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Original Article

PRISM score as a predictor of mortality among pediatric intensive care units.

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Abstract

Background: The pediatric risk of mortality (PRISM) score predicts mortality in the pediatric intensive care unit (PICU). This study aimed to evaluate the application of PRISM score as a predictor of mortality in intensive care units of a tertiary hospital.

Methodology: A descriptive cross-sectional study of one year was conducted within the Department of Pediatrics at Ziauddin University and Hospital, located in Karachi, Pakistan. The total number of 263 admitted neonates and children up to the age of 12 years were included. Patients more than 12 years of age admitted in wards and plane for any surgery were excluded from the study; the PRISM score tool was used to collect the data of the neonates and children.

Results: The mean PRISM score was high among non-survivors (15.3 ± 7.2) as compared to survivors (12.7 ± 9.2) (p=0.023). The predictability of the PRISM score regarding pediatric mortality was shown by the area under the curve (AUC) i.e., 0.636.

Conclusion: The PRISM score found a significant difference between survival and death groups. Therefore the implication of the PRISM score can be needed in PICU to reduce the mortality rate.

Keywords

PRISM Score, Pediatric Intensive Care, Mortality.

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Introduction

Advance technologies in PICU (Pediatric Intensive Care Units) can be more sophisticated to improve the quality of patient care and augment life expectancy, prolong the death process and improve the quality of life. Thus, it is necessary to estimate the disease severity estimator tool by designing the mortality prognostic scoring system. The PRISM Score is an established tool used to estimate the risk of death in the pediatric intensive care unit (PICU)[1]. Around the world, pediatric critical care units are not uniform due to differences in the quality of resources and funding. Therefore the application of the PRISM score will not be uniform according to the variability in PICU settings[3]. Different PICU score systems were used in the different settings; the researchers noted the variability.

Khajeh et al. discussed two analysis programs from PICUs, with the help of the pediatric index of mortality (PIM) and the PRISM score, which was significant to evaluate the pediatric patients at higher risk of mortality[4,5]. Lacroix et al. mentioned that the PRISM can be used in infants, neonates, children, and adolescents with severe disease but cannot be used in premature infants and adults[6].

For better care for the pediatric population in PICU, new methods are needed to make these units capable enough to treat cases of extreme difficulty[7]. They would then allow for inter-unit and intra-unit assessments with time and offer valuable information for comparing the severity of disease[8]. The two frequently used mortality risk scoring systems in the literature included the PRISM and the PIM[9]. The standard model for predicting mortality for PICU was PRISM, which was developed based on the Physiologic Stability Index (PSI) model. It was calculated based on abnormal values within the first 24 hours and incorporated 14 physiological variables such as age and status of the operative patient. The score was used in the study of deaths to achieve results based on quality assurance and cost containment, and hence gave a good idea of the risk of death for children at the end of the first 24 hours of intensive care[10].

World Health Organization (WHO) estimated that 10 million children die every year, of which 99% occur in developing countries. Acute respiratory disease and malaria were the most common causes of death in under 5-year-old children in these countries. With good care in PICU, physicians may save the lives of one million children in developing countries such as Pakistan[11]. A study by Ahmad Usaid Qureshi reported that patients 55.4% were suffering from malnutrition and were under 5th centile for the weight for age, while 34.7% had low weight for height parameter. Out of the total participants, 28.7 % of patients expired. Using PIM2, mortality was calculated to be 20.5%, whereas PRISM score was noted for 19.5%[12]. The rationale of this study is to evaluate the association between the observed result (survival/ death) and mortality and survival rates by PRISM score in a tertiary PICU at the tertiary care hospital Dr. Ziauddin Hospital Karachi.

Methodology

This descriptive cross-sectional study was carried out at the Department of Pediatrics, Ziauddin University, and Hospitals from Nov 1, 2017-1st April 2018. After approval from the Ethical Review Committee (ERC) of Ziauddin University Hospital, Karachi, a total of 263 ICU admitted neonates and children age up to 12 years of both sexes were included in the study by taking informed consent of parents.

A detailed history was taken in a predesigned approved questionnaire regarding age, sex, "underlying disease, readmission (up to 48 hours after discharge), multiple organ dysfunction syndromes, (MODS, defined as involvement of two or more organs), type of admission (clinical or surgical), the occurrence of nosocomial infection during hospitalization, mechanical ventilation (MV), treatment with vasoactive drugs and parenteral nutrition therapy (PNT)". PRISM score calculated on 14 variables (namely systolic blood pressure, temperature, heart rate, PaO2/FiO2 ratio (partial pressure of arterial oxygen/ fraction of inspired oxygen ratio), PaCO2 (partial pressure of arterial carbon dioxide), pH, Glasgow coma scale (GCS), pupillary reaction, PT (Prothrombin time) ratio

(Test/ Control) or PTT, urea, creatinine, serum potassium, platelets, blood glucose, and white blood cells) were collected at 24 hours of PICU admission.

Mean, and standard deviation, frequency, and percentages were calculated for quantitative variables. The score was collected from 14 variables of PRISM and mortality. Effect modifier like age was controlled by stratification using a T-test. P-value <0.05 was taken as significant. All statistical calculations have been performed on SPSS version 20.

Results

A total number of 263 participants were enrolled in this study. The mean age of the patients was 32.0 ±29.3 (in months). The median length of the stay in PICU was 4 days (minimum 1 and maximum 15 days). There were 149(56.7%) males, and 114(43.3%) females enrolled in this study. The demographic variables comparison was made among survivors and dead patients in table 1. The females were more survive 81.6% than males, and the death ratio was more abundant among the male patients. At the same time, the Readmission (up to 48 hours after discharge) was 51.7% in survivors and 48.3% in dead patients collectively significant difference (p<0.0001) was noted. Multiple organ dysfunction syndromes were 47.4% among died but higher 52.6% in survivors respectively. Nosocomial infection during hospitalization was 37.8% and 62.2% in survivors. Inotropes support were used in 40.2% survival while 59.8% in dead patients significantly (p-value <0.0001). The vasoactive drugs were highly used in survivors compared to dead children. A similar pattern was among the children who used the mechanical ventilator; among them, 85.5% survived, and 14.5% died.

Table 1: Baseline characteristics of the survivors and non-survivors.

Variables		Survivors	Non-Survivors	p-value
		n(%)		
Gender	Male	109(73.2)	40(26.8)	0.072
	Female	93(81.6)	21(18.4)	
Readmission (up to 48 hours after discharge)	No	172(83.9)	33(16.1)	<0.0001*
	Yes	30(51.7)	28(48.3)	
Multiple organ dysfunction syndromes	No	182(80.9)	43(19.1)	<0.0001*
	Yes	20(52.6)	18(47.4)	
Type of admission (clinical or surgical)	No	164(87.7)	23(12.3)	<0.0001*
	Yes	38(50.0)	38(50.0)	
Nosocomial infection during hospitalization	No	156(82.5)	33(17.5)	0.001*
	Yes	46(62.2)	28(37.8)	
Inotropes Support	No	163(98.2)	3(1.8)	<0.0001*
	Yes	39(40.2)	58(59.8)	
Number of Vasoactive agents or drugs used	One drug	20(45.5)	24(54.5)	<0.0001
	Two drug	29(64.4)	16(35.6)	
	Three drug	6(75.0)	2(25.0)	
	None	147(88.6)	19(11.4)	
Use of mechanical ventilation	No	131(72.8)	49(27.2)	0.015*
	Yes	71(85.5)	12(14.5)	
Duration of PICU stay	≤ 3 days	75(72.1)	29(27.9)	0.295
	4-7 days	72(78.3)	20(21.7)	
	≥ 7 days	55(82.1)	12(17.9)	

Patients were noted in the following PRISM variables: temperature, Acidosis, serum potassium, and blood glucose. The systolic blood pressure score was noted non-significantly higher among dead as compared to survivors. But in some variables, the mean score between survivors and dead patients was the same such as the Glasgow coma scale, prothrombin time, and platelets. At the same time, potassium score was found significantly higher among the survivors.

The comparison of mean PRISM score variables among survivors and non-survivors is mentioned in table 2.

Table 2: The mean PRISM score comparison with mortality (n=263).

Variables	Survivors	Non-survivors	p-value
	Mean±SD		
High Systolic blood pressure	4.6±1.9	5.0±2.0	0.074
High Temperature	3.1±0.3	3.7±1.2	<0.000*
Increased Heart rates	3.2±0.6	2.9±0.7	0.544
Acidosis(pH)or Total CO_2	2.1±0.3	4.4±1.8	<0.000*
PaO_2/FiO_2 ratio	2.8±0.4	2.9±0.4	0.298
$PaCO_2$	1.6±0.9	1.5±0.8	0.298
pH	2.3±0.6	2.7±0.5	0.734
Glasgow coma scale (GCS)	2.5±0.9	2.5±0.7	0.578
Pupillary reflexes	2.4±1.1	3.1±0.9	0.328
PT (Prothrombin time) ratio (Test/ Control)or pTT	2.9±0.5	2.9±0.7	0.074
Urea	2.6±0.5	3.2±0.9	0.081
Creatinine	2.7±0.9	2.9±0.7	0.315
Serum potassium	2.4±0.7	2.1±0.2	<0.000*
Platelets	2.8±1.1	2.8±0.9	0.077
Blood glucose	2.4±0.7	2.2±0.5	0.004*
White blood cells	3.5±0.8	2.9±0.9	0.674

The PRISM score intensity is shown in figure 1, the mean PRISM score was 13.3 ± 8.8. The overall PRISM score intensity increased from 15 to more than 30, while the increase was noted from 53.5% to 65.5% in the dead patients. The PRISM score of more than 30 was recorded in 65.5% of dead patients and 34.4% of survivors. Whereas the score 0-10 was 64.8% in survivors and 35.1% in dead patients.

The mean PRISM score comparison between dead and survivors is measured in table 3. The mean PRISM score was high among 61 dead patients, i.e., 15.3 ± 7.2. A significant difference in the PRISM score was observed among survivors and non-survivors (p=0.023).

Table 3: Comparative mean PRISM score among survivors and non-survivors.

Variable	Total	Survivors	Non-survivors	p-value	95% CI
PRISM Score	13.3 ± 8.8	12.7 ± 9.2	15.3 ± 7.2	0.023	(-5.12-0.07)

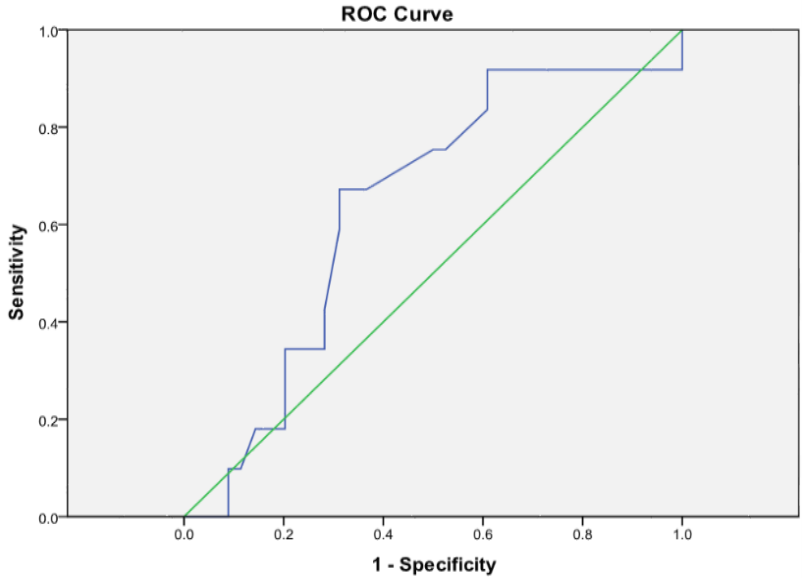

Figure 1: ROC for PRISM-III score.

The predictability of the PRISM score regarding pediatric mortality was shown by the area under the curve (AUC), i.e., 0.636 (63%), as shown in figure 1. The application of the prism score reflected the significant outcome of the study.

Discussion

A retrospective audit of pediatrics was carried out in the PICU of a tertiary care hospital for two years. Our study showed a mean age of 32.0 ± 29.3, which was lesser than the other study, and the majority were males compared to females. The age and gender of our study participants were also comparable to other studies conducted in PICUs of Malaysia and India[13,14]. A study conducted by Anwar and colleagues described the mortality to be 14%, which was lesser than our study 26.8% in males and 18.4% among females, respectively11. However, this proportion was higher comparable to the mortality rates reported by other PICU studies, ranging from 18 -35% respectively[15,16]. In another study, mortality was 6.9%, comparatively less than other studies in the region. But it is also lesser than our study and higher than many other studies from developed countries[17].The variations of mortality can be due to the intensive care setting difference and timely management. Improved outcomes were connected with timely identification of severely ill children in the wards before their physiologic deterioration and requirement for emergency resuscitation and ultimately admission in PICU[18].

The mean LOS (length of the stay) in PICU stay was 4 (1-15) days, most of the children were died within < 3 days, increased the stay the survival rate was gradually increased in our study, the non-significance showed that there is not any correlation of the LOS and mortality almost similar to our study, noted by Williams et al., exhibited that in the ICU, the duration of hospitalization was not taken as an independent risk factor for death[19].

In our study, most of the survived patients received mechanical ventilation support as compared to the dead patients. It showed that nursing care and ventilation support could reduce mortality. There is a contradiction to our study, Qureshi et al. noted 90% of the pediatric patients received mechanical ventilation whereas more than half, i.e., 50%, got vasoactive drugs[12]. According to another prospective studies from Pakistan, the mechanical ventilation rate was 27.8%, greater than the current study[20].

The mortality in pediatric and neonatal critical care units was predicted using PRISM III scores in India in the first 24 hours of admission in the PICU and NICU (neonatal intensive care unit). It was observed that with increasing PRISM III score, there was an increase in mortality. Similar findings were also observed in our study the mean PRISM score was significantly high, 15.3 ± 7.2 among dead patients and 12.7 ± 9.2 among survivals. It was then concluded that PRISM III scores could be effectively used as a reflector of the severity of illness[21]. With increasing PRISM III scores, an increase in the percentage of mortality was also observed, which is comparable to Indian, Asian, and other studies. The mortality of sepsis was reported as more than 50% in a Turkish PICU[22,23]. Yet, by confirming the PRISM score, El-Nawawy et al[24] identified certain physiological features that directly contributed to the risk of death with no adjustment for diagnosis. It is, thus, an important aspect to authenticate models before their application in a specified population[25,26].

The idea of over-estimation of mortality by PRISM was not found appropriate in specific pediatric populations. Since, in the present study, satisfactory discriminatory performance was obtained from PRISM in differentiating survivors from non-survivors, it supported the concept that PRISM scores, when high, are correlated with a greater risk of death, which was similar to certain other studies[27]. Martha et al. appraised the PRISM scores in 421 patients and, with proper calibration, found good discriminatory performances[28]. Brakel et al. showed that the PRISM score provides good discriminatory power for children suffering from meningococcal disease or with meningococcal septic shock[29].

Conclusion

The pediatric mortality rate is higher in underdeveloped countries compared to other developed countries of the world. Pediatric critical care and emergency medicine are at a promising stage in Pakistan, similar to the status in other developing countries. Certainly, there is a great need for trained pediatricians in this stage where injured or extremely ill children are presented in PICU to reduce the rates of deaths. The initiation has been done yet still; there is a long way to go. This field is full of challenges and opportunities simultaneously; however, its dynamism is also there. Dedication and motivation towards providing quality care to such critically and severely ill children is the most imperative part of pediatric critical care medicine. It is inspiring, but the journey of thousands of miles gets initiated with a single step. Accessibility and availability of such services to sick children, especially from developing countries like Pakistan, should enjoy this priority while designing health.

Conflicts of Interest

None.

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