Practice Guidelines for Nutrition in Critically Ill Patients: A Relook for Indian Scenario

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Abstract

Background and Aim: Intensive-care practices and settings may differ for India in comparison to other countries. While international guidelines are available to direct the use of enteral nutrition (EN), there are no recommendations specific to Indian settings. Advisory board meetings were arranged to develop the practice guidelines specific to Indian context, for the use of EN in critically ill patients and to overcome challenges in this field. **Methods:** Various existing guidelines, meta-analyses, randomized controlled trials, controlled trials, and review articles were reviewed for their contextual relevance and strength. A systematic grading of practice guidelines by advisory board was done based on strength of the supporting evidence. Wherever Indian studies were not available, references were taken from the international guidelines. **Results:** Based on the literature review, the recommendations for developing the practice guidelines were made as per the grading criteria agreed upon by the advisory board. The recommendations were to address challenges regarding EN versus parenteral nutrition; nutrition screening and assessment; nutrition in hemodynamically unstable; route of nutrition; tube feeding and challenges; tolerance; optimum calorie-protein requirements; selection of appropriate enteral feeding formula; micronutrients and immune-nutrients; standard nutrition in hepatic, renal, and respiratory diseases and documentation of nutrition practices. **Conclusion:** This paper summarizes the optimum nutrition practices for critically ill patients. The possible solutions to overcome the challenges in this field are presented as practice guidelines at the end of each section. These guidelines are expected to provide guidance in critical care settings regarding appropriate critical-care nutrition practices and to set up Intensive Care Unit nutrition protocols.

Keywords: Critically ill patients, enteral nutrition, guidelines, scientific formula, tube feeding

Introduction

Significance of nutrition in critical-care settings cannot be overstated. Critical illness is often associated with a catabolic stress state, and patients demonstrate systemic inflammatory response. Complications such as increased infectious morbidity, multi-organ failure, and prolonged hospitalization are not uncommon. Adequate nutrition intervention has shown to attenuate metabolic response to stress and favorably modulate immune responses. Nutritional support in critically ill patients prevents further metabolic deterioration and loss of lean body mass. Decrease in length of hospital stay, morbidity rate and improvement in patient outcomes have attracted and valued the use of nutrition support in the critically ill patients.

Grading Criteria

Various existing guidelines, meta-analyses, randomized controlled trials (RCTs), controlled trials, and review

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articles were reviewed for their contextual relevance and strength.

Systematic grading of the above reviewed evidence was done (from Level I to VI, with Level I graded as strongest and Level VI as weakest).

Level 1 assigned to "existing guidelines;" Level 2 to "RCTs/meta-analysis;" Level 3 to "controlled trials/studies;" Level 4 to "uncontrolled trials/studies;" Level 5 to "review articles;" and Level 6 to "expert opinion/advisory board opinion."

The practice guidelines were then graded as Grade A, B, or C, based on the strength of supporting evidence.

Grade A practice guidelines were supported by Level I/II evidence and denote "strongly recommended."

Grade B practice guidelines were supported by Level III/IV/V evidence and denote "recommended."

Grade C practice guidelines were supported by Level VI evidence and denote "suggested."

Detailed grading criteria are mentioned in Tables 1 and 2, respectively.

Importance/indications/timing of nutrition in critically ill patients

Various physiometabolic changes occur in critically ill patients. These changes may increase the risk of malnutrition.[1] Reduction in total calories and protein intake complicates the deteriorating clinical condition. Increase in sepsis, rise in inflammatory biomarkers, and metabolic imbalance may result in multiple organ failure, shock, and mortality. Thorough assessment of critically ill patients will help in deciding the strategy of nutritional support and further improve the patient outcomes.

Table 1: Strength for supportive evidence

Type of evidence (at least one supporting)	Strength	
Existing guidelines	High	I
RCTs/meta-analysis	High	II
Controlled trial/studies	Moderate	III
Uncontrolled trial/studies	Moderate to weak	IV
Review article	Moderate to weak	V
Expert opinion/advisory board opinion	Weak	VI

RCTs: Randomized controlled trials

Table 2: Grade of recommendation based on strength of supporting evidence

Grade of recommendation	Strength of supporting evidence	Level of Recommendation
A	High (I, II)	We strongly recommend
B	Moderate/moderate to weak (III, IV, V)	We recommend
C	Weak (VI)	We suggest

Nutritional support becomes important to fulfill the macro- and micro-nutrient requirements in such patients. Route-of-feed administration (enteral or parenteral) needs to be decided based on the assessment of hemodynamic status and gastrointestinal functioning.[2] This will prevent risks associated with the faulty feeding techniques. Early enteral nutrition (EEN) in critically ill patient is found to be associated with many benefits and at the same time, with reduced risk of complications.[3] Patient outcomes in Intensive Care Unit (ICU) are affected by appropriate timing of initiation, amount and type of nutrition. Initiating feeding within 24–48 h of critical illness is defined as early nutrition intervention.[4] Initiation of EN can be through oral route or via tube feeding, based on the achievement of nutrition adequacy targets.

Nutrient and electrolyte concentrations may be affected by some drugs, either directly or indirectly. Drug–nutrient interactions must be assessed daily. A multidisciplinary team including nutritionists should be assessing probable drug–nutrient interactions on daily basis.[5]

Practice guidelines

1. All the critically ill patients should undergo nutrition assessment, on admission[4] (A I)
2. Observation of signs of malnutrition (e.g., cachexia, edema, muscle atrophy, BMI <20 kg/m^2) is critical[6] (A I)
3. EN should be started early, preferably within first 24–48 h[4] (A I)
4. In case the nutrition requirement is not met adequately with EN even after 7 days of ICU admission, then usage of parenteral nutrition (PN) may be considered[4] (A I)
5. Nutritional support should to be considered as of therapeutic benefits and not just supportive or adjunctive[4] (A I)
6. Electrolytes should be strictly monitored in the patient on nutrition therapy[7] (B V)
7. Assessment of drug–nutrient interaction to be done on daily basis[5] (B V)
8. Tube feeding to be considered if even 50%–60% of nutrition targets are not met adequately within 72 h of oral nutrition support (C).

Feeding practices in hemodynamically unstable patients

Critically ill patients may be facing reduced peristalsis, gastrointestinal hypoperfusion and mesenteric ischemia. EN may trigger intestinal ischemia in patients who are not hemodynamically (HD) stable.[8] Hence, clinical monitoring of gut function is essential before initiating EN. Critically ill patients on two or more vasopressors/inotropes in high doses are at the risk of developing complications such as gut ischemia, and this may get worse with inadvertent initiation of EN. Thus, ambiguity remains regarding the timing of initiation of EN.[9] Neither clear guidelines nor validated studies are available which indicate the range of systolic and diastolic blood pressures to initiate or avoid EN.

In HD unstable patients, EN should be initiated when the patient is on stable/declining doses of vasopressors and adequately volume resuscitated.[10] In such cases, trophic feeding (10–20 mL/h) to initiate nutrition is the best strategy.[3]

Practice guidelines

1. Clinical monitoring of gut functioning should be started early when the patient is HD stable (C)
2. Once the patient has been fluid resuscitated and stabilized on declining doses of <2 vasopressors, EN may be started cautiously at low rates[4] (A I)
3. EN should be administered within 24–48 h once the patient is stable with vasopressors[10] (A I)
4. In persistent shock, early EN should be avoided[4] (A I).

Nutrition screening and assessment

Nutrition screening is done to identify patients at high nutritional risk. Nutrition assessment is detailed evaluation of nutrition status of the patient. Thus, subset of patients at high nutrition risk is identified by nutrition screening, whereas their nutrition status is evaluated in detail through nutrition assessment process.[11] Complete nutritional history is the first step in nutritional risk assessment. In critically ill patients, indirect information about patient's nutrition can be taken from family members. Information such as unintentional weight loss during last 3–6 months and recent decrease in nutrient intake taken from family members can help to understand nutritional history of the patient. The American Society of Parenteral and Enteral Nutrition (ASPEN) 2016 guidelines recommend using Nutrition Risk Screening-2002 and NUTRIC score for the determination of nutrition risk in critically ill patients. Among the assessment tools available, subjective global assessment (SGA) is inexpensive, quick and can be conducted at the bedside. It is a reliable tool for inferring outcomes in critically ill patients (detailed SGA tool referred in Table 3).[12] However, resource constraints specific to our critical-care settings such as shortage of dieticians/adequately trained paramedics and preoccupation of intensive care physicians with other priorities make nutrition screening and assessment difficult to be done for all the patients. Indicators such as anthropometrics or total body fat evaluation are not accurate to assess the nutrition status. The measurement of plasma concentrations of hepatic proteins lacks specificity.

Practice guidelines

1. Nutrition status of Indian malnourished patients can be assessed by SGA[13] (B III)
2. Initial monitoring of nutrition intervention must be done on daily basis and nutrition plans should be modified accordingly[14] (A I)
3. It is imperative that nutritional assessment is done by well-qualified and trained nutritionists, dedicated to the ICU[15] (A I)
4. It is desirable that nutritionist-to-critically ill patient ratio be maintained at 1:25 (C)
5. Wherever feasible, computed tomography (cross-sectional imaging) or ultrasonography (U/S) can be used to assess the lean muscle mass[16] (B V)
6. Facilitation of nutrition assessment will require good coordination between intensivist and nutritionist[17] (C).

Estimating energy/protein requirements

Preserving the muscle mass in ICU patient is important. Diagnosis, illness severity, nutritional status, and treatment of critically ill patient can influence the energy expenditure. Uncertainty remains on what to give to the ICU patient, to maintain the nutrition adequacy goals. The clinical outcome is dependent on provision, components, and route of feed. Indirect calorimetry is considered as gold standard for the measurement of energy requirements. Predictions based on anthropometrics or minute ventilation are not always accurate. However, cost and convenience remain the issue with indirect calorimeter.[18] Existing literature recommend using simplistic weight-based equations or published predictive equations for calculating energy-protein requirements[4] (some predictive equations may be obsolete). Recommendations change for obese patients.[4] High energy/proteins are required due to catabolic nature of critical illness.[4] Feeding tolerance needs to be accounted while planning EN.

Both underfeeding and overfeeding are not desirable. Underfeeding and intolerance are often reported in critically ill patients on EN, whereas infectious complications and overfeeding are reported with PN. Overfeeding more than metabolic demand is detrimental. Aggressive feeding during initial days of ICU stay can be detrimental and may result in refeeding syndrome. Aggressive nutrition support signals the body to halt its compensatory mechanisms and the body turns from a catabolic to anabolic state. Hypercapnia and refeeding syndrome are seen with overfeeding, while negative energy balance and poor outcomes are observed with underfeeding. Best survival is observed with calorie intake of at least 80% of the prescribed target.[19]

Practice guidelines

1. Feeding should be tailored as per the patient's requirement and level of tolerance (C)
2. Protein requirement for most critically ill patients is in range of 1.2-2.0 g/kg body weight/day[4] (A I)
3. Calories should be in range of 25-30 Kcal/kg body weight/day for most critically ill patients[4] (A I)
4. In severely hypercatabolic patients such as extensive burns and polytrauma, ratio of Kcal: nitrogen should be 120:1 or even 100:1 has been accepted[20] (B V)
5. For obese patients, adjustment in calorie and proteins must be done on basis of the body weight and BMI, as detailed in Table 1 (A I)
6. Recommendations for critically ill patients with acute kidney injury (AKI) are mentioned in separate section
7. Toronto formula is useful for estimating energy requirements in acute stages of burn injury and must be assessed and adjusted to changes in monitoring parameters[21] (C)
8. Harris–Benedict tool may not be suitable because the equations in this method are too long and time-consuming and overestimate the energy requirements (C)

Table 3: Subjective global assessment form

Name:

Date:

Medical history			A	B	C
Weight	Usual weight	Current weight			
Weight change past 6 months	Amount weight loss	Percentage weight loss			
0%-<5% loss					
5%-10% loss					
>10% loss					
Weight change past 2 weeks		Amount			
No change; normal weight					
Increase to within 5%					
Increase (1 level above)					
No change, but below usual weight					
Increase to within 5%-10%					
Decrease					
Dietary intake					
No change; adequate					
No change; inadequate					
Change	Duration of change				
Suboptimal diet					
Full liquid					
Hypocaloric liquid					
Starvation					
Intake borderline; increasing					
Intake borderline; decreasing					
Intake poor; no change					
Intake poor; increasing					
Intake poor; decreasing					
Gastrointestinal symptoms					
Frequency (never, daily, number of times/week)		Duration (<2 weeks, >2 weeks)			
Nausea					
Vomiting					
Diarrhea					
Anorexia					
None; intermittent					
Some (daily >2 week)					
All (daily >2 week)					
Functional capacity					
No dysfunction	Duration of change				
Difficulty with ambulation/normal activities					
Bed/chair-ridden					
Change past 2 weeks					
Improved					
No change					
Regressed					

Physical examination	A	B	C
Subcutaneous fat			
Under the eyes	Slightly bulging area		Hollowed look, depression, dark circles
Triceps	Large space between fingers		Very little space between fingers, or fingers touch
Biceps	Large space between fingers		Very little space between fingers, or fingers touch
Muscle wasting			
Temple	Well-defined muscle/flat	Slight depression	Hollowing, depression

Contd...

Table 3: Contd...

Clavicle	Not visible in Males; may be visible but not prominent in females	Some protrusion; may not be all the way along	Protruding/prominent bone
Shoulder	Rounded	No square look; acromion process may protrude slightly	Square look; bones prominent
Scapula/ribs	Bones not prominent; no significant depressions	Mild depressions or bone may show slightly; not all areas	Bones prominent; significant depressions
Quadriceps	Well rounded; no depressions	Mild depression	Depression; thin
Calf	Well developed		Thin; no muscle definition
Knee	Bones not prominent		Bones prominent
Interosseous muscle between thumb and forefinger	Muscle protrudes; could be flat in females		Flat or depressed area
Edema (related to malnutrition)	No sign	Mild to moderate	Severe
Ascites (related to malnutrition)	No sign	Mild to moderate	Severe
Overall SGA Rating	A	B	C

Source: Queensland Health. Available from: https://www.health.qld.gov.au/__data/assets/pdf_file/0030/143877/hphe_sga.pdf. SGA: Subjective global assessment

9. Weight-based equations are preferred for energy-protein calculations as per Tables 4 and 5 (A I).

Route of nutrition (enteral tube feeding vs. parenteral): Preference in critical-care settings

EN is preferably recommended over PN as early nutrition in critically ill patients.[22] The route of nutrition delivery determines the effect of the nutritional intervention. Enteral route is more physiologic, providing nutritional benefits without adversely affecting structural–functional integrity of gut and intestinal microbial diversity. EN has limitation in the acute disease phase and gastrointestinal dysfunction due to its potential lower nutritional adequacy. In contrast, the intended nutritional requirement is better secured with PN but hyperalimentation, hyperglycemia and infectious complications remain the key challenges.[23]

In critically ill patients, supplemental PN at the end of the 1st week after ICU admission is advisable when full EN support is not possible or fails to deliver caloric targets of up to 60%.[4]

Practice guidelines

1. EN should be considered over PN[4] (A I)
2. Combination of EN and PN should not be routinely recommended, except for specific indications[24] (A II).

Tube feeding

In patients with functional gastrointestinal tract, who cannot or will not eat, enteral feeding is the preferred method.[25] Enteral tube feeding can be done with different techniques that cover modern nasogastric (NG) feeding using fine tubes, nasojejunal feeding, and percutaneous endoscopic gastrostomy feeding.

Improvements in enteral tube feeding techniques, along with the development of wide ranges of nutritional formulae and enteral feed pumps, have made EN an effective intervention across various diseases.[26]

For most surgical intensive care patients, enteral feeding is preferably initiated by NG tubes. Some patients may not tolerate gastric feeding in case of delayed gastric emptying and poor intestinal motility. Such patients may benefit from postpyloric feeding.[27]

Table 4: Appropriate energy and protein intake for adult obese Intensive Care Unit patients

Nutrient	Recommendation	Guideline source
Energy	11-14 kcal/kg actual body weight/day for patients with BMI in the range 30-50	ASPEN 2016
	22-25 kcal/kg ideal body weight/day for patients with BMI >50	ASPEN 2016
Proteins	2.0 g/kg ideal body weight/day for patients with BMI 30-40	ASPEN 2016
	2.5 g/kg ideal body weight/day for patients with BMI ≥40	ASPEN 2016

Adapted from Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) 2016. BMI: Body mass index

Practice guidelines

1. NG route should be the first choice of enteral feeding. Jejunal route can be used if required[28] (A I)
2. Continuous formula feeding with pumps or gravity bags can be preferably done via fine bore (8F–12F) tubes[29] (A I).

Tube feeding and nosocomial infections

"Nutrient content" and "microbiological safety" are very important factors in patients with tube feeding.[30] Long-term enteral tube feeding with elemental diets is one of the common but relatively unrecognized risk factors for the development of Clostridium difficile colitis.[31] Contamination and batch-to-batch inconsistency are more likely with homemade or blenderized feeds than with scientific feeds. Maintaining the microbial quality of hospital-prepared blenderized feeds within the published standards of safety is difficult.[32] Various factors responsible for bacterial contamination of handmade formulations include unhygienic original food items, food-making process and devices, blenders, hygiene

Table 5: Recommended Energy-Protein requirements for use in Intensive Care Unit

Nutrient	Recommendations (per kg body weight per 24 h)	Guideline source
Energy	Individualize	PENG 2007
	Use validated equations, in the absence of indirect calorimetry	NSIG 2010
	Use 25-30 kcal/kg, or predictive equations, or indirect calorimetry	ASPEN 2009
	20-25 kcal/kg in acute phase of critical illness	ESPEN 2006
	25-30 kcal/kg in recovery phase	
	25 kcal/kg	ESPEN 2009
	Consider hypocaloric feeding in critically ill obese (BMI >30 kg/m^2), e.g., 60%-70% of target energy requirements, or 11-14 kcal/kg actual body weight, or 22-25 kcal/kg ideal body weight	ASPEN 2009
Protein	1.3-1.5 g protein/kg	ESPEN 2009
	1.2-2.0 g protein/kg if BMI <30 kg/m^2	ASPEN 2009
	2 g/kg ideal weight if BMI 30-40 kg/m^2	
	2.5 g/kg ideal weight if BMI >40 kg/m^2	
	Caution with excess nitrogen in severely ill	NICE 2006

Adapted from: Intensive Care Society of Ireland. Critical Care Programme Nutrition Support (Adults) Reference Document 2012. ASPEN: American Society of Parenteral and Enteral Nutrition; ASPEN: American Society of Parenteral and Enteral Nutrition; PENG: The Parenteral & Enteral Nutrition Group; NSIG: Nutrition Support Interest Group (NSIG) of the Irish Nutrition and Dietetic Institute (INDI); ESPEN: European Society of Enteral & parenteral Nutrition; NICE: National Institute for Health & Care Excellence

of the floor and air-conditioning, environment of kitchen, negligence by kitchen staff/nurses and food carriage process to the wards in a hot and humid conditions. These issues should be particularly evaluated in Indian settings. The closed system ready-to-use formulae are less prone to bacterial contamination since they do not require further preparation and hence can be used at patient's bed side.[30]

Feeding-related nosocomial infections in the critically ill patients can be prevented by maintaining the sterility of formula feeds.[32]

Practice guidelines

1. Scientific formula feed should be preferred over blenderized feeds to minimize feed contamination[33] (B III)
2. Whenever feasible, closed system ready-to-hang formula feeds should be preferred[30] (B III)
3. Blenderized formulae are more likely to have bacterial contamination than other hospital prepared diets[34] (B IV)
4. Hygienic methods of feed preparation, storage, and handling of both formula feeds and blenderized feeds are necessary[30] (B III).

Permissible underfeeding

Overfeeding is less likely to occur than underfeeding in ICU patients receiving EN. In critically ill patient, underfeeding is generally not recommended. However, patients having feeding intolerance may be underfed. Furthermore, intentional underfeeding of obese patients with BMI >30 kg/m^2 may add some benefit to the metabolic outcomes and decrease in the length of ICU stay. Hypocaloric enteral feeding in obese surgical patients was associated with shorter length of ICU stay, improved nitrogen balance, and reduced use of antibiotics.[35] In patients with acute respiratory distress syndrome (ARDS)/acute lung injury (ALI) or those expected to have duration of mechanical ventilation ≥72 h, either trophic or full feeding is appropriate.[4] Under prescription by physicians compared to the desired is one of the main reasons of underfeeding.[36] Relationship between hypocaloric intake and reduced mortality, infections, and nosocomial bacteremia has been found in some studies.[37]

Practice guidelines

1. Intentional underfeeding can be restricted to specific indications[28] (A I)
2. Obese patients can be subjected to underfeeding[38] (A I).

Monitoring tolerance and adequacy

Identification of patients at risk of feeding intolerance may assist in development of strategies to monitor and manage nutrition intolerance. This will ensure adequate delivery of nutrients to the critically ill patient. The nonuniformity of nutritional protocols to guide the practice may result in inadequacy in the delivery of nutritional support, increased morbidity, prolonged stay in ICU and increased mortality.

Constant monitoring of nutritional therapy is required. Factors that might affect the desired volume, total energy, etc. of the prescribed diet should be identified and recorded. Daily monitoring of the same can help evaluate EN tolerance.[39]

As recommended by the ASPEN guidelines 2016, up to 500 ml of gastric residual volume (GRV) should be used as cutoff.[4] In case intolerance is observed, metoclopramide or erythromycin can be used. However, in ICUs in India, there is a marked difference of opinion regarding the exact volume of GRV tolerance, and till such time this is resolved, we recommend that in all high-risk patients who cannot be assessed and are unconscious or on ventilator or are on bolus/intermittent feeds, GRV monitoring can be done every 6–8 hourly and the cutoff range be kept between 300 and 500 ml. However, in such high-risk patients, we recommend continuous feeding. In patients who are on continuous feeding, frequent GRV monitoring may not be required. Role of paramedics is important since they are the first ones to identify and report intolerance.

Practice guidelines

1. GRV should be measured by syringe aspiration and not by suction pump[40] (A II)
2. GRV of <300 ml can be refed[41] (B V) if it is not blood stained
3. Holding EN for GRVs <500 mL in the absence of other signs of intolerance should be avoided[4] (A I)
4. However, GRV cutoff range of 300–500 mL can be considered[42] (C), in Indian ICUs (C)
5. In case of high GRVs, efforts should be made to continue feeding with reduced volumes (C)
6. Prokinetic agents such as metoclopramide and erythromycin can be recommended in patients with intolerance and risk of aspiration[4] (A I)
7. Nurses should be trained for monitoring tolerance (C).

Selection of appropriate enteral formula

The composition of EN products varies greatly. Considering the basic macro- and micro-nutrient requirements of the patients, polymeric formula feeds are designed. Pharmacologic needs such as immune modulation are covered in specialty EN products containing arginine, glutamine, dietary nucleotides, and ω-3 fatty acids.

Blenderized tube feeding formula (BTF) is typically prepared at kitchen by blending food or meals into a liquid feed. BTF may be completely prepared from homemade food or a combination of food and standard formula.[43] Limitations of blenderized feeds include high microbial contamination, inconsistency in amount and supply of nutrients (16%–50%), higher osmolality and viscosity,[32,33] and possibility of blockage of the feeding tube.

EN can be initiated with the standard polymeric formula. The routine use of specialty/disease-specific formulae is not recommended in all critically ill patients. In comparison to formula feeds, blenderized feeds deliver lesser energy and protein values.

Practice guidelines

1. Standard polymeric formula feed should be recommended in critically ill patients[44,45] (A I)
2. Inconsistency in nutrient level can be avoided using the standard polymeric formula feeds[33] (B III)
3. Routine use of specialty formula feeds should be avoided[4] (A I).

Enteral feeding and diarrhea

Passage of three or more loose/liquid stools per day or more frequent passage than normal for the individual is defined as diarrhea.[46] Diarrhea is commonly observed in critically ill patients. Physicians are confronted with myriad of definitions of diarrhea. Enteral tube feeding is perceived to be the key cause among the various factors causing diarrhea. Understanding of enteral tube formulae, their composition and effect in the presence of gut dysfunction are important for managing diarrhea.[47] Patients with persistent diarrhea may benefit with the use of mixed fiber-containing or soluble fiber-supplemented or small peptide-based semi-elemental formula feeds.[48]

Practice guidelines

1. EN should not be interrupted in the event of diarrhea[4] (A I)
2. Feeds can be continued while evaluating the etiology of diarrhea[4](A I)
3. Use of a soluble fiber-containing formula or small peptide semi-elemental formula in divided doses over 24 h may benefit to patients with persistent diarrhea (after exclusion of hyperosmolar agent intake and C. difficile infection)[4,49] (A I)
4. Routine use of probiotics across the general population of ICU patients is not recommended. Probiotics should be used only for select medical and surgical patient populations, for which RCTs have documented safety and outcome benefit[4] (A I).

Importance of micronutrients

Significant redox imbalances leading to systemic inflammatory response syndrome, mitochondrial dysfunction, and multi-organ failure are seen in critical illness. Preexisting malnutrition, severity of current illness, and side effects of various therapeutic regimens/procedures may result in micronutrient deficiencies.[50] Depressed immunity, compromised wound healing and increased morbidity/mortality can be the consequences of such deficiencies. Hence, supplemental trace elements and vitamins represent an important therapeutic nutrition intervention to help reduce aforesaid complications. Effectiveness of intervention depends on adherence to strict timings, duration, and doses of micronutrients and/or the method of administration.[50,51] Selenium is considered as one of the most important micronutrients.[52]

Practice guidelines

1. Preexisting micronutrients' deficiency should be evaluated/assessed[53] (B V)
2. Patients on formula feeds may not require additional micronutrients, vitamins, and trace elements, if they are on complete and balanced formula feeds[6] (A I)
3. Micronutrients can be supplemented in patients on blenderized feeds and those on PN (C).

Immune-enhancing enteral nutrition

Inflammatory/oxidative stress responses and impaired immune function may be favorably modulated by immune-modulating nutrients such as ω-3 fatty acids, selenium, and antioxidants.[54] Patients suffering from trauma, traumatic brain injury (TBI), and ARDS may be prescribed immune-modulating nutrients. Glutamine supplementation has been shown to reduce nosocomial infections and length of hospital stay in critically ill surgical patients, without showing reduction in mortality.[55]

Practice guidelines

1. Immune-modulating nutrients should not be used routinely[4] (A I)
2. In ICU patients with very severe illness and not tolerating more than 700 mL enteral formulae per day, immune nutrients should not be used[22] (A I)
3. Immune-modulating nutrients could be considered

for patients with TBI and perioperative patients in the surgical ICU[4] (A I)
4. Glutamine is not recommended in critically ill patients with multiple organ failure[56](B V).

Standard nutrition in hepatic failure

Dietary misconceptions exist regarding the nutrition intervention in liver diseases, especially in Indian setting. Malnutrition is common in patients with end-stage liver failure and hepatic encephalopathy (HE). Inadequate dietary intake, altered synthesis/absorption of nutrients, increased protein losses, hypermetabolism, and inflammation contribute to malnutrition in this patient population. Compensation of nutrition deficiencies is recommended in such patients.[57]

Sodium restriction is the first dietary restriction to prevent development of edema and ascites. However, strict restriction may lead to protein-calorie malnutrition.[58] A sodium restriction to 2 g per day is recommended in patients with ascites.[59]

Practice guidelines

1. EN should be preferred in patients with acute and/or chronic liver disease, admitted to ICU[4] (A I)
2. No beneficial effects of branched-chain amino acid formulations in critically ill patients with encephalopathy who are receiving first-line luminal antibiotics[4] (A I)
3. Protein supplementation is recommended in liver failure. Protein-energy determination should be based on "dry" body weight or usual weight instead of actual weight[4] (A I)
4. Protein restriction should be avoided in refractory encephalopathy[60] (B V)
5. A whole-protein formula providing 35–40 kcal/kg body weight/day energy intake and 1.2–1.5 g/kg body weight/day protein is recommended[61] (A I)
6. Tailor sodium restriction to absolute need[60] (B V).

Standard nutrition in traumatic brain injury

In TBI, there is hypermetabolism and hypercatabolism with increased risk of muscle wasting, tissue atrophy, weight loss, negative nitrogen balance, and malnutrition.[62] Early nutritional intervention reduces the secretion of catabolic hormones and preserves body weight and muscle mass. As soon as volume resuscitation is complete and the patient is HD stable, EN should be attempted.[5] EN may facilitate recovery of TBI patients in the rehabilitation settings.[63]

Practice guidelines

1. Initiation of EEN after posttrauma period (within 24–48 h of injury), once the patient is HD stable, is recommended[4] (A I)
2. Protein recommendations should be in the range of 1.5–2.5 g/kg/day[4](A I)
3. Arginine-containing immune-modulating formulations or eicosapentaenoic acid/docosahexaenoic acid supplement with standard enteral formula in TBI patients is recommended[4] (A I).

Standard nutrition in respiratory compromised

Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory disorder of the lung and is characterized by progressive, persistent airflow obstruction.[64] Malnutrition incidence reported in critically ill COPD patients with acute respiratory failure (ARF) is up to 60%.[65] Reduced body weight and low fat-free mass are recognized as poor prognostic factors.[66] Osteoporosis is a commonly observed comorbid condition in COPD.[67,68] Nutrition and ventilation are essentially related. Giving small and frequent feeds without manipulating macronutrient composition helps attain optimal efficacy of oral nutrition intervention in clinically stable COPD patients.[69]

Practice guidelines

1. Calorie-dense EN formulations should be recommended for patients with ARF (especially if in state of volume overload)[4](A I)
2. Small frequent feeds should be preferred to improve nutritional compliance[69] (A I)
3. Monitoring of serum phosphate concentration and replacement of phosphate when needed is recommended[4] (A I)
4. A specialty high-fat/low-carbohydrate formulation is not recommended for ICU patients with ARF[4] (A I)
5. There is no additional advantage of disease-specific low-carbohydrate and high-fat over standard or high-protein or high-energy oral nutritional supplement in stable COPD patients[69] (A I).

Standard nutrition in acute kidney injury

Abrupt loss of kidney function resulting in failure to maintain fluid, electrolyte, and acid–base homeostasis is known as AKI.[70] In India, the overall incidence of AKI in ICU is approximately 20%–50% and can have mortality ratio of over 50%.[71] Hypercatabolism with lean body mass loss is responsible for protein energy wasting, which leads to increased morbidity and mortality risk in AKI.[72] Critically ill patients with AKI have significant protein catabolism, abnormal carbohydrate metabolism, and altered fat metabolism. This becomes more complicated in AKI patients on continuous renal replacement therapy since there are higher protein and micronutrient losses.[73]

Practice guidelines

1. Standard enteral formula is recommended for ICU patients with AKI[4] (A I)
2. Protein should not be restricted in patients with renal insufficiency[4] (A I)
3. Daily protein intake should be in the range of 1.2–1.7 g/kg actual body weight in AKI patients (C)
4. Provision of adequate nonprotein calories should be maintained to achieve total energy intake in patients with AKI[74] (B V)
5. In case of significant electrolyte imbalance, a specialty formulation designed for renal failure should be considered[4] (A I)

6. Low potassium and low phosphate diets can be implemented where corresponding serum levels are high[4] (A I).

Documentation of nutrition practices

Documentation of day-to-day nutrition practices is an important factor and often lacking in the Indian nutrition practice. None of the international guidelines have discussed and recommended about the organized documentation of the nutrition practices. To obtain high-quality nutrition care, nutritional practices should be documented from the very first step, i.e., with diagnosis and then with assessment, intervention, and monitoring. Maintenance of documents should be done collaboratively by all the team members involved in the care of critically ill patient.

Attitude and approach of less documentation, illegible documentation, documenting few variables such as volume, duration, and improper record of calories – proteins supplied – are key barriers in the development of high-quality documentation practices.

Practice guidelines

1. Documentation of body weight and its review on weekly basis is recommended.[75] (A II)
2. Documentation of the below mentioned is also recommended (C):
   - Screening and assessment tools used along with their scores and the weekly review scores
   - Nutritional diagnosis
   - Nutrition care plan on daily basis
   - Infectious complications and stool frequency on daily basis.

Conclusion

Nutrition is now regarded to be of therapeutic benefit and not just an adjunctive or support, in improving patient outcomes. Early, optimum, and adequate nutrition helps improve patients' overall prognosis and at the same time reduce the length of stay. EN is preferable in majority of cases. Scientific nutrition in the form of standard formula feeds should be preferred in majority of ICU patients over blenderized feeds. In comparison to blenderized feeds, the standard formula feeds have benefits of better feed hygiene, certain nutrient delivery, and lesser osmolality and viscosity. Scientific nutrition intervention is very important to achieve better clinical outcomes. Based on the Discussions and Practice Guidelines, an ICU nutrition protocol has been devised [in Annexure I] to be used in critical-care settings.

Further, larger Indian multicenter studies are required to strengthen nutrition practices.

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Conflicts of interest

There are no conflicts of interest.

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Annexure

Annexure I