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Original Research Article

Nutritional status in patients admitted to pediatric intensive care unit and its corelation with outcome

Maitri Patel, Ankita Badhiye*, Vaishali Chanpura, Bhargav Patel

Department of Pediatrics, Baroda Medical College, Vadodara, Gujarat, India

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***Correspondence:**
Dr. Ankita Badhiye,
E-mail: abadhiye@gmail.com

ABSTRACT

Background: The incidence of malnutrition in children admitted to pediatric intensive care unit (PICU), has always been significant. In addition, nutritional status of critically ill children deteriorates further during their PICU stay and may have negative effect on patients` outcome. This study aims to determine the critically ill children, to analyse and document its impact on outcome and to survey current nutritional practices and support in PICU.
Methods: This was a prospective observational study done over a period of 10 months on critically ill patients admitted in PICU of department of pediatrics at Baroda medical college and Sir Sayajirao Gaekwad hospital, Vadodara.
Results: Total of 350 patients admitted in PICU of S. S. G. hospital, Vadodara were enrolled in the study**.** Malnutrition was higher in age 6-60-month age group (57%) of patients admitted in PICU, 81% of severe acute malnutrition patients required mechanical ventilation and 19% required HFNC support, there was statistically significant difference in mortality (51.1%) of SAM patients as compared to normal patients.
Conclusions: Malnutrition is one of the leading causes of mortality in patients admitted to PICU, with more complications with prolonged ventilator support, longer duration of stay in PICU.

Keywords: Nutritional status, PICU, Outcomes, SAM, Malnutrition, Mortality, Enteral nutrition, Mechanical ventilation, Duration of stay

INTRODUCTION

The incidence of malnutrition in children admitted to the PICU, has always been significant in the studies conducted over the past 30 years. In addition, nutrition status of critically ill children deteriorates further during their ICU stay and may have a negative effect on patients' outcome. This study aims to determine the nutritional status of critically ill children, to analyze and document its impact on outcome and to survey current nutritional practices and support in PICU. Malnutrition occurs frequently in children in PICU, ranging from 35% to 72%. Children in PICU are at high risk of malnutrition due to variable energy requirements and limited energy reserve. Most poor clinical outcomes, including prolonged length of PICU stay, clinical complications, high medical cost and rising mortality are closely related to malnutrition.[1-7] Nutritional assessment of patient in PICU is recommended by the American society for parenteral and enteral nutrition (ASPEN). Guidelines such as the Asia Pacific and the Middle East consensus are in place to identify malnutrition and evaluate whether energy supply meets the actual requirements.[8,9] Optimal nutrition is important for severely ill children in PICU. However, due to factors like poor absorption, fluid restrictions and feeding interruption for diagnostic and therapeutic procedures, nutrition treatment is still a challenge in PICU.[10] The aim of our study is to observe the prevalence of malnutrition and feeding patterns and correlation with the outcome in critically ill children.

Outcome of patients admitted to ICU depends on multitude of factors: Condition on admission, severity of illness and optimum management. Several scoring systems including PRISM in pediatric patients and TOPS in neonates have been devised to predict outcome based on the condition of the patient at admission. Many studies have found out that nutritional status of pediatric patients at admission and their ongoing nutritional therapy while in ICU are independent predictors of mortality and morbidity in addition to metabolic and cardiorespiratory parameters. Malnutrition is highly prevalent in patients referred to our hospital, especially amongst 6-60 months. Pre-existing malnutrition predisposes to critical illness and affects the outcome of patients. We have analyzed the impact of malnutrition on severity of illness and outcome of patients.

METHODS

The present study was a prospective observational study, conducted at the PICU of the department of pediatrics at Baroda medical college and Sir Sayajirao Gaekwad hospital, Vadodara, during February 2022 to November 2022 after taking approval from the institutional ethics committee on human research (IECHR), Baroda medical college, SSG hospital, Vadodara. A total of 350 critically ill patients were enrolled during the study period. Patients fulfilling the inclusion criteria were included. The inclusion criteria were-all critically ill children between 1 month to 12 years, admitted to PICU during the study period. Patients with conditions as follows who would have failure to thrive due to organic causes and not malnutrition: chromosomal anomalies, musculoskeletal disorders, inborn errors of metabolism, caretaker/parent not giving consent for enrollment were excluded from the study. After taking consent and matching the eligibility criteria; detailed history, anthropometric measurements including weight, height, head circumference, MUAC were recorded on the predesigned Proforma with the help of weighing scale, stadiometer/infantometer and measure-tape. BMI and weight for height data was generated from that which gave the inference of nutritional status in the form of wasting, stunting, underweight. World health organization (WHO) classification of nutritional status of infants and children was used in the study. Detailed general and systemic examination were recorded in the predesigned proforma. All enrolled participants were treated according to PICU protocol providing respiratory and/or cardiovascular support in the form of oxygen, invasive/non-invasive ventilation and use of vasoactive agents respectively. The clinical course of the patients was monitored in ICU, and associated morbidities or additional investigations were included in Proforma. Patients were observed for requirement of ventilator support or need of vasoactive agents (inotropes) along with their type and duration. Outcome in form of survival or death along with days of hospitalization was noted. Data analysis was performed using IBM-SPSS version 21.0 (IBM-SPSS Science Inc., Chicago, IL).

RESULTS

The proportion of malnutrition was higher in the 6 months-5-year age group (59%) of which SAM was also significant (41%) (Table 1).

Comparison of the mortality in children of 6 months to 5 years age shows 47 (51.1%) patients with SAM died, 21 (23.3%) normal patients died, 45 (48.9%) patients with SAM survived, and 36 (97.3%) patients with MAM survived. The results show a statistically significant difference in mortality of SAM patients in 6 months to 5 years age group ($p \leq 0.0001$). Comparison of mortality in 5-12 years age group shows 60% patients with moderate underweight died, and 21% patients with normal weight died (Table 2).

The requirement of mechanical ventilation in failure to thrive was 75% and that in moderate acute malnutrition was 63%. Out of 92 patients of severe acute malnutrition 75 (81%) patients required mechanical ventilation while only 17 (19%) patients required HFNC support (Table 3).

Patients who succumb within 24 hours of admission have extremely poor status on presentation. These include refractory shock, severe trauma, untreatable cardiac disease and multiorgan failure. We had 13 (11.6%) such patients during our study period which contributed significantly to the high mortality, 58 patients (52%) patients were expired after treatment period of more than 3 days (Figure 1).

In our study comparing the nutritional therapy between patients shows 4 (2%) patients who underwent nutritional therapy died, 108 (92.3%) patients who did not undergo nutritional therapy died, and 195 (98%) patients who underwent nutritional therapy survived (Table 5).

Table 1: Distribution of malnutrition.

Age group		N	Percentage (%)
<6 months	Normal	47	58.75
	FTT	33	41.25
	Total	80	100
6 months-5 years	Normal	90	40.91
	Mam	37	16.82
	Sam	92	41.82
	Total	219	100
5-12 years	Normal	14	27.45
	Mild underweight	13	25.49
	Moderately underweight	10	19.61
	Severely underweight	12	23.53
	Overweight	1	1.96
	Obese	1	1.96
	Total	51	100

Table 2: Mortality versus nutritional status.

Age group		Mortality				P value
		No		Yes		
		N	%	N	%	
<6 months	Normal	32	68.10	15	31.90	0.49
	FTT	20	60.60	13	39.40	
6 months to 5 years	Normal	69	76.70	21	23.30	<0.0001
	Mam	36	97.30	1	2.70	
	Sam	45	48.90	47	51.10	
5 years to 12 years	Normal	11	78.60	3	21.40	0.031
	Underweight	9	69.20	4	30.80	
	Moderate underweight	4	40.00	6	60	
	Severely underweight	10	83.30	2	16.70	
	Overweight	1	100	0	0	
	Obese	1	100	0	0	

Table 3: Distribution of malnutrition in mechanical ventilated patients.

Mechanical ventilation		HFNC	
Normal	92	Normal	59
Failure to thrive	25	Failure to thrive	8
Moderate acute malnutrition	24	Moderate acute malnutrition	14
Severe acute malnutrition	75	Severe acute malnutrition	16
Moderately underweight	21	Moderately underweight	2
Severely underweight	10	Severely underweight	2
Overweight	0	Overweight	1
Obese	1	Obese	0
Total	248	Total	102

Table 4: Duration of stay versus mortality.

Duration of hospital stay (in days)	Mortality				P value
	No		Yes		
	N	%	N	%	
<7	34	26.00	97	74.00	<0.0001
7-14	106	92.20	9	7.80	
>14	98	94.20	6	5.80	

Table 5: Enteral nutrition versus mortality.

Mortality	No		Yes		P value
	N	%	N	%	
Nutritional therapy	9	7.70	108	92.30	<0.0001
	195	98.00	4	2.00	

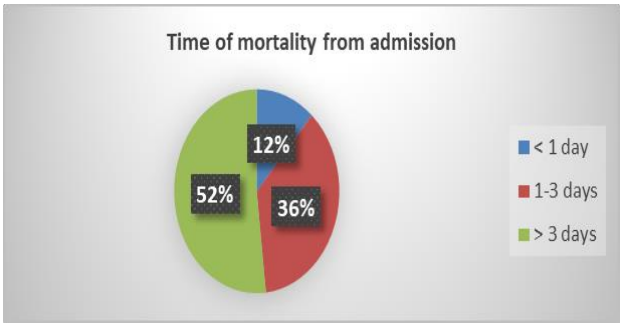

Figure 1: Time of mortality from admission.

DISCUSSION

In our study malnutrition in 6-60 months was 59% (Moderate-16.82%, severe-41.82%). This is the age when switch over to complementary feeding is needed. If this does not happen adequately it results in malnutrition. A study conducted by Bagri et al which was a retrospective study enrolling 332 critical ill children where malnutrition classification was done based on BMI values in age group 1-15 years of age had almost similar distribution of malnourished patients (Moderate-17.5%, severe-40%).[11]

Comparison of mortality versus nutritional status, in less than 6 months the mortality rate was 40% in FTT patients. In >5 years of age the mortality rate was 35% in undernourished children. This suggests that correlation between malnutrition and mortality is maximum among 6months -5 years followed by 5-12 year. A study conducted by Nangalu et al was a prospective study enrolled 400 patients had 10% mortality rate. Malnourished group was further divided into groups, one with mild to moderate malnutrition (weight for age 60-80% of expected) and second who were severely malnourished (weight for age <60% expected), it was noted that mortality was significantly higher in later group 27% compared to 7% in another group (p=0.01).[12]

In our study majority of patients (71%) had requirement of mechanical ventilation during PICU stay while 29% patients required HFNC support. 45% patients in our study had malnutrition and required mechanical ventilatory support (n=156) during the PICU stay with significant p values. During the period of mechanical ventilation there may be other contraindications for starting feeds ending up in prolonged mechanical ventilation support, prolonged PICU stay and aggravation of nutritional disorder as children require more calorie and protein during critical illness as compared to adults. A prospective cohort study conducted by Grippa et al nutritional status as a predictor of duration of mechanical ventilation enrolled 72 patients. It had malnutrition in 41.2% patients which is comparable to our study.[13]

In our study cross-tabulation analysis of duration of PICU stay and mortality there was significant correlation between the two variables with significant p values. Maximum mortality was during 1st week of admission due to poor condition on receiving and delayed referral. Patients usually become stable during the first week of admission. Mortality is high in the initial days post admission in patients who are very critical at presentation. Mortality in the 2nd and 3rd week is generally due to nosocomial infections, surgical complications and delayed onset of multiorgan failure (Table 4). A single center cohort study was conducted by Miura et al in Japan studying about the epidemiology of Long stay patients in the paediatric intensive care unit included 130 patients of age <18 years found that patients with prolonged stay required more procedures like central line insertion, foley catheterization, mechanical ventilation, ECMO support, renal replacement therapy, hospital acquired infections as well as tracheostomy and feeding gastrostomy with poor outcomes with respect to mortality.[14]

In our study the results show a significant difference in between nutritional therapy and mortality (p≤0.0001). Initiation of Enteral feeds during the PICU stay prevents gut dysbiosis and thereby improves the overall outcome of the patients especially the patients with severe acute malnutrition. As shown in the Table 5 enteral feeds were established in most of the population (223). Various reasons for not starting enteral feeds were septicemia and septic shock, respiratory failure and patients who had undergone gastrointestinal surgery a prospective observational study conducted by Muhammad et al "feeding-a hidden variable affecting the prognosis of critically ill children enrolled Two hundred twenty-one patients showed mortality rate 17.6%. In this study early enteral nutrition was as associated with lower rates of Mortality (5.6% vs 26.9%, p<0.001); Hospital acquired infections (18.9% versus 67.3%, p<0.001); and enteral feeding intolerance (13.3% versus 28.8%, p=0.018).[15]

Limitations

This is a single center study with small sample size which may not be representing the general population. Most of our patients are from a rural and lower socioeconomic background, and therefore have a higher prevalence of malnutrition as compared to the general population. We have not compared the impact of malnutrition as an independent determinant of mortality as compared to other factors. We did not directly measure weight in some of the children admitted to the ICU but instead relied on recorded hospital admission weights, parental knowledge, and infant health records.

CONCLUSION

Malnutrition is one of the leading causes of mortality in patients admitted to PICU, with higher incidence in tertiary care centers. Malnourished patients had longer duration of PICU stay because of poor condition on receiving, mechanical ventilatory requirement for longer time than normal nourished patient. Early enteral nutrition lowers the risk of mortality and morbidity while parenteral nutrition is associated with higher risk of mortality and morbidity. Mortality rate was higher in malnourished patients as compared to normal patients.

Recommendations

Further studies with a larger sample size should be carried out to confirm the findings of our study. In patients who could be stabilized after the initial critical phase, ICU outcome is decisively influenced by their nutritional status. Proper nutrition, either enteral or parenteral during the hospital stay significantly improves the outcome. This study highlights the need for appropriate nutritional assessment in sick children and use of appropriate nutritional protocols in the PICUs. Patients discharged from the PICU should be kept in regular follow-up for neurodevelopmental assessment.

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