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Research Article

Assessment of Sepsis Markers in Patients Admitted to the Pediatric Intensive Care Unit In Minia University Children Hospital

Gehan Lotfy Abdel Hakeem[1], Omima Mohamed Mohamed[2], Mina Sobhy Hanna, and Marwa Ibrahem Abdelrazic[1]

[1] Department of Pediatrics, Faculty of Medicine, Minia University, Egypt

[2] Department of Clinical pathology, Faculty of Medicine, Minia University, Egypt

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Abstract

Background: The most common cause of death in children worldwide is sepsis. According to the World Health Organization (WHO), it includes the top four causes of pediatric death: severe pneumonia, severe diarrhea, severe malaria, and severe measles. **Objectives:** to evaluate the predictive usefulness of sepsis indicators in septicemia patients hospitalized to Minia University Hospital's pediatric intensive care unit. **Patients and methods:** From October 2022 to June 2023, patients were chosen from the Pediatric Intensive Care Unit at Minia University's faculty of medicine. The inclusion criteria resulted in 75 patients being included in our study, who were then split into three groups (sepsis, septic shock, and multi-organ failure). **Results**: In comparison to other groups, sepsis indicators were significantly greater in the septic shock and multi-organ failure groups. **Conclusion:** In the field of pediatric critical care, sepsis indicators may have predictive significance for determining the severity and mortality of septicemia.

Keywords: Sepsis, children, critical, Prognostic value and severity.

Introduction

With an estimated 7.5 million fatalities per year due to sepsis, it is the top cause of death in children globally. [1]

The World Health Organization (WHO) lists severe pneumonia, severe diarrhea, severe malaria, and severe measles as the top four causes of childhood mortality. [2]

Worldwide, 49% of children who develop sepsis also have a coexisting disease that makes them more susceptible to infection. Infants have chronic lung illness or congenital heart disease, while children aged one through nine have underlying neuromuscular disease, and adolescents have pre-existing malignancy. These are the most prevalent comorbidities in children who acquire sepsis. [3]

Sepsis based on clinical data differs from sepsis based on research. Additionally, clinical practice may not be applicable to research trial findings. Despite this, a recent study called the Sepsis Prevalence, Outcomes, and Therapies (SPROUT) trial discovered that there is only a 42% concordance between physician diagnosis and the current diagnostic criteria utilized for research study inclusion. [4]

The sepsis diagnosis once established, pediatric patient clinical management should be improved through significant prospective multi-institutional trials. [5]

Neonatal sepsis must be distinguished from pediatric sepsis in the same way that pediatric sepsis must be distinguished from adult sepsis

due to the intricacy of age-based group disparities. Neonatal sepsis was not included in this study. [6]

Due to age-specific vital signs and the pediatric patient's exceptional physiologic reserve, which frequently hides the severity of their disease, it can be challenging to define sepsis in pediatric patients. [7]
Two or more systemic inflammatory response syndrome criteria, a confirmed or suspected invasive infection, cardiovascular failure, acute respiratory distress syndrome, or multiple organ dysfunctions are the criteria for pediatric severe sepsis. [8]

Despite receiving a lot of IV (intravenous) fluids, septic shock is the final stage of sepsis and is characterized by an abnormally low blood pressure. [9]

Rapid heartbeat, fever or hypothermia, chills or trembling, warmth, clammy or sweaty skin, and shaking are some early indicators of sepsis. Hyperventilation (rapid breathing), confusion or disorientation, and shortness of breath. [10]

Septic shock can have very significant side effects, including death, brain damage, heart failure, kidney failure, respiratory failure, and gangrene. [11]

The aim of this study is to identify the sepsis markers in PICU patients with different clinical diagnoses.

Patients and Methods

This prospective study involved 75 sepsis patients admitted to the Minia University Children's Hospital's pediatric intensive care unit between October 2022 and June 2023.

This study's diagnostic standards for septicemia were:

a. Any infection, whether suspected or confirmed, brought on by a pathogen, or any clinical symptom with a high likelihood of infection, linked to:
b. the presence of two or more of the clinical signs listed below, at least one of which must be an abnormality in temperature or white blood cell count.
c. A temperature of 38.5°C or lower.
d. Tachycardia or bradycardia with age-appropriate values.
e. Tachypnoea unrelated to neuromuscular illness or anesthesia (based on the age range).
f. Leukocyte count that is increased or inhibited in accordance with values for each age group.

According to the above criteria, our patients were divided into 3 groups:

1. Sepsis: 25 Cases.
2. Septic shock: 25 Cases.
3. Multi-organ failure:25 cases.

Inclusion criteria:
The study included all pediatric critical care unit admissions under the age of 12 who met the criteria for septicemia.
Exclusion criteria:
1. Neonates (age less than 28 days).

All patients were subjected to:

- Careful history-taking, taking into account factors including age, sex, primary illnesses, and drug use.
- A thorough clinical examination, which includes anthropometric measurements, body mass index, vital signs, chest, heart, and abdomen exams, as well as weight and height measurements.
- The patient's caretaker provided written informed permission for research approval.

Ethical approval:
The goal and design of the study were conveyed to each parent before they participated. By getting parents' informed consent prior to participant recruitment, which allowed participants the choice to withdraw from our research at any moment, we avoided using misleading techniques.
Additionally, this study was approved by the ethics committee of the Minia University faculty of medicine as well as the pediatric department council.
Approval number: 388:2022

- **Laboratory investigations:**

Routine laboratory investigations including:

- Complete Blood Count (CBC).
- C-reactive protein (CRP).
- Random Blood sugar.
- Renal Function Teste (urea & Creatinine).

- Liver Function Tests (ALT& AST).
- Prothrombin time and concentration (PT, PC).
- Blood culture.
- Electrolytes (sodium, potassium, calcium).

Statistical analysis

- SPSS version 22 (Statistical Software package version 22) was used to analyze the data. There was a descriptive analysis done. Mean, SD, and range were used to depict quantitative data. The Chi-square test for qualitative data between groups was used to compare frequency and percentage reports of qualitative data.
- Graphs were created using SPSS version 22 or Excel. If the P value was less than 0.05, it was deemed significant.
- Mann Whitney test for each pair of groups after the Kruskal Wallis test for non-parametric quantitative data between the three groups
- Post Hoc Bonferroni analysis comparing each pair of groups after the one-way ANOVA test for parametric quantitative data between the four groups.

Results

The age of the groups in the current study varied significantly, especially between Multiorgan failure and other groups. Children with multiorgan failure were the youngest in age (2.82–1.43), ranging from (1–1.6). There was no discernible age difference between the various groups. Table (1)

The Multiorgan failure group had significantly higher levels of ALT, AST, total, and direct bilirubin than the other groups. Table (2)

The Multiorgan failure group had considerably higher levels of urea and creatinine. The group with severe sepsis had a considerably higher mean serum Na level. The sepsis group's mean serum K level was substantially greater. Table (3)

Table (1): Sociodemographic data of studied groups

Variable	**Sepsis N=25 (100%)**	**Severe sepsis N=25 (100%)**	**Multiorgan Failure N=25 (100%)**	**Control N=25 (100%)**	**Significance**		
Age mean ±SD Range	6.92±3.01 (2-12)	6.73±2.61 (2.7-11)	2.82±1.43 (1- 6.1)	7.55±2.85 (2.5-11.5)	*P=0.001**		
					P1=0.80	*P2*=0.001	*P3*=0.38
					P4=0.001	P5=0.26	P6=0.001
Gender Male Female	 10 (40%) 15 (60%)	 12(48%) 13 (52%)	 14 (56%) 11 (44%)	 7(46.7%) 8(53.3%)	*P=0.73*		

P1: between sepsis and severe sepsis groups, P2: sepsis and Multiorgan failure, P3=Sepsis and control, P4: severe sepsis and Multiorgan failure, P5: severe sepsis and control, P6: Multiorgan failure and control

Table (2): Liver function tests among different studied groups

Variables	Sepsis N=25	Severe sepsis N=25	Multiorgan Failure N=25	Significance		
ALT	72.32±13.95	177.16±35.35	641.28±612.41	**P=0.001**		
				P1=0.29	**P2=0.001**	**P3=0.001**
AST	67.08±14.08	163.68±30.45	596.04±505.76	**P=0.001**		
				P1=0.25	**P2=0.001**	**P3=-0.001**
TB	1.19±0.16	1.93±0.23	3.19±0.32	**P=0.001**		
				P1=0.001	**P2=0.001**	**P3=0.001**
DB	0.46±0.09	0.97±0.16	1.22±0.19	**P=0.001**		
				P1=0.001	**P2=0.001**	**P3=0.001**

P1: Sepsis &severe sepsis, P2: Sepsis & Multiorgan failure, P3: severe sepsis, Multiorgan failure
ALT: Alanine Aminotransaminase, **AST**: Aspartate Aminotransferase, TB: Total Bilirubin, DB: Direct Bilirubin.

Table (3): Renal function tests and blood electrolytes among different studied groups

Variables	Sepsis N=25	Severe sepsis N=25	Multiorgan Failure N=25	Significance		
Urea	62.16±9.55	84.96±6.09	111.6±16.05	***P=0.001***		
				P1=0.001	***P2=0.001***	***P3=0.001***
Creatinine	0.99±0.26	1.66±0.15	2.22±1.39	***P=0.001***		
				P1=0.005	***P2=0.001***	***P3=-0.02***
Na	144.28±3.27	151.48±2.14	150.88±4.85	***P=0.001***		
				P1=0.001	***P2=0.001***	***P3=0.56***
K	4.02±0.32	3.27±0.23	2.88±0.25	***P=0.001***		
				P1=0.001	***P2=0.001***	***P3=0.001***
Ca	1.1±0.09	1.04±0.1	0.97± 0.09	***P=0.001***		
				P1=0.03	***P2=0.001***	***P3=0.011***

P1: Sepsis &severe sepsis, P2: Sepsis & Multiorgan failure, P3: severe sepsis, Multiorgan failure. Na: Sodium, K: Potassium, Ca: Calcium

Discussion

The current investigation aims to evaluate the sepsis markers in septic patients admitted to the pediatric intensive care unit at Minia University Children's Hospital from October 2022 to June 2023.

The youngsters in our study, whose ages spanned from 1 to 12, agreed with the findings of Kassem et al., 2019, *[12]*

Children in the multiorgan failure group were the youngest in age (2.821.43), ranging from (1-1.6), which was consistent with the findings of Xiao, 2019 *[13]*.

However, due to age issue, our results do not agree with Kamaleswaran et al.,2018 *[14]*.
Zidan et al.,2022, The percentage of males in the study group was (40%) and Vs (60%) were females, which was primarily due to the huge number of cases they screened and did not affect our study results. However, there was a non-significant relationship between gender and sepsis in our data.*[15]*.

In the Multiorgan failure group, liver function tests (ALT, AST, TB, and DB) were considerably higher. This outcome supports the findings of Zahmatkeshan et al., 2019 who found a

correlation between patient mortality and aberrant aminotransferases (ALT and AST), INR, total bilirubin, and direct bilirubin. [16]
Our findings concur with Shi, T., et al., 2020 who found that lower levels of albumin (ALB) and higher levels of the enzymes alanine aminotransferase (ALT) and aspartate transaminase (AST) were linked to a higher risk of mortality.[17].

Urine and creatinine levels on renal function tests were considerably higher in the multiorgan failure group. All non-survivor children had elevated renal functions, and Huang, L., et al.'s 2020 research demonstrated a statistically significant positive connection between elevated renal functions and risk of mortality[18].

As in Afroze, F., et al., 2021, who observed a substantial correlation between Na level and the risk of multi-organ failure, the mean of serum Na was significantly higher in our study's multi-organ failure group.[19].

Contrarily, Berhanu et al., 2023 discovered a connection between hyponatremia and risk of death. [20] This might be as a result of the widespread malnutrition and younger ages. [19]

Our results correspond with those of Sadeghi-Bojd et al., 2019, who found that the k level is normal or slightly raised in early sepsis. In our instances, the mean of serum K was considerably higher among the sepsis group. [21]

Our findings substantially concur with those of Velmurugan, 2021, who discovered that hypokalemia is common in multi-organ failure and has a favourable relationship with an increased risk of mortality. [22]

According to our study, hypocalcemia is positively correlated with the degree of sepsis, and this finding is consistent with Singh, 2019. [23]

Conclusion

There is a strong correlation between the level of sepsis indicators and the chance of dying. The severity of sepsis and the risk of sepsis-related mortality increase with the level of sepsis indicators. The presence of sepsis indica-tors has a significant predictive significance.

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