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Original research article

Prediction of Outcome of the Children Admitted with Shock in Pediatric Intensive Care Unit

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Abstract

Background: and objectives: In an intensive care unit setting it is necessary to have a rational and objective way to define and quantify severity of illness**.** Shock is a major cause of mortality in paediatric age group. This study intends to predict mortality in children admitted with shock using PIM2 and PRISM III scoring systems.

Methods: This study was conducted in PICU of GMC, Bettiah. ll the children beyond neonatal period admitted with clinical features of shock were included in the study. Within the first hour of admission PIM 2 was assessed and at 24 hours PRISM III score was assessed. Patients were followed up and the outcome was measured in the form of survivors and non survivors.

Results: A total of 87 cases were studied, in which 70 were survivors and 17 were non survivors. There was no statistical significant difference among non survivors between different age groups (p=0.199). Majority of the survivors and non survivors were males but there was no statistical significant difference between the genders (p=0.437). The observed mortality was 19.55%. PIM 2 and PRISM III estimated mortality as 17.7 % (SMR 1.1) and 20.26% (SMR 0.96) respectively. Both PIM 2 ($x2$=4.34; p=0.32) and PRISM III ($x2$=4.79; p=0.24) had goodcalibration. PIM 2 showed better discrimination (AUC=0.912) than PRISM III (AUC=0.902) in ROC curve. PIM 2 and PRISM III scores revealed positive and significant correlation, withspearman's rank correlation (r= 0.216; p=0.045**).**

Conclusion: Shock has high mortality in children. PIM 2 and PRISM III have good calibration with good discrimination in predicting mortality. Overall both scores exhibited excellent capacity to discriminate between the survivors and non survivors and can be used as a tool with comparable performance for the prognostic evaluation in children admitted with shock. Because of its simplicity PIM 2, is a better tool for resource limited setting.

Keywords: Shock, Dengue, Pediatric Risk of Mortality (PRISM) III; Paediatric Index of Mortality (PIM) 2

Introduction

The practice of pediatric critical care is dynamic and gaining importance. Pediatric population forms a vulnerable group and requires standard care for all ill children. However standard care is not well defined for pediatric critical care, as most of the protocols and practices in pediatric intensive care units are extrapolation of adult critical care.[1] In the context of intensive care, a rational and objective way to define and quantify the severity of illness is through the development of probability models predicting mortality risks. Ever since the introduction of mortality scores in the ICU, they have been used more frequently and nowadays the scores are part of the methodology of quality control and research.[2] These models will help in understanding of the effectiveness of different medical interventions and also development of standards that may guide the health care providers in optimizing the use of available medical

resources.[1] Special consideration should be given to disease specific scores. The disease specific and condition specific clinical scores aid in the evaluation of severity of the illness, prognosis, pathophysiological understanding and therapeutic needs of the patients. Shock is a clinical state characterized by inadequate tissue perfusion and is one of the most dramatic, dynamic and life-threatening problems faced by the physician in the critical care setting. Shock is a major cause of mortality in pediatric patients. It accounts for more morbidity and mortality in children worldwide than any other diagnosis.[3] There are few scores used specifically to predict the outcome in shock. Glasgow Meningococcal Sepsis Prognostic Score [GMSPS], Leclerc scoring system, Gedde-Dahl's MOC score [4] is used in children with meningococcal septic shock and Septic shock score [5] is in use to predict outcome in adults with septic shock. PRISM III and PIM 2 are the accepted models to predict mortality in pediatric patients in general.[1, 2,6] There are few studies done to test these models specifically for shock in Children. [7, 8] Hence this study intends to test the efficacy of these probability models in predicting the mortality in children who are admitted with shock of all origins to PICU.

Objectives

To assess the risk factors contributing to increased mortality in children admitted withshock to PICU.

To assess usefulness and comparison of PRISM III and PIM2 scoring systems as anoutcome indicator in children with shock.

Material and Method

The Prospective study. All children who are admitted with clinical features of shock to ,Government medical college and Hospital Bettiah, Bihar. Study duration of Two Years. a total of 87 children admitted with clinical features ofshock were studied.

Inclusion criteria: All children more than 1 month of age admitted to PICU with clinical features of shock.

Exclusion criteria:

*Children with PICU stay of less than 2 hours (either got discharged or died).
*Post operative patients with shock.
*Shock due to scorpion sting.

Clinical examination was performed on all the children admitted to PICU with shock to select the study population according to inclusion criteria and exclusion criteria. Demographic details were collected and entered in the prestructured proforma. These children were re- examined to note the clinical features. Blood pressure was recorded by sphygmomanometer using appropriate cuff size for that age. Pupillary reaction was tested on both eyes using a torch. The child was connected to a pulse oximeter and saturation, heart rate was noted.Under aseptic precautions radial artery or brachial artery was punctured to draw arterial blood into a heparinised syringe for arterial blood gas analysis. During securing intravenous line under asepsis, simultaneously blood was drawn for laboratory analysis. Treatment of the child was given first priority and performance of the study never interfered in treating the child. Following that, relevant clinical details and laboratory investigations were entered in the prestructured proforma. PIM 2 scores were entered at the time of admission or within 1 hour of admission. PRISM III scoring was taken within 24 hours of admission. The patient was followed up for the outcome, whether survived or died.

Results

A total of 87 patients were enrolled in the study. Among the 87 patients analyzed, 70 were survivors and 17 were non survivors, with the overall observed mortality of 19.55%. distribution of gender among the survivors and non survivors. Majority of the survivors and non survivors were males (54% and 64% respectively) andthere was no statistical significant difference between the genders (p=0.437).

Table 1: DISTRIBUTION OF AGE AMONG SURVIVORS AND NON SURVIVORS

AGE	TOTAL		SURVIVED	NON	SURVIVORS
<1y	13	(14.9%)	5	8	(47.0%)
1-5y	18	(20.7%)	16	2	(11.8%)
6-12y	51	(58.6%)	44	7	(41.2%)
>12y	5	(5.7%)	5	0	(0.00%)
	87	(100%)	70	17	(100%)

distribution of age among the survivors and non survivors. Majority of the children belonged to the age group 6-12y (58.6%) and <1y , 1-5y and >12y constituted14.9%, 20.7% and 5.7% respectively. Majority on non survivors belonged to age group <1y (47%) and 6-12 y (41.2%).

Table 2: COMPARISON OF TOTAL PRISM III SCORE AMONG SURVIVORSAND NON SURVIVORS

OUTCOME	NO OF PATIENTS	Total PRISM III score (Mean ± SD)	P value
EXPIRED	17	18.35±6.03	
SURVIVED	70	7.77±3.99	**<0.001**

comparison of PRISM III values of the survivors and non survivors. There is highly significant difference between the scores of two groups with p value <0.001. Higher PRISM III scores are associated with higher mortality. characteristics of parameters of PRISM III between the survivors and non survivors. It was seen that lower blood pressure, increased heart rate, absence of pupil reflex, lower GCS, low blood glucose, higher serum potassium, lower HCO3, lowerpH, lower PaCO2,lower PaO2 and prolonged PT & PTT were statistically significant and affected the outcome.

PRISM III accurately estimated mortality, with no differencebetween observed and expected mortality (p=0.242). PRISM III has good calibration for various levels of probability of death. the performance of both the prognostic scores. PIM 2 ($x2$=4.34,p=0.32) and PRISM III ($x2$=, p=0.24) had good calibration. PIM 2 showed better discrimination with area under ROC of 0.912 (0.822to 1) compared to PRISM III 0.902 (0.758- 1). PIM 2 and PRISM III revealed positive and significant correlation, with spearman's rank correlation r= 0.216 (p=0.045).

Discussion

Mortality prediction scores remain the best indicators for analyzing the performance of ICU and evaluate the quality of care and also help in optimal use of available resources. Various scoring systems are used in PICU. PRISM III and PIM 2 are the widely accepted models across the globe.[1] Both these scoring systems are developed and validated in developed countries. PIM 2 was validated in Australia and New Zealand[2] where as PRISM IIIwas validated in United States of America.[6] There are very few studies about validation of these scores in developing countries.[9] The performance of the PRISM III and PIM 2 scoring systems have been compared a number of times by the authors who developed the scores themselves, but have rarely been compared independently. These scoring systems are rarely used specifically

for shock.[7] Our aim in this study was to evaluate the risk factors in shock and testing these scoring systems in predicting mortality in shock and comparing both. In the present study we observed that mortality in children with shock was 19.55%, as compared to an Indian study with mortality of 26.4%.[3] In contrary the mortality is around 5%in developed countries, which could be attributed to early referral and better resources in the management.[10] Demographic profile like age and sex did not show significant influence on the outcome with p=0.199 and p=0.437 respectively. This is comparable with other studies whichshowed similar outcome.[11] But infants with shock had more mortality with 61.2% compared to other groups, suggesting they form a vulnerable age group when admitted with shock. When the type of shock was compared Dengue shock syndrome constituted 74.7% of cases. Hypovolemic shock was 18.4%, where as septic shock and cardiogenic shock formed 3.4% cases each. As compared to Indian study where hypovolemic shock with dehydration constituted maximum number of cases.[3] This difference could be attributed to dengue epidemic in our region. Dengue shock syndrome was considered as a different entity because its pathogenesis is complicated and multifactorial.[12] There is 100% mortality in patients with septic shock as compared to Daljit Singh et al where it was 47%.[3] Mortality in cardiogenic shock and dengue shock syndrome was 66.7% and 15.4 % respectively. Mortality of dengue shock was comparable to an Indian study with 16.6%.[29] Where as in diabetes ketoacidosis and acute gastroenteritis all the patients recovered.

The various parameters of PIM 2 affecting the outcome in the present study were FiO2/PaO2 ratio, base excess, requirement of mechanical ventilation within first hour and no pupillary reaction to light and presence of high risk diagnosis, which is comparable to study done in Korea.[13] The various parameters of PRISM III affecting the outcome were systolic blood pressure, heart Rate, mental status, acidosis, potassium and blood glucose levels and altered coagulation profile were also similar to a Korean study. Hence the risk factors which affect the outcome of the children admitted with shock include low FiO2/PaO2 ratio, higher base excess, mechanical ventilation, tachycardia, lower blood pressure, absent pupillary light reflex, poor mental status, metabolic acidosis, hyperkalemia, hypoglycemia and altered coagulation profile. The outcome of shock also depends on how early intervention is started.[3] And also younger age group especially infants are at higher risk as seen in our study with 61.2% mortality in infants. The discriminatory power of both the scoring systems was evaluated using ROC, PIM2 showed AUC 0.912 and PRISM III showed AUC 0.902. Both the scoring systems performed excellently in discriminating probability of survival and death with PIM2 better than PRISM III. There was positive and significant correlation between PIM2 and PRISMIII with spearman's rank correlation (r=0.216; p 0.045 value). Similar to our observation, many studies have shown that both the scoring systems have good calibration and good discrimination with accurate prediction of mortality.[11, 13] Good discriminatory power were also seen in studies from India.[14] The present study had limitation of small sample size compared with the original validation studies. The small sample size is likely to interfere with accurate application of Hosmer Lemeshow test of goodness of fit. Other limitations of the study were presence of dengue epidemic affecting the outcome during the study period. The present study concludes that shock has high mortality in pediatric age group.Both PRISM III and PIM 2 are good in prediction of mortality in children admitted with shock. PIM 2 has better discrimination between survivors and non survivors than PRISM III. Collection of data was relatively easier with PIM 2 and with minimal investigations it makesa useful tool in resource limited setting.

Conclusion

*****Shock has a poor outcome in paediatric age group with mortality of 19.55%.
*Infants are at greater risk when admitted with shock.

*Dengue shock syndrome is a common cause of shock in our region.
*Various factors like low FiO2/PaO2 ratio, higher base excess, mechanical ventilation, tachycardia, lower blood pressure, absent pupillary light reflex, poor mental status, metabolic acidosis, hyperkalemia, hypoglycaemia and altered coagulation profile affect the outcome of children admitted with shock. PRISM III and PIM 2 scoring systems are well calibrated and discriminate probabilityof survival and death in children admitted with shock
*PIM 2 is easier to use and with minimal investigations it makes a useful tool in resource limited setting.

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