Nutritional assessment for critically ill patients in the intensive care units

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Abstract
Aim: A nutritional assessment to meet complex needs of the critically ill patients in intensive care units.
Material and methods: A Case study of a critically ill patient in the intensive care unit using a comprehensive nutritional assessment was conducted in 2016.
Results: A nutritional assessment of a critically ill patient in the intensive care unit using an ABCDEFG approach is outlined. There is variation in nutrition practice among nurses in terms of assessment, as most of the nurses perceive the role associated with the doctor or dietician.
Conclusion: Critical care nurses have the capacity to conduct nutritional assessment and support for critically ill patients to prevent malnutrition. Nurses play a significant role in the assessment of nutrition in critically ill patients to prevent malnutrition.
Key words: Nutrition assessment, nutritional support, enteral nutrition, parenteral nutrition, critical care, clinical practice guideline, outcomes

1. Introduction
Malnutrition among critically ill patients is not appropriately assessed, leading to complications and delayed recovery from illness [1]. Studies reveal 40–43% of the admissions in ICU were malnourished [2]. Poor patient outcomes increase the financial burden, morbidity, complications, and mortality. These complications increase the lengths of hospital stay [3]. At least one-third of patients in developed countries is malnourished upon admission to the hospital and, if left untreated, will experience a decline in their nutrition status [4]. Early nutritional support among critically ill patients can increase energy and protein associated with lower mortality [5]. It can decrease infections when patients receive more energy/protein independent of severity of illness. Higher acuity patients benefit more from enteral nutrition at the rate of 20 mL/hour [7].

[6]. Nutrition support is a key area of management in critically ill patients. There is limited information about the nurse-led nutritional support practice for critical patients in ICU.

Importance
Patients treated in an intensive care unit (ICU) may have a life-threatening failure in one or several organ systems [8]. The metabolic responses are generally characterized by hypermetabolism and protein catabolism [9]. Early (<24 hours) enteral nutrition (EN) through a feeding tube is recommended by the European Society for Clinical Nutrition and Metabolism for all patients in ICUs unless they are expected to be on the full oral diet within three days [8]. However, EN is frequently associated with insufficient energy delivery [10] as well as oral feeding [9].

Failure to meet nutritional goals may be the result of variance in nutrition support nursing practices [11]. Body mass index (BMI) and serum levels of albumin, prealbumin, hemoglobin, magnesium, and phosphorus are required for nutritional assessment.
Nurses are the endpoint to implementing nutritional recommendations and key to the management and prevention of malnutrition.

**Aim**

This paper focuses on nutritional assessment to meet the complex needs of the critically ill patients in intensive care units.

**2. Materials and Methods**

A case study of the nutritional assessment for adequate support for critically ill patients in the ICUs was conducted in the intensive care unit.

**Design**

A case study approach was used to assess a critically ill patient in the intensive care unit using a comprehensive nutritional assessment conducted in 2016.

**Ethics**

Approval and ethical clearance was obtained from the Institution Review Board for the case study.

**3. Results**

In our case study of a nutritional assessment of a critically ill Patient in ICU, an ABCDEFG approach was used in the intensive care unit. Ms. AT, age 55 years, female, is referred from S community center today with a history of diarrhea and vomiting. She was diagnosed with caecum adenocarcinoma on a sigmoid biopsy taken one month back. Last week her CT abdomen showed large mass noted within the caecum and CT-Chest showed small thoracic pneumonia lymph node. Right hemicolecotony and exploratory laparotomy for small bowel infarction were done. She is unconscious with sedation and is mechanically ventilated. She is on CPAP/PS mode of ventilation support for critically ill patients in the ICUs was conducted.

**A: Anthropometric measurements**

**Table no: 01 Anthropometric measurement**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Calculation</th>
<th>Ms. AT values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td></td>
<td>165 cm</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td>91.1 Kg</td>
</tr>
<tr>
<td>Body mass index</td>
<td>Weight / Height (m)2</td>
<td>91.9/(1.65)x2=33.75 [Obese class I (moderately obese)]</td>
</tr>
<tr>
<td>Ideal Body Weight (IBW)</td>
<td>Males: IBW = 50 kg + 2.3 kg ([Height in cm) – 60] = 2.54 Females: IBW = 50 kg + 2.3 kg ([Height in cm) – 60] = 2.54</td>
<td></td>
</tr>
<tr>
<td>Adjusted Body Weight (ABW)*</td>
<td>0.25 X (Actual BW - IBW) + IBW</td>
<td>0.25 X (91.9 – 61.4) + 61.4 = 69.02 kg</td>
</tr>
</tbody>
</table>

*ABW is to be calculated only if patient’s whose body weight is > 30% of their IBW

**B: Biochemistry and lab values (use units with the values)**

**Table no: 02 Biochemistry and lab value**

<table>
<thead>
<tr>
<th>Clinical lab values</th>
<th>Clinical lab values</th>
<th>Clinical lab values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin 12.8 g/dl</td>
<td>S. Albumin- 28 gm</td>
<td>Total protein- 48 gm</td>
</tr>
<tr>
<td>S. Calcium 2.04 mmol/L</td>
<td>S. Phosphate 0.71 mmol/L</td>
<td>ALP- 11 IU/L</td>
</tr>
<tr>
<td>B. Glucose 5.0 g/dl</td>
<td>S. Sodium 143 mmol/L</td>
<td>S. Chloride 112 mol/L</td>
</tr>
<tr>
<td>S. Creatinine 393 μmol/L</td>
<td>Total Bilirubin 44mg/dl</td>
<td>Urea 33.0 mg/dl</td>
</tr>
<tr>
<td>S. Potassium 3.3 mmol/L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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C: Clinical assessment Well, body built. Moderately Obese. She has edema in both upper and lower limb. Good skin turgor. On nasogastric tube (NGT) feeding with Ensure 125ml/hour through pump machine. The patient is febrile (Temp 38-39.5°C) with cold compression and Injection Paracetamol. No pressure sores. Not known to have any chronic illness.

D: Dietary calculation:

Table 03: Dietary calculation

<table>
<thead>
<tr>
<th>Type of nutrition</th>
<th>Required / day</th>
<th>Received / day</th>
<th>Excess / deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total calories</td>
<td>Estimated Calorie need X ABW</td>
<td>(quantity) X (times taken/ day)</td>
<td>Actual Intake - Estimated Calories</td>
</tr>
<tr>
<td></td>
<td>35 X (69.02) = 2415.87 kCals / day</td>
<td>125 ml X 24= 3000ml = 3000kcal</td>
<td>3000 – 2415.87 = +584.13 kCals</td>
</tr>
<tr>
<td></td>
<td>Note: Severely stressed, on MV and has fever</td>
<td>Note: Ensure: 100ml = 100kcal</td>
<td></td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>Estimated Carbohydrate need X ABW</td>
<td>(quantity) X (times taken/ day)</td>
<td>Actual Intake - Estimated CHO</td>
</tr>
<tr>
<td>(g/kg/day)</td>
<td>7 X (69.02) = 483.17g / day</td>
<td>125 ml X 24= 3000ml = 406.8g</td>
<td>406.8 – 483.17 = -76.37g</td>
</tr>
<tr>
<td></td>
<td>Note: Severely stressed, on MV and has fever</td>
<td>Note: Ensure: 100ml = 13.56g</td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td>Estimated Protein need X ABW</td>
<td>(quantity) X (times taken/ day)</td>
<td>Actual Intake - Estimated Protein</td>
</tr>
<tr>
<td>(g/kg/day)</td>
<td>2 X (69.02) = 138.05g / day</td>
<td>125 ml X 24= 3000ml = 120g</td>
<td>120 – 138.05 = -18.05g</td>
</tr>
<tr>
<td></td>
<td>Note: Severely stressed, on MV and has fever</td>
<td>Note: Ensure: 100ml = 4g</td>
<td></td>
</tr>
</tbody>
</table>

E: Edema: peripheral lower limbs edema 3+

F: Fluid requirement

Table 04: Fluid requirement

<table>
<thead>
<tr>
<th>Required</th>
<th>Received</th>
<th>Excess / deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1st 10 kg X 100) + (2nd 10 kg X 50) + (3rd 10 kg X 25) + (remaining weight in kgs X 10)</td>
<td>Volume received per hour X 24</td>
<td>Actual Intake - Estimated Intake</td>
</tr>
<tr>
<td>(10 X 100) + (10 X 50) + (10 X 25) + (61.9 X 10) = 2369 ml</td>
<td>80 X 24= 1920 ml She is receiving DNS 80 ml/hour</td>
<td>1920 – 2369 = -449 (negative balance)</td>
</tr>
</tbody>
</table>

G: General assessment

Assessment of nutritional support calculates both energy and protein requirements to determine goals of nutrition therapy. It also takes into account weight, biochemistry values, clinical assessment, fluid, and general assessment. Initiating enteral nutrition within 24-48 hours following the onset of critical illness and admission to ICU is beneficial was found to be beneficial for Ms. AT. There is variation in nutrition practice among ICU nurses in terms of assessment, as most of the nurses perceive the role associated with the doctor or dietician.

A right approach was used to enhance the nutritional assessment in the case study. The goal is to safely deliver >80% of required calories daily. The outcome is to initiate enteral nutrition (EN) within 24-48 hours of admission, start EN at 25 ml/hour, elevate Hob >45 degrees; and provide anti-emetics as prescribed concurrently to start of EN. The following right approach was detailed in the study. Right Patient. The patient should be critically ill and fully resuscitated and hemodynamically stable. Assess clinical picture for the presence of shock, sepsis, multisystem organ failure, acute lung injury/ acute respiratory distress, trauma, burns, and upper GI bleeding. Right Nutrition Strategy. Use EN before parenteral nutrition (PN) if at all possible. Small bowel feeding and Supplementary PN when needed was used. Right dose. Consider the right weight to use in dosing – actual body weight, ideal body weight, and adjusted body weight. Start EN at goal rate, Strive to achieve 60-80% goal calories from EN in first 72 hours.

Right Evaluation/monitoring. Use of threshold for gastric residual volume 250–500mL should be considered. Use of a prokinetic at the start of EN should be considered- patients with EN intolerance leading to the use of a prokinetic are recommended (metoclopramide). Assess head of bed 30-45° and metabolic control, blood sugar control of 7-8 mmol/L. Right outcome/response. Develop and use a plan based on nutritional guidelines. Meet estimated nutritional needs. Provision of therapeutic intervention through nutrition. Her nutritional status and clinical outcomes improved.

We used the algorithm ‘Can we feed’ to increase our understanding and application of nutritional assessment in the case study.

C: Critical illness severity. During acute illness, increased vascular permeability with dramatic fluid shifts are common and hepatic protein synthesis is reprioritized. Both of these factors lead to reduced levels of albumin, prealbumin, and transferrin. Albumin remains a powerful independent predictor for outcome upon admission to the ICU regardless of nutrition status

A: Age. Age is an important independent variable in determining the morbidity and mortality of the individual in
most disease processes and should be considered when initiating nutrition therapy.

N: Nutrition risk screening. Other measures to evaluate nutrition status (bioelectric impedance, muscle function studies, creatinine, height index, anthropometric measures, and body composition studies) are often cumbersome and impractical and have limited use in the critically ill patient.

W: Wait for resuscitation. Studies have shown that initiation of early feeding during the first 24 to 48 hours of admission reduces hospital length of stay, the incidence of infectious complications, and even mortality compared to feeds started after that time point.

E: Energy requirements. The overall caloric requirements for the individual patient are often determined using simplistic weight-based calculations (20–40 kcal/kg/d) or traditional predictive equations such as the Harris-Benedict or the Penn State Equations. These equations are easy and practical to use, as the patient’s age, weight, and height are the only data points required to arrive at an estimate.

F: Formula selection. Based on biochemistry and dietary calculations during illness, an appropriate enteral feeding is recommended by the physician or dietitian.

E: Enteral access. Three general categories of options for enteral access exist: Oro/nasal access (nasogastric, orogastric, and nasojejunal tube), percutaneous access (percutaneous endoscopic gastrostomy or PEG, PEG in combination with a jejunal tube or PEG/J1, and direct percutaneous endoscopic jejunostomy or DPEJ), and surgical access (surgical gastrostomy or jejunostomy).

E: Efficacy
Documenting efficacy or adequacy of EN therapy is important because of tendencies toward a delay in the initiation of feeds as well as the various difficulties encountered during attempts to maintain target feeds.

D: Determine tolerance. Poor tolerance of EN can result from multiple factors, such as functional dysmotility, medications (narcotics, proton pump inhibitors, H2 blockers, antibiotics, etc.), inadequate gastric decompression, overly aggressive feeding, and hemodynamic instability. Gastric residual volumes should be interpreted in the context of the clinical picture.

4. Discussion
A nutrition risk assessment tool specific for critically ill patients links starvation, inflammation, and nutrition status to clinical outcomes, 80% of the prescribed amounts of protein and calories is associated with improved clinical outcomes [6]. Take steps to reduce the risk of aspiration or improve tolerance to gastric feeding [12]. Early nutrition within 24–48 hours is mandatory as it is related to reduce activation, the release of inflammatory cytokines and less gut permeability [13]. Use of immune-modulating formulas containing arginine in surgical ICU patients. The benefit of early gastric feeding may outweigh the harm associated with delayed EN delivery associated with postpyloric feeding tube placement [14].

An algorithm was used to emphasize the priority of each component of the nutritional assessment to identify important factors of critically ill patients [15]. Clinical practice guidelines have been developed to standardize feeding practice in the delivery of feeds to critically ill patients. Nurses should focus on maximizing benefits and minimizing risks of nutrition care when caring for critically ill patients, minimize the use of medications that impair gastric emptying such as sedation, minimizing interruption of feeding and accepting high gastric residual volumes, elevating the head of the bed (positioning) and administering prokinetics, regular checking of tube position, avoiding contamination of feeds and feeding equipment and careful attention to oral hygiene are effective and supported by EBP and systematic review and RCTs. This study suggests that ICU led nutritional program is a safe and strong directive to meet nutritional goals in the critically ill.

Barriers that affect the delivery of enteral nutrition in the critically ill are patient-related factors, feeding method factors, feeding process factors, under prescription by physicians, and frequent interruption of enteral nutrition [16]. A nurse-led enteral feeding algorithm allowed senior nursing staff to set a safe and nutritionally adequate target feed volumes based on patient body weight [17]. 60% of patients received the correct feed regimen and if this feeding algorithm is wholly adhered to, the ICU physicians and dieticians could utilize their effort in dealing with other complex problems of the patient. The average energy provided to critically ill patients by enteral nutrition is between 50% and 95% of requirements, and the average protein intake with enteral feeding ranges from 38% to 82% of requirements. The barriers that have an impact on the adequacy of enteral nutrition have been classified as patient-related factors, feeding method factors (feeding formula, feeding tube site), feeding process factors (feeding initiation time, time to meet target goal), under prescription by physicians, and frequent interruption of enteral nutrition. Nurse-led nutritional assessment using the ABCDEFG approach supports earlier attainment of critically ill patients’ nutritional goals in less complex cases and short-stay/general/surgery patients. Nurse-led nutritional model is a safe, but ongoing support from the dietitian is required to further improve adherence Initiate enteral nutrition within 24–48 hours of admission to ICU. Use a feeding protocol and a glycolic control protocol. Use promotility agents for patients who experience feed intolerance and use small bowel feedings where feasible and elevate the head of the bed to 45°. ICU nurses should be acquainted of best nutrition evidence-based practice of critically ill patients is
based on clinical guidelines and care bundles. Nurses need to integrate nutrition into care bundles management in ICU and use of nutrition support teams and dedicated dieticians or specialist support nurse for excellence in nutrition care.

**Conclusion**

Healthcare team members should work with interprofessional collaboration for safe and effective best nutritional screening and practices for acute and critical ill patients. Registered nurses are involved in the initial nutritional screening, assessment and adequate support to the patients. Dietitians complete the nutritional assessment and develop nutritional interventions with the team. Pharmacists evaluate the drug-nutrient interactions and make recommendations. Physicians oversee interprofessional collaborative care plan, interventions and documentation to nutritional support for the critically ill patients.

**Acknowledgment**

We acknowledge the team members in the critical care course and unit.

**Conflict of interest**

We declare no conflict of interest in the study.

**References**