



Original Research Article

STUDY OF ETIOLOGY, SEVERITY AND OUTCOME OF SHOCK IN CHILDREN OF AGE 1 TO 10 YEARS ADMITTED IN PEDIATRIC INTENSIVE CARE UNIT IN TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Pediatric shock accounts for significant mortality and morbidity worldwide. Shock approximately occurs in 2% of children admitted to pediatric ICU worldwide as per most western literature. Shock is classified based on severity as compensated or decompensated shock. Etiology based classification of Shock: Hypovolemic shock, Septic shock, cardiogenic shock, Distributive shock, Obstructive shock. The outcome of shock depends on severity at the time of presentation, etiology and resources available for intervention. It is necessary to monitor the patients in shock with clinical and laboratory parameters which guide the therapeutic intervention and defines the outcome. Early recognition and prompt intervention are extremely important in the treatment of all forms of shock. **Aims and objectives:** To study the Etiology, Severity and outcome of shock in children of age 1 to 10 years. To evaluate the response to treatment in various forms of shock

Materials and Methods: Hospital based observational study at PICU, King George Hospital, and Visakhapatnam for a period of one year. All children of age 1 to 10 years admitted with shock were taken detailed history, thorough physical examination and relevant laboratory investigations were done. The final statistical analysis was done with the use of Statistical Package for Social Sciences (SPSS) software version 21.0.

Results: A total of 60 cases were enrolled in the study of which the predominant age group involved was 1 to 3 years. Hypovolemic shock is most common followed by septic and mixed shock. Decompensated shock and compensated shock constituted 63.4% and 36.65% respectively. Most common etiology was Severe acute malnutrition (16.7%) followed by ADD with severe dehydration (13.3%); Dengue (13.3%) and severe Pneumonia (10%). 40% of the patients with shock responded to fluid resuscitation alone and 55% of the patients required inotrope support. Overall mortality rate was 31.7%. Mortality rate was more among the age group of 1 to 3 years. Mortality was highest in mixed followed by septic shock.

Conclusion: As the age of the patients increased, the mortality rate decreased and this is statistically significant with p value <0.05. Compensated shock had a survival rate of 100% while only 45% of decompensated shock survived. Abnormal ABG and high S. Lactate levels showed higher mortality. Most cases of decompensated shock leading to mortality were due to sepsis. This indicates the significance of early diagnosis of shock in compensated stage, etiology of shock and its timely management.

Keywords: Decompensated shock; septic shock.

INTRODUCTION

Pediatric shock accounts for significant mortality and morbidity worldwide. Shock approximately occurs in 2% of children admitted to pediatric ICU worldwide as per most western literature.^[1] Shock is an acute process in which the circulatory system is not able to provide sufficient oxygen and adequate nutrients to satisfy the metabolic demands of tissues. Insufficient oxygen at tissue level cannot support normal aerobic cellular metabolism leading to a shift to less efficient anaerobic metabolism.^[2-4]

Shock is classified based on severity as compensated or decompensated shock. Etiology based classification of Shock: Hypovolemic shock, Septic shock, cardiogenic shock, Distributive shock, Obstructive shock. The signs of shock can be very subtle in pediatric patients. Tachycardia, increased capillary refill time and altered level of consciousness are early signs of shock. Hypotension is a late feature of shock. For better outcome shock should be identified before development of hypotension.^[5-7]

Once diagnosed shock has to be managed aggressively. First hour is considered the golden hour. Early recognition and prompt intervention are extremely important in the treatment of all forms of shock. Early restoration of the normal hemostasis results in better outcome.^[8] The outcome of shock also depends on severity at the time of presentation, etiology and resources available for intervention. The mortality rates are high in developing countries compared to developed countries. It is necessary to monitor the patients in shock or impending shock with clinical and laboratory parameters which guide the therapeutic intervention and defines the outcome. This study is a hospital based observational study in children of age 1 to 10 years with shock. This study is taken up to find out the etiology, severity and assessment of the outcome.^[9-11]

MATERIAL AND METHODS

This study was a hospital based observational study done in children presenting to paediatric intensive care unit and ward, King George Hospital, Tertiary care hospital, Visakhapatnam, for a period of 1 year from August 2021 to July 2022. All children of age 1 to 10 years admitted with shock in paediatric intensive care unit in king george hospital, Visakhapatnam were included in this study. Ethics committee approval was obtained prior to the study at Andhra medical College. Prior informed consent was taken from parents or care takers of their children enrolled in this study. 60 children of age 1 to 10 years admitted to Pediatric Intensive Care Unit of King George Hospital with shock and those who meet the inclusion criteria were enrolled in this study. To evaluate the etiology, type and severity of

shock, a detailed history was taken; thorough physical examination and relevant laboratory investigations were done.

RESULTS

Of the total 60 patients 48% children are between 1 to 3 years constituting approximately half of the cases presenting to the pediatric intensive care unit with shock. 4 to 6 years proportion is 35%. 7 to 10 years proportion is 17%.

Among 60 patients, male children constitute 55%, female children constitute 45%. Hypovolemic shock constitutes the major proportion with 33.33% followed by septic shock and mixed type (hypovolemic + septic) each with 28.3%, cardiogenic shock 5%, obstructive shock 3% and mixed (hypovolemic + neurogenic) 1.6%. Tachycardia was noted in 60% of the cases, tachypnea was noted in 57% of the cases, oliguria was noted in 40% of the cases, hypotension was noted in 37% of the cases, and prolonged capillary refill time was noted in 64% of the cases. [Table 1]

Laboratory profile

12% of the patients had abnormal renal function tests like raised blood urea and serum creatinine, 20% of the patients had abnormal liver function tests like raised SGOT and SGPT. CRP was positive in 68% of the cases. Chest x-ray was abnormal in 18% of the cases with patchy infiltrates in 8 cases, cardiomegaly in 3 cases. Ultrasound abdomen was abnormal in 3% of the cases (liver abscess in 1 case, massive ascites in 1 case, mild hepatomegaly with moderate ascites in 1 case),^[12,13]

Distribution of severity of shock

Of the total 60 admissions, cases of decompensated shock constituted 63.4% and those of compensated shock constituted 36.65%,^[14-16]

Distribution of severity according to clinical type

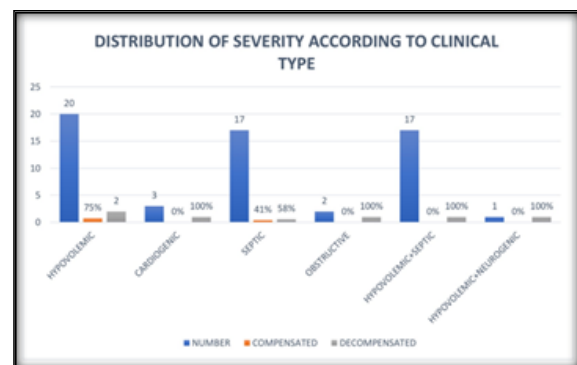


Figure 1: Distribution of severity according to clinical type

Of the total 20 cases of hypovolemic shock, 15 presented in compensated stage, which constitutes 75% of the total 20 cases. 5 cases of hypovolemic shock presented in the decompensated stage, constituting 25% of the total. Almost all cases of

cardiogenic, obstructive and mixed types of shock presented in the decompensated stage. Of the total 17 cases of septic shock, 7 presented in compensated stage which constitutes 41.1% of the total 17 cases. 10 cases of septic shock presented in decompensated stage which constitutes 58.9% of the total 17 cases.^[17,18]

Overall Mortality Rate

Overall mortality rate is 31.7% (19/60).

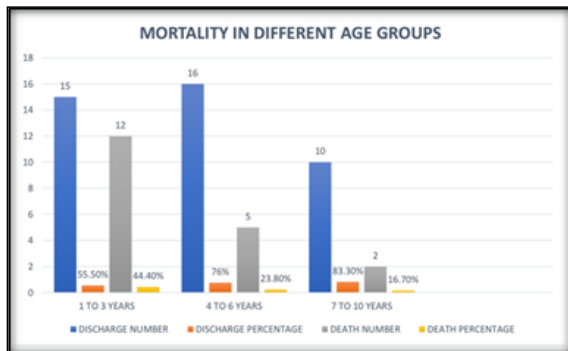


Figure 2: Mortality in different age groups

Of the total 27 cases in the age group 1 to 3 years the discharge rate is 55.5% and the mortality rate is 44.4%. Of the total 21 cases in the age group 4 to 6 years the discharge rate is 76% and the mortality rate is 23.8%. Of the total 12 cases in the age group 7 to 10 years the discharge rate is 83.3% and the mortality rate is 16.7%. As the age of the cases increased, the survival rate improved and the mortality rate decreased. However, with the chi-square value 3.8841 and p-value 0.14341 (>0.05) no significant association was observed.^[19,20]

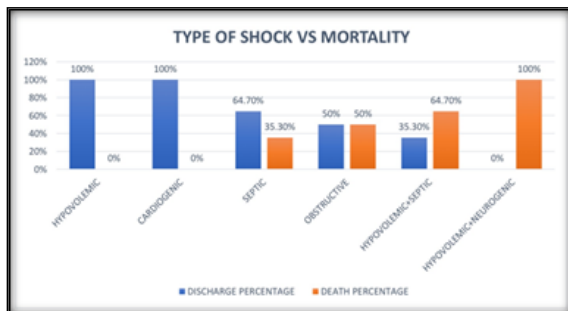


Figure 3: Types of shock vs mortality

The highest survival rate is observed among hypovolemic shock with 100% discharges. All 3 cases of cardiogenic shock were survived. Out of 2 cases of obstructive shock 1 survived and 1 expired. The total number of cases with septic shock was 17 out of whom 11 were discharged with the discharge rate of 64.7% and the mortality rate of 35.3%. The total number of cases with mixed shock (hypovolemic + septic) was 17 out of whom 6 were discharged with the discharge rate of 35.3% and mortality rate of 64.7%. 1 case of Hypovolemic + neurogenic shock was expired. With a chi-square value 22.7016 and p value 0.000145 significant association was reported.^[21,22]

Distribution of outcome according to severity

The discharge rate among cases presenting in a state of compensated shock is 100% and the discharge rate in cases presenting with decompensated shock is 47.3%. With chi-square value 14.7967, p-value of 0.00012 (<0.05), significant association was observed.^[23,24]

Outcome of patients on mechanical ventilator with shock

Out of total 60 cases with shock ventilator care was given to 20 patients of them 3 survived with a discharge rate of 15%.^[25]

GCS at the time of diagnosis vs outcome

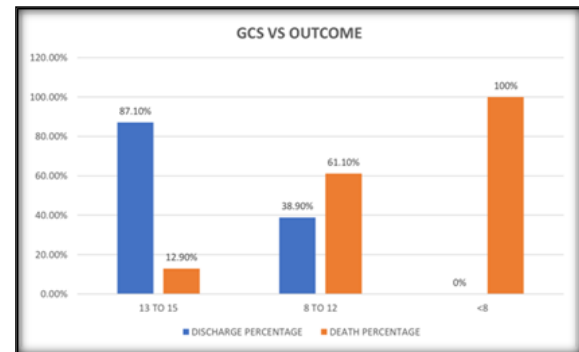


Figure 4: GCS vs outcome

Among the 60 patients those who presented with GCS <8 at the time of admission had a mortality rate of 100% and those who presented with GCS of 8 to 12 at the time of admission had a mortality rate of 61.1% and those with GCS of 13 to 15 at the time of admission had a mortality rate of 12.9%. With chi-square value 17.2304 and p-value of 0.000181 (<0.05) significant association was observed.

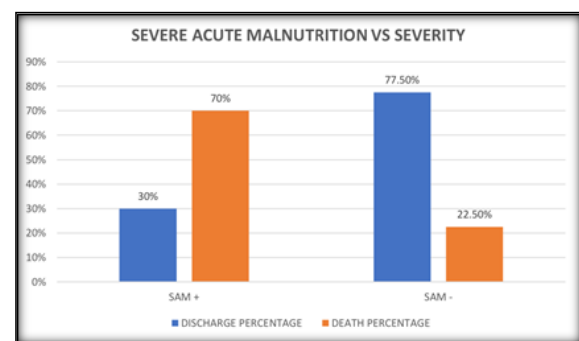


Figure 5: Severe acute malnutrition vs severity

Out of 50 children in the age group 1 to 5 years 10 cases had SAM (10/50). The mortality rate among SAM cases was 70%. With the chi-square value 8.295 and p-value 0.003975 (<0.05) significant association was observed.

Etiology and outcome of hypovolemic shock

Out of the total 20 cases of hypovolemic shock, 40% (8/20) were acute diarrheal disease with severe dehydration. Cases, 35% (7/20) were dengue cases. 15% (3/20) were severe DKA. 10% (2/20) was due to upper GI bleed. Dengue was the commonest cause of hypovolemic shock.^[26]

Etiology vs outcome of septic shock

Of the total 17 cases of septic shock, the leading causes were respiratory tract infections with 47% (8/17). Followed by central nervous system infections 41.1% (7/17). Scrub typhus and MISC constitute 5.8% (1/17) each.^[27]

Etiology and outcome of mixed shock

Out of the total 17 cases of mixed shock, 47% (9/17) were severe dengue cases. 16% (3/17) were viral meningoencephalitis. 15% (3/17) were complicated malaria. 10.5% (2/17) were severe pneumonia. 6% each (1/17) were nephrotic syndrome and scrub typhus.^[28]

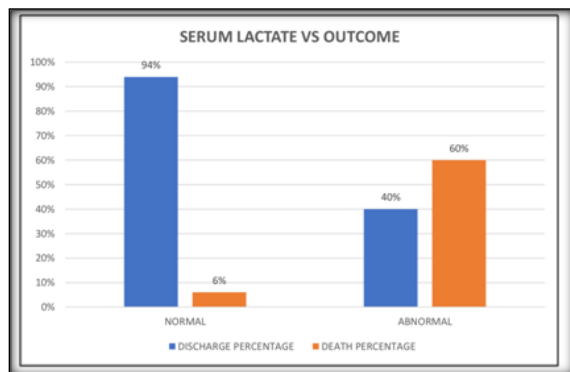


Figure 6: Serum lactate vs outcome

Among the total 60 patients 32 cases had normal serum lactate at the time of diagnosis of shock with the discharge rate of 94% and the death rate of 6%. 28 cases had abnormal serum lactate at the time of diagnosis of shock with the discharge rate of 40% and the death rate of 60%. With the chi-square value 20.4713 and p-value <0.00001 (<0.05) significant association was observed.^[29]

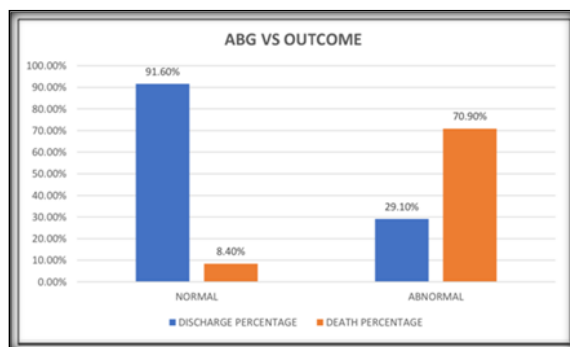


Figure 7: ABG vs outcome

Among 19 patients who expired, 17 patients had abnormal ABG like metabolic acidosis, hypoxia and respiratory acidosis. With chi-square value 25.3125 and p-value.

DISCUSSION

Out of 60 children with shock enrolled in the study, 48% cases are between 1 to 3 years and males constituted 55%. In the current study, the shock was clinically categorized as hypovolemic, cardiogenic, septic, obstructive and distributive shock.

Hypovolemic shock constituted the major proportion with 33.33%.^[30,31] Other causes include Septic shock and mixed (Hypovolemic + septic) type of shock each with 28.3% respectively, cardiogenic shock with 5%, obstructive shock with 3%. Cases of compensated shock constituted 36.6% whereas cases of decompensated shock constituted 63.4%. In the current study, 75% of the hypovolemic shock cases presented in the compensated stage with normal blood pressure while 25% presented in the decompensated stage.^[31,32] All cases of cardiogenic, obstructive and mixed shock presented in the decompensated stage. 58.9%,^[33] of the septic shock presented in the decompensated stage and 41.1% of the septic shock cases presented in compensated stage. Fever was noted in 77%, tachycardia was seen in 60% of the cases, tachypnea in 57% of the cases whereas oliguria, hypotension was seen in 40%, 37% of the cases respectively. In the present study, 12% of the patients had abnormal renal function tests like raised blood urea and serum creatinine, 20% of the patients had deranged liver function tests like raised SGOT and SGPT. CRP was positive in 68% of the cases. In the study, 35% cases had abnormal liver function tests, 46% had abnormal renal function tests.^[34-36]

In the present study overall mortality was 31.7%. In this study,^[29] the mortality rate was 34% and mortality rate of 6%. In the current study the mortality among age group 1 to 3 years was 44.4%, among age group 4 to 6 years was 23.8% and among age group 7 to 10 years was 16.7%. As the age of the patients increased, the survival rate improved and the death rate decreased.^[37-39] The difference in the survival rate in various age groups. In the present study all the cases of hypovolemic shock have survived, indicating the significance of initial fluid bolus and subsequent reassessment. Mixed (hypovolemic + neurogenic) shock had the high death rate 100%. Obstructive shock had equal rate of survival and mortality (50%). Cardiogenic shock had 100% survival rate. Septic shock had mortality rate of 67% in the current study. This indicates that mortality in shock depends upon the etiology and the type of shock. In the present study compensated shock had a survival rate of 100% whereas only 45% of decompensated shock survived. Which indicates the significance of early diagnosis of shock in compensated stage and timely referral.^[40,41]

In the present study, the highest number of admissions were of severe acute malnutrition 16.7%, severe dengue 13.3%, followed by ADD with severe dehydration with 13.3%, severe pneumonia cases were 10%. Viral meningoencephalitis and acute bacterial meningitis cases were 6.7% each. Severe DKA and complicated malaria were 5% each.^[42]

ABG was done for all cases at the time of presentation. Among them 35 cases had normal ABG. Abnormalities in ABG were metabolic acidosis, and respiratory acidosis. Among 19 cases who expired, 17 cases had abnormal ABG

presentation with significant p-value inferring that there is significant association between abnormal ABG and the outcome. Among the total 60 patients, 54% had normal serum lactate at presentation. Of them the discharge rate of 94% and the death rate of 6%. 46% had abnormal serum lactate at presentation. Of them the discharge rate of 40% and the death rate of 60%. With the p-value of <0.00001, inferring that there is significant association between abnormal serum lactate and outcome.^[43-45]

The mortality rate was 100% among those who had GCS <8 at presentation. The mortality rate was 61.1% among those who had GCS of 8 to 12 at presentation. The mortality rate was 12.9% among those who had GCS of 13 to 15 at presentation. As the GCS of the patients increased, the survival rate improved. With p-value of 0.000181 (<0.05) significant association was observed. In the current study 10 children among the age group of 1 to 5 years found to had SAM. All of them presented with septic shock. 3 of them survived and 7 expired and there is significant association was observed between SAM and mortality.^[45-47]

Of the total 20 cases of hypovolemic shock, 40% were acute diarrhoeal disease with severe dehydration, 35% were dengue cases. 15% were severe DKA. 10% were due to upper GI bleed. Acute diarrhoeal disease was the commonest cause of hypovolemic shock. Severe sepsis constituted 6 to 8% of Pediatric intensive care admissions.^[46,47] Severe acute malnutrition was the commonest risk factor associated with septic shock. The most common cause of sepsis in a global study, done among all age groups was acute diarrhoeal disease with severe dehydration and the most common cause of sepsis related mortality was lower respiratory tract infection. Of the total 17 cases of septic shock, leading causes were respiratory tract infections with 47%, followed by central nervous system infections 41.1%. Scrub typhus and MISC constitute 5.8% each.^[46-48]

Of the total 17 cases of mixed shock, 47% were severe dengue cases. 16% were viral meningoencephalitis. 15% were complicated malaria. 10.5% were severe pneumonia. 6% each were nephrotic syndrome and scrub typhus.^[49] In the current study multiorgan dysfunction syndrome was noted in 5%. Among those 2 children expired. Among total 60 cases, 2d echo was done for 44 cases, out of whom 3 children had VSD7 and 9 had myocardial dysfunction.^[50,51]

In the present study, fluid responsive cases were 40%. Fluid non responsive and inotrope responsive shock cases were 55%. 5% cases needed only inotrope. Hence inotrope requirement was present for a total of 60%. 6.7% cases had anemia at admission and needed packed red blood transfusion at the time of presentation.^[52] The usage of inotropes or vasopressors in shock must follow the fluid resuscitation, if first used may worsen organ perfusion if the patient has inadequate intravascular volume. Vasoactive agents are preferably started

within 60 min of resuscitation. In the current study the inotrope of choice was Dobutamine for cardiogenic shock and milrinone was the second line if needed. The inotrope of choice in warm septic shock was Noradrenaline and Adrenaline for cold septic shock. Ventilator care was given to 34% cases, among which survivors were 15%. Of the 66% cases who were not ventilated survival rate was 95%.^[51-54]

CONCLUSION

Shock is an acute syndrome in which the circulatory system is unable to provide adequate oxygen and nutrients to meet the metabolic demands of vital organs and tissues. The signs of shock can be very subtle in pediatric patients. Tachycardia, increased capillary refilling time, decreased urine output and altered level of consciousness are early signs of shock, and hypotension is a late feature of shock. From the present study, the following are the risk factors for mortality. Age group – 1 to 3 years (45%). Infections of the central nervous system. Predisposing conditions like severe acute malnutrition. Abnormal ABG, Need for mechanical ventilation, elevated serum lactate and low GCS at the time of diagnosis. Decompensated shock. Early recognition and prompt intervention are extremely important that early restoration of normal hemostasis associated with better outcome.

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Conflict of interest

None.

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