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Original Research Article

A study of clinical profile and outcome of shock in pediatric intensive care unit of Al-Ameen Medical College and Hospital, Vijayapura

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ABSTRACT

Background: The clinical syndrome of shock, a clinical state characterized by inadequate tissue perfusion, is one of the most dramatic, dynamic and life-threatening problems faced by the physician in the critical care setting.
Methods: This retrospective observational study analysed all critically ill children aged 1 month to 12 years who were admitted to our hospital's Pediatric Intensive Care Unit (PICU) between January 2023 and December 2023, requiring mechanical ventilation and presenting with clinical evidence of shock. The majority of deaths in this cohort were attributed to decompensated shock. The Paediatric Index of Mortality 3 (PIM3) score was calculated for each patient to evaluate the severity of illness and predict outcomes. The authors meticulously documented the patterns of morbidity and mortality across different types of shock and assessed the outcomes in the PICU. All collected data were systematically compiled and tabulated for comprehensive analysis.
Results: The frequency of shock in our PICU was 2.1% (n=257). However, among mechanically ventilated patients it was present in 104.31 patients. Septic shock was the most commonly encountered shock (62.6%). Out of 186 cases, 125 survived (67.2%), 61 died (32.8%). Shock had no correlation with PIM3 score and mortality.
Conclusions: Shock is a significant cause of morbidity and mortality in children, especially those under 5 years of age. In our study, septic shock was identified as the most prevalent form of shock, with severe pneumonia being the leading cause. We found that mortality rates were higher in patients who required prolonged mechanical ventilation. To improve outcomes and management strategies, larger prospective multicentric studies in developing countries are highly recommended.

Keywords: Shock, Morbidity, Mortality, Septic shock, Critically ill

INTRODUCTION

Shock is a clinical syndrome, characterized by inadequate tissue perfusion. It is one of the most dramatic, dynamic and life-threatening problems that the physician encounters in a critical care setting. Shock is an acute decompensated state in which the circulatory system of the body fails to provide adequate oxygen and nutrients that are required to meet the metabolic demands of vital organs.[1] As a result of inadequate ATP production, the cell reverts to anaerobic metabolism thereby resulting in acute energy failure. This renders the cell being incapable of maintaining homeostasis, further resulting in the disruption of ionic pumps, accumulation of intracellular sodium and calcium, efflux of potassium, and eventual cell death. Widespread cell death ultimately results in multi-organ dysfunction.[2]

Majority of the childhood illnesses have the potential to eventually progress to shock. Shock accounts for more

morbidity and mortality in children worldwide than any other diagnosis.[3]

A high index of suspicion is critical for the early identification of shock. Early initiation of treatment plays a major role in reducing the chances of progression of shock and ending up in cardio respiratory failure. Rapid and focused cardiopulmonary assessment has proven to be of great value in the early recognition of shock.[4]

Many studies have classified shock at presentation and emphasized that there exists a wide range of etiologies for shock. The mortality rate of shock in pediatric patients is on a considerable decline owing to widespread educational efforts in terms of pediatric advance life support and regular updates in management guidelines which focus on early recognition, prompt intervention, and rapid transfer of critically ill patients to a PICU via an efficient and reliable transport service.[5]

Though shock is a commonly encountered problem in the critical care setting, there is a paucity of data in the Indian literature. Knowledge about the morbidity pattern and etiology of shock in PICU will give us better understanding of the illness which will guide us plan the appropriate management, and subsequently to improve the outcome. Thus, the present study has been carried out to know about the risk factors in a critically ill child with shock and its association with outcome. The objectives of the present study were to find the etiology and the type of shock seen in patients in our PICU, to know the risk factors for mortality of shock in children admitted and to know their outcome.

METHODS

The present retrospective observational study was done at PICU of Al-Ameen Medical College and Hospital, Vijayapur, Karnataka with a study period of One year, between January 2023 and December 2023. The sample size was 186. Prior written informed consent was taken from parents and this study was approved by Institutional Ethical Committee.

Children in the age group of 1 month to 12 years presenting with shock (or) who later develop shock during PICU stay were included in our study. Children who had received inpatient treatment before admission in PICU, children who were given shock post cardiac arrest, and children who suffered traumatic shock/burns were excluded from our study.

Patients (1 month-12 years) admitted for shock in PICU, personal details and history were taken initially. Rapid cardiopulmonary assessment and physical examination including general and systemic examination were done and entry made in the datasheet.

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 to the PICU only if they required 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. Routine investigations were taken in all the patients, specific investigations that are mentioned in the proforma were taken in required cases.

The patients were managed according to the protocol adapted from text book 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.

Out of the 257 patients studied, 186 accounted for shock and were recruited in our study as per the inclusion and exclusion criteria. At an alpha error of 5% and assuming a precision of 6, the sample size was fixed at 6 and the subjects were selected using simple random sampling technique. The data obtained was entered in a Microsoft Excel sheet, and statistical analysis was performed using SPSS v.22 software. Descriptive analysis was performed using mean±SD, quantitative variables were compared with independent t test, and categorical variables were compared using Chi square test. Other statistical methods were used as required and p value <0.05 was considered statistically significant.

RESULTS

During the study period 257 patients were studied, of which 186 were accounted for shock. Proportional morbidity of shock in children 1 month to 12 years during the 1-year study period was analyzed. There were totally 186 children admitted with shock in this period in the whole hospital.

$$= \frac{\text{total number of children with shock}}{\textit{total number of hospital admissions (in patients) during the study period}} \times 100$$

$$= \frac{257}{12000} \times 100$$

$$= 2.1\%.$$

Table 1: Age and sex distribution with shock.

Age group	Male		Female		Total	
	N	%	N	%	N	%
1-12 months	50	64.1	28	35.9	78	42
>1-5 years	34	50.7	33	49.2	67	36
>5-10 years	21	63.7	12	36.3	33	17.7
>10-12 years	5	62.5	3	37.5	8	4.3
Total	110	59.1	76	40.9	186	100

Table 2: Clinical presentation of shock.

S. No.	Clinical presentation	N	%
1.	Fever	82	44
2.	Breathlessness	20	10.7
3.	Refusal of feeds	18	9.6
4.	Oliguria	13	6.9
5.	Convulsions	12	6.4
6.	Vomiting	10	5.3
7.	Abdominal pain	10	5.3
8.	Polyuria	6	3.2
9.	Scorpion sting	2	1
10.	Diarrhoea	7	3.7
11.	Bleeding manifestations	4	2.1
12.	Poisoning	2	1

Table 3: Type of shock in different age groups.

Age group	Hypovolemic shock		Septic shock		Cardiogenic shock		Distributive shock		Total	
	N	%	N	%	N	%	N	%	N	%
1-12 months	5	6.4	53	67.9	15	19.2	5	6.4	78	42
>1-5 years	9	13.4	32	47.7	10	14.9	16	23.8	67	36
>5-10 years	10	30.3	10	30.3	4	12.1	9	27.2	33	17.7
>10-12 years	3	37.5	3	37.5	1	12.5	1	12.5	8	4.3
Total	27	14.5	98	52.6	30	16.1	31	16.6	186	100

Table 4: Final diagnosis (etiology) in children with shock.

S. no.	Final diagnosis	N	%
1.	Bronchopneumonia	55	29.5
2.	Sepsis without focus	25	13.4
3.	Seizure disorder/status epilepticus	21	11.2
4.	Acute CNS infections	17	9.1
5.	Congenital heart disease	17	9.1
6.	Diabetic keto acidosis	11	5.9
7.	Dengue shock syndrome	10	5.3
8.	Scorpion Sting	2	1
9.	Asthma	3	1.6
10.	Acute watery diarrhoea	7	3.7
11.	Bronchiolitis	2	1
12.	Kerosene ingestion	1	0.5
13.	Myocarditis	2	1
14.	Tetanus	1	0.5
15.	Dilated cardiomyopathy	3	1.6

Continued.

S. no.	Final diagnosis	N	%
16.	Hepatic encephalopathy	2	1
17.	Bleeding disorders	4	2.1
18.	Neem oil ingestion	1	0.5
19.	Renal tubular acidosis	1	0.5
20.	Extra hepatic portal obstruction/PHT	1	0.5
21.	Leptospirosis	1	0.5

Table 5: Category of shock in all age groups of children.

Age group	Compensated shock		Decompensated shock		Total	
	N	%	N	%	N	%
1-12 months	40	51.2	38	48.7	78	42
>1-5 years	52	77.6	20	29.8	67	36
>5-10 years	20	60.6	11	33.3	33	17.7
>10-12 years	3	37.5	2	2.5	8	4.3
Total	115	61.8	71	38.2	186	100

Table 6: Outcome of children presented with shock.

S. No.	Outcome	N	%
1.	Survived	125	67.2
2.	Death	61	32.8

Table 7: Association between the risk factors and outcome (death) (univariate analysis).

S. no.	Variables	Outcome				P value	OR for death	95% CI for OR
		Died		Survived				
		N	%	N	%			
1.	Age							
	<1 year	30	49.1	45	36	0.051	1.70	(0.993, 2.913)
	>1 year	31	50.9	80	64			
2.	Undernutrition							
	Yes	21	34.4	25	20	0.03	1.11	(1.12, 3.72)
	No	40	65.6	100	80			
3.	Decompensated shock							
	Yes	45	73.8	26	20.8	0.001	12.07	(4.34, 20.94)
	No	16	26.2	99	79.2			
4.	Sepsis							
	Yes	34	55.7	52	41.6	0.07	1.34	(0.458, 2.20)
	No	27	44.3	73	58.4			
5.	Cardiogenic shock							
	Yes	16	26.2	10	8.0	<0.001	3.62	(1.73, 7.52)
	No	45	73.8	115	92.0			
6.	Duration of shock							
	> or =6 hours	43	70.4	29	23.2	0.003	6.35	(2.88, 12.15)
	<6 Hours	18	29.6	98	78.4			
7.	Duration of illness							
	>12 hours	32	52.4	72	57.6	0.21	0.72	(0.43, 1.28)
	<12 hours	29	47.6	53	42.4			
8.	Leucopenia							
	Yes	14	23.0	5	4.0	<0.001	5.91	(2.38, 14.71)
	No	47	78.0	120	96.0			
9.	Hypocalcemia							
	Yes	23	37.7	12	9.6	<0.001	5.00	(2.58, 9.76)
	No	38	62.3	113	90.4			

Continued.

S. no.	Variables	Outcome				P value	OR	95% CI for OR
10.	Inotrope requirement							
	Yes	58	95.0	74	59.2	<0.001	14.45	(5.00, 41.55)
	No	03	5.0	51	40.8			
11.	Ventilatory support							
	Yes	59	96.7	53	42.4	<0.001	104.31	(14.25, 776.12)
	No	02	3.3	72	57.6			
12.	MODS							
	Yes	43	70.4	15	12.0	<0.001	11.69	(6.60, 24.00)
	No	18	29.6	110	88.0			

1% of all in hospital admissions had shock at presentation.

In the present study overall frequency of shock is 2.1% and younger age group is more affected, progressively reduces as age advances.

In this study male:female ratio is 4.1:1 (Table 1).

In this study, the predominant presenting feature in children with shock was fever (82 cases, 44%), followed by breathlessness (20 cases, 10.7%), refusal of feeds (18 cases, 9.6%) oliguria (13 cases, 6.9%) convulsions (12 cases, 6.4%) vomiting (10 cases, 5.3%), abdominal pain (10 cases, 5.3%), polyuria (6 cases, 3.2%), 2 patients (1%) presented with scorpion sting. 7 patients (3.7%) presented with diarrhea, 4 (2.1%) with bleeding manifestations and 2 (1%) history of poisoning (Table 2).

In the present study, septic shock was the commonest type of shock (98/186, 52.6%) followed by distributive shock (31/186, 16.6%), hypovolemic shock (27/186, 14.5%), and cardiogenic shock (30/186, 16.1%), in those who get admitted in the PICU. In 1 month to 12 months age group, septic shock was the common type of shock (53/78, 67.9%) followed by cardiogenic shock, distributive shock and hypovolemic shock.

In >1 year to 5 years age group, septic shock (32/67, 47.7%) continues to be a common type of shock followed by distributive shock (23.8%), 14.9% hypovolemic and 13.4% cardiogenic shock in this age group. In more than 5 years to 10 years age group, hypovolemic shock and septic shock was 30.3% and 30.3% followed by both distributive and cardiogenic shock 27.2% and 12.1%. In >10 years to 12 years age group hypovolemic shock was the most common one followed by septic shock, cardiogenic, and distributive shock (Table 3).

In this study shows final diagnosis in children with shock presents bronchopneumonia was the common cause for shock in children (29.5%), followed by sepsis without focus (13.4%), seizure disorder (11.2%), acute CNS infection (17 cases, 9.1%). In some cases more than one cause was found, bronchopneumonia and acute CNS infection (Table 4).

In this study, category of shock, in all age group children shows bronchopneumonia was the common cause for shock in children (29.5%), followed by sepsis without focus (13.4%), seizure disorder (11.2%), acute CNS infection (17 cases, 9.1%). In some cases, more than one cause was found, bronchopneumonia and acute CNS infection (Table 5).

It is found that out of 186 cases, 125 survived (67.2%), 61 died (32.8%) (Table 6).

Association between the risk factors and outcome (univariate analysis) shows that there is highly statistically significant association between the following risk factors and adverse outcome (mortality) undernutrition, decompensated shock, cardiogenic shock, leucopenia, hypocalcemia, inotrope requirement, ventilatory support, MODS (Table 7).

Undernutrition was present in higher proportion of children who died (21/61, 34.4%) when compared to those who had survived (25/125, 20.5%). Odds of being undernourished is 1.11, among the children who died, when compared to those who had survived (1.11 (1.12, 3.72).

Decompensated shock was present in higher proportion of children who Died (45/61, 73.8%) when compared to those who had survived (26/125, 20.8%). Odds of having decompensated shock is 12.07, among the children who died when compared to those who had survived (12.07 (4.34, 20.94).

The other variables, age, duration of illness and sepsis were not significantly associated with the corresponding 95% confidence interval for odds.

DISCUSSION

Shock is a major cause of morbidity and mortality in critically ill children worldwide. The frequency of shock noted in pediatric intensive care was 2.1%. Most commonly shock occurred in younger age group from 1 month to 12 months and it progressively reduced as age increases. In this study we found males were most commonly affected.

In this study, septic shock was the most commonly encountered shock in all the age group children and the distribution of shock changed at different age group. In 1-month to 12 months infants after septic shock, cardiogenic shock was followed by distributive and hypovolemic shock. In children of 1 to 5 years, a pattern of septic shock followed by distributive, hypovolemic, and cardiogenic shock was seen. In children of 1 to 5 years, hypovolemic shock and septic shock were common followed by distributive and cardiogenic shock. In children after 10 years of age, hypovolemic shock followed by septic shock was seen. Thus, a pattern of shock observed according to the age of the cases.

Septic shock was the most commonly encountered shock in all the age group children and in younger age group septic shock was followed by cardiogenic, distributive and hypovolemic shock. But as age advances hypovolemic shock was followed by septic shock.

According to Western data, shock occurs in approximately 2% of all hospitalized children and adults in united states.[6] In the Western countries, shock occurs in approximately 2% of all hospitalized infants, children and adults.[6] The mortality considerably varies depending on the etiology and clinical scenario. There is sparse data about the incidence of shock in developing countries. Few Indian studies have reported a frequency of 4.3%, while another has reported it to be 9%.[7,8] Majority of patients in the present study were under 5 years of age, of which 42% were infants. Present study findings are consistent with the previous studies even though the frequency of shock is less in comparison which depends on the admission of children at the hospital and space availability for the other admissions.[8-12]

The major risk factors in critically ill patients were Undernutrition ((21/61, 34.4%) in children who had died, (25/125, 20.5%) who had survived. Death occurred due to decompensated shock (73.8%) and survived by decompensated shock (20.8%). Leucopenia, hypocalcemia, inotrope requirement, ventilatory support, MODS were significant in the study. Many cases required ventilator support but survival rate is less in the study.

Benamer et al reported leucocytosis in 50% patients, anemia in 40% and raised liver enzymes in 43%.[12] Authors observed higher proportion of the above data in present study, which could be attributed to most children being under 5 years age and one-third of the patients being infants. Also, malnutrition (37.2% in present study) being common in a developing country like ours can make children vulnerable to infections as well as higher incidence of anemia. Authors noted evidence of sepsis in patients. However, due to financial constraints and logistic reasons, authors could not perform quantitative CRP and arterial lactate levels.

Severe pneumonia was the commonest illness leading to mechanical ventilation and presenting with septic shock. Militaru et al from Romania also reported respiratory infection to be the most (64%) common etiology followed by digestive tract infection and urinary tract infection. but at our study pneumonia was followed by seizures disorders and acute CNS infections.[11]

Majority of patients with cardiogenic shock had decompensated shock requiring early intubation and inotropic support. Ventilator associated pneumonia developed in few patients. Few developed dengue shock syndrome, acute watery diarrhea and hepatic encephalopathy.

Mortality rate was high (32.8%) in this study. Critically ill children requiring Mechanical ventilation have high chance of morbidity and mortality. In addition, shock in children is difficult to diagnose in early stages and contributes significantly to mortality in children.[4,5] Pollack et al reported mortality rate of more than 50% in pediatric patients with septic shock.[13]

A few other Indian studies have also reported mortality rates of 47% in Punjab, 58% in Haryana, and 50% in AIIMS, New Delhi.[14,15] Another study in Romania reported a mortality rate of 53% in children with shock.[11] Need for mechanical ventilation and decompensated shock were significantly associated with mortality. Han et al reported that non-survivors required more inotropic therapies as compared to survivors.[16] Since authors have included on those children who required mechanical ventilation, the present study mortality rate is proportionately higher in intensive management as per standard surviving sepsis guidelines and other standard protocols.

Authors did not find any correlation of mortality in shock with PIM3 score. Kaur et al demonstrated that mortality among children with sepsis, severe sepsis, and septic shock were not predicted by any individual factors including the time lag to PICU transfer, duration of PICU stay, presence of multiorgan dysfunction, and PRISM score at admission.[14] However, it had small sample size hence further research in this is imperative. Present study being retrospective had its limitations since management decisions could not be effectively standardized in poor resource setting.

Management of septic shock especially in those children requiring mechanical ventilation requires good infrastructure, trained staff and protocol-based management. Inspite of these, the morbidity and mortality in this condition is high. Developing countries need more feasible, clear and practical guidelines which can be utilized in resource limited settings.

Limitations

Retrospective nature was the limitation of this study. Variation in filling the patient records, completeness of data as well as variation in the management protocol could have influenced our findings. Adherence to early goal directed therapy could not be evaluated because of the study nature.

CONCLUSION

Shock is a major cause of morbidity and mortality in children especially below 5 years of age. Septic shock is the commonest form of shock in children who developed shock and required mechanical ventilation. Severe pneumonia was the commonest illness causing Septic shock. Mortality was associated with longer length of stay on mechanical ventilation. Larger prospective multicentric study in developing countries is desirable.

Recommendations

It is desirable to have customized protocol for each unit in line with surviving sepsis campaign guidelines. Larger well-designed studies using uniform protocols are needed to study the epidemiology and outcome of shock in Indian children.

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