RESEARCH ARTICLE

Adequacy of nutritional support in critically ill patients post implementation of nutritional protocols in surgical intensive care unit of a university hospital

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Abstract

Objective: To evaluate improvement in nutrition support therapy after the implementation of nutritional protocols in critically ill surgical patients.

Methods: The ambidirectional study was conducted at the surgical intensive care unit of Aga Khan University Hospital, Karachi, using an evidenced-based nutritional protocol. The pre-protocol retrospective data group A comprised patient records from July to September 2018, while the post-protocol prospective data group B related to the period between October and December 2018. Both data sets involved patients of either gender aged at least 18 years who needed admission to surgical intensive care unit and were unable to take oral nutrition for >2 days and remained under intensive care for up to seven days. Data was analysed using SPSS 21.

Results: Of the 65 patients, 30(46.2%) were in group A; 21(70%) males and 9(30%) females with mean age 40±16.55 years (range: 18-80 years). The remaining 35(53.8%) were in group B; 27(77%) males and 8(23%) females with mean age 48.66±17.7 years (range: 18-86 years). Nutritional screening indicated that 16(53.3%) patients in group A and 35(100%) in group B were at the risk of developing malnutrition. Patients receiving enteral nutrition within 24 hours of admission increased from 7(23.35%) in group A to 17 (48.3%) in group B. Overall, the amount of enterally administered calories increased from mean 321057±2495 kcal (29.6%) in group A to mean 384585±2343 (92.6%) in group B. The amount of protein administered increased from mean 622.2±148.7 kcal (14.7%) in group A to mean 549±125.48 kcal (67.1%) in group B.

Conclusions: Implementation of nutritional protocol resulted in improved delivery of nutritional support in the surgical intensive care unit.

Keywords: Enteral nutrition, Parenteral nutrition, Nutritional protocol, Vasopressor support. (JPMA 72: .1355; 2022)

DOI: https://doi.org/10.47391/JPMA.3349

Introduction

Incidence of malnutrition in surgical patients is reported to be as high as 35-60%.[1] Malnutrition is a prevalent consequence in critically ill patients and can be observed due to several reasons, including hyper-metabolism and inadequate energy and protein reserves.[2] The surgical intensive care unit (SICU) population includes postoperative patients having undergone major surgical procedures with systemic infections and traumatic injuries, which may include injuries either to the brain, chest, abdomen or multiple fractures leading to surgical complications, such as respiratory failure, massive blood-loss, secondary infections or organ failure.[3]

However, mechanically ventilated patients in ICUs are unable to consume oral nutrition, and, therefore, artificial nutrition serves as a life-sustaining therapy to meet the nutritional requirements of these patients.[4] Under-nutrition in ICU patients, if present, may have grave consequences[1] which include increased rate of infective postoperative complications, morbidity and mortality.[4] Therefore, achieving quality nutritional support in surgery-related critical illness is crucial and has been reported to improve wound healing and collagen deposition.[5] The provision of nutrition causes blunting of stress-induced hyper-catabolism, reduces the systemic inflammatory response to surgical trauma and improves immunological function.[6,7] Resultantly, it has a positive impact on patient outcomes in terms of decreasing postoperative septic complications, reducing length of hospital stay[6] and decreasing the cost of treatment.[5]

The route of nutrition delivery is an important factor influencing the effects of nutritional intervention in patients.[8] International guidelines recommend early initiation of enteral nutrition (EN) rather than parenteral nutrition (PN) due to its lower cost, lower rate of complications and the potential to preserve gut mucosal integrity, and to prevent translocation of bacteria and endotoxins known to cause sepsis.[7]

However, optimisation of both energy and protein levels is challenging in the SICU setting[5] and there are often major discrepancies between what is prescribed and what the critically ill patients actually receive.[9] This could be due

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to several reasons, such as the variability in age, different diagnosis, clinical conditions, disease, types of surgical procedures and prior health status, among others.[10]

Recently, there has been a transition in the role of nutrition in the critically ill, and high-grade evidence supports the fact that nutritional therapy has the potential to optimise recovery from illness by supplying vitamins, minerals and cell substrates.[7] International guidelines recommend the use of nutritional protocols as a key strategy to improve delivery of nutrition and to enable bedside nurses to initiate, modify and monitor the administration of EN to individual patients.[4,11] The purpose of these protocols is to standardise the administration of EN and PN, to shorten the time to achieve caloric goals, and to increase the delivery of EN-based calories provided to patients.

To date, there has been no study looking at the implementation of nutritional management protocol in an SICU setting in Pakistan. The current study was planned to evaluate improvement in nutrition support therapy after the implementation of nutritional protocols in critically ill surgical patients.

Materials and Methods

The ambidirectional study was conducted at the SICU of Aga Khan University Hospital (AKUH), Karachi, using an evidenced-based nutritional protocol. The pre-protocol retrospective data group A comprised patient records from July to September 2018, while the post-protocol prospective data group B related to the period between October and December 2018.

The SICU in AKUH consists of a total of seven beds. The data collection included time of initiation of feeding, type of feeding initiated, method either continuous or bolus, and mean calories and proteins given.

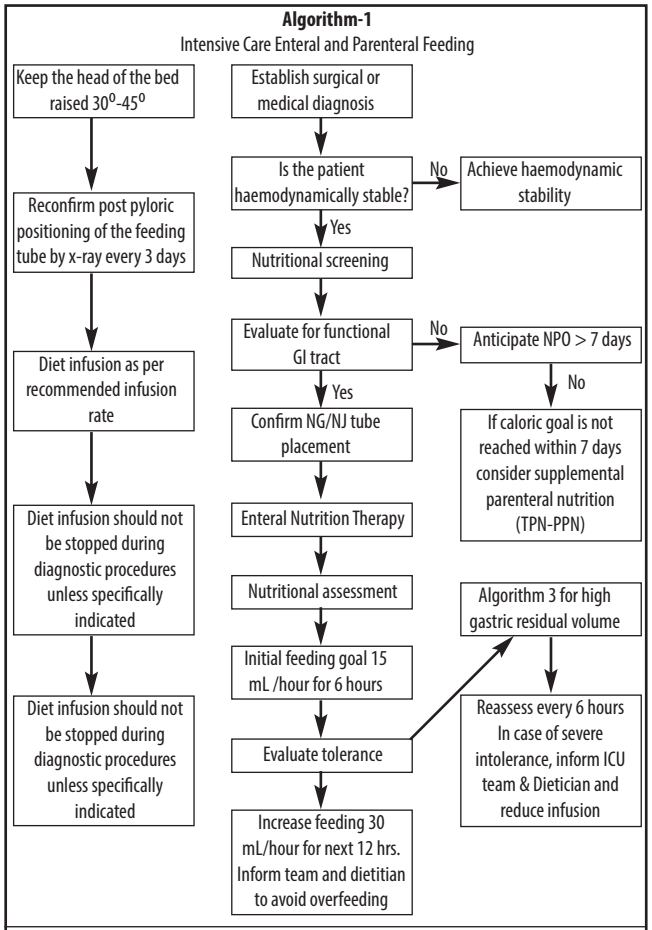
After approval from the institutional ethics review committee (ERC) all patients who met the inclusion criteria were included during the 7-month study period; 3 months pre-implementation, 1-month implementation phase, and 3 months post-implementation.

The inclusion criterion comprised all men and women >18 years of age requiring SICU admission who were unable to take oral nutrition for >2 two days and their expected length of SICU stay was >48 hours, as studies suggest nutritional support for surgical patients usually takes place within 48-72 hours and is associated with improved clinical outcomes.[11,12]

Those excluded were paediatric patients because they have different nutritional management guidelines and protocols. Also excluded were patients who died, were discharged in <48 hours and those in whom nutritional regimen was withdrawn or withheld due to end-of-life situations.

All patients who met the inclusion criteria during the study period were included. The evidence-based Nutrition Protocol was developed after due ERC approval in 2015 based on an extensive review of literature, including cross-sectional studies, consensus statements on nutritional support in different diseases, and randomised controlled trials (RCTs).[13]

Standard feeding practice at the tertiary care facility involved daily nutritional assessment and calculation of caloric and protein requirement by the dietician and recommendation of appropriate rate of continuous infusion or bolus feeding over 24 hours in the form of pre-formulated feeds. However, the final decision to start the tube feeds rested with the admitting surgeons and intensivists, and the rate of tube-feeding was adjusted as tolerated by the SICU team. In routine practice, Nutritional Care Management System (NCMS) software is utilised at



Annexure: Nutritional protocol for in critically ill patients in surgical intensive care unit.

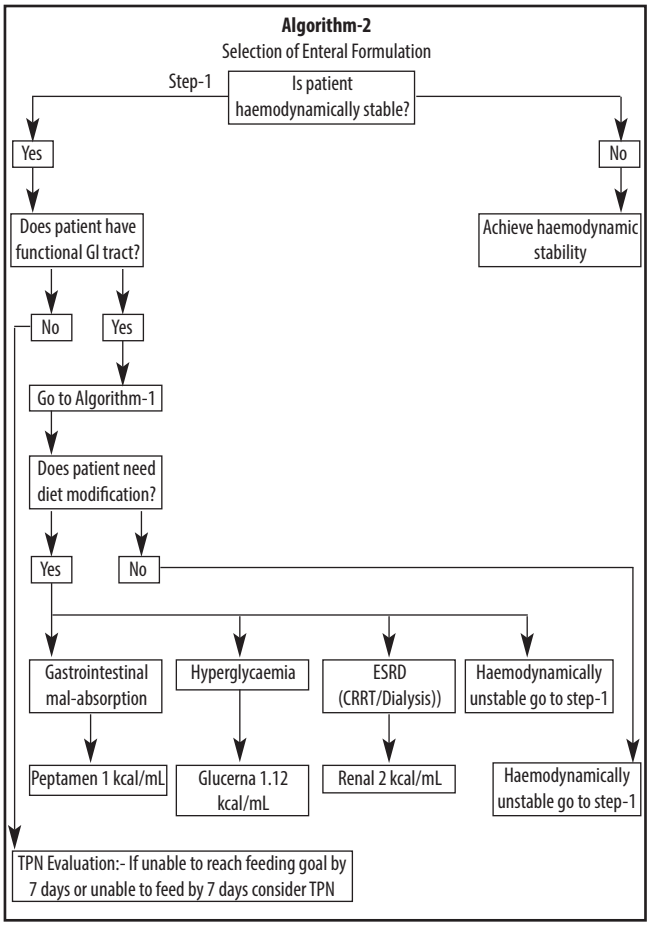
AKUH which identifies patients on enteral, nil per oral (NPO) and oral diet during their entire course of stay. In addition, specialised nutritional consultation is generated for patients requiring parenteral support. Once assessed by the dietitian, details of anthropometric, selected enteral supplement and initiated dilution are not only documented on the filed nutritional assessment, but also entered into the NCMS for medical record purposes.

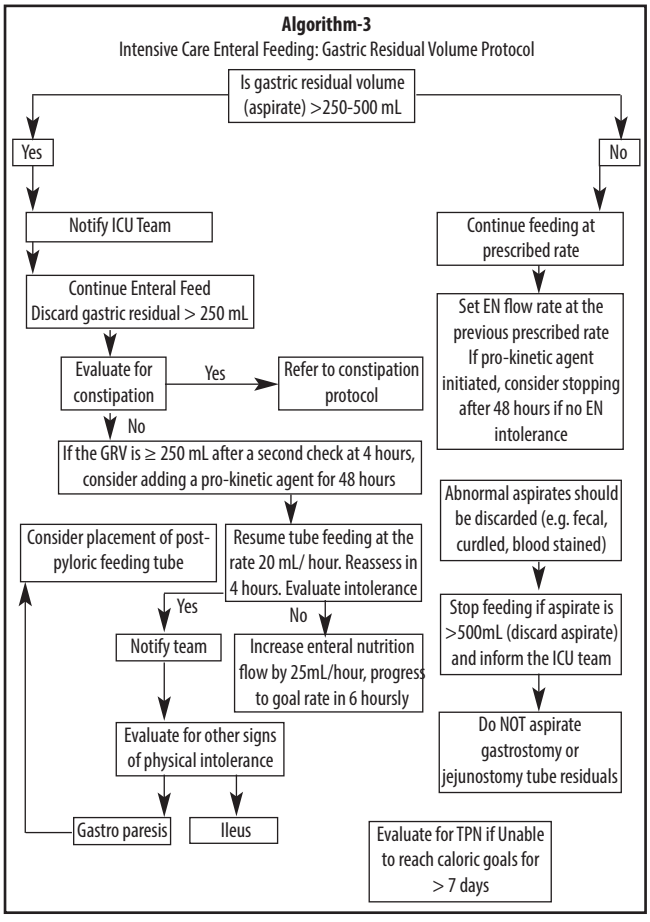
The pre-implementation data was collected retrospectively. Medical record number of patients who were eligible for the study was identified, and data of those who met the inclusion criterion was reviewed. Clinical data was taken through the medical record file and the attached flow sheets which were filled as part of the hospital routine every day by nurses attending to the admitted patients in all three shifts of 8-hour each. Nutritional screening is a routine practice in ICUs and the presence of malnutrition is evaluated using the nutritional screening score (NSS), which is part of the physician history form (Annexure). The NSS is filled by the admitting nurses. The patients were grouped into surgical, including elective and emergency cases if they were admitted from the operating room (OR) and non-surgical if they did not undergo any surgical procedure in the preceding 48 hours and were admitted to SICU from the surgical wards.

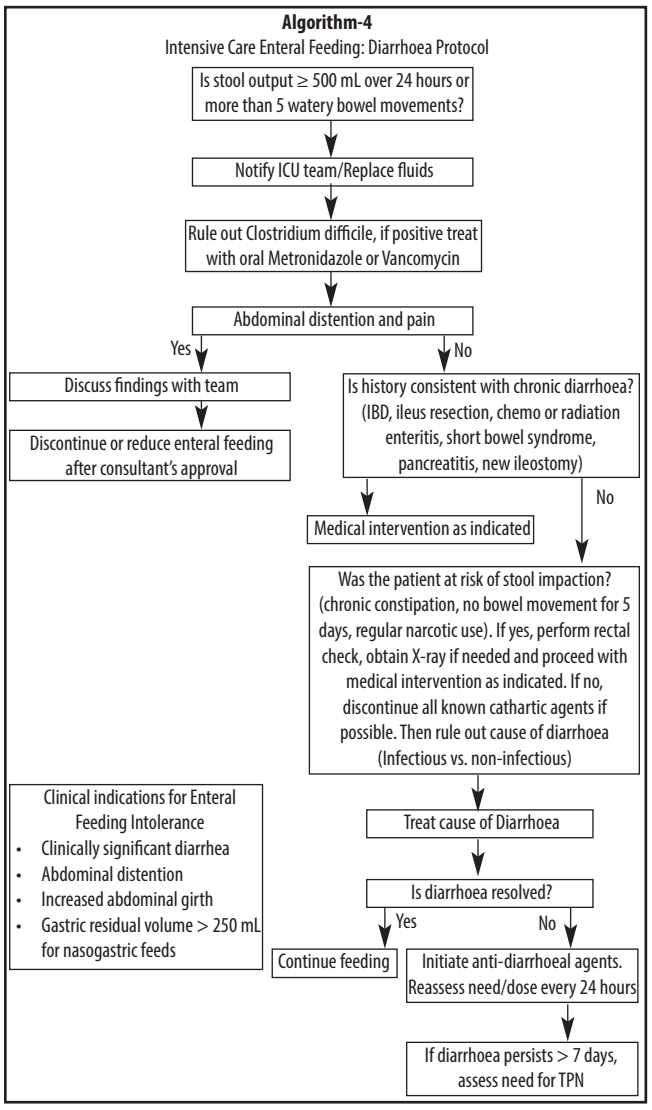
During the implementation phase, clinical training sessions were held for all SICU staff physicians, house staff, and nurses in order to familiarise them with the protocol. The training sessions were repeated at the beginning of each month for the new SICU house staff during the post-implementation phase of the study. Copies of the protocol were posted throughout the SICU and were made available in each patient file and at the nursing stations. The physicians were encouraged to initiate early enteral feeding within 48 hours of admission if and when appropriate.

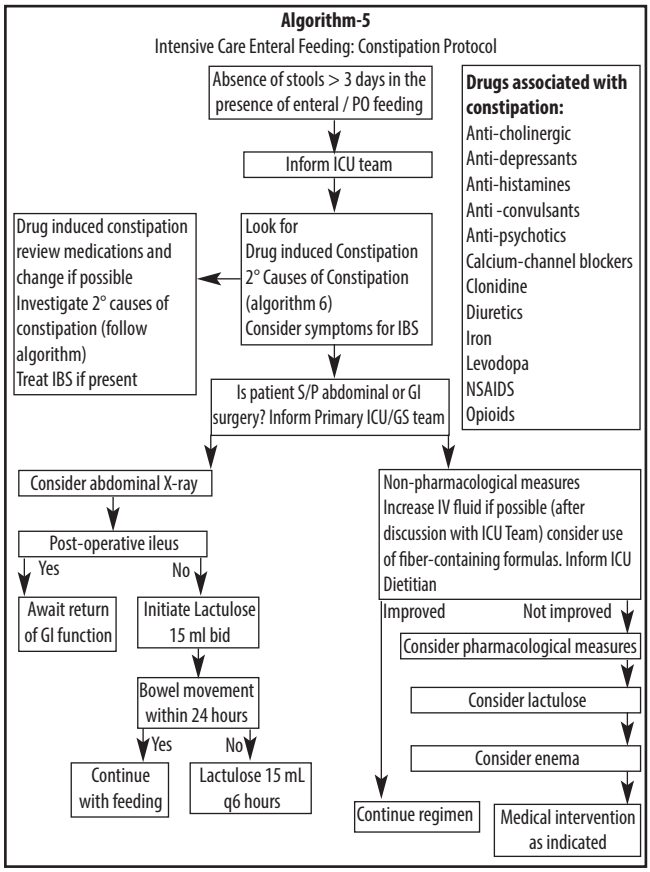
Following the implementation, the patients were enrolled according to the inclusion-exclusion criteria. After taking informed consent from the patients or their attendants. As the study was observational in its dimension, the changes were reviewed post-implementation of the protocol. There was no additional cost burden on the patients.

Data was analysed using SPSS 21. The normalcy of data was determined using Shapiro-Wilk and Kolmogorov-Smirnov tests, and data was found to be not normally distributed.









As such, continuous variables were reported using Wilcoxon test, and chi-square test was used to report categorical variables, as appropriate.[9,11] Distributions of variables were described by mean (median) and mean (standard deviation), as appropriate. P=0.05 was set as the level of significance.

Heyland et al. argued that on average 80% of the nutritional requirements of ICU patients should be achieved during their ICU stay,[14] calling it the adequate level of nutritional intake for ICU patients. The current study also aimed for the same target, and nutritional goal of 80% was used to compared the two groups.

Results

Of the 90 patients in the pre-implementation period, 60(67%) were excluded, and of the 145 in the post-implementation phase, 110(76%) were excluded. As such, of the total 235 patients, the final sample had 65(27.6%) patients. Of them, 30(46.2%) were in group A; 21(70%) males and 9(30%) females with mean age 40±16.55 years (range: 18-80 years). The remaining 35(53.8%) were in group B; 27(77%) males and 8(23%) females with mean age 48.66±17.7 years (range: 18-86 years).

Anthropometric measurements were not significantly different between the groups (p>0.05) (Table 1). NSS indicated that 16(53.3%) patients in group A and 35(100%) in group B were at the risk of developing malnutrition.

EN and PN support initiation as well as caloric compliance were noted in both the groups and the findings were compared, indicating that group B on average received higher nutritional support following the implementation of the protocols, and when the risk of malnutrition is higher, intake through PN was expected to increase (Table 2).

In order to fulfill the usual protein and calorie requirements of the patients additional macronutrients in the form of supplemental protein and medium chain triglyceride (MCT) oil were used in addition to the prescribed enteral formulations in group B (Table 3).

The use of nasogastric (Ng) feeding was 27(90%) in group

Table-1: Characteristics of the patient at the time of admission to the surgical intensive care unit (SICU).

Parameters	Pre implementation	Post implementation	*p*-value
Age in years. (mean±SD)	18-80 (40±16.55)	18-86 (48.66 ±17.7)	0.050[a]
Gender			
Male	21 (70%)	27 (77.1%)	0.763[a]
Female	9 (30%)	8 (22.9%)	
Weight in kg, mean	69.4 (11.50)	72 (6.0)	0.431[a]
Height in cms, mean	169 (7.0)	163 (6.0)	0.779[a]
Mechanical ventilation Ventilator days,	0-7	0-7	0.016[a]
min-maximum mean;	5.07 (1.99)	5.44 (1.86)	
Type of admission	3 (10%)	21 (60%)	0.001[a]
Elective -surgery	10 (33%)	8 (22.9%)	
Emergency- surgery Non operated	17 (56.7%)	6 (17%)	
Cause of Admission			
Respiratory	5 (16.6%)	1 (2.9%)	89.324[b]
Trauma	1 (3.3%)	4 (11.4%)	
Sepsis	18 (60%)	10 (28.6%)	
Renal	-	3 (8.6%)	
Neurosurgery	2 (6.6%)	14 (40%)	
Others	4 (13.3%)	3 (8.6%)	
Number of Patients reported as Malnourished upon admission			
Not at risk of Malnutrition (0 N.S Score)	14 (46.6%)	0(0%)	NA
At risk of Malnutrition (≥2 N.S score)	16 (53.4%)	35 (100%)	0.015[a]
Presence of Weight Loss			
Yes	3 (10%)	5 (14.3%)	NA
No	4 (46.7%)	29 (82.9%)	
Not Known	13 (43.3%)	1 (2.9%)	
Vasopressor during SICU stay	15 (50%)	14 (40%)	0.068[b]
mean (SD)	1.50 (0.509)	1.60 (2.0)	
Body Mass index			0.388[a]
(BMI)c (Mean)	26.1 kg\m^2	27.1 kg\m^2	
Minimum BMI	20.00 kg\m^2	15.62 kg\m^2	
Maximum BMI	34.00 kg\m^2	41.60 kg\m^2	
Disposition at the end of 7 days			
Discharged from the ICU	8 (26.7%)	16 (45.7%)	0.000[a]
Still in the ICU	13 (43.3%)	19 (54.2%)	

(a) Wilcoxon or ; (b) Chi Square test, as appropriate; (c) BMI was calculated as weight in kilograms divided by height in meters squared; SD: Standard deviation.

A and 25(71.4%) in group B. The use of Ng with oral diet was 3(10%) in group A and 3(8.5%) in group B. In addition to Ng feeding, the use of naso-jejunal feeding was done in 1(2.9%) group B case. The difference in the use of peripheral versus central access for the use of partial parenteral nutrition (PPN) revealed no major differences between the groups(p>0.05).

The use of standard enteral supplemental formula 1kcal\ml was was in 11(36.6%) group A cases and in 15(42.9.%) group B cases. The use of high-calorie high-protein supplementation was done in 5(16.7%) group A cases and 3(8.6%) group B cases. As for the utilisation of the protocol, its usage in changing enteral supplements, especially in the presence of hyperglycaemia and diarrhoea, was observed in in both groups (Table 4).

Factors impeding delivery of nutritional intake included radiological procedure 5 (17%) in group A and13 (37%) in group B. Patients who required vasopressor support were 2 (5.7%) in group A and 1(2.9%) in group B. Patients with abdominal compartment syndrome were 5 (17%) in group A and1 (2.9%) in group B, followed by weaning trial 3(8.6%) in group A and15 (42.9%) in group B.

Discussion

Evidence suggests that supplementation of exogenous protein has the potential to favourably impact the course of critical illness.[15] However, formula selection and the prescription of protein for patients depends upon the presenting diagnosis, co-morbidities and the calculated daily calorie and protein needs. The current study met the requirements of the patients with additional macronutrients.

Different guidelines have recommended nutritional screening to evaluate patients at risk of developing malnutrition.[16,17] In the current study, most patients in both groups were at risk of malnutrition and reported weight-loss, diagnosis of sepsis, requirement of mechanical ventilation for >5 days, among others. It was further observed that group A in comparison to the group B was significantly underfed. However, after implementation of the indigenously developed protocol, significant differences were observed in the nutritional delivery, the achieved caloric goal being 92.8%. Multiple studies from around the world suggest that actual delivery of nutritional support in ICU in the form of calories and protein is about 50%.[17-19] he current suggested that 91.4% of patients reached >50% after implementation of the protocol. Prior to implementation, only a small number of the patients in group A were able to reach 50%. However, despite rigorous implementation of the protocol, only 40% patients in group B were able to achieve the recommended caloric goal. Thus, the remainder of the caloric deficit is attributable to failure to deliver nutritional support.

Heyland et al. reported that delivery of >80% proteins decreased mortality. To achieve nitrogen balance and to defray catabolism in critical illness, protein requirements of 2.2 to 3.5 gm/kg/day have been recommended.[14] The

Table-2: Initiation and prescribing parameters of nutrition support.

Initiation of Nutrition Support	**Pre-implementation** n=30 value (%)	**Post-implementation** n=35 value (%)	***p*-alue**
Day 0 of Admission (within 24 Hours)	(n=7) 23.3%	(n=17) 48.3%	0.042
Day 1 of Admission (within 48 Hours)	(n=8) 26.7%	(n=8) 22.9%	0.396
Day 2 of Admission (within 72 Hours)	(n=4) 13.3%	(n=9) 25.7%	0.211
Day 3 of Admission (within 96 Hours)	(n=2) 6.7%	(n=1) 2.9%	0.803
Cumulative total energy Prescribed (ICU days 1–7)			0.000
mean (median) 25th-75th percentile	3171 (2800) 1892-4283	8371 (8219) 6213-10200	
% of Nutrition requirements	29.6%	92.8%	0.586
mean; median (SD)	321057 (2495)	384585 (2343)	
Cumulative EN	(69905 Kcal) 75.6 %	(272376Kcal) 88.2 %	0.000
Parenteral Nutrition	(n=0) 0% *not reported	(25945) 8.4 %	NA
% Kcal with Dextrose	(20879 kcal) 22.5%	(9531.7 Kcal)3.08%	0.058
% Kcal with Propofol	(1645 Kcal) 1.7%	(10447 Kcal) 3.38%	0.000
Total Kcal with Dextrose + Propofol + EN + PN	(n=30) 92429	(n=30) 308768	0.000
% No nutrition Support	(n=5) 16.7%	(n=0) 0% not reported	NA
% Kcal Deficit	70.3%	24.7%	0.000
Cumulative total prescribed Protein (ICU days 1–7)			0.074
mean (median) 25th-75th percentile	622 (633) 525-695	549 (540) 450-648	
% of Protein requirements	14.7%	67.6%;	0.00
mean (SD)	622.6 (148.7)	549 (125.48)	
Protein Given gm\kg\day	91	372	0.000
% Protein Deficit	85.1% (15900.2 gms)	2% (6306.9 gms)	0.000

EN: Enteral nutrition, PN: Parenteral nutrition. A) Wilcoxon or b) Chi-Square test, as appropriate.

Table-3: Use of additional macronutrient.

% Use of Additional	**Pre-Implementation** n (%)	**Post-Implementation** n (%)
MCT Oil	29 (96.6)%	19 (54)
Supplemental Protein	1 (3.3)	24 (68.6)
Total Number of Patients	30	35

MCT: Medium chain triglyceride.

Table-4: Use of additional macronutrient.

Use of Enteral Formula	**Pre-Implementation** n (%)	**Post-Implementation** n (%)
Standard (1kcal\ml)	11 (36.6)	15 (42.9)
High Calorie High Protein (1.5kcal\ml)	5 (16.7)	3 (8.6)
Elemental (1kcal\ml)	1 (3.33)	3 (8.6)
Diabetic (1.12kcal\ml)	3 (10)	4 (11.4)
Standard + High Cal High Protein	3 (10)	3 (8.6)
Standard + Elemental	5 (16.7)	3 (8.6)
Disease Specific (Renal)	2 (6.7)	1 (2.9)
Standard + Diabetic	3 (10)	2 (8.6)
Elemental + Diabetic	2 (6.7)	3 (8.6)
EN not initiated	0	2 (5.7)

EN: Enteral nutrition.

results of the current study showed that 28.5% patients were able to achieve >80% protein requirements. We feel that despite the use of supplemental protein to reach protein targets, the failure to have adequacy in group B could be attributed to compromised hepatic and renal functions coupled with acute critical illness.

The guidelines joint issued by the Society of Critical Care Medicine (SCCM) and the American Society for Parenteral and Enteral Nutrition (ASPEN) do not encourage routine use of small bowel0feeding.[17] Contraindications to the use of EN leads to reliance on PN.[17,20] Our results conferred that gastric feeding was utilized more, and no major differences in the access of PN were found. Furthermore, our data also indicated that oral feeding was initiated in combination of enteral feeding in achieving adequacy of nutrition support which is in line with the recommended published evidence.[17]

The recommendations on the use of PN differ between published guidelines. In case of contraindications to EN, PN has been recommended varying from 3 to 7 days.[16,17] The use of PN in the subjects was limited and was seen more in group B. However, those subjects who were able to tolerate EN; PN was slowly tapered off. The success of our protocol was observed in the appropriate prescription of PN and initiation of EN when possible.

The majority of patients in group B were admitted with head trauma requiring neurosurgery in comparison to group A in which 60% had diagnosis of sepsis and also had absence of abdominal compartment syndrome.

The implementation of the protocol had little impact on the reasons for withholding feed. Multiple studies have highlighted the reasons of interruption of enteral feeding and they account for almost more than one-third of feed-holding time.[21-23] The most common reasons highlighted have been extubation/(re)intubation, radiological procedures and high gastric residual volume (GRV) etc.[22,24] The most common reasons for withholding feed in both groups A and B were radiological procedure, weaning trial, haemodynamic instability and abdominal compartment syndrome. N significant differences were found between the groups, and these factors were found to be unavoidable in most cases.

The current study also explored the reasons that may have been associated with improved adequacy of nutrition support in group B. The use of evidenced-based protocols

led to the early initiation of EN and the use of additional macronutrients in the form of supplemental protein and MCT oil. The biggest challenge in the current study was aligning the multidisciplinary group including nurses and physicians on overcoming the existing practices and considering the use of the developed protocol which offered an opportunity to optimise delivery of nutritional care in surgically ill patients.

However, it should be noted that the two study groups by their very nature were expected to be different. In theory, the two could not have the same characteristics or the same nutritional requirements. However, the point of reference for comparison in the context of the current study was the practice of administering and / or initiating nutritional support before and after the implementation of the nutritional protocol. In this way, several studies can be listed for further guidance.[21,25,26]

Conclusion

Implementation of the evidence-based nutritional protocols in the SICU resulted in improved delivery of calories and proteins with a significant increase in the early initiation of nutritional support within 24 hours of admission to SICU.

Acknowledgements: The Authors would like to Acknowledge Dr. Faisal Khan Head of Surgical Intensive Care Unit Department of Anaesthesiology for his immense support and encouragement for the initiation of the project.

Disclaimer: The text is based on an academic thesis.

Conflict of Interest: None.

Source of Funding: None.

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