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A STUDY TO ASSESS THE OUTCOME OF CHILDREN WITH SHOCK ADMITTED IN PEDIATRIC DEPARTMENT AT TERTIARY HEALTH CARE CENTER

Paediatric Medicine

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ABSTRACT

Background: Shock constitutes a major percentage of diagnosis in paediatrics. About 10 million children die of shock every year in the world. The present study was undertaken to assess the cause and outcome of children with shock admitted in pediatric ward in a tertiary care center in central India. **Method:** A total of 83 children in the age group of 1 month to 12 years with diagnosis features of shock during period of 1 year from 1st January 2021 to 31st December 2021 were enrolled in the study. **Results:** The frequency of shock was 3.69% of total admissions in the PICU. Hypovolemic shock (40.96%) was the most common type of shock (55.55%). 45(54.21%) cases were presented in compensated stage while 38(45.78%) cases were presented in decompensated state. Inotropes were required in 60(72.28%) cases whereas ventilatory support was required in 53(63.85%) cases. MODS occurred in 30(36.14%) cases of which 22(73.33%) died whereas 08(26.66%) survived. Out of 83 cases, 56(67.46%) survived and 27(32.53%) were died and the mortality rate was highest in 1-12 months age group (41.17%) and in cardiogenic shock (62.5%). Among various risk factors, undernutrition {3.08 (1.19, 7.65)}, decompensated shock {2.74 (1.09, 7.07)}, leucopenia {6.91(1.55, 32.72)}, inotrope requirement {5.71, (1.40, 23.52)}, ventilatory support {27.53, (3.23, 220.84)} and MODS {4.33 (1.55, 12.53)} were found to be the independent risk factors for mortality. **Conclusion:** Early recognition of shock by meticulous assessment of physiological status and treatment improves the outcome and decreases the complications of shock and thus the duration of hospital stays, resources utilized.

KEYWORDS

Shock; Hypovolemic; Septic; Inotropes; Mortality; MODS; Leucopenia

INTRODUCTION

Shock is defined as a state of acute energy failure due to inadequate glucose substrate delivery, oxygen delivery, or mitochondrial failure at the cellular level [1]. This insufficient or improper delivery and distribution of oxygen and nutrients result in altered cellular and sub cellular function leading to anaerobic metabolism and accumulation of lactic acid which ultimately leads to cellular damage, multiple organ dysfunction and finally cardiopulmonary collapse [1,2]. Data from the developed countries shows that shock occurs in approximately 2% of all hospitalized infants and children with mortality rate varying substantially depending upon the etiology and clinical circumstances [3]. However, in developing countries shock is most commonly associated with acute diarrhea illness with trends now changing towards increase in incidence of severe sepsis as cause of shock [4].

Although, the shock states in children are classified according to the etiological factors namely hypovolemic shock due to volume depletion, cardiogenic shock due to cardiac dysfunction, distributive shock due to abnormal vasodilatation and septic shock due to increased vascular permeability [5]. Once diagnosed, shock has to be managed aggressively. First hour is considered the golden hour. Evaluation and treating of underlying cause should proceed simultaneously. This analysis aims to address these gaps in understanding by exploring the prevalence of shock, its clinically determined etiology, fluid management practices and outcomes among hospitalized children. The outcome in septic shock is even worse when it is associated with co-morbidities and multiple organ dysfunctions. Advances in pediatric intensive care guidelines for septic shock management have improved survival of overall children. However, it continues to be an important cause of morbidity and mortality in the resource limited countries [6].

Early recognition with efficient, anticipatory, and aggressive management of children in shock is mandatory and will often be rewarding, as early restoration of tissue perfusion to normalcy will determine the immediate outcome. The final outcome will depend upon the nature of etiology [7] and the availability of intervention measures. The time lapse between the onset of this state and the time of admission and initiation of resuscitative measures is a great factor in determining the outcome [8]. As there are very few studies on pediatric shock from India so we planned this study to assess the cause and outcome of children with shock admitted in pediatric ward in a tertiary care center in central India.

MATERIALS AND METHODS

After obtaining Institutional Ethical Committee approval and written informed consent from parents or guardian, this hospital based observational study was conducted in total 83 cases of age between 1 month to 12 years admitted with clinical features of shock in our tertiary care hospital, during a period of 1 year from 1st January 2021 to 31st December 2021. Post-operative patients with shock, shock due to scorpion sting snake bite and poisoning and patients who lost to follow up were excluded from the study.

Definition of shock:

Shock is a clinical state in which the recorded blood pressure was below the 5th centile for age or 2 standard deviations below the mean for age 5 and / or a state in which at least three of the following criteria for decreased perfusion were identified.

- Weak peripheral pulses,
- Mottled/ cool extremities with a capillary refill of more than 3 sec,
- Tachycardia- (heart rate>180 beats/minute for infants and >160 beats/ min for children) or bradycardia (heart rate <60 beats/min),
- Urine output <0.5 ml/kg/hr.

Methodology

Personal details and history were taken, and complete clinical examinations were performed on children admitted in pediatric ward with clinical features of shock. Rapid cardio-pulmonary assessment and physical examination including general and systemic examination were done. BP was recorded in relaxed right arm supine position with mercury Sphygmomanometer (diamond mercurial blood pressure apparatus) with appropriate cuff size. Three readings were taken and an average of the three values was recorded. For the recording of SPO2, the left thumb of the patient was connected to pulse oximeter. Under aseptic precaution intravenous line was secured and blood was sent for lab investigations like CBC, total leukocyte count, serum electrolyte, serum urea, serum creatinine, SGOT, SGPT, serum bilirubin, RBSL and blood culture sensitivity. All sick children were initially evaluated in the emergency room of the hospital and initial stabilization of the patient including airway, breathing followed by fluid resuscitation was carried out. Children presenting with acute watery diarrhea were admitted in the PICU only if they require some intensive care in the form of ventilation, inotrope support or dialysis. All other cases of shock were admitted in PICU.

The proforma was designed to notify the type of shock identified in the emergency room, the probable risk factors to mortality, the results of investigations and the progress of the patient. The patients were managed according to the protocol adapted from textbook of the paediatric intensive care and as per PALS guidelines. Management details and complications were recorded. During the PICU stay periodic vital signs and other measures like urine output and oxygen

saturation were recorded. IV fluid therapy, rate and duration of inotrope and other organ support like ventilatory support were documented. Treatment of the child was first priority and performance of the study was never interfered in treatment of child.

Statistical Analysis

Data were analyzed using SPSS version 21.0 for windows. As the variables were in qualitative form, we have used chi-square test in the univariate analysis to observe the association between the study variables and the outcome. To quantity the magnitude of association we have used odds ratio and its corresponding 95% confidence interval to observe the precision of the estimates. For observing the independent association between the risk factors and outcome, we have used logistic regression (as the variable is in binary form) and arrived at the adjusted odds ratios and the corresponding 95% confidence intervals. P value <0.05 was considered statistically significant.

OBSERVATION AND RESULTS

During the study period, 2245 children were admitted in our tertiary care center, among them 83 (3.69%) children had shock. Hence, a total of 83 children were included in the study. The incidence of shock was higher in the younger age group (1-12 months; 40.96%) and progressively reduces as the age advances with sight male predominance (51.80%) as shown in Table 1.

Table 1: Demographic data of children with shock

Demographic data		No. of patients	Percentage
Age Group	1 to 12 months	34	40.96
	>1 to 5 years	31	37.34
	>5 to 10 years	14	16.86
	>10 to 12 years	04	4.81
Gender	Male	43	51.80
	Female	40	48.19

The predominant presenting feature in children with shock was fever (61 cases, 73.49%), followed by breathlessness (43 cases, 51.80%) as depicted in figure 1. Out of 83 cases presented with shock, 21 (25.30%) were under nourished. Out of 21 patients, maximum i.e., 11 were in the >1year to 5 years age group (35.48%).

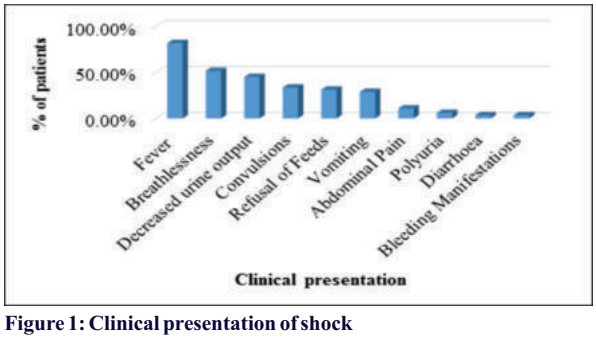

Figure 1: Clinical presentation of shock

Hypovolemic shock (40.96%) was the most common type of shock in children admitted in PICU. Out of 83 cases, 45 cases (54.21%) were presented in compensated stage, while 38 cases (45.78%) were presented in decompensated state, (Table 2).

Out of the decompensated shock, septic shock constitutes the majority (47.36%) followed by hypovolemic (23.68%), cardiogenic (15.78%) and distributive shock (13.15%). While out of compensated shock, hypovolemic shock constitutes the majority (55.55%) followed by septic and distributive (20% each) whereas least common was cardiogenic shock (4.44%).

Table 2: Etiology, severity, and duration of shock

Variables		No. of patients	Percentage
Etiology	Hypovolemic shock	34	40.96
	Septic shock	27	32.53
	Cardiogenic shock	08	9.63
	Distributive Shock	14	16.86
Severity	Compensated	45	54.21
	Decompensated	38	45.78
Duration	>6 hours	36	43.37
	<6 hours	47	56.62

Inotropes were required in 60 cases (72.28%) for the treatment of shock. There was 100% inotrope requirement in both septic and cardiogenic shock. In Hypovolemic shock 35.29% required inotrope, in distributive shock 2 patients (14.28%) required inotropes. Out of 60 cases, 38 (63.33%) were required single inotrope (27 responsive and 11 not responsive to single inotrope) and 22 (36.66%) required double inotropes (3 were responsive while 19 were not responsive to double inotropes and finally died). Ventilatory support was required in 53 cases (63.85%).

Out of 83 cases, maximum i.e., 20 (24.09%) were diagnosed as dengue shock syndrome followed by bronchopneumonia (19.27%) and sepsis with focus (16.86%) as depicted in figure 2.

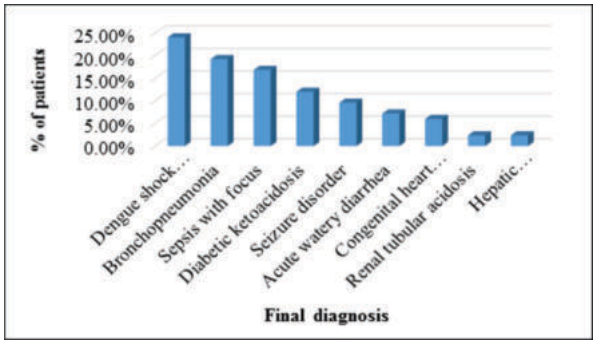

Figure 2: Final diagnosis

Out of 83 cases, 56 (67.46%) survived and 27 (32.53%) were died (Figure 3). MODS occurred in 30 cases (36.14%) of which 22 died (73.33%) whereas 08 (26.66%) survived. The mortality rate was highest in the 1 to 12 months age group (41.17%) followed by >5 to 10 years (28.57%), >1 to 5 years (25.80%) and lowest in >10 to 12 years (25%). However, the highest mortality was found in cardiogenic shock (62.5%) followed by septic (44.44%) and hypovolemic shock (23.52%), lowest mortality in distributive shock (14.28%).

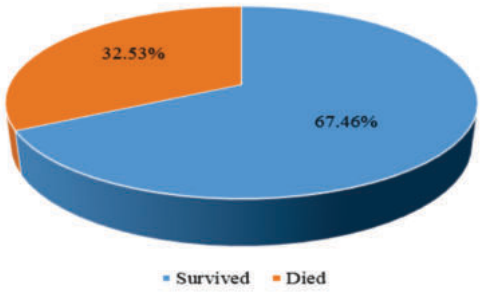

Figure 3: Outcome of children presented with shock.

From the table 3 it is evident that there was highly statistically significant association between the risk factors such as undernutrition, decompensated shock, cardiogenic shock, leucopenia, hypocalcemia, inotrope requirement, ventilatory support, MODS, and mortality. The other variables i.e., age, and sepsis were not significantly associated as the corresponding 95% confidence interval for odds ratio contained.

Table 3: Associated between the risk factors and outcome (Death) (Univariate Analysis)

Variables		Outcome		P value	Odds ratio For death	95% CI for OR
		Survived	Died			
Age	<1 year	20 (35.71%)	14 (51.85%)	0.053	1.72	(0.995, 2.922)
	>1year	36 (64.28%)	13 (48.14%)			
Undernutrition	Yes	12 (21.42%)	09 (33.33%)	0.025	2.13	(1.18, 3.83)
	No	44 (78.57%)	18 (66.66%)			
Decompensated Shock	Yes	19 (33.92%)	19 (70.37%)	<0.001	14.08	(7.36, 26.96)
	No	37 (66.07%)	08 (29.62%)			

Sepsis	Yes	15 (26.78%)	12 (44.44%)	0.071	1.66	(0.961, 2.83)
	No	41 (73.21%)	15 (55.55%)			
Cardiogenic shock	Yes	03 (5.35%)	05 (18.51%)	<0.001	3.65	(1.79, 7.55)
	No	53 (94.64%)	22 (81.48%)			
Duration of shock	≥6 Hours	16 (28.57%)	20 (74.07%)	<0.001	7.33	(3.95, 13.20)
	<6 Hours	40 (71.42%)	07 (25.92%)			
Leucopenia	Yes	03 (5.35%)	06 (22.22%)	<0.001	5.89	(2.39, 14.81)
	No	53 (94.64%)	21 (77.77%)			
Hypocalcemia	Yes	06 (10.71%)	10 (37.03%)	<0.001	5.12	(2.58, 9.76)
	No	50 (89.28%)	17 (62.96%)			
Inotrope requirement	Yes	34 (60.71%)	26 (96.29%)	<0.001	14.51	(5.10, 41.63)
	No	22 (39.28%)	01 (3.70%)			
Ventilatory support	Yes	27 (48.21%)	26 (96.29%)	<0.001	111.32	(14.30, 781.13)
	No	29 (51.78%)	01 (3.70%)			
MODS	Yes	08 (26.66%)	22 (73.33%)	<0.001	12.70	(6.72, 24.11)
	No	48 (90.56%)	05 (9.43%)			

Among the various risk factors, undernutrition {3.08 (1.19, 7.65)}, decompensated shock {2.74 (1.09, 7.07)}, leucopenia {6.91(1.55, 32.72)}, inotrope requirement {5.71, (1.40, 23.52)}, ventilatory support {27.53, (3.23, 220.84)} and MODS {4.33 (1.55, 12.53)} were found to be the independent risk factors for mortality, (Table 4).

Table 4: Associated between the risk factors and outcome (Death) (Multi-Variate Analysis)

Variables		Outcome		Odds ratio For death	95% CI for OR
		Survived	Died		
Undernutrition	Yes	12 (21.42%)	09 (33.33%)	3.08	(1.19, 7.65)
	No	44 (78.57%)	18 (66.66%)		
Decompensated Shock	Yes	19 (33.92%)	19 (70.37%)	2.74	(1.09, 7.07)
	No	37 (66.07%)	08 (29.62%)		
Leucopenia	Yes	03 (5.35%)	06 (22.22%)	6.91	(1.55, 32.72)
	No	53 (94.64%)	21 (77.77%)		
Inotrope requirement	Yes	34 (60.71%)	26 (96.29%)	5.71	(1.40, 23.52)
	No	22 (39.28%)	01 (3.70%)		
Ventilatory support	Yes	27 (48.21%)	26 (96.29%)	27.53	(3.23, 220.84)
	No	29 (51.78%)	01 (3.70%)		
MODS	Yes	08 (26.66%)	22 (73.33%)	4.33	(1.55, 12.53)
	No	48 (90.56%)	05 (9.43%)		

DISCUSSION

In the present study, 83 cases of shock were registered out of the 2245 pediatric cases admitted during the study period. Thus, the incidence of shock was 3.69%. Duration of shock was more than 6 hours in 36 cases (43.37%) and less than 6 hours in 47 cases (56.62%). Similar findings are reported in previous studies [9-12]. The incidence of shock was higher in the younger age group and maximum patients were observed in infancy (1 to 12 months) (40.96%) followed by >1 to 5 years (31; 37.34%) with sight male predominance (51.80%) which is comparable with the other studies conducted by Singh D et al [9], Venkatraman L et al [11] and Kurade A et al [13]. The predominant presenting feature in children with shock was fever (81.90%), followed by breathlessness (43 cases, 51.80%) as similar to our study most of the studies reported fever as the most common presenting complaint [13, 14]. Out of 83 cases presented with shock, 21 (25.30%) were under nourished. Out of 21 patients, maximum i.e., 11 were in the >1year to 5 years age group (35.48%) which is comparable with the study conducted by Rangasamy K [14].

The hypovolemic shock was the most common type (40.96%) followed by septic shock (32.53%) and distributive shock (16.86%) while cardiogenic shock was the least common type (9.63%). Similar findings are reported in a study done by Vijaya Mohan VK [15]. In a current study, sepsis was found in 32.53% of cases and most of them were gram negative organisms, which is similar to the previous studies [16, 17]. The other culture negative septic shock can be explained as the majority of patients had received intravenous antibiotics as outpatients before being referred to our hospital. The compensated shock was present in maximum number of cases (45; 54.21%) and decompensated shock was present in 38 cases (45.78%). These findings are in accordance with the study done by Krishna Kumari TV [6] and Rangasamy K [14]. Out of the decompensated shock, septic shock constitutes the majority (47.36%) while out of compensated shock, hypovolemic shock constitutes the majority (55.55%). Similar findings are reported in the study carried out by Vijaya Mohan VK [15]. Inotropes were required in 60 cases (72.28%) for the treatment of shock. There was 100% inotrope requirement in both septic and cardiogenic shock. In hypovolemic shock 35.29% required inotrope, in distributive shock 2 patients (14.28%) required inotropes. However out of 60 cases, 27 (32.53%) were required single inotrope and responsive. 11 (13.25%) were not responsive to single inotrope, in this group most of them presented in decompensated stage and started directly on adrenaline infusion. 03 out of 60 cases (3.61%) were responsive to double inotropes while 19 (22.89%) were required double inotropes and were not responsive to them and finally died. The mean duration at which maximum dose of inotropes, maintained was 26:20 hours, in surviving patients. In patients who died inotropes were continued till death. The mean time taken to wean the patients from inotropic support was 14:20 hours. These findings correlated with the earlier studies [6, 9, 13, 14, 18].

MODS occurred in 30 cases (36.14%), of them 22 died (73.33%) whereas 08 (26.66%) survived. Thus, the mortality was higher in patients with MODS. Out of 83 cases, ventilatory support was required in 53 cases (63.85%). These results are comparable with the study done by Singh D et al [9] and Rangasamy K [14]. However, the overall mortality rate was 32.53% which is comparable with previous studies [9, 16]. The mortality rate was highest in the 1 month to 12 months age group, and lowest in >10 years to 12 years age group. Similarly, finding reported in Singh D et al [9] and Vijayamohan VK study [15]. Also, it was observed that the mortality was highest in patients with cardiogenic shock (05; 62.5%), followed by septic shock (12; 44.44%), hypovolemic shock (08; 23.52%) and distributive shock (02; 14.28%). These findings are in accordance with the previous studies [9, 16].

Among the various risk factors analyzed previously, undernutrition {3.08 (1.19, 7.65)}, decompensated shock {2.74 (1.09, 7.07)}, leucopenia {6.91(1.55, 32.72)}, inotrope requirement {5.71, (1.40, 23.52)}, ventilatory support {27.53, (3.23, 220.84)} and MODS {4.33 (1.55, 12.53)} were found to be the independent risk factors for mortality as reported in previous studies [16, 19, 20]. Similarly, in Rangasamy K study they found, undernutrition decompensated shock, need for ventilatory support, MODS, leucopenia and inotrope requirement were the independent risk factors for mortality [14].

CONCLUSION

Shock constitutes a major percentage of diagnosis in paediatrics. The age below one-year children were more affected by shock than other age group of children. No difference in prevalence or severity of shock at presentation between the two sexes was noticed. Hypovolemic shock was diagnosed to be the commonest and death rate was reported to be highest in cardiogenic shock. There was an increased need for

inotropes and mechanical ventilation in non-survivors as compared to survivors. Early recognition of shock by meticulous assessment of physiological status, timely referral and treatment improves the outcome and decreases the complications of shock and thus the duration of hospital stays, resources utilized. Hypovolemic shock due to acute gastroenteritis is common. Measures to implement oral rehydration therapy should be intensified at primary health centers and sub centers. Larger well-designed studies using uniform protocols are needed to study the epidemiology and outcome of shock in Indian children.

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