CASE SERIES

Frequency of need for Mechanical Ventilation and Dialysis in Children with Septic Shock

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Abstract

TTo determine the frequency of need for mechanical ventilation and dialysis in children admitted with septic shock to the Paediatric Intensive Care Unit (PICU), this descriptive case series was conducted from August 2015 to February 2016. A total of 100 children from 1 month to 15 years of age of both sexes having septic shock diagnosed within 24 hours of admission were enrolled from the PICU of Children's Hospital Lahore after informed consent from parents of the patients. The standard guideline for the treatment of septic shock was followed. Patients were followed throughout the stay in the hospital to assess the need for mechanical ventilation or the need for dialysis. Arterial blood gases and urea, creatinine were assessed daily or more frequently (if needed) till discharge or death. Of the 100 patients recruited in the study, with a mean age of 2.16±3.26 years, 63 (63 %) were male while 37 (37%) were females. The frequency of need for mechanical ventilation was recorded in 75 (75%) while 22 (22%) required dialysis. We concluded that the frequency of dialysis in children admitted to PICU with septic shock is significantly lower as compared to frequency of mechanical ventilation.

Keywords: Children, septic shock, outcome, need for ventilation, dialysis.

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Introduction

Sepsis is a clinical entity specified by body inflammatory response to a pathogen.[1] The significance of depicting an early sign of sepsis and its management has been emphasized by researchers being more important in cure and treatment and its effect on short term outcome have been studied. Sepsis produces different clinical symptoms that are mainly because of the body's response towards pathogens, which may cause rapid worsening and followed by abnormal function of one or more organs leading to septic shock[2] (a condition sometimes occurring in severe sepsis, in which the blood pressure falls and the organs of the body fail to receive sufficient oxygen.). This in turn; is accompanied by single or multiple organ dysfunction, acute respiratory distress syndrome, neurological dysfunction, acute renal failure which can lead death if not recognized promptly and treated aggressively.[3,4] Just like most of the infections, the majority affected by this comprise of children, people with weaker immunity and aged people as their immune system is not strong enough to handle this infection. On the other hand in adults and healthy people, the immune system is strong so the mortality rate is low.[5]

Study reports have been compiled consisting of sepsis, severe sepsis, and septic shock.[6,7] The three levels of the disease may vary and the population sepsis incidence ranged from 22 to 240/100000, that of severe sepsis from 13 to 300/100000 and of septic shock 11/100000.[8] Sepsis is the major cause of infant mortality in developing countries and causing almost over half a million deaths worldwide.[9] A major portion of this death is in third world countries.[10] In developed countries range of mortality caused by septic shock is from 10% to 50% among children while in developing countries like Pakistan many more children develop sepsis and die.[11,12] In septic shock there is a high risk of developing acute respiratory distress syndrome requiring mechanical ventilation in up to 68% patients[13] and renal failure requiring dialysis in upto 51% patients.[14]

In developing countries like Pakistan where the child mortality rate is high due to sepsis and septic shock, we could not find any study which highlights the outcome of septic shock in children. So, the purpose to conduct this study was to document local data on the outcome of children admitted with septic shock especially in the context of the need for mechanical ventilation and dialysis. This will help us to re-emphasize the importance of recognizing septic shock promptly for a better outcome in children. The collection of data and study of results will reveal local parameters and immune system strength also. It will also help to minimize the risk of further complications and severity in the infections.

Patients and Methods

This cross sectional study was conducted from August 2015 to February 2016 using Delphi Technique as a part of a project approved by the local IRB titled "Outcome of Children Admitted with Septic Shock". Convenient, Non-

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purposive sampling technique was used and a sample size of 100 cases was calculated with a 95% confidence level, 10% margin of error and taking an expected percentage of need for dialysis i.e. 51%[13] (least among both) in children admitted with sepsis shock.

After informed consent from parents, each patient fulfilling the operational definition of septic shock was registered for the study. The patient's brief history and important parameters (heart rate (HR), blood pressure (BP), temperature (Temp), and respiratory rate (RR)) were measured immediately on arrival. As the measurement of these parameters was a key step towards diagnosis and research work so special care was taken for accurate measurement of all parameters and counter check. BP was measured by an oscillometric method in all patients. The temperature was measured with a standardized digital thermometer and HR was manually recorded and counter-checked by ECG tracing on a cardiac monitor without any interruption. Complete blood count and appropriate cultures were done for each case. The standard guideline for the treatment of septic shock was followed. Patients were followed throughout the stay in the hospital to assess the need for mechanical ventilation or the need for dialysis. Arterial blood gases and urea, creatinine were assessed daily till discharge or death. The information gathered was documented in the data collection form.

Data were entered in Statistical Package of Social Sciences (SPSS version 20). Descriptive statistics were used to describe frequencies and percentages of gender and the need for mechanical ventilation and dialysis. Age was described as mean and standard deviation (SD). The data was further analyzed by stratifying in various age groups, nutrition status15 (assessed by height for age and weight for height) duration of sepsis and gender. A complete picture of the data is given in Table-1 and Table-2.

Results

A total of 100 patients who were confirmed to be suffering from septic shock were considered to find the frequency of need for ventilation and dialysis in children admitted in PICU with septic shock. The mean age the as 2.16±3.26 years. Age distribution of the patients showed that 83 (83%) were between 1-5 years of age while 17 (17 %) were between 6-15 years of age. Majority 63 (63 %) were male while 7 (37 %) were females.

The frequency of need for mechanical ventilation was recorded in 75 (75 %) while 22 (22 %) required dialysis.

When the mechanical ventilation requirement was stratified for the age, there were 63 out of 83 (76%) patients less than 5 years and 12 out of 17 (70%) above 5 years of age with a *p*-value of 0.41. (Table-1) Similarly, stratifying dialysis for age, 19 out of 83 (23%) patients were less than 5 years and 3 out of 17 (18%) above 5 years of age with a *p*-value of 0.45 (Table-2).

Table-1: Need for Mechanical Ventilation Stratified for Various Variables (n =100).

Variable	Total No. (n=100)	Mechanical Ventilation (n=75)
Age:		
< 5 Years	83	63 (76%)
> 5 Years	17	12 (70%)
Gender:		
Male	63	46 (73%)
Female	37	29 (78%)
Nutrition Status:		
Well nourished	53	42 (79%)
Malnourished	47	33(70%)
Duration of Illness:		
< 3 days	42	28 (67%)
> 3 days	58	47 (81%)

Table-2: Need for Dialysis Stratified for Various Variables.

Variable	Total No. (n=100)	Dialysis (n=22)
Age:		
< 5 Years	83	19 (23%)
> 5 Years	17	03 (18%)
Gender:		
Male	63	12 (19%)
Female	37	10 (27%)
Nutrition Status:		
Well nourished	53	12 (23%)
Malnourished	47	10 (21%)
Duration of Illness:		
< 3 days	42	11 (26%)
> 3 days	58	11 (19%)

As regards gender stratification, 73% of male patients (46 out of 63) required mechanical ventilation compared to 78% of females (29 out of 37) with a *p*-value of 0.54. Similarly compared to 19% (12 out of 63) males, 27% (10 out of 37) female patients required dialysis (*p*-value 0.35).

Contrary to general belief, 70% of malnourished children (33 out of 47) required mechanical ventilation compared to 79% with normal nutrition status (42 out of 53), *p*-value 0.29. Similar were the results regarding the need for dialysis, where 21% (10 out of 47) malnourished required as compared to 23% (12 out of 53) with normal nutrition status, *p*-value 0.86.

Eighty percent (47out of 58) of children with a duration of illness more than 3 days at presentation required mechanical ventilation compared to 67% (28 out of 42) where the duration of illness at presentation was less than 3 days (*p*-value 0.10). Moreover, 19% (11 out of 58) with a

duration of illness more than 3 days required dialysis compared to 26% (11 out of 42) with a duration of less than 3 days (*p*-value 0.38).

Discussion

Sepsis is a clinical syndrome that has the ability to worsen the severity of the infection. It causes cardinal inflammation in tissues that are located far from the infection point. These include vasodilation, leukocyte accumulation, increased microvascular permeability, etc. Similarly, Systemic inflammatory response syndrome (SIRS) is another similar syndrome that has the ability to obfuscate a noninfectious insult e.g. acute pancreatitis, pulmonary contusion, etc. In developing countries like Pakistan where the mortality rate in children is high due to sepsis and septic shock, we did not find any study that highlights the outcome of septic shock in children. So, this study was planned to find out local data regarding the outcome of children admitted with shock.

Previously, the literature review revealed that in septic shock there is a high risk of developing Acute Respiratory Distress Syndrome needing mechanical ventilation in 68% patients[13] and renal failure needing dialysis in 51% patients.[14] These findings are comparable with the frequency of mechanical ventilation but relatively higher for the need of dialysis when correlated with our study, this may be due to racial and regional differences.

Jaramillo-Bustamante JC et al.[16] described the socio-demographic and clinical characteristics of patients with sepsis who were admitted at participating paediatric intensive care units and recorded that there were 55% male and 45% females while 68% percent of the patient's required mechanical ventilation. Another study depicted that the use of mechanical ventilation in the emergency department for patients suffering from septic shock with respect to different adjustments and setting of the ventilator, monitoring, and titration methodologies to determine the effect of propagation of acute lung injury after admission in the medical emergency department. It was recorded that Lung-protective ventilation was used in 68 (27.1%) patients and of the dialysis was done in 10% of the cases. They further recorded that after admission from the emergency, they had an increased frequency of mechanical ventilator duration, vasopressor dependence, and hospital length of stay (LOS). The frequency of mechanical ventilation and dialysis was lower than reported in our study.

Demographic data for children admitted in nine PICUs about Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network of children brought to clinical emergency for mechanical ventilation revealed that Acute respiratory failure is the second largest cause after pneumonia, bronchiolitis, trauma, seizures, sepsis, and pulmonary oedema. The data was collected over a span of six months and approx. 17.1% admitted to these PICUs required mechanical ventilation. These patients included those who were reported with septic shock.[17]

Another study recorded that sepsis (22.7%), was the most common indications for ventilation, but this study was restricted to neonates only.[18] Anantharaj recorded a survival rate of 46.1% in cases of sepsis managed with mechanical ventilation.[19]

Szakszon K and others[20] concluded that there are no recommendations defined for the treatment of acute renal failure with ongoing sepsis in children. Authors found that peritoneal dialysis is an easy-to-perform bedside procedure and efficient renal replacement modality in low body weight, seriously ill patients. Early commencement of peritoneal dialysis not only improves fluid and electrolyte imbalance but also may significantly decrease the devastating effects of systemic cytokines storm in sepsis and contribute to a more favourable outcome, even in cases of critical cardiovascular status.

Though, this may be helpful for us to re-emphasise the importance of recognizing septic shock promptly for a better outcome in children. The higher number of children with septic shock requiring mechanical ventilation and dialysis may have various reasons. The fact that a relatively larger number required these interventions when the duration of illness was more than 3 days may suggest late presentation, a phenomenon seen so often in our set-up. Further studies will be required to investigate the reasons of increased need for ventilation and dialysis among septic children in our setup.

Conclusion

We concluded that the frequency of dialysis in children admitted to PICU with septic shock is relatively lower (22%) and the need for ventilation with septic shock is relatively higher (75%) than other published studies.

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