e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(11); 914-920

Original Research Article

# A Prospective Hospital-Based Assessment of the Predictors of Outcome in Pediatric Septic Shock

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**Received: 05-09-2022 / Revised: 06-10-2022 / Accepted: 20-10-2022**

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**Conflict of interest: Nil**

**Abstract**

**Aim:** The aim of the present study was to analyze predictors of poor outcome in septic shock.

**Methods:** The present study was conducted in the S.K. Medical College and Hospital, Muzaffarpur, Bihar, India for the period of 6 months. During the study period of 6 months, total 120 cases were admitted. There were 100 cases of shock of different etiologies and of these 57 cases of septic shock were enrolled in the study.

Among the enrolled patients 3 did not give consent to participate in the study, 4 patients left against medical advice and 10 patients expired during the course of the illness. 40 of 50 (40/50 = 80%) cases enrolled in the study were discharged after recovery while 10 (10/50 = 20%) expired.

**Results:** On analysis of clinical symptoms as predictors of outcome, fever was the most common symptom present in all the patients. On analysis of the vital parameters, a delayed capillary refill time (>3 seconds) was a statistically significant (p=0.008) predictor of poor outcome with all the 9 patients having failed to survive, having a prolonged CRT on admission. Amongst the laboratory predictors, a low mean pH on admission had a statistically significant (p=0.008) association with a poor outcome.

**Conclusion:** A delayed capillary refill time on admission and a low mean pH were statistically significant predictors of mortality in septic shock, in this study.

**Keywords:** Septic shock, Mortality, Capillary refill time, Low



## Introduction

Pediatric sepsis remains as a major cause of mortality and morbidity worldwide. It includes a clinical spectrum of severity - Systemic Inflammatory Response Syndrome (SIRS), sepsis, severe sepsis, septic shock and multi-organ failure. It is important to identify the determinants that predict the progression and mortality in SIRS, so as to deal with such patients in a timely manner. There are very few Indian studies conducted on such determinants. [1] The earlier studies from India and abroad have given a few determinants of outcome/mortality. [2-5]

Sepsis is one of the most common causes of morbidity and mortality in infants and children worldwide particularly in developing countries. [6] The global data on sepsis in children are incomplete but it

is estimated that infection accounts for more than 60% mortality under five children. According to World Health Organization (WHO) four big causes of death in children worldwide are severe Pneumonia (1.9 million deaths/year), severe diarrhea (1.6 million/year), severe malaria (1.1 million/year), severe measles (5,50,000 deaths/year). World Health Organization (WHO) used the term severe when children develop acidosis or hypotension or both. [7] Sepsis causes a release of inflammatory mediators, maldistribution of intravascular volume and depression of myocardial function resulting into septic shock. Septic shock is a clinical picture arising out of tissue hypoperfusion following microbial infection.

The worldwide burden of pediatric septic shock is huge. Estimates of the incidence of sepsis suggest that there are more than 42,000 cases annually in the United States and millions worldwide and 5-30% of total sepsis patients develop septic shock. The mortality rate in septic shock patients may be as high as 50%. The outcome in septic shock is worse when associated with co-morbidities and multiple organ dysfunctions. [8] Patients presenting with sepsis or septic shock progress rapidly to serious states, and if left untreated, may rapidly progress to death. Even with treatment the mortality in septic shock may be as high as 50%. It is estimated that sepsis and septic shock is the 4th leading cause of hospital admission. [9]

The global data on sepsis estimates that infection accounts for more than 80% mortality in under-five children. Septic shock is a dreaded and potentially fatal complication of sepsis. Septic shock has been found to be the most common type of shock occurring in Pediatric Intensive Care Unit with an incidence of around 35%. In India, overall mortality rate in patients with pediatric septic shock is around 47% which is comparable to global figure of around 50%. [4]

The aim of the present study was to analyze the predictors of poor outcome in septic shock.

## Methods

The present study was conducted in the S.K. Medical College and Hospital, Muzaffarpur, Bihar, India for the period of 6 months. During the study period of 6 months, total 120 cases were admitted. There were 100 cases of shock of different etiologies and of these 57 cases of septic shock were enrolled in the study.

Among the enrolled patients 3 did not give consent to participate in the study, 4 patients left against medical advice and 10 patients expired during the course of the illness. 40 of 50 (40/50 = 80%) cases enrolled in the study were discharged after recovery while 10 (10/50 = 20%) expired.

All children aged 1 month – 6 years, admitted with or having developed septic shock during the course of hospital stay were included.

Patients of malignancy, on immuno suppressive or chemotherapy drugs, who left the treatment in between or whose parents did not consent, were excluded.

### Diagnostic criteria

- Septic Shock: Sepsis plus cardiovascular organ dysfunction as described below.[10]
- Despite >40ml/kg of isotonic intravenous fluid in one hour:
- Hypotension of blood pressure less than fifth percentile for age or systolic blood pressure less than two SD below normal for age, or
- Need for vasoactive drug to maintain blood pressure, or
- Any two of the following:
- Unexplained metabolic acidosis: base deficit > 5mEq/L.
- Increased arterial lactate > two times upper limit of normal.
- Oliguria: urine output < 0.5mL/kg/hour.

- Prolonged capillary refill time: > five seconds.
- Core to peripheral temperature gap > 3° C (5.4° F).

Systemic Inflammatory Response Syndrome (SIRS):

Two of four criteria, one of which must be abnormal temperature or abnormal leukocyte count [10]

1. Core temperature > 38.5oC (101.3oF) or < 36oC

(96.8oF) (rectal, bladder, oral or central catheter)

2. Tachycardia:

- Mean Heart Rate > two SD above the normal for age in absence of external stimuli, chronic drugs or painful stimuli, or
- Unexplained persistent elevation of heart rate over 0.5 - 4hr, or
- In children less than one-year old, persistent bradycardia over 0.5hr (mean heart rate less than tenth percentile for age in absence of vagal stimuli, beta blockers, congenital heart diseases).

3. Respiratory Rate more than two SD above normal for age or acute need for mechanical ventilation not related to neuromuscular disease or general anesthesia.

4. Leukocyte count elevated or depressed for age (not secondary to chemotherapy) or more than 10% immature neutrophils.

Sepsis: SIRS in the presence of or as a result of suspected or proven infection [4]. Refractory Septic Shock: Septic shock which lasts for more than one hour and does not respond to fluid or pressor administration. [10]

Multi Organ Dysfunction Syndrome (MODS):

MODS is defined as a clinical syndrome characterized by the development of progressive and potentially reversible physiologic dysfunction in two or more organs or organ systems that is induced by a variety of acute insults, including sepsis and homeostasis cannot be maintained without intervention.[10] Outcome was defined on the basis of survival. The patients who completely recovered from septic shock and got discharged uneventfully, were categorised as survivors while those who expired during the treatment were categorised as non-survivors. A written informed consent was obtained in a language well understood by the parents/guardians. A detailed history, general physical examination and systemic examination findings at the time of diagnosis of septic shock, were recorded on a standardized proforma.

## Results

**Table 1: Clinical symptoms as a predictor of outcome**

| Characteristic | Expiry (n=10) | Discharge (n=40) | P Value |
|---|---|---|---|
| Fever | 10 (100%) | 40 (100%) | - |
| Altered mental status | 3 (30%) | 16 (40%) | 0.720 |
| Breathlessness | 8 (80%) | 24 (60%) | 0.140 |
| Abdominal pain | 3 (30%) | 17 (42.5%) | 0.710 |
| Decreased urine output | 1 (10%) | 8 (20%) | 0.650 |
| Bleeding | 1 (10%) | 3 (7.5%) | 1.000 |

On analysis of clinical symptoms as predictors of outcome, fever was the most common symptom present in all the patients.

**Table 2: Vital parameters as a predictor of outcome**

| Characteristic | Expiry (n=10) | Discharge (n=40) | P Value |
|---|---|---|---|
| **Heart rate** | | | |
| Below normal | 0 | 0 | 0.550 |
| Normal | 0 | 4 (10) | |
| Above normal | 10 (100) | 36 (90) | |
| **Blood pressure** | | | |
| Below normal | 10 | 38 (95) | 1.000 |
| Normal | 0 | 2 (5) | |
| Above normal | 0 | | |
| **Respiratory Rate** | | | |
| Below normal | 0 | 0 | 1.000 |
| Normal | 0 | 2 (5) | |
| Above normal | 10 (100) | 38 (95) | |
| **Temperature** | | | |
| Below normal | 0 | 0 | 1.000 |
| Normal | 2 (20) | 10 (25) | |
| Above normal | 8 (80) | 30 (75) | |
| **Capillary refill time** | | | |
| Normal | 0 | 18 (45) | .008 |
| Delayed CRT | 10 (100) | 22 (55) | |

On analysis of the vital parameters, a delayed capillary refill time (>3 seconds) was a statistically significant (p=0.008) predictor of poor outcome with all the 9 patients having failed to survive, having a prolonged CRT on admission.

**Table 3: Arterial Blood gas parameters as a predictor of outcome**

| Characteristic | Expiry (n=10) | Discharge (n=40) | P Value |
|---|---|---|---|
| Mean pH+SD | 7.20+0.09 | 7.29+0.08 | p=0.008 |
| Mean pO2+SD | 88.62+22.83 | 124.78+67.37 | p=0.122 |
| Mean pCO2+SD | 42.06+9.26 | 35.26+11.23 | p=0.100 |
| Mean HCO3+SD | 16.88+3.50 | 19.06+4.61 | p=0.191 |

Amongst the laboratory predictors, a low mean pH on admission had a statistically significant (p=0.008) association with a poor outcome.

**Table 4: Laboratory markers of sepsis as a predictor of outcome**

| Characteristic | Expiry (n=10) | Discharge (n=40) | P Value |
|---|---|---|---|
| Mean TLC+SD (‘000) | 15.28+7.31 | 14.67+8.11 | p=0.838 |
| Mean Polymorphs+SD | 71.0+21.22 | 72.79+17.77 | p=0.795 |
| Mean RBS+SD | 122+48.16 | 114.95+43.51 | p=0.670 |
| Mean CRP+SD | 3.76+2.58 | 5.56+6.93 | p=0.449 |
| Mean ESR+SD | 23.44+12.60 | 25.74+13.53 | p=0.646 |

**Table 5: Microbiological positivity as a predictor of outcome**

| Characteristic | Expiry (n=10) | Discharge (n=40) | P Value |
|---|---|---|---|
| Positive blood culture | 0 | 1 (2.5%) | - |
| Positive urine culture | 2 (20%) | 4 (10%) | p=0.344 |
| Other body fluid positivity | 1 (10%) | 11 (30%) | p=0.270 |

None of the other laboratory markers of sepsis (Table 4) or any positive microbiologic culture (Table 5) was found to have significant statistical association with outcome.

## Discussion

Sepsis in children is a significant cause of morbidity and mortality worldwide. [11] The mortality rate of sepsis in children from pediatric intensive care unit (PICU) of developing countries is higher than 50%. [12] World Health Organization statistics have shown that 80% of death in children <4 years can be classified as sepsis-related deaths. [13] Assessment of severity of illness at admission is important for effective patient management, prognostication, and optimum utilization of resources. [14]

In present study, 40 patients got discharged after completion of treatment and 10 expired during hospital stay while 4 patients went LAMA and hence were lost to follow up. Out of these 50 cases, (40/50 = 80%) were discharged after recovery and 10 (10/50 = 20%) expired. The mortality rate in different series has shown a considerable variability. Khan et al [15] reported a series of severe sepsis and septic shock cases with mortality rate of 24%, although the septic shock patients were studied for a time frame of 2 years. Ghimire et al [16] in their series reported mortality rate as 25.53%.

There was no significant association of presenting symptoms between survivors and non-survivors. However, fever was the most common presenting symptom in both the groups followed by breathlessness. In another study, Kurade and Dhanawade in their study reported fever as the most common presenting symptom and predictor of mortality associated with sepsis. [17] Choudhary et al furthermore identified younger age, low GCS at admission, need of mechanical ventilation and a shorter duration of hospital stay, to be significantly associated with mortality among pediatric septic shock patients. [18] In this study, however, it was observed that none of the presenting symptoms were statistically significant predictors of mortality.

This study hence proves that delayed CRT is an important indicator of peripheral perfusion, thus confirming the diagnosis of shock and its early recognition and management is an important predictor of mortality. Amongst the different vital parameters studied between the two groups significant statistical association was observed for delayed capillary refill time only. Ghimire et al. on the other hand recognized PRISM III scores as the predictor of mortality among these children. [16] Vasundhara et al assessed clinical parameters and immediate outcome of children with shock in a tertiary care hospital in Andhra Pradesh. [19] Among 75 children with shock, 74.66% children survived, and 25.33% children died.

There was no significant association between the different laboratory and biochemical parameters between the two groups. Kurade and Dhanawade in their series identified leucopenia as a predictor of mortality. [17] In the present study, acidosis (low arterial pH) had a significant statistical association with poor outcome of septic shock. In present study no statistically, significant difference was found between culture sensitivity of relevant samples between the two groups. Culture sensitivity is important for directing the direction of treatment of specific etiology. Different studies, like that of Ghimire et al and Kurade and Dhanawade have cited infection as the most common source of shock with Staphylococcus aureus as the most common micro – organism. [16,17]

The reason for our inability to find out association of mortality with a number of clinical and laboratory parameters was relatively much smaller sample size. This

is one of the major limitations of the present study. However, in view of the rural background of our patients, and their beliefs it was difficult to prevent high dropout rate which eventually affected our ability to find out association of different demographic, clinical and laboratory parameters with mortality. [20]

## Conclusion

A delayed capillary refill time on admission and a low mean pH were statistically significant predictors of mortality in septic shock, in this study. However, in view of the limitations of study, and a diversified picture of clinical/ laboratory parameters identified as predictors of mortality in different studies, it is also of the view that a single variable cannot be considered to be a reliable predictor of mortality among children with septic shock. Further studies with focus on multivariate relationships or those using some clinically validated scoring systems are recommended on a larger sample size with low dropout rate.

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