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CAUSES AND OUTCOMES OF PEDIATRIC SHOCK

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ABSTRACT

Background: Pediatric shock is a life-threatening condition caused by insufficient tissue perfusion, which can lead to organ malfunction and death if not treated immediately. It is still a major cause of childhood mortality, especially in low-resource settings where avoidable diseases like sepsis and severe gastroenteritis are prevalent. Early recognition is challenging, as children maintain blood pressure until late stages, making clinical assessment crucial. Local statistics on pediatric shock in Iraq are limited. **Objectives:** To evaluate the etiology, clinical characteristics, management, and outcomes of pediatric shock in a tertiary care hospital in Mosul, Iraq. **Methods:** A hospital-based observational study was conducted at Al-Khansaa Teaching Hospital from February 2025 to January 2026. A total of 200 children aged 1 month to 14 years diagnosed with shock based on clinical criteria were included. Data on demographics, clinical presentation, type and etiology of shock, laboratory findings, management strategies, and outcomes were collected and analyzed using SPSS version 30. **Results:** The mean age was 28.9 ± 24.3 months, with a male predominance (56.5%). Most patients were aged 12–59 months (43.5%), and 55.5% were from rural areas. Hypovolemic shock (44%) and septic shock (36%) were the most common types. Acute gastroenteritis (38.5%) and sepsis (32%) were the leading etiologies. Clinically, tachycardia (93%) and prolonged capillary refill time (84%) were the most frequent findings, while hypotension was present in only 29% of cases. Leukocytosis was observed in 54.5% of patients. All patients received intravenous fluids; antibiotics were administered to 74.5%, inotropes to 41.5%, and mechanical ventilation was required in 18.5%. The overall mortality rate was 14.5%, with the highest mortality observed in septic (25%) and cardiogenic shock (22.2%). **Conclusion:** Pediatric shock is primarily caused by avoidable conditions, particularly severe gastroenteritis and sepsis. Early clinical recognition and management are crucial for better outcomes. To reduce mortality, primary healthcare services must be strengthened, access to early treatment improved, and critical care resources enhanced.

KEYWORDS: Acute gastroenteritis, Hypovolemic shock, Iraq, Sepsis.

1-INTRODUCTION

Pediatric shock is a major medical emergency defined by inadequate tissue perfusion and decreased oxygen transport to important organs, which causes cellular malfunction and, if left untreated, it can progress to multi-organ failure and death.[1-2] It continues to be a major cause of morbidity and mortality in children around the world, especially in low- and middle-income countries where healthcare resources are generally inadequate and presentation delays are widespread.[3]

The pathophysiology of shock in children differs greatly from that in adults. Children have strong compensatory mechanisms, such as tachycardia and peripheral vasoconstriction, that assist keep blood pressure stable in the early stages of shock. As a result, hypotension is usually a late and serious indication in pediatric patients, signifying decompensated shock. This physiological characteristic makes early detection difficult, particularly in busy or under-resourced healthcare settings.[4-5]

Pediatric shock can be categorized into numerous categories based on its underlying cause, including hypovolemic, septic, cardiogenic, distributive, and obstructive shock.[4-6] The most common in developing countries are hypovolemic shock (often caused by severe dehydration from acute gastroenteritis) and septic shock.[3] Other, less common causes include bleeding, congenital or acquired heart disorders, and anaphylaxis. The prevalence of these causes varies by area, socioeconomic status, and access to healthcare.[6-8]

Clinically, pediatric shock presents with a spectrum of signs and symptoms, including tachycardia, prolonged capillary refill time, altered mental status, oliguria, cold extremities, and, in advanced stages, hypotension.[9] In resource-limited situations, clinical evaluation is critical because advanced monitoring and laboratory investigations such as serum lactate levels or invasive hemodynamic monitoring may not be easily available. Delays in diagnosis and treatment commencement are prevalent, contributing to poor results.[10]

Pediatric shock must be treated quickly and aggressively, which includes fluid resuscitation, the administration of inotropes or vasopressors, antimicrobial therapy in situations of suspected sepsis, and supportive care such as oxygen therapy or mechanical ventilation. However, in resource-limited situations, obstacles such as insufficient intensive care facilities, drug shortages, and a lack of skilled people may impede optimal management.[11]

Despite the clinical importance of pediatric shock, there is a lack of local data in Iraq, particularly in Mosul, on its etiology, clinical patterns, and prognosis. The majority of existing information comes from studies conducted in high-resource settings, which may not adequately reflect the realities of healthcare delivery in low-resource areas. As a result, the aim of this study is to analyze the etiology and clinical outcomes of pediatric shock in a tertiary care hospital in a resource-limited setting, with the goal of finding frequent etiologies, assessing treatment outcomes, and determining characteristics associated with poor prognosis.

2-PATIENTS AND METHODS

This is a hospital-based observational study, carried out in Al-Khansaa Teaching Hospital in Mosul, Iraq, from February 2025 to January 2026. The study population were children aged between 1 month and 14 years who are diagnosed with shock based on clinical criteria at the time of presentation or during hospitalization. Shock is defined clinically by the presence of signs of impaired tissue perfusion, including tachycardia, prolonged capillary refill time (greater than 2 seconds), altered level of consciousness, weak peripheral pulses, and reduced urine output, with or without hypotension. The study excluded neonates under one month of age, patients with incomplete medical records and children with terminal chronic illnesses where shock is part of end-stage disease.

The data collecting form included demographic information such as gender, age and residence. Clinical data were included the presenting symptoms, vital signs at admission, capillary refill time, level of consciousness, and urine output. The type of shock was classified clinically into hypovolemic, septic, cardiogenic, distributive, or obstructive based on history and examination findings. Information regarding the underlying cause of shock was recorded, including conditions such as acute gastroenteritis leading to dehydration, systemic infections causing septic shock, trauma or hemorrhage, and cardiac disorders. Laboratory investigations, where available, was documented, including complete blood count, serum electrolytes, blood cultures, and other relevant tests. Details of management was collected, including the type and volume of fluid resuscitation administered, use of inotropes or vasopressors, administration of antibiotics, and need for respiratory support such as oxygen therapy or mechanical ventilation. Outcome measures was included the clinical recovery, development of complications, need for intensive care unit admission, length of hospital stay, and mortality. Recovery was defined as stabilization of vital signs and resolution of shock with discharge from the hospital, while poor outcomes was included death or the development of severe complications such as multi-organ dysfunction.

The statistical analysis was carried out using SPSS software (Statistical Packages for Social Sciences, version 30). Continuous variables were expressed as mean and standard deviation, while categorical variables will be presented as frequencies and percentages.

3- RESULTS

The study includes a total of 200 children. The mean age was 28.9 ± 24.3 months. Moreover, 113 (56.5%) were males and 87 (43.5%) were females. With male to female ratio of 1.3:1. As shown in figure 1.

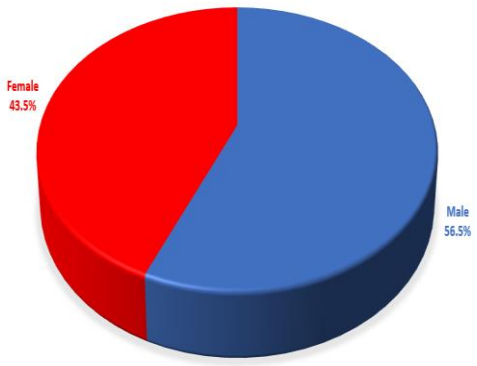

Figure 1: Distribution of the study patients according to their gender.

Table 1 shows age distribution of the study patients. The majority of patients were aged 12-59 months (43.5%), followed by those how aged less than 12 (31.5%) and more than 60 months (25%).

Table 1: Patients age category (number = 200).

Age category	Number	Percent
Less than 12 months	63	31.5%
12-59 months	87	43.5%
More than 60 months	50	25%

Rural residence was reported among 111 (55.5%) children, while urban residence was reported among 89 (44.5%) Children. As shown in figure 2.

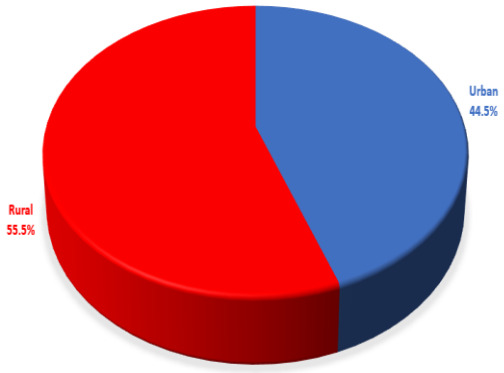

Figure 2: Distribution of the study patients according to their residency.

Table 2 shows distribution of the study patients according to the type of shock. Hypovolemic shock was prevalent among 88 (44%) patients, followed by septic shock among 72 (36%) patients, cardiogenic shock among 18 (9%) patients, distributive shock among 6 (12%) and obstructive shock among 10 (5%) patients.

Table 2: Distribution of patients according to the type of shock (number =200).

Type of shock	Number	Percent
Hypovolemic	88	44%
Septic	72	36%
Cardiogenic	18	9%
Distributive	12	6%
Obstructive	10	5%

Table 3 shows patients' etiology of shock. Acute gastroenteritis was the commonest cause of shock (38.5%), followed by sepsis (32%), pneumonia (11.5%), cardiac causes (5.5%).

Table 3: Etiology of shock (number =200).

Etiology of shock	Number	Percent
Acute gastroenteritis	77	38.5%
Sepsis	64	32%
Pneumonia	23	11.5%
Cardiac causes	11	5.5%
Other	11	5.5%

Table 4 shows patients' clinical findings. Tachycardia was prevalent among 186 (93%) patients, prolonged capillary refill time among 168 (84%) patients, altered consciousness among 92 (46%) patients, oliguria among 76 (38%) patients and hypotension among 58 (29%) patients.

Table 4: Patients' clinical findings (number =200).

Clinical findings	Number	Percent
Tachycardia	186	93%
Prolonged capillary refill time	168	84%
Altered consciousness	92	46%
Hypotension	58	29%
Oliguria	76	38%

Table 5 shows laboratory findings of the study patients. Leukocytosis was prevalent among 109 (54.5%). To less extend electrolyte disturbances was prevalent among 29 out of 63 patients and positive culture among 28 out of 91 patients.

Table 5: Patients' laboratory findings (number =200).

Clinical findings	Number	Percent
Leukocytosis	109/ 200	54.5%
Electrolyte disturbances	29/63	46.03%
Positive culture	28/ 91	30.76%

Table 6 shows details of the patients' management plan. Intravenous fluid was given to all patients, antibiotics for 149 (74.5%) patients, inotropes for 83 (41.5%) patients, oxygen for 118 (59%) patients and mechanical ventilation for 37 (18.5) patients.

Table 6: Patients' management plan (number =200).

Management option	Number	Percent
Intravenous fluid	200	100%
Antibiotics	149	74.5%
Inotropes	83	41.5%
Oxygen therapy	118	59%
Mechanical ventilation	37	18.5%

Table 7 shows mortality details of the study patients. Among 29 (14.5%) death. Sepsis was the commonest cause of death (25%), followed by cardiogenic shock (22.2%), distributive shock (16.7%), obstructive shock (10%) and hypovolemic shock (4.5%).

Table 7: Mortality details of the study patients (number =200).

Type of shock	Number	Percent
Hypovolemic	4/88	4.5%
Septic	18/72	25%
Cardiogenic	4/18	22.2%
Distributive	2/12	16.7%
Obstructive	1/10	10%

4. DISCUSSION

The current study provides a complete assessment of the epidemiological, clinical, and outcome aspects of pediatric shock in a resource-limited setting, highlighting key patterns that are consistent with yet distinct from worldwide data.

This cohort of 200 children, with a mean age of 28.9 ± 24.3 months and a predominance of children aged 12-59 months (43.5%), aligns with previous reports indicating that early childhood is the most vulnerable period for shock due to immature immune responses and higher susceptibility to infectious diseases. Recent pediatric critical care studies have found similar age distributions, with children under the age of five accounting for the vast majority of shock cases, particularly in low- and middle-income countries.[12-13] The observed male predominance (56.5%) is consistent with previous findings, and could represent biological predisposition or sociocultural healthcare-seeking practices.[14]

The higher proportion of rural residents (55.5%) highlights differences in healthcare access and delayed presentation, both of which have been linked to increased morbidity in pediatric emergencies in low- and middle-income countries.[15] Limited access to early medical care, poor sanitation, and nutritional inadequacies in rural areas are likely to lead to a higher burden of severe presentations such as shock.

Hypovolemic shock was the most common (44%), followed by septic shock (36%). This distribution represents the epidemiological profile of developing countries, where dehydration due to severe gastroenteritis is still the predominant cause of pediatric shock. Comparable studies from similar contexts suggest that hypovolemic shock accounts for 40-60% of occurrences.[16-17] In contrast, study from high-income country show a higher prevalence of septic shock, indicating variations in disease load and healthcare systems.[18] The high frequency of septic shock in this study is still clinically significant, highlighting the persistent burden of severe infections.

This finding is consistent with global pediatric data, which show that diarrheal illnesses and systemic infections are significant contributors to pediatric mortality, particularly in resource-limited settings.[19] The contribution of pneumonia (11.5%) emphasizes the significance of lower respiratory tract infections in inducing shock, which is commonly caused by hypoxia and a systemic inflammatory response.[20]

Clinically, tachycardia (93%) and prolonged capillary refill time (84%) were the most common findings, highlighting their significance as early and sensitive markers of pediatric shock. These findings are consistent with worldwide pediatric advanced life support (PALS) recommendations, which emphasize hypotension as a late and often dangerous indication in children.[21] The study's very low prevalence of hypotension (29%) supports this approach and emphasizes the importance of early detection based on mild clinical symptoms. Altered consciousness (46%) and oliguria (38%) indicate a trend to decompensated shock and organ failure.

Laboratory results revealed leukocytosis in 54.5% of patients, confirming the high prevalence of infectious etiologies. The comparatively low rate of positive cultures (30.76%) is consistent with earlier study, which found that culture negative is widespread due to previous antibiotic usage or insufficient microbiological resources.[22] Electrolyte abnormalities (46.03%) suggest dehydration and metabolic derangements, particularly in gastroenteritis, and are known predictors of poor outcomes if not treated promptly.[23]

Management strategies followed typical pediatric shock procedures, with all patients receiving IV fluids and a large proportion receiving antibiotics (74.5%) and inotropes (41.5%). The utilization of oxygen therapy (59%) and mechanical ventilation (18.5%) indicate the severity of sickness in a significant number of patients. These findings are consistent with recent multicenter studies, which show similar intervention rates in pediatric intensive care units.[24] However, the relatively large need for inotropes indicates that a significant proportion of patients presented in severe stages of shock.

The overall mortality rate of 14.5% is within the documented range for pediatric shock in LMICs, but is still greater than those in developed countries (usually <5%).[25] Notably, septic shock was linked to the highest mortality (25%), followed by cardiogenic shock (22.2%). This is consistent with previous evidence, which shows that septic and cardiogenic shock have worse outcomes due to complex pathophysiology and management problems.[26] The comparatively low fatality rate in hypovolemic shock (4.5%) demonstrates its reversibility with prompt fluid resuscitation, stressing the significance of early management.

This study has a few limitations that should be noted. First, the single-center design limits the findings' generalizability to other contexts, particularly locations with disparate healthcare infrastructures or epidemiological profiles. Second, due to the study's cross-sectional observational design, causal links between clinical variables and outcomes cannot be established. Third, several laboratory investigations, such as blood cultures, were not conducted on all patients, thereby leading to underestimate of infectious etiologies and decreased diagnostic accuracy. Fourth, the potential impact of pre-hospital care (for example, prior fluid therapy or antibiotic administration) was not considered, which could have altered both clinical presentation and laboratory results. Furthermore, precise severity grading systems (such as PRISM or PELOD) were not used, which restricted risk categorization and prognosis

comparisons. Finally, long-term outcomes and post-discharge follow-up were not considered, limiting the evaluation to in-hospital mortality only.

5- CONCLUSION

To summarize, pediatric shock in this group is primarily caused by preventable and treatable diseases, mainly acute gastroenteritis and sepsis, with hypovolemic and septic shock being the most common types. Early clinical symptoms such as tachycardia and delayed capillary refill time were common, emphasizing their importance in early detection, although hypotension remained a late and uncommon finding. Despite following standard management protocols, the observed fatality rate (14.5%), particularly among septic and cardiogenic shock patients, underlines the continued problems of rapid diagnosis and optimal management in resource-constrained settings.

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Conflict of intertest

About this study, the authors disclose no conflicts of interest.

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