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Predictors of Mortality in Acutelly Ill Children Admitted To the Paediatric Intensive Care Unit

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Abstract

Background: Mortality is the most frequently assessed outcome. So, it is very important to look for the predicting factors of PICU mortality including PRISM III score.

Aim: To assess the risk factors contributing to the increased mortality in our PICU.

Material and methods: This is a prospective observational study done at Narayana Hrudayalaya Multispecialty Hospital, Bangalore, India .Standard demographic, clinical and laboratory data was obtained prospectively from all the patients stayed in PICU for >6 hours. Patients who had history of chronic disease were excluded. Patient's hospital course followed to determine the early outcome of their acute sickness (as dead or survived).

Results: Out of 144 patients admitted to the PICU, 16 (11.1%) patients died. Children with acute respiratory distress syndrome at admission were at 3 times higher risk of death (adjusted OR: 3.44, 95% CI: 0.992-11.952). Children with PRISM III scores of >10 were at 6 folded higher risk of death in the PICU (adjusted OR: 6.47, 95% CI: 0.743-56.340). Children with Acute kidney injury, acute liver failure and MODS were at 2 fold higher risk of death with the values of adjusted OR: 2.118, 95% CI: 0.508-8.839, OR: 2.130, 95% CI: 0.561-8.077 and OR: 2.066, 95% CI: 0.292-14.640 subsequently.

Conclusion:- In addition to PRISM III score ARDS,Acute kidney injury, Acute liver failure, MODS and haemodialysis were also found to be significant but not independent predictors of mortality in PICU.

Keywords: mortality, PRISM III score, PICU, Multiorgan dysfunction syndrome

Introduction

The practice of pediatric critical care is dynamic and evolving. Whether adult or pediatrics, severities of illness, assessments are critical for wide range of ICU management and administration [1, 2]. Mortality is the most frequently assessed outcome. For pediatric intensive care, various methods are available for mortality prediction, including the Pediatric Risk of Mortality (PRISM, PRISM III) and the Pediatric Index of Mortality (PIM and PIM2) [3,4,5,6]. PRISM III is a widely accepted and is a standard against which other scores are compared. However there are some limitations with the use of PRISM III; a lot of information is needed to calculate it and many units do not calculate it routinely, worst reading of 12/24h is used and a lot of deaths occur (in one study over 40%) within first 24hrs, so the score may be diagnosing death rather predicting it. So, it is very

important to look for other predicting factors of PICU mortality rather than PRISM-III score. The main objective of this study is to assess the risk factors contributing to the increased mortality in our PICU.

Subjects and Methods

Study design: Prospective observational study

Ethics: The study was approved by the institutional ethics committee. Informed consent was obtained from the parents prior to inclusion of subjects into the study.

Sample size: A total of 144 patients fulfilled the eligible criteria for inclusion.

Inclusion criteria & Exclusion criteria: This study included children from 1 month till 12 years and who stayed in pediatric intensive care unit more than 6 hours. Patients with history suggestive of a previous chronic disease were excluded. A total of 144 patients fulfilled the eligible criteria for inclusion.

Methodology: This study was done at Narayana Hrudayalaya Multispecialty Hospital, Bangalore, India. It is a tertiary referral hospital with a 10-bed pediatric intensive care unit (PICU).

The initial vital signs and basic laboratory investigations were recorded.

Following parameters were recorded:

- Age ,sex and weight
- PRISM III score at admission
- Respiratory failure
- Heart failure
- Liver failure
- Acute kidney injury as per pRIFLE criteria
- CNS involvement
- Sepsis as per SIRS definition
- Multiorgan dysfunction syndrome
- Need for mechanical ventilation
- Use of >2 fluid boluses
- Need for ionotropes and central line
- Length of PICU stay
- Need for dialysis
- Blood tests: including arterial blood gas (pH, total CO2, PaO2 and PaCO2), serum levels of sugar, BUN and creatinine, platelet and white blood cell counts, prothrombin time and partial thromboplastin time
- Patient outcome: dead or alive

No patient was imposed by any excessive cost or hazard for mere study.

Statistics: Statistical Package for Social Sciences SPSSTM version 20and Microsoft Office Excel® 2007 was used for statistical analysis of recorded data. Categorical (qualitative) variables were sorted in Contingency Tables and compared by Chi-square test or Fisher's exact test. Quantitative variables were assessed by student t-test. Multivariate logistic regression analysis was performed including significant variables in bivariate analysis in order to control for confounding. Results were considered to be statistically significant if there was $P \leq 0.05$.

Results

During the study period 144 patients were admitted to the PICU, of whom 16 (11.1%) died. 43 (29.9%) children admitted to the ICU during the study period were one year or younger. Table 1 presents the factors that could contribute to death in children admitted to the ICU. Younger children reported higher death rate compared to older children (40% for children aged less than 12 months compared to 21.97% among those aged more than 12 months)however it was stastically insignificant (p value 0.149).

Univariate analysis (table3) showed that PRISM III score >10 at admission was found in 76% of the patients who died as compare to 50 % of the patients who survived and this difference was stastically significant (p Value 0.005).

56.3% patients of Acute respiratory distress syndrome at admission died in PICU whereas only 19.6 % patients had ARDS at admission survived and this difference was also stastically significant (p value0.003). Acute kidney injury as per pRIFLE criteria was found in 75% of the patients who died as compare to 39.8% of the patients who survived which is stastically significant with the p value of 0.014. Acute liver failure at admission was the presenting diagnosis in 75% of the patients who died whereas only 43.7% of the patients who survived had acute liver failure at admission (p Value 0.031). Multiorgan dysfunction syndrome was also found to be significant factors predicting mortality in PICU with the p value of 0.045. 31.2% of children who had central line died in the pediatric ICU whereas 35.1 % patients who hadn't had central line were alive this difference were stastically insignificant (p value 1.000). Similarly, 50% of children who needed mechanical ventilation died in PICU compared to only 21.9 % of those who survived needed mechanical ventilation. This difference was statistically insignificant (p value 0.547). Children who stayed in pediatric ICU for more than 4 days reported higher mortality rate opposed to those stayed for less than 4 days (82% versus 59.4%). However, this difference was statistically insignificant, p=0.241.

In multivariate logistic regression analysis (table 4), children with acute respiratory distress syndrome at admission were at 3 times higher risk of death (adjusted OR: 3.44, 95% CI: 0.992-11.952). Children with Acute kidney injury and acute liver failure were at 2 fold higher risk of death with the values of adjusted OR: 2.118, 95% CI: 0.508-8.839 and OR: 2.130, 95% CI: 0.561-8.077 subsequently. Patients with MODS were also at 2 fold higher risk of death (adjusted OR: 2.066, 95% CI: 0.292-14.640).Patients in whom dialysis was done were also had 1.9 times more risk as compare to those in whom it was not done (adjusted OR: 1.940, 95% CI: 0.353-10.652). Patients with PRISM III scores of >10 were at almost 6 folded higher risk of death in the PICU opposed to those with PRISM III score of <10 (adjusted OR: 6.47, 95% CI: 0.743-56.340).

Discussion

The overall mortality rate at our PICU (11.1%) which is almost equivalent to the other mortality rates reported at PICUs in USA and Europe (4.4-16.2%). Prediction of patient outcome is important for the patients and family and is relevant for policy formulation and resource allocation; the optimum usage of ICU beds will obviously allow maximum utilization of limited resources [7, 9]. Because of the shortage of available beds in PICUs [10] and the cost of critical care borne by the families, the selection of patients has always been a factor determining patient care. Factors such as availability of beds and cost frequently delay the hospitalization and transfer of patients [11].Together, these factors may increase the length of stay, cause the patient's condition to deteriorate, increase the risk of adverse events, and increase hospital costs and finally increase the mortality rate in PICU.

This study confirms many previous observations about deaths within a PICU, and adds some details of value. In this study, 75% of admitted patients underwent mechanical ventilation for 24 hours or more. Our study did not find mechanical ventilation as a significant predictor of mortality as described by others [12, 13, 14, and 15]. PRISM III scores have been studied extensively [2, 8, 16, 17, 18, 19, 20 and 21] and the results were similar to the present study as we have also found that PRISM III is a significant predictor for mortality in pediatric ICU.In addition to PRISM score we observed that the ARDS, acute kidney injury, acute liver failure, MODS and haemodialysis were also a found to be significant factors predicting mortality in PICU.

Patients undergoing cardiac surgery are admitted to a separate cardiothoracic intensive care unit for immediate postoperative care, and are only transferred to the PICU when they are stable this could be the reason that we had less number of heart failure unstable patients hence we could not comment on its significance .

Conclusion

The mortality in PICU is still very high and in addition to PRISM III score ARDS,Acute kidney injury, Acute liver failure, MODS and haemodialysis were also found to be significant but not independent predictors of mortality in PICU however we need to have further multicentre studies on predictors of mortality in PICU to strongly support our analysis.

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Table 1: Patients characteristics

S. N.	Variables	Number(n=144)	Percentage
1.	Age <1 year	43	29.9
2.	Male	96	66.7
3.	Weight <10kgs	47	32.6
4.	PRISM >10	88	61.1
5.	ARDS	34	23.6
6.	Need for Mechanical Ventilation	108	75
7.	Central line inserted	50	34.7
8.	Ionotropes used	115	79.9
9.	Heart failure	10	6.9
10.	Acute liver failure	68	47.2
11.	Acute Kidney injury	63	43.8
12.	Sepsis	110	76.4
13.	≥4 days of PICU stay	102	70.8
14.	MODS	8	5.6
15.	CNS involvement	128	88.9
16.	Dialysis done	10	6.9

PRISM=pediatrics risk of mortality score,

ARDS – Acute respiratory distress syndrome

MODS= Multiorgan dysfunction syndrome

Table 2: Comparison of baseline characteristics in two groups by Univariate Analysis

S.N	Baseline Variables	Non survivor (n=16)		Survivor (n=128)		P value
		Number	Percentage	Number	Percentage	
1	Age in years					
	≤ 1 years	2	40.0	41	21.9	0.149
	>1 years	14	60.0	87	78.1	
2	Gender					
	Male	12	70	84	64.1	0.579
	Female	4	30	44	35.9	
3	Weight					
	<10 kg	5	26.6	42	26.6	0.900
	>10 kg	11	73.4	86	73.4	

Table 3: Predictors of mortality in PICU by using Univariate analysis

S.N	Variables	Non survivor (n=16)		survivor (n=128)		P value
		Number	Percentage	Number	Percentage	
1	Length of Stay in PICU ≥4 days	9	82.0	93	59.4	0.241
2	PRISM III score >10	15	76.0	73	50.0	0.005**
3	Need for Ventilation	11	50.0	97	21.9	0.547
4	Sepsis	12	34.4	98	28.0	1.000
5	ARDS	9	56.2	25	19.5	0.003
6	Acute kidney injury	12	75	51	39.8	0.014
7	Heart failure	2	12	8	6	0.307
8	Liver failure	12	75	56	43.7	0.031

9	Central line inserted	5	31.2	45	35.1	1.000
10	MODS	3	18.75	5	3	0.045
11	Ionotropes used	16	100	99	77.3	0.042
12	>2 fluid boluses at admission	7	43.7	87	67.9	1.000
13	Dialysis	4	25	6	4	0.014

PRISM- Pediatric risk of mortality score,

ARDS – Acute respiratory distress syndrome

MODS- Multiorgan dysfunction syndrome

Table 4: independent predictor of mortality by using Logistic Regression analysis

S.N.	Risk factors	B	P value	Adj.OR	95%CI
1	ARDS	1.237	0.051	3.44	0.992-11.952
2	PRISM ≥10	1.867	0.091	6.471	0.743-56.340
3	Acute kidney injury	0.751	0.303	2.118	0.508-8.839
4	Acute liver failure	0.756	0.266	2.130	0.561-8.077
5	MODS	0.726	0.468	2.066	0.292-14.640
6	Dialysis done	0.663	0.446	1.940	0.353-10.652