How Much Does Thrombocytopenia Affect the Predictive Risk of Mortality Score (Prism Ⅲ) in Critically-ill Children?

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Abstract

Background: The main goal of the pediatric intensive care unit (PICU) is to reduce mortality. PRISM is one of the predictor models of mortality in patients admitted to the PICU. This study aimed to evaluate the effect of thrombocytopenia on the predicted death rate (PDR) in pediatrics admitted to the PICU, by the PRISM scoring system.

Methods: This cross-sectional study was performed on patients admitted to the PICU of Akbar Hospital, Mashhad, Iran, from March 2019 to March 2020. Based on the information collected during the first 4 h of patient admission to the PICU, the PRISM score was calculated by the PRISM online calculator. The percentage of PDR calculated for each patient indicated the possibility of patient mortality. Statistical analysis was carried out using SPSS software (Version 25, SPSS Inc., Chicago, IL, USA) at the significant level of $\alpha=0.05$.

Results: The results of data analysis showed that with the increase in the severity of thrombocytopenia, the mortality percentage increased and corresponded with the rate of PDR.

Conclusions: Based on these results, it can be concluded that the effect of thrombocytopenia on mortality corresponded with what was considered in the PRISM scoring system and thrombocytopenia does not increase the risk of mortality.

Key Words: Intensive Care Unit (ICU), Mortality, Pediatrics, Pediatric Risk of Mortality (PRISM), Pediatric scoring system, Predicted Death Rate (PDR).

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1- INTRODUCTION

The main goal of the Pediatric Intensive Care Unit (PICU) is to reduce mortality in critically-ill children. To achieve this goal, intensive monitoring and treatment of these patients at high risk of death should be performed (1). Increasing care needs have led to the use of new methods of evaluation to determine the care needs and severity of the disease. Various tools have been developed to predict the mortality rate of patients admitted to the hospital, as well as evaluate and classify the severity of diseases (2, 3).

There are various factors involved in patient mortality, including intensive care unit (ICU) functioning, demographic and clinical characteristics of the patients, as well as managerial and organizational factors. Since critical illnesses cause changes in physiological status and biochemical parameters, disease severity is predicted by changing the scores of scoring systems (4).

The Pediatric Risk of Mortality (PRISM (was first calculated based on the data collected in the PICUs, in the United States between 1980 and 1985. In PRISM, the physiological abnormalities that occur during the first 24 h of admission to the ICU are important. PRISM III was the result of data collection in the PICU in the United States during 1993-94 (5). PRISM III has modified versions that predict disease severity, quality of care, and risk of death based on 17 physiological variables (6).

Thrombocytopenia is one of the most common hematologic abnormalities in the PICU (7). This complication is usually associated with issues, such as sepsis, diffuse intravascular coagulation, high blood volume transfusion, and chemotherapy (8). The prevalence of thrombocytopenia has been reported to be 15% to 60% in patients admitted to the

PICU (9, 10). Several mechanisms cause thrombocytopenia; however, the main mechanisms include decreased platelet production and increased platelet degradation. Decreased production is observed in bone marrow failure syndromes (aplastic anemia, myelodysplastic syndromes, and drug-induced thrombocytopenia) and increased platelet degradation is also seen in conditions, such as diffuse intravascular coagulation and thrombotic micro angioplasty. A less common mechanism for causing thrombocytopenia is blood thinning. Blood thinning is observed in patients with extensive bleeding (receiving colloids, crystalloids, and platelet-poor blood products). In general, it is now recognized that in many types of thrombocytopenia, such as immunological thrombocytopenia and hepatitis C virus infection, several mechanisms may be involved in the development of thrombocytopenia (11-16). This study aimed to investigate the relationship between thrombocytopenia and mortality in children admitted to the PICU and compare it with death predicted by the PRISM scoring system and PDR.

2- MATERIALS AND METHODS

This cross-sectional study was performed on 300 patients admitted to the PICU of Akbar Hospital, Mashhad, Iran, from March 2019 to March 2020. All patients were under 18 years of age. The severity of thrombocytopenia was divided into four groups: 1) mild: platelet count 100,000 to 149,000 per microliter of blood. 2) Moderate: 50,000 to 99,000 per microliter of blood. 3) Severe: less than 50,000 per microliter of blood. 4) Very severe: less than 20,000 per microliter of blood.

The PRISM score was calculated for patients, which is a scoring system to determine the probability of mortality in children admitted to the PICU. This scoring system includes clinical

parameters, such as the patient's lowest blood pressure, lowest and highest temperature, highest heart rate, consciousness status, pupil status, laboratory parameters (e.g., pH, partial pressure of carbon dioxide, bicarbonate, partial pressure of arterial oxygen, blood glucose, potassium, creatinine, urea, white blood cells, prothrombin time, partial thromboplastin time, platelets count,(and clinical conditions (e.g., chronic or acute cancer; underlying diseases including endocrine, hematological, musculoskeletal, renal complications; type of patient admission including the operating room, transferring from the ward and the emergency room; and the presence of cardiopulmonary resuscitation 24 h before entering the PICU).

Based on the mentioned information that was calculated in the first 4 h of patient admission to the PICU, the PRISM score was calculated by the PRISM online calculator. The percentage of Predicted Death Rate (PDR) calculated for each patient indicated the possibility of patient mortality. Patients with various malignancies, those who were undergoing chemotherapy or radiotherapy in the last 30 days, and cases receiving high blood volume were excluded from the study.

In this study, patients were evaluated during hospitalization, and a checklist including demographic characteristics, thrombocytopenic severity, PRISM score, and PDR was completed for patients. After data collection and analysis, the incidence of thrombocytopenia in patients admitted to the PICU was calculated. The clinical manifestations of thrombocytopenia observed in patients were recorded, and the short-term outcomes of these patients (mortality or discharge) were evaluated. The data were extracted from the Hospital Information System. Statistical analyses were carried out using SPSS software (version 25, SPSS Inc., Chicago, IL, USA) at the significant level of $\alpha=0.05$.

3- RESULTS

This study was conducted on a total of 300 patients admitted to the PICU with a mean age of 45.08±49.02 months. The majority (n=156; 52%) of the patients were male. A total of 74 (24.7%) patients died, and 226 (75.3%) patients were discharged. The patients were classified into five groups: without thrombocytopenia, and with mild, moderate, severe, and very severe thrombocytopenia (**Table 1**).

Table-1: Severity of thrombocytopenia in different patients

Thrombocytopenic status	Frequency (%)
Without thrombocytopenia	237 (79.0)
Mild (Platelet count 100,000 to 149,000 per microliter of blood)	31 (10.3)
Moderate (50,000 to 99,000 per microliter of blood)	24 (8.0)
Severe (Less than 50,000 per microliter of blood)	7 (2.3)
Very severe (Less than 20,000 per microliter of blood)	1 (0.3)

Along with the increase in the severity of thrombocytopenia, the mortality rate had also increased. The mortality rate in patients without thrombocytopenia was 18.56% (**Table 2**).

Table-2: Comparison of the relationship between the severity of thrombocytopenia and the patient's condition at discharge

Thrombocytopenic status	Deceased; Frequency (%)	Improved Frequency (%)	P-Value*
Without thrombocytopenia	44 (18.56)	193 (81.43)	
Mild (Platelet count 100,000 to 149,000 per microliter of blood)	13 (41.93)	18 (58.07)	
Moderate (50,000 to 99,000 per microliter of blood)	11(45.83)	13 (54.17)	0.001>
Severe (Less than 50,000 per microliter of blood)	5 (71.42)	2 (28.58)	
Very severe (Less than 20,000 per microliter of blood)	1(100)	0 (0)	

 * Chi-square test was used to compare groups

The results show a significant negative correlation between the patient's primary platelet count (in the first four hours of hospitalization in the PICU) and PDR (P=0.002, r=0.177).

As shown in **Table 3**, with the increase in the severity of thrombocytopenia during hospitalization, the average PDR should also increase. There is also a significant relationship between the severity of thrombocytopenia and PDR (P≤ 0.005).

Table-3: Relationship between the severity of thrombocytopenia and PDR

Thrombocytopenic status	PDR Mean ± SD	P-Value
Without thrombocytopenia	19.48±33.44	
Mild (Platelet count 100,000 to 149,000 per microliter of blood)	37.17±40.23	
Moderate (50,000 to 99,000 per microliter of blood)	45.48±43.97	0.05>
Severe (Less than 50,000 per microliter of blood)	73.63±41.32	
Very severe (Less than 20,000 per microliter of blood)	100.00	
Total	24.92±37.09	

According to the results, the average PDR is significantly correlated with discharged and deceased patients (P≤0.05) (**Table 4**).

Table-4: Relationship between the average PDR and the patients' being discharged or deceased

Condition	PDR Mean ± SD	P-Value
Discharged	6.25±12.40	0.05>
Deceased	81.93±28.02	

4- DISCUSSION

Given the importance of improving critically-ill patients and preventing patient mortality in all countries of the world, the development of models that predict mortality plays an important role in the performance of ICUs. PRISM is one of the predictor models of mortality in patients admitted to the PICU (3). This study aimed to investigate the relationship between thrombocytopenia and mortality in children admitted to the PICU and to compare it with death predicted by the PRISM scoring system.

The data analysis in this study shows that along with the increase in the severity of thrombocytopenia, an increase in the average predicted mortality rate is also observed. Also, the results showed that there is a significant relationship between the average PDR and the death of patients. Based on these results, it can be concluded that the effect of thrombocytopenia on mortality corresponded with what was considered in the PRISM scoring system.

Rang et al. conducted a study in 2018 and 2019 and examined 62 pediatric patients admitted to the PICU with a diagnosis of septic shock. Among them, 43 (69.3%) patients had thrombocytopenia, of which 33 (76.7%) cases had severe thrombocytopenia. The 28-day hospital mortality rate was 41.62%. In all patients, platelet level was significantly associated with mortality. In addition, the PRISM scoring system was also associated with patient mortality. In our study, patients with lower platelet counts had a mortality rate consistent with the percentage predicted by the PRISM scoring system.

However, our study was not limited to sepsis cases (17).

In a study conducted in Nepal, 100 pediatric patients admitted to the PICU were evaluated for their thrombocytopenia status and its severity at the time of admission to the PICU. A total of 34 (34%) patients had varying degrees of thrombocytopenia, including mild (n=14; 14%), moderate (n=10; 10%), and severe (n=10; 10%). Overall, the severity of thrombocytopenia was significantly higher in those who died, and it increased the mortality rate by 18 times (18). In our study, mortality increased with the increasing severity of thrombocytopenia.

Scoring systems have been used to predict death, compare the performance of different PICUs, and evaluate how resources are allocated. Patient mortality is affected by many factors, such as the patient's clinical condition, demographic and clinical characteristics, hospital management, admission rate, and disease variability. These scoring systems should be independent of time and place, and it is possible to implement the model in any different environment (19). These systems can be used as a criterion for assessing the workload of ICUs and also comparing the quality and effectiveness of care and facilities (20, 21). A study was conducted in 2018 which showed that the PRISM score requires an observation period of 24 h, which represents a limitation of its use as an inclusion criterion in clinical trials. Therefore, the scoring system was limited. However, the PRISM III score showed good calibration (6). Based on these results, it can be concluded that the effect of thrombocytopenia on mortality

corresponded with what is considered in the PRISM scoring system

5- CONCLUSION

Based on these results, it can be concluded that the effect of thrombocytopenia on mortality corresponded with what is considered in the PRISM scoring system and thrombocytopenia does not increase the risk of mortality.

6- ETHICAL CONSIDERATIONS

The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (IR.MUMS.MEDICAL.REC.1398.476).

7- CONFLICT OF INTEREST

None.

8- ACKNOWLEDGMENT

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