Original Article

Indian Journal of Trauma and Emergency Pediatrics
Volume 9 Number 4, October - December 2017
DOI: http://dx.doi.org/10.21088/ijtep.2348.9987.9417.5

Role of ScvO2 in the Management of Fluid Refractory and Cathecholamine Resistant Shock among Children: A Hospital Based Randomized Controlled Trial

Manisha Vidyanand Chavan*, Pratibha Milind Patil, Mandar Haval*****

Abstract

Background: The highest mortality rates are observed in children under five years in developing countries. Shock is the result of various etiologies and the leading causes of shock in children younger than 5 years of age. More specifically, the outcome benefit of further optimizing metabolic parameters, namely ScvO2, directed therapy remains unknown. Even though current ACCM/PALS guidelines represent best practice, prospective randomized trials are lacking to confirm all components of these recommendations. Hence the present study was undertaken to assess the role of ScvO2 in management of fluid refractory. *Methods:* The study design was one year randomized controlled trial. Institutional Ethical Clearance was obtained for the study prior beginning of the study. Children fulfilling the selection criteria were selected After obtained written informed consent, demographic data was recorded and history was taken. Clinical examination was done for all patients and findings were recorded on predesigned and pretested proforma. *Result:* 31.37% children in group A and 27.45% in group B presented with fever. Majority of the children were hypotensives. 66.67% of patients in both the groups had ephedrine. Outcome among children with group B was significantly better (94.12%) compared to group A (80.39%) supporting the current ACCM/PALS guidelines. *Conclusion*: It may be concluded that, ScvO2 in management of fluid refractory and catecholamine resistant shock has reduced the mortality but did not influence the hospital stay.

Keywords: ScvO2; Shock; Fluid Refractory; Hospital Stay.

Introduction

More than 10 million children die each year in the world. The highest mortality rates are observed in children under five years in developing countries. Shock is the result of various etiologies and the leading causes of shock in children younger than 5 years of age are; pneumonia (19%), Diarrhea (18%), malaria (8%), neonatal pneumonia or sepsis (10%), preterm delivery (10%), and asphyxia at birth (8%) [1].

Author Affiliation: *,**Assistant Professor ***Consultant Paediatrician, Department of Paediatrics, Ashwini Rural Medical College, Hospital and Research Centre, Kumbhari, Solapur, Maharashtra 413006, India.

Corresponding Author: Pratibha M. Patil, Assistant Professor, Department of Paediatrics, Ashwini Rural Medical College, Hospital and Research Centre, Kumbhari, Solapur, Maharashtra 413006, India.
E-mail: chavanmanisha972@gmail.com

Received on 28.12.2017, **Accepted on** 15.01.2018

Several types of shock syndrome can be recognized based on the etiology. Sepsis remains a major cause of mortality and morbidity for children. Although mortality from pediatric sepsis and sepsis shock has decreased from over 95% in 1960s to nearly 10% in 1990s, data from a recent United States survery suggests that more than 4,300 children die each from severe sepsis and septic shock and the annual cost is approximately $ 2 billion [2].

Definitions for pediartric systemic inflammatory response syndrome sepsis, severe sepsis and septic shock were standardized at the international consensus conference in 2002 [3].

Sepsis is defined as SIRS in the presence of suspected or proven infection; and severe sepsis is defined as sepsis with accompanying organ dysfunction. When cardiovascular failure occurs in the setting of severe sepsis then it is classified as septic shock. The consensus definition also provides specific criteria for diagnosis of organ dysfunction (repiratory, cardiovascular, hematologic, neurologic, renal and

hepatic). In adults the classic picture of septic shock is one of high cardiac output and low systemic vascular resistance (SVR) (warm shock) [4,5].

However pediatric vascular tone is maintained in septic shock [6,7,8] and sepsis – induced myocardial dysfunction is more common. Therefore, pediatric septic shock can occur as low cardiac output (CO) / high SVR, high CO / low SVR, or low CO SVR. In fact, in one study where cardiac index was measured, the majority (80%) of septic shock cases had low cardiac index only about 20% presented in the typical "warm shock" (bounding peripheral pulses and flash capillary refill) [7].

This has important therapeutic implications as children have more myocardial dysfunction in the setting of septic shock compared to adults and might benefit from early inotropic support and even in some instances afterload reduction. 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 [1].

Early recognition and aggressive fluid resuscitation have a crucial role in the treatment of paediatric septic shock. The American College of Critical Care Medicine – Paediatric Advanced Life Support (ACCM/PALS) guidelines [9] recommend rapid, stepwise interventions with the following therapeutic endpoints in the first hour; capillary refill of < 2 s, normal pulses with no differential between peripheral and central pulses, warm extremities, urine output > 1 ml/kg/h and normal mental status [1].

In adults the ability to increase oxygen consumption as oxygen delivery is enhanced by clinical interventions is associated with better survival in septic shock [10]. No evidence in pediatrics exists that oxygen extraction decreases in septic shock. In children with septic or cardiogenic shock, the major determinant for oxygen consumption is oxygen delivery, not oxygen extraction [8], therefore efforts should be aimed at improving CO and oxygen delivery.

Further hemodynamic optimization using metabolic endpoints to treat global tissue hypoxia include a superior vena cava oxygen saturation (ScvO2) > 70% and cardiac index > 3.3 and < 6.0 1/min/m2 with normal perfusion pressure for age [11]. The evidence which has resulted in these current guidelines has been derived from limited prospective and retrospective studies or case series [7,12,13,14]. More specifically, the outcome benefit of further optimizing metabolic parameters, namely ScvO2, in goal–directed therapy remains unknown. Although current ACCM/PALS guidelines [9] represent best practice, prospective randomized trials are lacking to confirm all components of these recommendations.

Hence the present study was undertaken to assess the role of ScvO2 in management of fluid refractory and catecholamine resistant shock.

Objectives

1. To assess the role of ScvO2 in management of fluid refractory and catecholamine resistant shock.
2. To assess the mortality in above patient with and without ScvO2.

Methodology

The present study was conducted at department of Paediatrics during the study period. The study design was one year randomized controlled trial. Institutional Ethical Clearance was obtained for the study prior beginning of the study. Based on the 80% of the previous three year hospital statistics the sample size was calculated as 51 in each group.

Children fulfilling the selection criteria were selected and their next of kin or legal guardians were briefed about the nature of the study and a written informed consent was obtained from the selected patients.

Selection Criteria

Inclusion Criteria

Age between 1 to 12 years

Children presenting with fluid refractory and catecholamine resistance shock not responded after 60 ml/kg of any resuscitation fluid or requiring cardiovascular agents with presence of atleast two of the following four criteria and one of which must be abnormal temperature or abnormal leucocyte count [15].

1 Core temperature > 38.5^0C or < 36^0C
2 Tachycardia – Defined as mean heart rate more than 2 SD above normal for that age in absence of external stimuli, long term drug use or painful stimuli or otherwise unexpalin persistent elevation over 0.5 to 4 hours.
3 Mean respiratory rate more than 2 SD above normal for that age or patient on mechanical ventilator.
4 Leucocyte count elevated or depressed for that age (not secondary to chemotherapy induced leucopenia).

Exclusion Criteria

1. Patient refusal.
2. Age less than 1 month or more than 12 years.
3. Uncorrected cyanotic heart disease.
4. Referral other hospitals more than 6 hours after diagnosis of severe sepsis or septic shock.

Randomization

Based on type of treatment children were divided into groups of 51 each that is;

Group A – A total of 51 children presenting with severe sepsis or fluid refractory septic shock, not responded after 40 mL/kg of any resuscitation fluid or those who required cardiovascular agents at any time during resuscitation were studied for the outcome variables.

Group B –A total of 51 children presenting with severe sepsis or fluid refractory septic shock, not responded after 40 mL/kg any resuscitation fluid or those who required cardiovascular agents at any time during resuscitation were enrolled and received ACCM/PALS therapies for septic shock directed toward the endpoint of scvO2 > 70%.

Data Collection

After obtained written informed consent, demographic data was recorded and history was taken. Clinical examination was done for all patients and findings were recorded on predesigned and pretested proforma.

Procedure

Parameters such as detail for vitals, blood pressure, tacypnea, oxygen saturation and detailed systemic examination was documented. Investigations such as complete blood count, C – reactive protein, blood culture and chest X-ray were checked in each patient.

After admission, meticulous monitoring of vital signs like heart rate, respiratory rate, blood pressure, SpO_2, fluid chart consisting of amount and type of intravenous fluid given and accurate urine output was maintained in all patients.

Routine investigation like CBC, serum electrolytes, renal function tests liver function tests and special investigations like platelet count and haematocrit was done in all patients. Also chest X-ray, USG abdomen, coagulation profile (PT, aPTT, INR) was performed wherever indicated.

Total White Blood Cell Count

Tlc count according to age as per given in table were considered as leucopenia and leukocytosis, respectively.

Shock: Shock was defined as below.

Fluid Refractory Shock: Shock persists despite use of more than 60 ml/kg fluid resuscitation [16].

Dopamine Resistant Shock: Dopamine infusion to 10 µg/kg/min in first hour [16].

Catecholamine resistant shock persists despite use of catecholamines such as epinephrine or non epinephrine [16].

Refractory Shock: Shock persists despite goal directed use of lonotropic agents, vasopresores, vasodilators and maintainance of metabolic (glucose and calcium) and hormonal (thyroid and hydrocortisone) homeostasis [16].

Hypotension

Hypotension was considered when blood pressure was less than 5th percentile (70 mmHg + 2 X age in years) [15].

At admission, patients had given three challenges for crystalloids (20 ml/kg). If shock still persisted then ionotropes were started.

Venous Oximetry

Sustained tissue hypoxia is one of the most important cofactors in the pathophysiology of organ dysfunction. Therefore, the assessment of the adequacy of tissue oxygenation in critically ill patients is crucial. Unfortunately, normal values in blood pressure, central venous pressure, heart rate, and blood gases do not rule out tissue hypoxia or imbalances between whole body oxygen supply and demand. This discrepancy causes an increased interest in more direct indicators of adequacy of tissue oxygenation such as venous oximetry. The golden standard of venous oximetry necessitates pulmonary artery catheterization for obtaining mixed venous oxygen saturation (SvO2) [9].

However, insertion of a pulmonary artery catheter into critically ill patients has been increasingly questioned due to lack of evidence that such a monitoring improves outcome. Central venous oxygen saturation (ScvO2) taken via a central venous catheter mostly reflects the degree of oxygen extraction form the brain and the upper part of the body. Venous oximetry by using ScvO2 may be an easy alternative to the measurement of ScvO2 [9].

Limits of mixed venous oxygen saturation

SvO_2 > 75%	Normal extraction O_2 supply > O_2 demand
75% > SvO_2 > 75%	Compensatory extraction Increasing O_2 demand or decreasing O_2 supply
75% > SVo_2 > 75%	Exhaustion of extraction Beginning of lactic acidosis O_2 supply < O_2 demand
30% > SvO_2 > 25%	Sever lactic acidosis
SvO_2 < 25%	Cellular death

The cardio circulatory system may be challenged by two different conditions. Firstly, a drop in DO2 can be induced by anemia, hypoxia, hypovolemia, or heart failure, Secondly, fever pain, stress etc. may also decrease SvO2 or ScvO2 by increasing whole – body VO2.

Pulmonary artery catherization allows obtaining true mixed venous oxygen saturation (SvO2) while measuring central venous oxygen saturation (ScvO2) via central venous catherter reflects principally the degree of oxygen extraction from the brain and the upper part of the body. ScvO2 reflects the relationship between whole – body O2 consumption and cardiac output. Indeed, it has been shown that the SvO2 is well correlated with the ratio of O2 supply to demand [9].

Interventions

The patients assigned to the intervention group that is group B received ACCM/PALS therapies directed toward the endpoint of ScvO2 ≥ 70%. If the ScvO2 was < 70%, we have calculated the blood pressure and decision of epinephrine, nor–epinephrine and adrenalin was taken. In both groups, other supportive therapies, such as mechanical ventilation, nutrition, antibiotics, were decided by the medical team, according to the routine practice [9].

Statistical Analysis

The categorical data was expressed as rates, ratios and percentages. Continuous data was expressed as mean ± standard deviation (SD). The comparison between two groups was done using student 't' test and chi-square test. A probability value of less than 0.05 was considered as statistically significant.

Results

In the present study, males outnumbered females in both the groups (70.59% group A and 66.67% in group B). The male to female ratio in group A was 2.4:1 and group B it was 2:1.

In this study, among children in group A, most of them (39.22%) were aged between 1 to 3 years followed by 31.37 between 4 to 6 years and 19.61% had age between 7 to 9 years and in group B, the same age groups constituted 37.25%, 31.37% and 23.33% respectively. The mean age among children in group B was 5.04 ± 3.05 years and in group B it was 5.06 ± 3.02 years.

Table 1: Baseline characteristics

Characteristics	Group A (n=51)		Group B (N==51)	
	Number	Percent	Number	Percent
Sex				
Male	36	70.59	34	66.67
Female	15	29.41	17	33.33
Age (years)				
1 to 3	20	39.22	19	37.25
4 to 6	16	31.37	16	31.37
7 to 9	10	19.61	12	23.53
10 to 12	5	9.80	4	7.84

Table 2: Clinical examination

Parameters	Group A (n=51)		Group B (N==51)	
	Mean	SD	Mean	SD
Hear rate (bpm)	148.86	13.65	150.82	12.82
Respiratory rate (bpm)	40.41	18.56	39.59	18.07

Table 3: Clinical findings

Clinical parameters	Group A (n=51)		Group B (N==51)	
	Number	Percent	Number	Percent
Blood Pressure				
Normal	5	9.80	4	7.84
Hypotensive	46	90.20	47	92.16
Temperature (0c)				
< 38.5 (Afebrile)	35	68.63	37	72.55
>38.5 (Febrile)	16	31.37	14	27.45
Anaemia grades				
Not present (>12 gm %)	1	1.96	0	0.00
Mild (10 to 11.99 gm%)	13	25.49	8	15.69
Moderate (7 to 9.99 gm%)	36	70.59	39	76.47
Severe (<7.00 gm%)	1	1.96	4	7.84
Leucocyte count				
Normal (4000 to 12000)	1	1.96	0	0.00
Leucocytosis (>12000)	47	92.16	47	92.16
Leucopenia (<4000)	3	5.88	4	7.84
C- reactive protein				
Positive	35	68.63	31	60.78
Negative	16	31.37	20	39.22
Blood culture				
Positive	10	19.61	7	13.73
Negative	41	80.39	44	86.27
Organisms				
Staph aureus	8	80.00	4	57.14
Klebsiella	2	20.00	3	42.86
Chest x – ray findings				
Normal	35	68.63	33	64.71
Pneumonia	16	31.37	18	35.29
Mechanical ventilation				
Yes	10	19.61	6	11.76
No	41	80.39	45	88.24

In the present study the mean heart rate was slightly less (148.86±13.65 bpm) in group A compared to group B (150.82±12.82 bpm) whereas, the mean respiratory rate in group A was slightly more (40.41 ±18.56 bpm) compared to group B (39.59±18.07 bpm).

In this study majority of the children (90.20%) in group A and 92.16% in group B were hypotensives.

In this study 31.37% children in group A and 27.45% in group B presented with fever.

In the present study majority of the children (70.59% in group A and 76.47 in group B) had moderate anaemia. The mean haemoglobin levels were 9.33±1.23 gm% in group A and 8.84±1.28 gm% n group B suggestive of moderate anaemia in both the groups.

In this study majority of the children (92.16%) in both the groups had leucocytosis (leucocyte count more than 12000 / mm^3). The mean leycocyte count in group A was 19137.10±6995.96 / mm^3 and in group B it was 20782.00±10157.40 / mm^3

The CRP was positive in 68.63% of group A and 60.78% of group B children.

The blood culture was positive among 19.61% of children in group A and 13.73% children in group B.

In this study among the 10 children with positive culture 80% had staph aures and 20% had klebsiella species. In group B of the seven children with positive culture 57.14% had staph aureus and 42.86% had klebsiella species.

In the present study X-ray findings revealed 31.37% children with pneumonia in group A and 35.29% in group B.

Among the patients in group A, 19.61% children were on mechanical ventilator whereas 11.76% in group were ventilated.

In the present study 66.67% of patients in both the groups had ephedrine. Norephedrine was administered among 23.53% and 25.49% and milrinone among 9.80% and 7.84% in group A and B respectively. In this study outcome among children with group B was significantly better (94.12% Improved and 5.88% expired) compared to group A (80.39% improved and 19.61% expired).

In the present study more than half had hospital stay between seven to fourteen days. The mean hospital stay in group A slightly less (8.07+3.78 days) compared to group B (9.69 + 3.83 days). However this difference was statistically not significant (p=0.29).

Table 4: Treatment

Drugs	Group A (n=51)		Group B (N==51)	
	Number	Percent	Number	Percent
Epinephrine	34	66.67	34	66.67
Norepinephrine	12	23.53	13	25.49
Milrinone	5	9.80	4	7.84
Total	51	100	51	100

Table 5: Outcome

Outcome	Group A (n=51)		Group B (N==51)	
	Number	Percent	Number	Percent
Improved	41	80.39	48	94.12
Expired	10	19.61	3	5.88
Total	51	100.00	51	100.00

$\chi^2 = 4.32$, df = 1, p = 0.038

Table 6: Length of PICU stay

Length of stay (days)	Group A (n=51)		Group B (N==51)	
	Number	Percent	Number	Percent
< 7	17	40.48	15	31.25
7 to 14	22	52.38	26	54.17
> 14	3	7.14	7	14.58
Total	42	100	48	100

$\chi^2 = 2.48$, df = 2, p = 0.290

Discussion

Under the auspices of the Surviving Sepsis Campaign, an international effort to increase awareness and to improve outcome in severe sepsis [18]. Guidelines of hemodynamic support for pediatrics were also published [15].

Further hemodynamic optimization using metabolic endpoints to treat global tissue hypoxia include a superior vena cava oxygen saturation (ScvO2) ≥ 70% and cardiac index > 3.3 and <6.0 l/min/m2 with normal perfusion pressure for age. However, the benefit of optimizing metabolic parameters, such as ScvO2, in goal- directed therapy remains unknown [9]. In the present study, males outnumbered females in both the groups (70.59% in group A and 66.67% in group B) with male to female ratio of 2.4:1 in group A and 2:1 in group B. Similar study from Brazil also reported male predominance. In a study 33 from Ludhiana, India of total 98 children presented with shock male – female ratio was 1.6:1. However, in the literature no sex predilection for sepsis is known [18].

In this study, among children in group A, most of them (39.22%) were aged between 1 to 3 years followed by 31.37% between 4 to 6 years and 19.61% had age between 7 to 9 years and in group B, the same age groups constituted 37.25%, 31.37% and 23.33% respectively. The mean age among children in group

B was 5.04±3.05 years and in group B it was 5.06± 3.02 years.

A study from United States reported that, boys of 10 years of age had significantly higher rates of severe sepsis than girls, particularly among infants [2]. A study from Ludhiana, India reported mean age as 2.8±3.4 years [19].

In the present study 31.37% children in group A and 27.45% in group B presented with fever. The mean heart rate was slightly less (148.86±13.65 bpm) in group A compared to group B (150.82±12.82 bpm) whereas, the mean respiratory rate in group A was slightly more (40.41±18.56 bpm) compared to group B (39.59±18.07 bpm). Majority of the children (90.20% in group A and 92.16% in group B) were hypertensive. Most of the children (70.59% in group A and 76.47% in group B) had moderate anaemia. The mean haemoglobin levels were 9.33 ± 1.23 gm % in group A and 8.84±1.28 gm% in group B suggestive of moderate anaemia in both the groups.

In the present study, majority of the children (92.16%) in both the groups had leucocytosis. The mean leycocyte count in group A was 19137.10± 6995.96 / mm3 and in group B it was 20782.00 ± group B children. Blood culture was positive among 19.61% of children in group A and 13.73% children in group B. Among the 10 children with positive culture 80% had staph aureus and 20% had klebsiella species. In group B of the seven children with positive culture 57.14% had staph aureus and 42.86% had klebsiella species. The chest X-ray findings revealed 31.37% children with pneumonia in group A and 35.29% in group B. Among the patients in group A, 19.61% children were on mechanical ventilator whereas 11.76% in group were ventilated.

Many children with fever have tachycardia and warm extremities on physical examination. Not all of those children are in shock. For early recognition of shock it is then absolute necessary to evaluate the mental state of the child. In general, children in shock are lethargic and have decreased consciousness, but the opposite (agitation, restless, anxious) also occurs. Underlying mechanisms include most likely a combination of cerebral hypoperfusion, metabolic alterations and production of cytotoxic substances. Oxygen debt will occur when the shock is not recognized and thus not treated properly. Clinically, the child suffers from depressed consciousness, poor skin perfusion, decreased urinary output and hyperventilation to compensate for the metabolic acidosis [20].

In the present study 66.67% of patients in both the groups had ephedrine. Norephedrine was administered among 23.53% and 25.49% and Millirinone among 9.80% and 7.84% in group A and B respectively. Outcome among children with group B was significantly better (94.12% Improved and 5.88% expired) compared to group A (80.39% improved and 19.61% expired) supporting the current ACCM / PALS guidelines. Goal – directed therapy using the endpoint of a ScvO2 ≥ 70% provided a significant and additive impact on the outcome of children and adolescents with septic shock. Similar results were reported in a study from Brazil [9].

In the present study more than half (52.8% in group A and 54.17% in group B) had hospital stay between seven to fourteen days. The mean hospital stay in group A slightly less (8.07± 3.78 days) compared to group B (9.69±3.83 days). However this difference was statistically not significant. However our results contradicted with the results of similar study from Brazil where mean hospital stay of nine days was reported in control group and seven days in intervention group were reported but these findings were statistically not significant [9].

Overall, the present study supports role of ScvO2 in management of fluid refractory and catecholamine resistant shock. However to explore these findings further research with larger sample size and considering other parameters such as organ failure, may be emphasized.

Conclusion

Based on the results of this study it may be concluded that, ScvO2 in management of fluid refractory and catecholamine resistant shock has reduced the mortality but did not influence the hospital stay.

Reference

1. Arkin AA, Citak A, Pediatric shock, Signa Vitae 2008; 3(1):13–23.
2. Watson RS, Carcillo JA, Linde – Zwirble WT, Clermont G, Lidicker J, angus DC. The epidemiology of severe sepsis in children in the United States. Am J Respir Crit Care Med 2003;167(5):695–701.
3. Brilli RJ, Goldstein B. Pediatric sepsis definitions: past, present, and future. Pediatr Crit Care Med 2005;6(3): S6-8.
4. Groeneveld AB, Bronsveld W, Thijs LG. Hemodynamic determinants of mortality in human septic shock. Surgery 1986;99(2):140–53.

5. Groeneveld AB, Nauta JJ, Thijs LG. Peripheral vascular resistance in septic shock: its relation to outcome. Intensive Care Med 1988;14(2):141 – 7.
6. Kirklin JK, Blackstone EH, Kirklin JW, McKay R, Pacifico AD, Bargeron LM. Intracardiac surgery in infacnts under age 3 months : predictors of postoperative in – hospital cardiac death. A,m J Cardiol 1981;48(3):507–12.
7. Ceneviva G, Paschall JA, Maffei F, Carcillo JA. Hemodynamic support in fluid – refractory pediatric septic shock. Pediatrics 1998;102(2):e19.
8. Carcillo JA, Pollack MM, Ruttimann UE, Fields AI. Sequential physiologic interactions in pediatric cardiogenic and septic shock. Crit Care Med 1989;17 (1):12–6.
9. de Oliveira CF, de Oliveira DS, Gottschald AF, Moura JD, Costa GA, Ventura AC, et al. ACCM / PALS haemokdynamic support guidelines for paediatric septic shock: An outcomes comparison with and without monitoring central venous oxygen saturation. Intensive Care Med. 2008;34(6):1065–75.
10. Hayes Ma, Timmins AC, Yau EH, Palazzo M, Watson D, Hinds CJ. Oxygen transport patterns in patients with sepsis syndrome or septic shock: influence of treatment and relationship to outcome. Crit Care Med 1997;25(6):926–36.
11. Carcillo JA, Fields AI, American College of Critical Care Medicine Task Force Committee Members. Clinical practice parameters for haemodynamic support of paediatric and neonatal in septic shock. Crit Care Med 2002;30(1):1365–78.
12. Carcillo Ja, Davis AL, Zaritsky A. Role of early fluid resuscitation in paediatric septic shock. Jama 1991; 266:1242–5.
13. Oliveira CF, Troster E, Oliveira DSF, Gottschald A, Moura J, Costa G, et al. An outcomes comparision of ACCM / PALS guidelines for paediatric septic shock with and without central venous oxygen saturation monitoring. Pediar Crit Med 2007;8:A237–8.
14. Pizarro CF, Troster EJ, Damiani D, Carcillo Ja. Absolute and relative adrenal insufficiency in children with septic shock. Crit Care Med 2005;33: 855–9.
15. Khilnani P. Clinical management guidelines of pediatric septic shock. Indian J. Crit Care Med 2005; 9:164–72.
16. Goldsein B, Giroir B, Randolph A. International pediatric sepsis consensus conference: definitions for sepsis and organ dysfunction Pediatr Crit Care Med 2005;61):2–8.
17. Dellinger RP, Carlet JM, Masur H, Gerlach H, Calandra T, Cohen J, et al; Surviving Sepsis Campaign Management Guidelines Committee. Surviving Sepsis Campaign guidelines for management of severe sepsis and septic shock. Crit Care Med. 2004;32(3):858–73.
18. Pinsky Mr. Septic Shhock 2012. Available from URL: http://emedicine.medscape.com/article/168402 - overview. Accessed on: 18.02.2012.
19. Singh D, Chopra A, Pooni PA, Bhatia RC. A clinical Profile of shock in Children in Punjab, India. Dayanand medical college, Ludhiana. Indian Paediatr 2006;43:619–22.
20. Kneyber MCJ. Management of Septic Shock in Children, Severe Sepsis and Septic Shock – Understanding a Serious Killer, Dr. Ricardo Fernandez (Ed.), China: In Tech; 2012 Available from: http//www.intechopen.com/books/severe-sepsis-and-septic-shock-understandign –a-serious-killer/ early recognisition – and-management-of-paediatric-shock Accessed on: 05.05.12.