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Original Research Article

Impact of Early Enteral Nutrition on Outcome of Critically ill Children

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Abstract:

Background: The provision of optimal nutrition therapy in critically ill patients is a fundamental goal of critical care. Critically ill patients are at increased risk for gut injury and ischemia, hemodynamic instability; however it has been shown that enteral nutrition (EN) is the preferred mode of nutrient intake in patients with a functional GI system.

Aim & Objective: To find out whether early enteral feeding would improve clinical outcomes for mechanically ventilated critically ill patients in our pediatric ICU.

Methods: It was a hospital based Prospective observational study over a period of 1 year in 55 critically ill children aged 1 month to 18 years who were admitted to PICU, Trauma centre of a tertiary care hospital of Lucknow, Uttar-Pradesh. Out of these 28 patients (50.9%) had feeding within 48 hrs of ICU admission while in 27 feeding started after 48hrs of admission.

Results: Mean duration of length of ICU stay (10.54 ± 5.95 v/s 16.85 ± 13.70 days) and mechanical ventilation (5.96 ± 3.86 v/s12.77 ± 9.81 days) in patients was significantly higher in late feeding (≥48 hrs) group as compared to patients in whom early feeding (<48 hrs) was initiated.

Conclusion: Based on the finding of this study it can be concluded that early initiation of nutritional support via enteral route as soon as possible after ICU admission is beneficial.

Keywords: Early Enteral Feeding, ICU Stay, Optimal Nutrition Therapy.

Introduction

The provision of optimal nutrition therapy in critically ill patients is a fundamental goal of critical care. Careful and timely assessment of energy needs and provision of adequate nutrients through the appropriate route while catering to all associated risks involved are key steps toward achieving this goal. [1] Inadequate nutrient delivery during critical illness results in higher rates of multiple system involvement, worsening nutritional status, increased incidence of complications, prolonged length of ICU stay, and mortality. [2,3] Critically ill patients are at increased risk for gut injury and ischemia, hemodynamic instability, however it has been shown that enteral nutrition (EN) is the preferred mode of nutrient intake in patients with a functional GI system. [4,5]

On average, nearly 50% of critically ill children fail to reach nutrition goals, instead reaching only 37–70% of the prescribed energy delivery prior to discharge from the PICU. [5-7] although early EN is strongly associated with lower mortality in critically ill children, [8] there is no literature clearly stating the definition of early EN. [9] Both in adult intensive care units (ICUs) and PICUs, early EN were generally defined as the initiation of EN within 24–48 h of admission to the ICU. [10,11] However, early initiated feeding is not synonymus with provision of adequate goal calories. In recent studies, a significant improvement in mortality has been shown with increased enteral energy intake and not merely with early initiation of feeding.

Most studies showed that implementation of a evidence based nutrition support algorithm will help critically ill patients to acquire target caloric intake and minimise avoidable interruptions, hence better outcome. However, it remains controversial on whether early enteral feeding is effective in improving patient important outcomes such as mortality, nosocomial infections, and duration of mechanical ventilation and length of stay in ICU. The aim of the present study was to find out whether early enteral feeding would improve

clinical outcomes for mechanically ventilated critically ill patients in our pediatric ICU.

Material & methods

It was a hospital based Prospective observational study over a period of 1 year in critically ill children aged 1 month to 18 years who were admitted to PICU, Trauma centre of a tertiary care hospital of Lucknow, Uttar-Pradesh. Patients who do not need mechanical ventilation, patients with multiple organ dysfunction or in need of increasing vasopressor support, children who were on full oral diet from 3days before admission in PICU and patients on compassionate care towards probable end of life were excluded from the study.

Methodology

We had enrolled a total of 55 patients of encephalitis admitted to PICU who needed mechanical ventilation for more than 72 hours and observed patients who received at leastone-quarter of cumulative goal enteral energy over the first 48 hours of PICU admission and compared them with patients who received delayed enteral feeding i.e. after 48 hours of admission.

Baseline characteristics, demographic details, anthropometric profile like, age, height, mid upper arm circumference etc, detailed history and examination of enrolled patients were noted. Relevant investigations were done and diagnosis was made. Patients were investigated and managed according to the unit protocols under the guidance of the consultants and their progress was noted.

A majority of the studies have described initiation of feeds as early as 6 hours and as late as 48 hours after admission to the PICU. [12-14] In a multicenter study of nutrient delivery in the PICU, early EN—defined as delivery of one-quarter of cumulative goal enteral energy over the first 48 hours—was associated with a survival benefit. [15] In our study feeding was calculated and advanced according to unit protocols and was given through a nasogastric tube inserted at the time of admission every 2 hourly. Energy needs in each child was calculated using the Schofield equation. [16]

Any patient with severe acute malnutrition was fed as per WHO protocol starting with F-75 and gradually building up feeds. A stepwise, evidence-based algorithm for initiating, advancing, and maintaining enteral nutrition in critically ill children was used. The PICU staff followed a consistent standard of care and quality at all levels based on institutional protocol.

Complications like ventilator associated pneumonia were suspected in patients with worsening respiratory parameters with supportive clinical findings of infections (fever, purulent secretions or leukocytosis) along with new or progressive pulmonary infiltrates on Chest X ray(in those mechanically ventilated >48 hours) & endotracheal aspirates were sent for gram stain and culture. Blood cultures and urine cultures were sent in all enrolled patients after 48 hours of PICU admission as per ICU protocols and the same were noted and evaluated in both early and late feeding groups. [17]

Statistical Analysis: The collected data of the subjects were entered into the MS office including MS word, MS excel and MS access and was processed and analyzed for percentages and proportions. Appropriate statistical tests were applied to draw inferences and significance. EPI Info 2000 was used to derive statistical inferences and significance.

Observation & Results

The baseline demographic characteristics of patients at presentation (enrolment) are summarized in Table 1. The age of patients ranged from 0.5 to 12.0 yrs with mean (± SD) 5.97 ± 3.35 yrs and median 6 yrs. Among patients, mostly were ≤6 yrs (56.4%), males (58.2%) and had moderate grade of malnutrition (45.5%).

Table 1: Demographic characteristics of patients

Demographic characteristics	No. of patients (n=55) (%)
Age (yrs): Mean ± SD	5.97 ± 3.35
Sex:	
Female	23 (41.8)
Male	32 (58.2)
Grade of malnutrition:	
Normal	24 (43.6)
Moderate	25 (45.5)
Severe	6 (10.9)
PRISM 3 score: Mean ± SD	27.49 ± 7.25

Among patients, the most prevalent cause of EN interruption was gastric haemorrhage with abdominal distension (23.6%), RT output (volume or content) and vomiting (14.7%), bedside procedures (lumbar puncture, re-intubation, extubation 10.9 %), radiological procedures (CECT head, USG abdomen 7.2%), Feeding tube issues (displaced, blocked 7.2%). However, 20 (36.4%)

patients did not have EN interruption. Pseudomonas was the most common infection in blood (10.9%), whereas Enterococcus was in urine (3.6%). However, 40 (72.7%) patients did not have blood infection and 51 patients (92.7%) had no urine infections. Further, in patients, the most prevalent ventilator associated pneumonia was due to Pseudomonas (14.5%) followed by Acinetobacter (10.9%) whereas 74.5% did not have it.

At final evaluation, 37 (67.3%) patients discharged, 5 (9.1%) LAMA and 13 (23.6%) died due to disease accounting overall mortality of 23.6%. The correlation of early EN with clinical characteristics (cause of EN interruption, duration MV, PICU stay, blood infection, urine infection and ventilator associated pneumonia) is summarized in Table 2. Except duration of MV, other clinical characteristics did not correlate well with early EN i.e. early EN was not found to be associated with cause and frequency of EN interruption, PICU stay, blood infection and urine infection ($p>0.05$) respectively.

However, mean duration of mechanical ventilation showed significant association with early EN ($p=0.002$) (Table 6). On the other hand χ^2 test showed significant ($p<0.05$ or $p<0.01$) association of both ventilator associated pneumonia (VAP) and final outcome with initiation of feeding suggesting that early initiation of feeding may be associated to ventilator associated pneumonia and final outcome (showing favourable impact).

Table 2: Association of different predictor variables with feeding duration in all studied patients (n=55)

Variable	Feeding duration		t/χ^2 value	p value
	<48 hrs (n=28) (%)	≥48 hrs (n=27) (%)		
Grade of malnutrition:				
Normal	15 (53.6)	9 (33.3)	4.11	0.128
Moderate	9 (32.1)	16 (59.3)		
Severe	4 (14.3)	2 (7.4)		
PRISM 3 score	23.96 ± 6.25	31.15 ± 6.43	4.20	<0.001
Duration of MV (days)	5.86 ± 3.63	11.96 ± 9.17	3.27	0.002
PICU stay (days)	10.68 ± 6.05	14.07 ± 12.18	1.32	0.194
Blood infection:				
None	23 (82.1)	17 (63.0)	3.55	0.616
Acinetobacter	1 (3.6)	3 (11.1)		
Cons	0 (0.0)	1 (3.7)		
Enterococcus	1 (3.6)	1 (3.7)		
Klebsiella	1 (3.6)	1 (3.7)		
Pseudomonas	2 (7.1)	4 (14.8)		
Urine infection:				
None	26 (92.9)	25 (92.6)	2.00	0.572
Acinetobacter	0 (0.0)	1 (3.7)		
Candida	1 (3.6)	0 (0.0)		
Enterococcus	1 (3.6)	1 (3.7)		
VAP:				
None	25 (89.3)	16 (59.3)	6.63	0.036
Acinetobacter	1 (3.6)	5 (18.5)		
Pseudomonas	2 (7.1)	6 (22.2)		
Final outcome:				
Discharge	24 (85.7)	13 (48.1)	9.69	0.008
Expired	2 (7.1)	11 (40.7)		
LAMA	2 (7.1)	3 (11.1)		

Discussion

Early Enteral Nutrition provides a number of benefits to the critically ill pediatric patient. In general, EN is more physiological than PN, maintains the functional integrity of the gastrointestinal mucosa by nourishing the gut first, and thus decreases the risk for bacterial translocation and subsequent infectious complications.

In our study the duration of mechanical ventilation and PICU stay of patients ranged from 2 to 39 days and 4 to 54 days respectively with mean 8.85 ± 7.52 days and 12.35 ± 9.63 days respectively and median 7 days and 9 days respectively which was nearly same as a study conducted by Nilesh M. Mehta, et al. [4] Duration of mechanical ventilation ($p<0.01$) was significantly higher in late feeding (≥48 hrs) group as compared to patients in whom early feeding (<48 hrs) was initiated. In contrast to

our findings, a study conducted by Mikhailov et al (2014) [18] comparing those who received EEN to those who did not, adjusted for PIM2 score, age, length of ICU stay did not differ (P = 0.59), and the duration of MV for those receiving EEN tended to be longer than for those who did not, but the difference was not significant (P = 0.058). In our study we did not found significant association of preexisting malnutrition with final outcome ($\chi2$=1.64, p=0.650).

This was similar to a study conducted by De Souza Menezes et al (20l6) [19] who found malnutrition was associated with longer duration of MV and PICU length of stay but not mortality on univariate analysis. Malnutrition was associated with longer duration of mechanical ventilation on multiple logistic regression modeling (OR, 1.76; 95% CI, 1.08–2.88; P = 0.024).

Among patients, Pseudomonas was the most common infection in blood (10.9%) whereas Enterococcus was in urine (3.6%). However, 40 (72.7%) patients did not have blood infection and in 51 patients (92.7%) no urine infections. Further, in patients, the most prevalent ventilator associated pneumonia was pseudomonas (14.5%) followed by Acinetobacter (10.9%) whereas 74.5% did not have it.

The $\chi2$ test showed insignificant (p>0.05) association of blood infections and urine infections with the time of initiation of enteral feeding indicating that early initiation of feeding may not be associated to increased incidence of nosocomial infections and was similar to a study conducted by Tripathi S et al (2015) [20] who found that there was no difference in either unadjusted or adjusted rates of hospital-acquired infections or vasopressor-free days among the 2 groups.

At final evaluation 37 (67.3%) patients discharged, 5 (9.1%) LAMA and 13 (23.6%) died accounting overall mortality of 23.6%. After excluding LAMA cases, comparing the frequency (%) of final outcome (discharge/expired) with early EN groups there was significant association between final outcome and early EN ($\chi2$=9.68, p=0.008). In a study conducted by Mikhailov et al (2014) [18] EEN is strongly associated with lower mortality in patients with PICU Length of stay of ≥96 hours.

Conclusion & Recommendations

Based on the finding of this study it can be concluded that early initiation of nutritional support via enteral route as soon as possible after ICU admission is beneficial. Thus, guidelines on nutrition for critically ill children has to be reformed and widely circulated clearly citing the indications, contraindications, barriers to enteral feeding and developing a protocol for enteral feeding in pediatric ICU stating reasons for EN interruptions and duration for which feeds should be held. Larger RCTs evaluating the impact of early enteral nutrition in critically ill children are needed to promote adequate caloric intake and withhold unnecessary delay and interruptions to enteral feeding, thus reducing mortality and incidence of ICU complications in pediatric ICUs.

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