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To study Pediatric sepsis and septic shock prognosis using the shock index

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Abstract
Introduction: Sepsis in children and young adults is primarily caused by infection with viruses, bacteria, parasites, fungi, or toxins. It is feasible to achieve successful management of sepsis and septic shock within the initial hours following a patient's admission to the pediatric intensive care unit.
Methods: A prospective clinical trial was conducted in the paediatric critical care unit of the Department of Paediatrics, Nootan Medical College and Research Center, Visnagar, Gujarat, India from February 2020 to January 2021. The trial was granted approval by the ethical review board of the hospital.
Results: A total of 40 pediatric patients diagnosed with sepsis/septic shock and admitted to the pediatric intensive care unit were subjected to analysis. Infants who had a distinct type of shock or were classified as having a higher level of severity were excluded from the study. The shock index of children was classified at 0, 1, 2, 4, and 6 hours following admission.
Conclusion: Initial evaluation we need more research into SI in ambulances to the emergency room, SI as a measure of treatment responsiveness, and the link of SI with organ dysfunction so that we may establish more sensitive and specific upper limits.

Keywords: Septic shock, pediatric sepsis, and prognostic measure

Introduction
Sepsis most commonly occurs in children and young adults due to infections caused by viruses, bacteria, parasites, fungi, or toxins. In the crucial initial hours following admission to the pediatric intensive care unit, it is feasible to treat sepsis and septic shock successfully [1]. Hypotension in children is defined as a systolic blood pressure reading below a certain threshold, as shown in the table below [2].
The average SBP for a healthy child is around 105/80, and these cutoffs are slightly higher than that. A comprehensive battery of diagnostic testing for shock symptoms should be conducted if the patient experiences a decrease in blood pressure of 10 mmHg from their baseline. To find these cutoffs, researchers have employed typically developing children who are not suffering from any serious illnesses [3, 4].
A child's blood pressure could be unusually low if they seem sick, when in fact it will be higher than normal due to trauma or stress. Septic shock hypotension is not due to intravascular volume loss but rather vasodilatation. It is expected that compensatory mechanisms such as tachycardia and vasoconstriction will not be effective in cases of hypotension in children experiencing shock. Symptoms of hypotension include a sudden drop in blood volume of 20–25%. Thus, hypotension seems to be a very late sign of clinical status and a frightening precursor to imminent cardiac arrest [5, 6].
In the 1960s, Allgower and Buri created the Shock index, which is determined by dividing the blood pressure by the heart rate. They have observed that the SI of a healthy adult should fall somewhere in the range of 0.5 to 0.7. The Shock Index-the ratio of heart rate to systolic blood pressure-may be a marker of mortality in pediatric sepsis and septic shock. Some pertinent studies are shown in [7, 8].
The clinical significance and ease of determination of SI as a predictor of mortality were demonstrated by Rousseaux, Jérémie, *et al*. There were variations in age-adjusted SI between survivors and non-survivors, and an abnormal SI at admission and 6 hours was a predictor of death. During the first six hours following intensive care unit admission, Yukri yasaka *et al*. looked at the correlation between changes in the shock index and outcomes, as well as shock index cutoff values for ICU mortality.

Fluid resuscitation and the use of vasoactive medicines were found to improve shock index, according to Carcillo *et al*., making it easier to evaluate the efficacy of treatment. A pediatric-specific shock index, as compared to an age-insensitive shock index, is better at identifying children with potentially fatal injuries, especially those affecting the abdomen, as per studies conducted by Shannor N. Acker *et al*. [9, 10].

A different study by Shannon N. Acker *et al*. found that SIPA is a better indicator of trauma severity than age-adjusted hypotension for determining whether to get emergency medical help. Finding out if the PICU shock index can foretell mortality in children with sepsis or septic shock is the main objective of this research. To define acceptable criteria for monitoring the patient's status, it is helpful to examine the link between shock index and outcome in the first 6 hours following ICU admission [11, 12].

Methods

A prospective clinical trial was conducted in the paediatric critical care unit of the Department of Paediatrics, Nootan Medical College and Research Center, Visnagar, Gujarat, India from February 2020 to January 2021. The trial was granted approval by the ethical review board of the hospital.

Inclusion Criteria

Definition of sepsis and septic shock for children admitted

Exclusion Criteria

Other forms of shock in children who attend for treatment.

Hospitalized kids who meet the inclusion criteria were analysed. In this case, we were able to secure written permission from the parents or guardians. Systolic and diastolic blood pressures were taken at 0, 1, 2, 4, and 6 hours post-treatment. Auscultation was used to count heart rates and a mercury sphygmomanometer with the appropriate cuff size was used to monitor blood pressure. The patients were split into two groups, one for each possible outcome.

Results: Forty children hospitalized with sepsis or septic shock and admitted to the pediatric intensive care unit were assessed for this research. Babies that did not fit the criteria for the study's defined shock type or who showed signs of a more severe kind of shock were not included. Upon arrival, the children were categorized at 0, 1, 2, 4, and 6 hours later using the shock index.

Table 1: Subject demographics and background info (n=40)

Sr. No.	Parameter with value	
1	Age in years (Mean ± SD)	5.1±2.5
2	Sex ratio (M/F)	2
3	**Severity on admission**	
	Sepsis (18)	45%
	Severe sepsis (12)	30%
	Septic shock (10)	25%

The study's population had an average age of, and the average male to female ratio was 1 to 1.

Table 2: Comparison of Mortality Rates by Age

Sr. No	Age in years	Outcome	Mortality
1	All age (40)	Survived (38)	05%
		Died (02)	
2	≤1 year (18)	Survived (17)	45%
		Died (1)	
3	>1 to ≤6 years (12)	Survived (11)	30%
		Died (1)	
4	>6 to ≤12 years (10)	Survived (10)	25%
		Died (0)	

The severity of infection was found to increase with age in our study population, with Sepsis > Severe Sepsis > SEPTIC SHOCK being the overall distribution across all age groups. However, the distribution of severity varied somewhat between and even within the different age groups. Data are depicted as a horizontal bar chart, with the length of the bar corresponding to the percentage of total participants falling into that category. It was specified under each heading that the respective groups' N values varied. Our research found that an increase in SI occurred in 1% of the survivors and 1% of the fatalities. 23 of those who made it through the ordeal with a reduced shock index, while 9 did not. Consequently, we can deduce that there is a 1.56-fold increased relative risk of mortality for every unit increase in SI between admission and 6 hours, and a correspondingly increased likelihood of surviving for every unit drop in SI between admission and 6 hours.

Discussions

This study presents the hourly threshold values of shock index for patients admitted to the PICU with a diagnosis of sepsis/septic shock, ranging from 0 to 6 hours after admission. According to the research conducted by Yuki Yasaka *et al*., shock index values falling within this range are regarded as representative. Based on a study conducted by Yuki Yasaka *et al*., it has been determined that the typical range for children under the age of one falls within the interval of 0.8 to 2.3. The findings of our study indicate that the threshold value is 2.16 at the 0 hour mark and 1.77 at the 6 hour mark. To clarify, if the specific incidence (SI) in the age group of 1 year at 0 hours is 2.16, it would yield a sensitivity of 57.14 percent and a specificity of 75 percent. Consequently, this would lead to a relative risk of mortality that is 2.01 times greater. In the age group of 1-year-olds, it has been observed that a SI value greater than 1.77 is linked to a relative risk of death that is 2.85 times higher (95% CI: 0.78, 10.37). This association is supported by a sensitivity of 71.43 and a specificity of 75 [11-13].

According to Yuki Yasaka *et al*., the average range for children aged 1 to 6 years old is between 0.7 and 1.22, based on the mean of two age groups. The findings of our study indicate that the threshold value was 1.43 at the 0-hour mark and 1.16 at the 6-hour mark. If the specific incidence (SI) in the 1 to 6 year old age group at 0 hours was 1.43, it would result in a sensitivity of 84.71 percent and a specificity of 60 percent. This indicates a relative risk of mortality that is 2.14 times higher. In the age group of 1 to 6 years, it has been observed that a SI value over 1.16 at the 6-hour mark is associated with an increased likelihood of mortality. This association is supported by an odds ratio (OR) of 87, a confidence interval (CI) ranging from 2.95 to 2534, a sensitivity of 100%, and a specificity of 80% [14-16].

Yuki Yasaka *et al*. reported that the typical range for children aged six and older is between 0.5 to 1.2, based on a mean-average of two age groups. However, our investigation revealed A threshold value of 2.03 was determined at the 0-hour mark, whereas a value of 1.56 was observed at the 6-hour mark. To clarify, a SI value greater than 2.03 at the 0 hour mark for children between the ages of 6 and 12 is linked to a 7-fold higher likelihood of mortality (CI = 0.67-72), with a sensitivity of 50% and a specificity of 98%. Likewise, when the SI exceeds 1.56 in individuals between the ages of 6 and 12, there is a 15-fold increase in the relative risk of mortality. This estimate is based on a sensitivity of 50%, specificity of 85.71%, and a confidence interval ranging from 2.25 to 99.7 [17, 18].

The age-stratified cut-off values for specific intelligence (SI) at 0 and 6 hours align with the upper limit of the standard normal range of SI as established by Yuki Yasaka's study for the 1-year-old and 1-to-6-year-old age groups, respectively. Nevertheless, our cutoff value for the older age group exceeded the top limit of the conventional normal range of SI by a significant margin. The much larger threshold value observed in our study among children aged 6 to 12 years old may be due to enhanced shock compensation in older children or a distinct distribution of severity and outcome [19-21].

The aforementioned study found that higher values of SI were linked to an increased risk of mortality in children with sepsis/septic shock. However, the researchers were unable to establish a definitive threshold for mortality in any age group. The Two-Way Repeated-Measures ANOVA was employed to examine the presence of a statistically significant association between the SI at various time points and age groups. However, no significant correlation was observed. Furthermore, as a result of the restricted sample size, it was not possible to establish statistical significance. Nevertheless, a notable association has been observed between an elevated mortality risk and elevated mean SI values in the deceased cohorts in comparison to the surviving cohorts, indicating that these disparities hold clinical significance [22-24].

Research conducted on adults has demonstrated that increased levels of SI generally have an adverse effect on prognosis. In a study conducted by Yuki Yasaka *et al*., it was determined that both a decrease in SI over a period of 6 hours and a sustained increase in SI did not serve as a predictor of mortality in the PICU. Conversely, in the case of children with a higher socioeconomic index (SI) at admission, a decrease in SI was found to be associated with improved outcomes in the age groups of 0-3 and 12+. The findings of our study indicated that there was a 1.56-fold higher likelihood of death associated with a 6-fold increase in the incidence of social isolation from the moment of admission (0-6 hours), with a 95% confidence interval ranging from 0.7 to 3.49 [18-20].

Conclusion

SI can serve as a potential indicator of the probability of mortality in children diagnosed with sepsis or septic shock. In order to monitor children who are at a heightened risk, we can employ the usage of SI, a straightforward, non-intrusive, cost-effective, and expeditious bedside clinical method. Children exhibiting an elevated SI may derive advantages from heightened resuscitative and critical care interventions, given that the likelihood of mortality escalates with elevated SI values and as the SI trend continues to expand. Further research is required to discover more precise and sensitive threshold values for pre-admission SI in the ambulance to ER, SI as an indicator of treatment response, and the correlation between SI and organ dysfunction.

Conflict of Interest

None

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Nil

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