

CLINICAL PROFILE AND IMMEDIATE OUTCOME OF CHILDREN WITH SHOCK

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Abstract

Background: To determine the clinical profile of children aged 1 month to 12 years getting admitted with shock and to determine the immediate outcome of children with shock. **Materials and Methods:** This is a prospective observational study conducted in Pediatric Intensive Care Unit in Institute of child health for a period of one year among 220 children in the age group of 1 month to 12 years diagnosed as shock. Clinical details and lab data were entered in proforma. **Results:** Majority of patients were males in the age group 1- 5 years (42.2%) and fever was the most common presenting symptom (82.3%). Septic shock (57.7%) was the commonest followed by hypovolemic shock. 138 patients had compensated shock (62.7 %) while 82 had decompensated shock. Complications were observed in 52 patients (24.5 %) and MODS was the commonest (24.5%). 156 patients survived while 64 were no survivors. **Conclusion:** Septic shock is the commonest type of shock and pneumonia was the most common etiology. Cardiogenic & septic shock was more among non survivors. Most non survivors had decompensated shock. Longer duration of shock, need for ionotropes and ventilator indicate poor prognosis.

INTRODUCTION

Shock is an acute state in which the metabolic demands of the body tissues and organs are not met due to inadequate oxygen supply.^[1] Early recognition of shock is helpful in successful resuscitation of critically ill children. Shock can coexists with myocardial dysfunction and acute lung injury. Shock occurs in approximately 2% of all hospitalized infants, children and adults in developed countries and mortality rate varies depending on a etiology and clinical circumstances. Shock accounts for 2% of children admitted to Pediatric ICU worldwide as per western literature and Nelson textbook of Pediatrics. About 10 million children die of shock every year in the world.^[2] The highest mortality rates are observed in children under five years in developing countries. Shock is the result of various aetiologies and the leading causes of shock in children younger than 5 years of age are: pneumonia (19 %), diarrhoea (18 %), malaria (8 %), neonatal pneumonia or sepsis (10 %), preterm delivery (10 %), and asphyxia at birth (8%).^[3] The early recognition of signs of shock and aggressive therapy to restore the intravascular volume and reverse the biochemical cascade is believed to improve outcome. High index of suspicion is needed for early identification of shock.

Early institution of treatment will definitely reduce the chances of progression of shock to end up in cardio respiratory failure. Rapid and focused cardiopulmonary assessment adds in the early recognition of shock state.^[4]

During shock, body tries to compensate for the hypoxic state by attempting to preserve the oxygenation of vital organs like brain, heart, liver and kidney at the cost of other organs like muscles, GIT and skin. Untreated shock causes irreversible tissue and organ injury and ultimately death. Early recognition and intervention along with the rapid transfer of critically ill patients to a pediatric intensive care unit have led to decrease in the mortality rate for shock.

Patients presenting with sepsis or septic shock progress rapidly, and if left untreated to death. Even with treatment, the mortality in septic shock is as high as 50% mortality. It is estimated that sepsis and septic shock is the 4th leading cause of admission. This study was undertaken to analyze the clinical profile of children aged 1 month to 12 years getting admitted with shock and to determine the immediate outcome of children with shock.

MATERIALS AND METHODS

This is a prospective observational study conducted in Pediatric Intensive Care Unit in Institute of child health for a period of one year among 220 children in the age group of 1 month to 12 years diagnosed as shock. Clinical details and lab data were entered in proforma.

The study included children in the age group of 1 month to 12 years admitted with shock.

The Sample Size of the Study

Sample size is calculated by the formula Z^2pq/d^2

P = prevalence,

q = 100-p,

d = 5 (absolute precision)

As per the study done by Vasundhara et al.5, proportion of CNS infections causing septic shock = 17.3 %

p=17.3 %, q = 82.7, d = 5 , Z =1.96

n = Z^2pq/d^2 = 220 subjects

Methods

All children in this age group who are admitted with shock are analyzed. The diagnosis of shock is made clinically based on the findings like tachycardia, blood pressure, weak or absent distal pulses, a gap between the core-peripheral temperature and capillary refill time. Detailed history including age, gender, fever, convulsions, breathlessness, rashes, vomiting, diarrhea, duration of onset of illness will be collected. Following this child will be subjected for a detailed clinical examination. Clinical features at the time of admission are recorded. The parameters include temperature, heart rate, respiratory rate, capillary refill time, sensorium and blood pressure, urine output. The sensorium of the child is classified as A (Alert), V (Verbal), P (Pain Responsive) and U (Unresponsive) as per PEMC guidelines

Inclusion Criteria

All children in the age group 1 month to 12 years who are admitted with shock are studied.

RESULTS

Gender distribution

Gender distribution showed that males were highest 161 nos. (73.2%) and females were just over one fourth of the total patients. (26.8%).

Age and gender distribution

The age and gender distribution showed majority of the males were in the age group 1 year to 5 years (42.2%), the majority of females were in the age group 1 month to 1 year (37.3%). The lowest number of males was in age group 1 month to 1 year (23%) and lowest number of females was in the age group 1 year to 5 years (30.5%).

Presenting Symptoms

The presenting symptoms showed Fever was the commonest symptoms among the patients (82.3%), followed by breathlessness in 51.4%, vomiting in 33.2%, diarrhoea in 26.4%, convulsions in 18.2% and rashes in 10.5%.

Physiological status at the time of admission

The physiological status on admission was mostly alert patients (76.8%), response to pain in 44 patients (20%) and verbal response in 3.2%.

Shock severity and type

The severity of shock showed 138 patients were with compensated (62.7%) and decompensated in 82 patients (37.3%). The type of shock showed septic shock in 127 patients (57.7%), followed by hypovolemic shock in 46 patients (20.9%), Cardiogenic shock in 30 patients (13.6%) and anaphylactic shock in 17 patients (7.7%). The duration of shock showed majority were less than 4 hours (63.6%) and more than 4 hours in 36.4%. The comparison of type of shock and severity of shock showed all types were decompensated and this was statistically significant.

Table 1: Shock severity and type

Severity of shock	(n)	(%)
Decompensated	82	37.3
Compensated	138	62.7
Types of shock	(n)	(%)
Septic	127	57.7
Hypovolemic	46	20.9
Cardiogenic	30	13.6
Anaphylactic	17	7.7
Duration of shock	(n)	(%)
< 4 hours	140	63.6
> 4 hours	80	36.4
Types of shock	Severity of shock	
	Compensated (n)	Decompensated (n)
Septic	52	75
Hypovolemic	11	35
Cardiogenic	19	11
Anaphylactic	0	17

Fischer's exact test; p value <0.001

Requirement of Fluid bolus and inotropes

The requirement of fluid bolus of < 40ml/ kg was needed in 161 patients (73.2%) and > 40ml/ kg in 59 patients (26.8%). The requirement of inotropes was needed in 139 patients (63.2%). Only one inotrope was needed in 106 patients (48.2%), more than one in 33 patients (15%) and none in 81 patients (36.8%). Duration of inotropes of ≤ 24 hours was needed in 111 patients (50.5%).

Table 2: Requirement of fluid bolus and inotropes

Requirement of fluid bolus	(n)	(%)
< 40ml/ kg	161	73.2
> 40ml/ kg	59	26.8
Requirement of inotropes	(n)	(%)
Yes	139	63.2
No	81	36.8
Number of inotropes	(n)	(%)
One	106	48.2
>One	33	15.0
Nil	81	36.8
Duration of inotropes	(n)	(%)
≤ 24 hours	111	50.5
> 24 hours	43	19.5
Not applicable	66	30.0

Requirement of Transfusion and Ventilators

Transfusion was required in 49 patients (22.3%) and ventilators were used in 67 patients (30.5%). ICU stays of < 72 hours and > 72 hours were same.

Table 3: Requirement of Transfusion and Ventilators

Requirement of Transfusion	(n)	(%)
Yes	49	22.3
No	171	77.7
Requirement of Ventilators	(n)	(%)
Yes	67	30.5
No	153	69.5
ICU stay	(n)	(%)
< 72 hours	110	50.0
>72 hours	110	50.0

Table 4: Blood investigations

Haemoglobin	(n)	(%)
Normal	49	22.3
Low	165	75.0
High	6	2.7
Total leucocyte count	(n)	(%)
Normal	43	19.5
Low	7	3.2
High	170	77.3
Platelet count	(n)	(%)
Normal	102	46.4
Low	61	27.7
High	57	25.9
AST	(n)	(%)
Normal	175	79.5
Low	0	0.0
High	45	20.5
ALT	(n)	(%)
Normal	178	80.9
Low	0	0
High	42	19.1
Serum Creatinine	(n)	(%)
Normal	190	86.4
Low	0	0
High	30	13.6
Prothrombin count	(n)	(%)
Normal	173	78.6
Low	0	0
High	47	21.4
INR	(n)	(%)
Normal	162	73.6
Low	0	0
High	58	26.4
Lactate	(n)	(%)

Normal	61	27.7
Low	0	0
High	159	72.3
CRP	(n)	(%)
Normal	30	13.6
Low	0	0
High	190	86.4

Chest X-ray

The chest X-ray showed abnormal changes in 132 patients (60%).

Echocardiography

The Echocardiography showed a normal result in 122 patients (55.5%), and abnormal results in 51 patients (23.2%). Echocardiography was not done 47 patients (21.4%).

Aetiology

The aetiology for shock among the patients showed pneumonia as the highest number in 80 patients (36.4%), followed by post covid MISC in 40 patients (18.2%), Congenital/Acquired heart disease in 37 patients (16.8%), ADD&Anaphylaxis 17 patients each (7.7%), neurological causes in 14 patients and other reason in 15 patients (6.8%).

Table 5: Aetiology

Aetiology	(n)	(%)
Pneumonia	80	36.4
MISC (Post covid)	40	18.2
Congenital/Acquired heart disease	37	16.8
ADD	17	7.7
Anaphylaxis	17	7.7
Others	15	6.8
Neurological causes	14	6.4

Complications

The complications were observed in 52 patients (24.5%), in them MODS were observed in 24 patients (46.1%), ARDS in 6 patients (11.5%), AKI & DIC in the remaining patients.

Outcome

The outcome showed non-survivors of 64 patients (29.1%), Survivor without sequelae of 155 patients (70.5%) and Survivor with sequelae of 1 patient.

Association between outcome and Age/gender

The association of age and the outcome showed younger patients were more likely to be non-survivors and this was statistically significant. The gender distribution showed majority of non-survivors were males and this was statistically significant.

Table 6: Association between outcome and Age/gender

Age	Outcome	
	Non-Survivors (n)	Survivors (n)
1-month to 1 year	33	26
1 year to 5 years	19	67
5 years to 12 years	12	63
Chi-square test value 28.879; d.f 2; p value <0.001		
Gender	Outcome	
	Non-Survivors (n)	Survivors (n)
Male	38	123
Female	26	33
Chi-square test value 8.767; d.f1; p value 0.004		

Association between outcome and presenting symptoms

The presenting symptoms showed Fever, breathlessness and vomiting was associated with more non-survivors.

Table 7: Association between outcome and Presenting symptoms

Presenting symptoms	Outcome		Chi-square test - p value
	Non-Survivors (n)	Survivors (n)	
Fever	59	122	0.018
Breathlessness	41	72	0.011
Convulsions	5	35	0.012
Rashes	3	20	0.090
Vomiting	21	52	0.998

Association between outcome and Shock

The severity of shock showed most non-survivors had decompensated shock severity, however this was statistically significant. The type of shock showed cardiogenic and septic shock more among non-survivors, and

this was statistically significant. The duration of shock showed more than 4 hours mostly among non-survivors and this was statistically significant.

Table 8: Association between outcome and Shock

Shock severity	Outcome	
	Non-Survivors (n)	Survivors (n)
Decompensated	43	39
Compensated	21	117
Chi-square test value 34.5, d.f1; p value <0.001		
Type of Shock	Outcome	
	Non-Survivors (n)	Survivors (n)
Septic	35	92
Hypovolemic	6	40
Cardiogenic	23	7
Anaphylactic	0	17
Fischer's exact test; p value <0.001		
Duration of Shock	Outcome	
	Non-Survivors (n)	Survivors (n)
< 4 hours	29	111
> 4 hours	35	45
Chi-square test value 13.096, d.f 1; value <0.001		

Association between outcome and use of Inotropes/ventilator

The requirement of inotropes meant all those patients were non-survivors and this was statistically significant. The requirement of ventilators was also high among non-survivors and this was statistically significant.

Association between outcome and ICU stay/Complications

The ICU stay of < 72 hours and > 72 hours was equal among the survivors and non-survivors, there was no statistical significance. The presence of complications means more non-survivors and this was statistically significant.

Table 9: Association between outcome and ICU stay/Complications

ICU stay	Outcome	
	Non-Survivors (n)	Survivors (n)
< 72 hours	32	78
≥ 72 hours	32	78
Chi-square test value 0.000, d.f 1; p value 1.000		
Complications	Outcome	
	Non-Survivors (n)	Survivors (n)
Yes	49	5
No	15	151
Chi-square test value 131.860, d.f 1; value <0.001		

Association between outcome and Aetiology

The aetiology showed pneumonia and Congenital/Acquired heart disease was the highest among the non-survivors and this was statistically significant.

Table 10: Association between outcome and Aetiology

Aetiology	Outcome	
	Non-Survivors (n)	Survivors (n)
Pneumonia	17	63
ADD	0	17
Congenital/Acquired heart disease	30	7
Anaphylaxis	0	17
Misc. (Post covid)	5	35
Neurological causes	2	12
Others	10	5
Fischer's exact test; p value <0.001		

DISCUSSION

This study was done on children in the age group of 1 month to 12 years admitted with shock. In total 220 students were included in the study.

In our study the gender distribution showed that males were highest 161 nos. (73.2%) and females were just over one fourth of the total patients.

(26.8%). The age and gender distribution showed majority of the males were in the age group 1 year to 5 years (42.2%), the majority of females were in the age group 1 month to 1 year (37.3%). The lowest number of males was in age group 1 month to 1 year (23%) and lowest number of females was in the age group 1 year to 5 years (30.5%). Reviewed study by Daljit Singh et al.^[6] This

prospective study was conducted to determine the frequency, aetiology, type and outcome of shock in hospitalized children in the age group of 1 month to 15 years. There were 98 cases of shock, constituting 4.3% out of total admissions. Mean age was 2.8 ± 3.4 years. Similarly, Kurade A et al.^[2] A total of 94 (9%) out of 1035 admissions had shock and 53(56.3%) of them had a diagnosis of septic shock. Analysis was done on 43 (M:F, 20:23). The mean age was 3 year (range 1month– 14 years). Maximum (48.83%) cases were in infancy

In our study the presenting symptoms showed fever was the commonest symptoms among the patients (82.3%), followed by breathlessness in 51.4%, vomiting in 33.2%, diarrhoea in 26.4%, convulsions in 18.2% and rashes in 10.5%.

The physiological status on admission was mostly alert patients (76.8%), response to pain in 44 patients (20%) and verbal response in 3.2%. Kurade A et al.^[2] The common presenting symptom was fever (62.79%) followed by altered mental status in 30.23%. Paediatric SIRS criteria were met in 35(81.3%). Most common abnormal lab parameters were elevated liver enzymes (86.04%) followed by anaemia (62.79%) and leucocytosis (60.46%). Thrombocytopenia and Coagulopathy was seen in 55.81% and 60.41% respectively.

A study from Libya reported fever (88%) as the most common presenting complaint followed by cough (38%), diarrhea (35%) and vomiting (28%).^[7] A Study from Romania also reported that most children (98%) presented with changes in core temperature followed by significant changes in heart rate and tachypnea.^[8]

In our study the severity of shock showed 138 patients were with compensated (62.7%) and decompensated in 82 patients (37.3%). The type of shock showed septic shock in 127 patients (57.7%), followed by hypovolemic shock in 46 patients (20.9%), Cardiogenic shock in 30 patients (13.6%) and anaphylactic shock in 17 patients (7.7%). The duration of shock showed majority was less than 4 hours (63.6%) and more than 4 hours in 36.4%). The comparison of type of shock and severity of shock showed all types were decompensated and this was statistically significant. Kurade A et al.² Pneumonia was the commonest etiology (51.1%) followed by cellulitis/abscess in 30.2%. Blood culture was positive in 18.6% and Staphylococcus was the commonest organism. Frequency of MODS was 90.69%. Most (74.41%) cases presented with decompensated shock and 97.67% required inotropes. Majority (88.37%) required mechanical ventilation. Fisher JD et al.^[9] and Gaines NN et al.^[10] also reported predominance of respiratory illness and isolation of respiratory pathogen from the septic shock patients. A study from Romania also reported respiratory infection to be the most (64%) common aetiology followed by digestive tract infection and urinary tract infection.^[11]

In our study the complications were observed in 52 patients (24.5%), in them MODS were observed in

24 patients (46.1%), ARDS in 6 patients (11.5%), AKI & DIC in the remaining patients. In our study the aetiology for shock among the patients showed pneumonia as the highest number in 80 patients (36.4%), followed by post covid in 40 patients (18.2%), Congenital/Acquired heart disease in 37 patients (16.8%), ADD & Anaphylaxis 17 patients each (7.7%), neurological causes in 14 patients and other reason in 15 patients (6.8%). Reviewed study by Daljit Singh et al.^[12] Hypovolemic shock due to acute diarrheal disease was the commonest type (45.9%) followed by septic, cardiogenic and distributive shock. Compensated stage was common in hypovolemic shock (88.9%) whereas majority of patients with septic shock (73.5%) presented in decompensated stage.

In the present study the requirement of fluid bolus of < 40ml/ kg was needed in 161 patients (73.2%) and > 40ml/ kg in 59 patients (26.8%). The requirement of inotropes was needed in 139 patients (63.2%). Transfusion was required in 49 patients (22.3%) and ventilators were used in 67 patients (30.5%). ICU stay of < 72 hours and > 72 hours were same. Reviewed study by SuchitraRanjit. Et al.^[13] studied Over a 28-month period, of 37 patients with septic shock, 22 children remained in shock despite 60 ml/kg fluid and dopamine and/or dobutamine infusions as per guidelines. On clinical examination, 12 patients had warm shock and ten had cold shock, however, six exhibited an unusual pattern of cold shock with wide pulse pressures on invasive arterial monitoring. The most common echocardiographic finding was uncorrected hypovolemia in 12/22 patient while ten patients had impaired left ± right ventricular function. Echocardiography permitted an appreciation of the underlying disordered pathophysiology and a rationale for adjustment of treatment. Shock resolved in 17 (77%) and 16 patients (73%) survived to discharge.

In our study the non-survivors were 64 patients (29.1%), Survivor without sequelae of 156 patients (70.9%). The association of age and the outcome showed younger patients were more likely to be non-survivors and this was statistically significant. The gender distribution showed majority of non-survivors were males and this was statistically significant. The presenting symptoms showed Fever, breathlessness and vomiting was associated with more non-survivors. The duration of shock showed more than 4 hours mostly among non-survivors and this was statistically significant. The requirement of ventilators was also high among non-survivors and this was statistically significant. The ICU stay of < 72 hours and > 72 hours was equal among the survivors and non-survivors, there was no statistical significance. The aetiology showed pneumonia and Congenital/Acquired heart disease was the highest among the non-survivors and this was statistically significant. Reviewed study by Daljit Singh et al.¹² showed overall survival was 73.6%. The survival rate was best in hypovolemic shock (97.7%) followed by septic (53.3%) and cardiogenic shock

(43.7%). Inotropes and ventilatory support were required in 46% and 23% patients, respectively. Diagnosis and management of shock in compensated stage carried better prognosis than in uncompensated shock irrespective of the age of the patient. Another study by Kurade A et al.^[2] The mortality rate was 60.46% and mean duration of PICU was 8.3 days. Anemia, leucopenia, decompensated shock and need for mechanical ventilation were significantly associated with mortality ($p < 0.05$). It concluded that Septic shock was the most common type of shock encountered in PICU and carries a high mortality. Maximum number of patients was below 1 year and pneumonia was the commonest underlying cause. Mortality was reviewed by Swati M. Gadappa et al.^[12] Septic shock was the most commonly encountered shock ($n=48$, 61.5%). Mortality was highest in cardiogenic shock ($n=12$, 80%) and obstructive shock ($n=4$, 80%). Survival was best in Hypovolemic shock. Authors found significant correlation between LOS MV and mortality ($p=0.018$). Type of shock had no correlation with PIM3 score ($p=0.374$) and mortality ($p=0.884$). This study concluded that Shock is a major cause of morbidity and mortality in children especially below 5 yrs of age. Larger prospective multicentric study in developing countries is desirable. TomerAvni et al.^[13] This concluded that Evidence suggests a survival benefit, better hemodynamic profile and reduced adverse events rate for norepinephrine over dopamine. Norepinephrine should be regarded as the first line vasopressor in the treatment of septic shock. Martha C Kutkoet al.^[14] The overall mortality rate for the study cohort was 13.5%. There were differences in case mortality rates between patients requiring one inotropic agent (0%) and patients requiring multiple inotropic agents (42.9%), between oncology patients who had undergone bone marrow transplantation (38.5%) and oncology patients without bone marrow transplantation. There did not appear to be differences in the case mortality rates between oncology and nononcologic patients or among patients with varying degrees of neutropenia. Mortality from septic shock occurs most frequently in the context of multiple organ system failure. Rousseaux J, et al.^[15] A total of 146 children admitted with septic shock between January 2000 and April 2010 were included. Shock index was significantly different between survivors and non-survivors at 0, 4, and 6 hours after admission ($P = 0.02$, $P = 0.03$, and $P = 0.008$, respectively). Age-adjusted SIs were different between survivors and non-survivors at 0 and 6 hours, with a relative risk of death at these time points of 1.85 (1.04-3.26) ($P = 0.03$) and 2.17 (1.18-3.96) ($P = 0.01$), respectively. Moreover, an abnormal SI both at admission and at 6 hours was predictive of death with relative risk of 1.36 (1.05-1.76).

CONCLUSION

- Gender distribution showed that males were highest in the study. The age and gender distribution showed majority of the males were in the age group 1 year to 5 years, the majority of females were in the age group 1 month to 1 year. The gender distribution showed majority of non-survivors were males and this was statistically significant. The association of age and the outcome showed younger patients were more likely to be non-survivors and this was statistically significant.
- The outcome showed non-survivors of 64 patients (29.1%).
- The severity of shock showed 62.7% were with compensated and rest were decompensated. The severity of shock showed most non-survivors had decompensated shock severity, however this was statistically significant.
- The type of shock showed septic shock in 57.7%, followed by hypovolemic shock in 20.9%. The type of shock showed cardiogenic and septic shock more among non-survivors, and this was statistically significant. The duration of shock showed more than 4 hours mostly among non-survivors and this was statistically significant.
- The requirement of fluid bolus of $> 40\text{ml/kg}$ was needed in 26.8%, the inotropes were required for 63.2%, transfusion was required in 22.3%, ventilators were used in 30.5%. The requirement of ventilators was also high among non-survivors and this was statistically significant.
- The chest X-ray showed abnormal changes in 60% and the blood culture showed growth in only 6.8%.
- The aetiology for shock among the patients showed pneumonia as the highest number in 80 patients. The aetiology showed pneumonia and Congenital/Acquired heart disease was the highest among the non-survivors and this was statistically significant.

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