Original Research Article

Study on etiological organisms in a suspected case of sepsis in the children admitted to paediatric intensive care unit

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ABSTRACT

Background: Identifying common etiological organisms among cases of suspected sepsis and their sensitivity pattern for common antibiotics will help in initiating appropriate therapy. Finding association of positive culture with other markers of infection like total leucocyte count, haemoglobin, C-reactive protein.

Methods: Descriptive and an observational study conducted in Kempegowda Institute of Medical Sciences, hospital paediatric intensive care unit, Bangalore, Karnataka, India. Data was collected prospectively. Duration of study was for 1 year from February 2018 to February 2019.

Results: During the study, 52 cases admitted to paediatric intensive care unit were suspected to have sepsis and 91 samples were sent for culture. Out of these, 46 were blood, 34 were of urine and 11 others (pleural, CSF, ET). Among these samples tested 26% (18) of blood, 23.5% (8) of urine and 45.45% (5) of other samples showed organisms.

Conclusions: In this study, author were able to know the common etiological agent involved in sepsis. Author were able to identify the antibiotic sensitivity patterns among various organism which provide valid data for initiation of appropriate treatment.

Keywords: Antibiotic sensitivity, Etiological organism, Culture, Sepsis

INTRODUCTION

The incidence of sepsis is more common in intensive care units and it would be a suitable area to target for reducing morbidity and mortality due to sepsis.¹⁻³ Focused efforts to identify those at risk should lead to early diagnosis and earlier administration of specific therapy.⁴ Though culture remains the gold standard for diagnosis of the causative organisms, the time taken to detect these organisms may take longer duration, as many as 3-5 days. This involves chance of complication while reports are awaited.⁵

There have been advancements in field of infectious disease control, mainly focused on early diagnosis and

administration of appropriate therapy pertaining to sepsis, with relative significant impact.⁶⁻¹³

The mortality rate among cases of sepsis, admitted to intensive care unit, is dependent on the condition of the patient during admission and also on the development of complications like sepsis shock and multi organ dysfunction.¹⁴ Isolation of bacteria among children admitted to hospital is more common in intensive care patients treated for sepsis or septic shock.¹⁵

The terminologies like infection, SIRS, sepsis, severe sepsis, septic shock are based on international consensus definitions for paediatric sepsis.

Infection

Suspected or proven infection or a clinical syndrome associated with high probability of infection. Systemic inflammatory response syndrome (SIRS) 2 out of 4 criteria, 1 of which must be abnormal temperature or abnormal leukocyte count:

- Core temperature $>38.5^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ (rectal, bladder, oral, or central catheter)
- Tachycardia: Mean heart rate >2 SD above normal for age in absence of external stimuli, chronic drugs or painful stimuli or unexplained persistent elevation over 0.5-4 hr or in children <1 -year-old, persistent bradycardia over 0.5 hour (mean heart rate $<10^{\text{th}}$ percentile for age in absence of vagal stimuli, β -blocker drugs, or congenital heart disease)
- Respiratory rate >2 SD above normal for age or acute need for mechanical ventilation not related to neuromuscular disease or general anaesthesia
- Leukocyte count elevated or depressed for age (not secondary to chemotherapy) or $>10\%$ immature neutrophils.

Sepsis

SIRS plus a suspected or proven infection.

Severe sepsis

Sepsis plus 1 of the following:

- Cardiovascular organ dysfunction, defined as:
 - Despite >40 ml/kg of isotonic intravenous fluid in 1 hour
 - Hypotension $<5^{\text{th}}$ percentile for age or systolic blood pressure <2 SD below normal for age or Need for vasoactive drug to maintain blood pressure or

2 of the following:

- Unexplained metabolic acidosis: base deficit >5 meq/L
- Increased arterial lactate: >2 time's upper limit of normal
- Oliguria: urine output <0.5 ml/kg/hr
- Prolonged capillary refill: >5 sec
- Core to peripheral temperature gap $>3^{\circ}\text{C}$
- Acute respiratory distress syndrome (ARDS) as defined by the presence of a Pao₂/Fio₂ ratio ≤ 300 mmHg, bilateral infiltrates on chest radiograph, and no evidence of left heart failure or
- Sepsis plus 2 or more organ dysfunctions (respiratory, renal, neurologic, hematologic, or hepatic).

Septic shock

Sepsis plus cardiovascular organ dysfunction as defined above.

Multiple organ dysfunction syndrome (MODS)

Presence of altered organ function such that homeostasis cannot be maintained without medical intervention.⁶

Most common reason for paediatric admissions is fever.¹⁶⁻²⁰ Most common clinical association of underlying infection is fever. However, among these cases, small group of patients have sepsis.^{17,18,20-22} As mentioned earlier, culture being the gold standard for diagnosing the causative organism, there are few drawbacks, like it being more expensive and takes longer duration for reports. Because of this, other investigation become essential including total leukocyte count, C reactive protein, haemoglobin.^{17-19,21-23}

This study will try to identify common etiological organisms among cases of suspected sepsis and their sensitivity pattern for common antibiotics and association positive culture with other markers of infection like total leukocyte count, haemoglobin, C-reactive protein (CRP).

METHODS

This study is a descriptive and an observational study conducted in Kempegowda Institute of Medical Sciences Hospital, Bangalore, Karnataka, India paediatric intensive care unit. Data was collected prospectively. Duration of study was for 1 year from February 2018 to February 2019. All patients older than 1 month up to 17 years of age who were admitted in paediatric intensive care unit of Kempegowda Institute of Medical Sciences hospital, Bangalore, Karnataka, India were included in the study. The cases exclude were age less than or equal to 1 month and also those had congenital or acquired immune deficiencies or malignancies.

The cultures were taken from patients who had fever or history of fever without any localized or focal infections. Axillary temperature was measured. Aseptic techniques were used to collect samples and samples were sent for culture and sensitivity and for analysis of other lab parameters (total leukocyte count, C reactive protein, haemoglobin). BACTEC technique was used for culture samples and routine microbiology methods were used for identifying the isolates. Both aerobic and anaerobic cultures were done and were statistically regarded as one sample. The parameters like age, sex, prior antibiotic used, duration of fever, duration of hospital stay was analysed.

Descriptive statistics was used was statistical analysis. It included mean and inferential statistics (which include use of student t test and chi square test). Differences between the mean values of two continuous variables were tested using student t test and for categorical variables, chi square test was used to test significance of differences in proportion of two or more groups. Fischer exact test was used in place of chi square test wherever

necessary. The p value of <0.05 was considered as significant.

RESULTS

During the study, 52 cases admitted to paediatric intensive care unit were suspected to have sepsis and 91 samples were sent for culture. Out of these, 46 were blood, 34 were of urine and 11 others (pleural, CSF, ET). Among these samples tested 26% (18) of blood, 23.5% (8) of urine and 45.45% (5) of other samples showed organisms.

Most common infectious organism found was *Staphylococcus aureus* in blood. Other organisms like *Enterobacter*, *Enterococcus*, *Pseudomonas* and *Acinetobacter* were also isolated. Most common organism isolate in urine was *E. coli* (Table 1).

Table 1: Etiological organisms isolated from various specimens.

Sample	Organism	%
Blood (12)	<i>Staph aureus</i>	4 (33%)
	<i>Enterobacter</i>	2 (16.66%)
	<i>Acinetobacter</i>	2 (16.66%)
	<i>Pseudomonas</i>	2 (16.66%)
	<i>Klebsiella</i>	1 (8.33%)
	<i>Enterococcus</i>	1 (8.33%)
Urine (8)	<i>E. coli</i>	6 (75%)
	<i>Klebsiella</i>	1 (12.5%)
	<i>Acinetobacter</i>	1 (12.5%)
Others (5)	<i>Acinetobacter</i>	2 (40%)
	<i>Pseudomonas</i>	2 (40%)
	<i>Enterobacter</i>	1 (20%)

Most common infectious organism found was *Staphylococcus aureus* in blood. Other organisms like *Enterobacter*, *Enterococcus*, *Pseudomonas* and *Acinetobacter* were also isolated. Most common organism isolate in urine was *E. coli*.

Most of urine cultures were positive in less than 3-year age group (7 among 8 positive). Most of gram-positive organisms were sensitive to linezolid (100%) followed by tetracycline and vancomycin (75% except for *Enterococcus* which was sensitive only to linezolid). Among gram negative organism, most were sensitive to gentamycin (100%) followed by amikacin (58.8%) and netillin (41.1%).

Most gram-negative organisms were resistant to ampicillin (76.5%) and cefepime (41.17%). *Acinetobacter* and *Klebsiella* species were resistant to both these antibiotics.

Out of 52 individuals, 13 had received antibiotics prior to collection of samples for culture and 39 didn't receive any antibiotics. Culture was positive in 30.8% (9) cases among those who received prior antibiotics and in 43.6% (17) cases among those who didn't receive prior antibiotics (p value 0.5225).

The sex wise distribution among culture positive and negative groups shows no statistical difference among male and female cases with p value (0.12008). There were total of 12 male and 9 female culture positive cases and 24 male and 7 female culture negative cases respectively.

The difference in mean average duration of fever and hospital stay among positive and negative culture groups are not statistically significant, p value being (0.38153) and (0.6872) respectively. There were total of 2 culture positive cases and 5 culture negative cases whose stay in the hospital was less than or equal to 3 days, and 19 culture positive cases and 26 culture negative cases had duration of stay of more than 3 days in the hospital. There were 10 culture positive and 11 culture negative cases with history of duration of fever less than or equal to 3 days, and 11 culture positive and 20 culture negative cases with history of duration of fever more than 3 days (Table 2).

Table 2: Sex wise distribution and mean duration of hospital stay and mean duration of fever before admission among culture positive and negative groups.

Variables		Culture positive	Culture negative
Sex	Male	12	24
	Female	9	7
Mean duration of stay	<=3days	2	5
	>3 days	19	26
Mean duration of fever	<= 3 days	10	11
	>3 days	11	20

The sex wise distribution among culture positive and negative groups shows no statistical difference among male and female cases. The difference in mean average duration of fever and hospital stay among positive and negative culture groups are not statistically significant.

The age wise distribution among culture positive and culture negative groups showed no statistically significant difference p value being (0.8853). Among age group of less than 3 years, 3 to 10 years and more than 10 years the culture positive cases were 14, 3, 4 and culture negative cases were 19, 6, 6 respectively (Table 3).

Table 3: Age wise distribution of culture positive and culture negative groups.

Variable		Culture positive	Culture negative
Age	<3 years	14	19
	3-10 years	3	6
	>10 years	4	6

The age wise distribution among culture positive and culture negative groups showed no statistically significant difference.

The mean value of total leucocyte count in individuals with positive culture was 15,715+/-14,266 cells/mm³ and 13,761+/-9,822 cells/mm³ among negative culture (p

value 0.501). The mean haemoglobin was 10.2+/-2.4 g% in individuals with positive culture and 10.08+/-2.23 g% in individuals with negative culture (p value 0.853). In case of mean CRP values 6.22+/-9.4 mg/dl was found in positive culture individuals and value of 4.93+/-10.23 mg/dl was found in individuals with negative culture (p value 0.6604).

DISCUSSION

The common cause of mortality and morbidity among patients admitted to paediatric intensive care unit are bacterial infections. The identification and sensitivity testing of positive organisms are required for appropriate treatment and improved prognosis.

In my study, most common organism isolated from blood culture was *Staphylococcus aureus*. It accounted for 33.3%. These results are similar to other studies that reported *Staphylococcus aureus* as most common isolates from children.²⁴ Similarly, in urine, most common organism was *E. Coli* and most of urine cultures were seen positive in <3 years age group patients.

In this study, it was noticed that, linezolid was most sensitive antibiotic among gram positive organisms followed by tetracycline and vancomycin. Similarly, most of gram-negative organisms were sensitive to gentamycin followed by amikacin and netillin. This information may help start of appropriate antibiotics while culture reports are awaited instead of starting patient on multiple antibiotics.

The figure from this study also showed antibiotics were prescribed in large portion of patients, including both culture positive (100%) and culture negative (90.3%).

The study also showed lack of relation between the culture reports and other markers of infection which includes total leucocyte count, haemoglobin and CRP. There was no statistically significant difference between these values among culture positive and culture negative groups. CRP which was considered as an important predictor of infection also failed to demonstrate any significant difference between the two groups.²⁵

This study prompts requirement of more such studies with more cases and also inclusion of other hospital setup, referral hospitals and tertiary centres with regional coverage which could bring additional information and help in identifying other etiological organisms and their sensitivity patterns.

CONCLUSION

In this study, authors were able to know the common etiological agent involved in sepsis. Authors were able to identify the antibiotic sensitivity patterns among various organism which provide valid data for initiation of appropriate treatment.

There were no significant differences between the culture outcome and laboratory results of total counts, haemoglobin and CRP. This becomes important because most of this lab information may influence to change the clinician's decision regarding treatment or use of other antibiotics which may actually not be necessary.

Similar studies are required to know more about various etiological agents in different hospital settings to acquire more information for appropriate management of case of sepsis in paediatric intensive care unit.

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REFERENCES

1. Eykyn SJ, Gransden WR, Phillips I. The causative organisms of septicaemia and their epidemiology. J Antimicrob Chemother. 1990;25(100):41-58.
2. Villota DE, Algora A, Rubio JJ, Roig M, Mosquera JM, Galdós P, et al. Septicaemia in a medical intensive care unit. Clinical, biomedical and microbiological data in 109 cases. Intensive Care Med. 1983;9:109-15.
3. Mylotte JM, Kahler L, McCann C. Community-acquired bacteremia at a teaching versus a nonteaching hospital: impact of acute severity of illness on 30-day mortality. Am J Infect Control. 2001;29:13-9.
4. Maldini B, Antolic S, Zdravcevic SK. Evaluation of bacteremia in a pediatric intensive care unit: epidemiology, microbiology, sources sites and risk factors. Coll Antropol. 2007;31(4):1083-8.
5. Hensley OJ, Hart CA, Cooke RW. Serious infection in a neonatal intensive care unit: a two-year survey. J Hyg. 1985;95(2):289-97.
6. Goldstein B, Giroir B, Randolph A. International Consensus Conference on Pediatric Sepsis. International pediatric sepsis consensus conference: definitions for sepsis and organ dysfunction in pediatrics. Pediatr Crit Care Med. 2005;6(1):2-8.
7. Oliveira CF, Oliveira DS, Gottschald AF, Moura JD, Costa GA, Ventura AC, et al. ACCM/PALS haemodynamic 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.
8. Wolfler A, Silvani P, Musicco M, Antonelli M, Salvo I. Italian Pediatric Sepsis Study (SISPe)

- group. Incidence of and mortality due to sepsis, severe sepsis and septic shock in Italian Pediatric Intensive Care Units: a prospective national survey. *Intensive Care Med*. 2008;34(9):1690-7.
9. Oliveira CF. Early goal-directed therapy in treatment of pediatric septic shock. *Shock*. 2010;34(1):44-7.
10. Batista SR, Gomes AP, Lima CL, Vitorino RR, Perez MC, Mendonça EG, et al. Sepsis: news and perspectives. *Rev Bras Ter Intensive*. 2011;23(2):207-16.
11. Hanna W, Wong HR. Pediatric sepsis: challenges and adjunctive therapies. *Crit Care Clin*. 2013;29(2):203-22.
12. Pérez VD, Jordan I, Esteban E, Soler GP, Murga V, Bonil V, et al. Prognostic factors in pediatric sepsis study, from the Spanish society of pediatric intensive care. *Ped Infect Dis J*. 2014;33(2):152-7.
13. Schlapbach LJ, Straney L, Alexander J, MacLaren G, Festa M, et al. ANZICS paediatric study group. mortality related to invasive infections, sepsis, and septic shock in critically ill children in Australia and New Zealand, 2002-13: a multicentre retrospective cohort study. *Lancet Infect Dis*. 2015;15(1):46-54.
14. Kutko MC, Calarco MP, Flaherty MB, Helmrich RF, Ushay HM, Pon S, et al. Mortality rates in pediatric septic shock with and without multiple organ system failure. *Pediatr Crit Care Med*. 2003;4(3):333-7.
15. Randolph AG, McCulloh RJ. Pediatric sepsis: important considerations for diagnosing and managing severe infections in infants, children, and adolescents. *Virulence*. 2014;5(1):179-89.
16. Brockmann VP, Ibarra GX, Silva WI, Hirsch BT. Etiology of acute fever without source in infants consulting at an emergency department. *Rev Chilena Infectol*. 2007;24:33-9.
17. Pratt A, Attia MW. Duration of fever and markers of serious bacterial infection in young febrile children. *Pediatr Int*. 2007;49:31-5.
18. Simon AE, Lukacs SL, Mendola P. Emergency department laboratory evaluations of fever without source in children aged 3 to 36 months. *Pediatrics*. 2011;128:e1368-75.
19. Mansour KM, Kuypers FA, Wang TN, Miller AM, Larkin SK, et al. Secretory phospholipase A2: a marker of infection in febrile children presenting to a pediatric ED. *Am J Emerg Med*. 2011;29:1163-8.
20. Nakabayashi M, Adachi Y, Itazawa T, Okabe Y, Kanegane H. MxA-based recognition of viral illness in febrile children by a whole blood assay. *Pediatr Res*. 2006;60:770-4.
21. Manzano S, Bailey B, Gervais A, Cousineau J, Delvin E. Markers for bacterial infection in children with fever without source. *Arch Dis Child*. 2011;96:440-6.
22. Girodias JB, Bailey B. Approach to the febrile child: A challenge bridging the gap between the literature and clinical practice. *Paediatr Child Heal*. 2003;8:76-82.
23. Baraff LJ. Management of infants and young children with fever without source. *Pediatr Ann*. 2008;37:673-9.
24. Sabui T, Tudehope DI, Tilse MJ. Clinical significance of quantitative blood cultures in newborn infants. *Ped Child Heal*. 1999;35:578-81.
25. Sanders S, Barnett A, Velez CI, Coulthard M, Doust J. Systematic review of the diagnostic accuracy of C-reactive protein to detect bacterial infection in nonhospitalized infants and children with fever. *J Pediatr*. 2008;153:570-4.

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