attempt to find the new normal following a multi-year pandemic, now is the time to explore how patient outcomes can be optimized in effective and efficient ways. Utilizing data sets from the ICU stays during COVID may provide insightful data, given that there was an uptake of relatively healthy people (prior to contracting the virus) requiring prolonged ICU level care. Examining trends that included aggressive nutrition interventions during a period of critical illness and during the post ICU phase may provide meaningful insight into the effect on patient outcomes.

Conclusions

Numerous barriers may prevent patients from achieving adequate energy and protein intake, during the ICU phase and during the post ICU phase. Unfortunately, there has been little replication to further repeat, or elaborate on the etiology of these findings since they were published. To optimize patient outcomes, clear guidance should be provided on nasoenteric FT placement, continuation following extubation, and timing of removal. Readmission rates, length of stay, and rehabilitation potential are linked to the prevalence of malnutrition. Minimizing barriers to achieve adequate calorie and protein intake during intubation and during the post ICU phase is crucial in a patient's clinical course. Early interventions to address oral muscle strength and swallow function should be implemented to lessen the risk for PED. In order to establish strong, evidenced based guidelines for the post-ICU phase, additional research is needed across a variety of disease states, ages, ICU subspecialties, and types of interventions. Getting patients as close to their baseline, decreasing readmission and mortality rates, are worthwhile goals to investigate, and standardize optimal care for.

Practice guidelines established at a national level should address best practices for administration of AANH when oral intake is insufficient or impaired. In this, the size of the nasoenteric FT, and timing of placement should be outlined. A validated malnutrition screening and assessment tool should be included throughout a patient's clinical course. In addition, a multidisciplinary approach should be emphasized to address risk factors for PED with early screening and interventions when a patient is clinically appropriate. Lastly, established criteria for PED screening and treatment should be included. For experts to be able to publish guidelines, it is imperative that additional research is conducted to fully understand the intersectionality of these essential, and often, overlooked aspects of critical care.

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