Original Article

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TANAFFOS

Improving the Practice of Nutrition Therapy in the NRITLD Critically Ill Patients: An International Quality Improvement Project

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Background: In previous decades several studies have been performed demonstrating that providing appropriate nutritional support to intensive care unit patients affects complications, time of mechanical ventilation, length of ICU stay, and risk of death. In this study we provided a report of nutrition statuses in Masih Daneshvari's ICU as compared to 156 ICUs from 20 countries that participated in an international nutrition survey.

Materials and Methods: All patients admitted to an intensive care unit during a specified one-month period who required artificial nutrition were included in this study. Characteristics of patients, performance of nutrition practices, and ICU outcomes were registered for all patients and compared with data from 156 other intensive care units from various countries around the world.

Results: Twenty patients, of which 11(55%) were males and 9(45%) were females, were included in this study. The median age was 50.5 yrs (IQR: 40.5-56.0). Seventeen (85%) of them had EN nutrition only, 2(10%) had PN nutrition only, and 1(5%) had both EN and PN nutrition during their stay in the ICU. The adequacy of calorie intake was 67.6% (vs. 61.1% in all 157 ICUs) and the adequacy of protein intake was 84.9% (vs. 56.7% in 157 ICUs).

Conclusion: In our ICU, enteral feeding was superior to parenteral feeding. Also we considered early initiation of enteral feeding within 48 hours following ICU admission. We just used polymeric formula during this study. As a result of formula variation limits, we overestimated calories and protein needs. Glutamine and Selenium supplementations have not been used yet for patient in our ICU, regardless of their proven benefits in oxidative stress conditions like pulmonary diseases. Therefore, limited use of supplementations like selenium is inevitably among the disadvantages of Masih Daneshvari Hospital's ICU, which is a tertiary-care center for chronic pulmonary diseases.

Key words: Nutrition, Quality improvement, Critical care, Intensive care unit

INTRODUCTION

Nutrition of critically ill patients is an important issue in Intensive Care Units (ICUs). According to the evidence, providing nutritional support for these patients within 24 hours of ICU admission reduces mortality (1, 2). Furthermore, it is mentioned that critically ill patients who receive less nutrition are more likely to experience increased complications, prolonged mechanical ventilation and longer stay in the intensive care unit (2).

In the last decade, several studies have been performed that describe the association between inadequate feeding and outcome of patients in the ICU (3- 6). Furthermore, it is shown that the route of nutrient administration affects responses and that early enteral feeding is beneficial for ICU patients; consequently, timely initiation of enteral feeding should be considered along with the timing and route of administration, formula selection, and monitoring (2, 7).

Moreover, many observational studies have shown the inability of critical care practitioners to adequately feed patients. These studies have revealed the wide variation of feeding practices in different ICUs (2). Hence, using the guidelines for critically ill patients' nutrition is recommended in the intensive care units (7).

During the previous years, a series of International Nutrition Surveys have been performed by a Critical Care Nutrition team in Canada. The aforementioned survey is a period-prevalence survey of nutrition practices, the purpose of which is to improve the guidelines of ICU patients' nutrition. The last survey was carried out in Sep. 2009, and Masih Daneshvari's ICU also participated in this study.

In this article, we prepared a report to compare the nutrition of Masih Daneshvari's ICU patients with the other ICUs that participated in this international study.

MATERIALS AND METHODS

A total of 20 patients admitted from September to October 2009 in the intensive care unit of Masih Daneshvari Hospital who required artificial nutrition were included in this study. The performance of Masih Daneshvari's ICU in nutrition practices was compared to that of "Sister Sites" in its region, comprised of 15 ICUs from China, India, Japan, Singapore and Taiwan. A total of 156 ICUs from 20 countries were involved in collecting data for the International Nutrition Survey 2009 (Table 1). First, the characteristics of our ICU with regards to hospital type, size of hospital (number of beds), multiple ICUs in the hospital, ICU type, size of ICU (number of beds), case types, presence of a medical director, presence of a dietitian, and full time equivalent dietitian (one per 10 beds) were compared with sister sites and all 157 ICUs.

Table 1. Total ICUs from 20 countries included in the international nutrition survey (2009).

Sister Sites	Countries	Number of ICUs
Canada	Canada	32
Australia and New Zealand	Australia	20
	New Zealand	2
USA	United States of America	63
Europe	Czech Republic	1
	Ireland	2
	Italy	2
	Norway	1
	Switzerland	1
	United Kingdom	7
Latin America	Brazil	1
	Colombia	5
	Mexico	2
	Peru	1
	Venezuela	1
Asia	China	1
	India	10
	Iran	1
	Japan	1
	Singapore	2
	Taiwan	1

A teaching hospital is defined as a hospital that provides training to medical students and residents. Hospitals that have only occasional medical students/residents are considered non-teaching hospitals. Open ICUs, are sites where patients are under the care of an attending physician (e.g. internist, family physician, surgeon) and intensivists (i.e. physicians with training in critical care) are consulted when necessary. Closed ICUs are defined as sites in which patients are under the care of an intensivist or care is shared between the intensivist and another attending physician. The Full Time Equivalent Dietitian (FTE) is a measure of the amount of time the dietitian is dedicated to the ICU relative to a full-time position e.g. a FTE of 1.0 refers to a dietitian working in a 10 bed ICU full-time or four dietitians working half-time in a 20 bed ICU.

The characteristics of patients, weight used in the calculation of nutrition prescription, methods used to calculate the energy requirement, and prescribed energy and protein intake according to the dietitian's or physician's recommendations, in the three groups were also compared.

After that, the nutritional adequacy was compared in the three groups as a summary measure of performance. The nutritional adequacy is defined as the amount of calories or protein received divided by the maximum amount prescribed at the initial assessment, expressed as a percentage. Days without EN (enteral nutrition) or appropriate PN (parenteral nutrition) were included in the analysis and were counted as 0% adequacy, regardless of presence of prescription; and only days that follow permanent progression to exclusive oral intake were excluded. The type of nutrition used for patients, the initiation time of EN, the composition of enteral formulas, and Glutamine and Selenium supplementation were also compared in different ICUs. For assessing the strategies used for optimization of delivery and minimization of risks of EN, the feeding protocols were compared in the ICUs. Also, the percentage of days during which EN feeds where interrupted by either combination of EN and PN feeds or PN only feeds was calculated. Finally, the use of lipids and intensive insulin therapy were compared in different ICUs.

For quantitative variables falling within the normal distribution, a mean and range were provided; similarly, for those values lying outside the normal distribution, a median and inter quartile range (IQR) were provided. The qualitative variables were also described as a percentage.

RESULTS

Of the 157 ICUs included in this survey, 116(73.9%) were from teaching hospitals. The mean size of hospitals was 503 beds with a range of 50 to 1,500 beds. Different characteristics of these ICUs are shown in Table 2.

Table 2. The characteristics of the intensive care units included in this study.

	Our site	Sister Sites	All Sites
Hospital Type			
Teaching	Yes	14(87.5%)	116(73.9%)
Non-teaching	-	2(12.5%)	41(26.1%)
Size of Hospital (beds); mean (range)	250	600(250-1000)	503(50-1500)
Multiple ICUs in Hospital	Yes	14(87.5%)	100(63.7%)
Case Types			
Medical	Yes	15(93.8%)	150(95.5%)
Surgical	Yes	16(100%)	150(95.5%)
Trauma	No	11(68.8%)	98(62.4%)
Pediatrics	No	3(18.8%)	29(18.5%)
Neurological	No	10(62.5%)	113(72.0%)
Neurosurgical	No	8(50%)	100(73.7%)
Cardiac Surgery	Yes	5(31.3%)	62(39.5%)
Burns	No	5(31.3%)	31(19.7%)
Others	Yes	3(18.8%)	14(8.9%)
Medical Director	Yes	16(100%)	149(94.9%)
Size of ICU (bed); mean (range)	12	23(10-24)	19(6-64)
Presence of Dietitian	Yes	11(68.8%)	145(92.4%)
Full time Equivalent Dietitian (per 10 beds); mean (range)	1.7	0.4(0.0-1.7)	0.4(0.0-1.7)

Of a total of 20 patients who were admitted to Masih Daneshvari's ICU, 11(55%) were males and 9(45%) were females. The median age was 50.5 years with an IQR of 40.5-56. Thirteen (65%) of them were in the medical group, 3(15%) in the elective surgical group and 4(20%) in the emergency surgical group. The admission diagnosis was respiratory disease in 16(80%), cardiovascular / vascular disease in 2(10%), and other diagnoses in 2(10%). Ten (50%) of them were reported to have ARDS; the mortality rate within 60 days after ICU admission was 30% (6 patients). Other characteristics of patients are presented in Table 3.

The Actual Body Weight (ABW) (Measured or Estimate) was used in the calculation of nutrition prescriptions for all 20 patients (100%) in our ICU; however, in our sister sites, the common methods were: 1) Estimation: 68(26.2%); 2) ABW: 59(22.7%); and 3) Ideal Body Weight (IBW) based on HAMWI Formula: 59(22.7%). The most common method among all 3,032 patients from 157 ICUs was ABW (48.1% for 1,459 patients).

The "Ireton-Jones equation" and "weight based: 25-29 Kcal/Kg" methods were used to calculate the energy requirements for all patients in our ICU: non weight-based 20-24 Kcal/Kg method for 1(5%); and weight-based 30-35 Kcal/Kg method for 19(95%) patients. The most common method among sister sites and all sites was weight based: 25-29 Kcal/Kg (for 123(47.3%) and 1,049(34.6%), respectively). The median of prescribed energy intake by weight (Kcal/Kg) was 30(IQR: 30-30) in our patients vs. 25.3(IQR: 24.2-30) and 24.4(IQR: 20-27) in sister sites and all sites, respectively; and the measurements for protein in the three groups were 1(IQR: 1-1), 1.2(IQR: 1-1.5) and 1.2(IQR: 1-1.4) g/Kg, respectively. The details are shown in Table 4. Seventeen (85%) of the 20 patients in our ICU received EN only, 2(10%) received PN only, and 1(5%) received EN+PN nutrition. In 18 patients who received EN nutrition, the time of initiation of EN was prior to ICU admission in 2(11.1%), 0-24 hrs. after admission in 13(72.2%), and 24-48 hrs. after admission in 3(16.7%) patients. The composition of EN formula for all 18(100%) patients who received EN in our ICU was polymeric formulas, as were the formulas used in our sister sites and all sites (60.2% and 85.9%, respectively). Enteral glutamine was not used for our patients (vs. 17.3% and 5.9% use in sister sites and all sites, respectively). The use of selenium supplementation was 25 %(for 5 patients) in our ICU vs. 11.5% in sister sites and 3.1% in all sites. Feeding protocols containing motility agents, small bowel feeding, withholding for procedures, and HOB (Head of Bed) evaluation algorithms, were used to optimize delivery and minimize the risks of EN as well. The rate of protocol feeding use in our sister sites was 50% and in all sites was 82.2%.

The adequacy of calories and protein from total nutrition (EN+PN) on different days of ICU is shown in Figures 1 and 2. The mean adequacy of calories from total nutrition in our ICU was 67.6% (vs. 64% and 61.1% in sister sites and all sites, respectively). The mean adequacy for EN in EN only patients was 64.9% (vs. 56% and 51.4% in sister sites and all sites, respectively). Also, the mean adequacy of protein from total nutrition was 84.9% (vs. 60.7% and 56.7% in sister sites and all sites, respectively) and for EN in EN only patients was 81.6% (vs. 54.6% and 51.2% in sister site and all sites, respectively). Further details are shown in Table 5.

Table 3. Patients' Characteristics

	Our site	Sister Sites	All Sites
Age (years); median(IQR)	50.5(40.5-56)	58.0(44-72)	61.0(48-73)
Sex			
Male	11(55.0%)	180(69.2%)	1815(59.9%)
Female	9(45.0%)	80(30.8%)	1217(40.1%)
APACHE II Score; median (IQR)	22.5(19-30)	22.0(17-26.5)	22.0(17-28)
Presence of ARDS	10(50.0%)	67(25.8%)	413(13.6%)
Days on Mechanical Ventilation (60-days censored); median(IQR)	5.0(3.2-6.4)	6.5(3.2-11.0)	7.2(3.3-15.1)
Days in ICU (60-days censored); median (IQR)	6.3(5.2-9.7)	10.5(5.8(19.3)	10.3(5.9-19.8)
Days in Hospital (60-days censored); median (IQR)	10.5(6.6-15.1)	16.3(9.1-35.5)	18.9(10.4-36.7)
Patient died (within 60 days)	6(30.3%)	82(31.5%)	741(24.8%)

Table 4. Patient nutrition assessment information

	Our site Median (IQR)	Sister Sites Median (IQR)	All Sites Median (IQR)
Prescribed Energy Intake (kcals)	2040 (1741.5-2190)	1635.0 (1500-2000)	1800.0 (1545-2017)
Prescribed Protein Intake (g)	69.5(60-73)	78.0(62.5-92)	90.0(75-104)
Prescribed Energy Intake by weight (kcals/kg)	30.0(30.0-30.0)	25.3(24.2-30.0)	24.4(20.0-27.0)
Prescribed Protein Intake by weight (g/kg)	1.0(1.0-1.0)	1.0(1.0-1.5)	1.2(1.2-1.4)

Table 5. Overall performance and adequacy of nutrition

	Our site	Sister Sites Mean(Range)	All Sites Mean(Range)
Adequacy of calories from total nutrition (EN+PN+propofol)	67.6%	64% (31.9%-96.3%)	61.1% (20.2%-96.7%)
Adequacy of protein from total nutrition (EN+PN)	84.9%	60.7% (33.3%-85.4%)	56.7% (16.5%-96.2%)
Adequacy of calories from EN in EN only patients	64.9%	56.0% (9.7%-90.3%)	51.4% (9.7%-90.3%)
Adequacy of protein from EN in EN only patients	81.6%	54.6% (11.7%-88.1%)	51.2% (11.7%-90.0%)
Received calories from total nutrition (EN+PN+propofol)	1395	1271 (753-1657)	1298 (657-1947)
Received protein from total nutrition (EN+PN)	60	58 (30-90)	64 (29-108)
Received calories from EN in EN only patients	1347	1153 (491-1657)	1185 (491-1727)
Received protein from EN in EN only patients	58	53 (21-82)	60 (21-104)

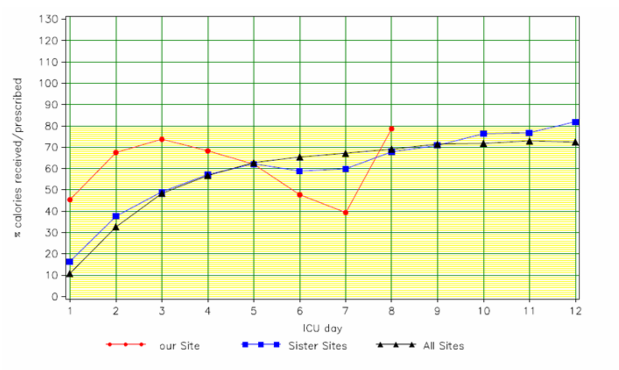

Figure 1. Adequacy of calories from appropriate nutrition

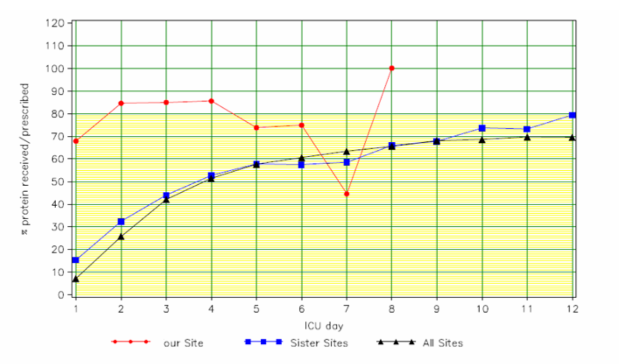

Figure 2. Adequacy of protein from appropriate nutrition

From total of 102 days that patients were on EN in our ICU, EN was interrupted half the times (51 days). This rate was 30.7% in our sister sites and 32.2% in all sites. The median of total duration of feeding interruption was 5 (IQR: 4-7) hours with the most common reason of fasting for endotracheal extubation or intubation (27.5%) and fasting for other bedside procedures (23.5%).

Of the 20 patients included in our study, 3(12%) patients received PN nutrition during their ICU stay, one for gastrointestinal perforation, one for gastrointestinal surgery, and the third one for no clinical reason. The main reason for using PN nutrition in sister sites and all sites was gastrointestinal surgery (50% and 21.6%, respectively).

In terms of comparing the lipid profiles administered to PN patients during their 20 days of ICU stay, 100% received MCT/LCT physical mixture; contrarily, in our sister sites and all sites, a Soybean oil-based formula was most commonly employed (40% and 49.5%, respectively).

The Glycemic Control Protocol was also used in our ICU, 15(93.8%) of sister sites and 144(91.7%) of all sites.

From the total of 137 days in our ICU, we had 2(1.5%) hypoglycemic days (blood glucose < 3.5 mmol/L at least once during the day). This rate was 1.1% in sister sites and 1.9% in all sites.

DISCUSSION

The catabolic response to stress is characterized by whole-body protein loss. In addition, normal anabolic activity, needed to drive protein synthesis, is decreased. Therefore, normal compensatory anabolism for catabolic stimuli is lacking (8).

Moreover, in the critically ill patients, high levels of stress hormones and pro-inflammatory cytokines prevent ketone synthesis. Therefore, fasting adaptation mechanisms are impaired, which necessitates initiation of early feeding as soon as possible.

With regard to nutrition support, it is generally believed that enteral feeding is superior to parenteral feeding (9, 10).

Considering the above, 18 of our 20 patients received only enteral feeding and 2 out of 20 received both enteral and parenteral feeding, which was acceptable according to *Critical Care Nutrition* guidelines. Also we consider the early initiation of enteral feeding to be that started within 48 hours of ICU admission, the benefits of which have been proven.

Critical Care Nutrition guidelines recommend the use of an enteral formula with fish oils, or borage oils, in patients with acute respiratory disease. The primary reason for ICU admission was acute respiratory distress syndrome in 30% of our patients. However, none of them received fish oil enriched formula.

It is notable that we used only polymeric formula in this study. As a result of variable limitations in formulas, we overestimated the calorie and protein needs. This may explain the higher adequacy of calorie and protein measurements for our patients.

Keep in mind that this polymeric formula was exclusively used just for this study design. Unfortunately, in the daily practical routines of our ICU, kitchen regimen is the only provided regimen. Thus, poor clinical outcomes and management failure should be expected in the natural clinical setting of Masih Daneshvari Hospital's ICU.

It is well-documented that there is an increased loss of micronutrients during times of stress and injuries (11-14). Since laboratory measurement of these elements is extremely difficult or even impossible in some cases, it is more rational to prevent these probable deficiency states by increasing the amount of intake.

Selenium is one of the best studied micronutrients in clinical trials (12,15,16). It is believed that in critically ill patients, a low level of selenium is associated with increased oxidative stress, organ failure and mortality.

Critical Care Nutrition recommends that the use of IV/PN selenium supplementation alone or in combination with other antioxidants should be considered in critically ill patients (15,17,18). However, selenium supplementation has not been used yet for any patient in our ICU, regardless of its proven benefits. Because Masih Daneshvari Hospital is a tertiary care center for chronic respiratory diseases, we encounter many critically ill patients with chronic and profound oxidative and hypoxic stress. Therefore, limitation in use of these supplementations is an inevitable pitfall of our ICU.

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