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Original Article

Bacteriological Pattern of Pediatric Sepsis in PICU of A Tertiary Care Hospital

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Abstract

Background: *Pediatric and neonatal sepsis are one of the main causes of mortality in neonatal and Pediatric Intensive Care Units (PICU) of developing countries. To evaluate the bacteriological pattern of pediatric sepsis in a newly set PICU. The etiopathogenesis and medication susceptibility pattern of causative agents need to be reviewed frequently due to the continuously evolving bacteriologic profile of childhood sepsis.*

Materials and methods: *This descriptive observational study was conducted in the PICU of Chattogram Medical College Hospital, Chattogram. The study was carried out from March 2017 to February 2018. According to inclusion/exclusion criteria 146 pediatric patients were taken as sample by purposive sampling. Data were collected by face-to-face interview from the parents or caregivers. Clinical examination was done by researcher herself, blood culture reports and retrospective data were collected from hospital records. The blood culture was done in the laboratory in the department of microbiology, and in the department of clinical pathology, Chattogram Medical College Hospital, for further processing.*

Results: *Among 146 respondents the frequency of culture positive specimens was 19%. Among the culture positive patients, majority (48%) fall in infant age group. Male to female ratio were 1.05:1, 1.24:1and 1.3:1 in 2016, 2017 and 2019 respectively. Majority of the patients (67.2%) were from rural area in all 3 years. There was no significant difference in sex and area of living distribution between the years. Regarding different ICU modalities among the culture positive patients, oxygen hood was used for (48.3%), Cardiac monitor (24.1%) ventilator (44.8%) and inotrope (24.1%). There was no significant difference in provision of different ICU modalities between culture positive and negative patients. Among the 27 culture positive samples, majority of the isolated micro-organisms were gram negative bacteria (86.4%) followed by gram positive bacteria (13.6%) with Acinetobacter sp. (29.6%), Pseudomonas sp. (25.9%) and Klebsiella sp. (25.9%) predominating.*

Conclusion: *This study was undertaken in order to document the most common types of pathogens causing sepsis in children admitted in the newly established Pediatric Intensive Care Unit (PICU) of Chattogram medical college hospital and their outcome. From the current study, we found that majority of the organisms were gram negative in the PICU. If a specialized center like PICU has its own microbiological and antibiotic sensitivity pattern, then they can have their own protocol to establish.*

Key words: PDW; PC; PDW/PC; PICU; Prognostic marker.

INTRODUCTION

Intensive care is predominantly concerned with the management of patients with acute life-threatening conditions in a specialized unit. Caring of critically ill children remains one of the most demanding and challenging aspects of the field of pediatrics. In a study of admission pattern in a PICU of Dhaka Shishu Hospital, it is shown that infections (Bronchopneumonia 21%, bacterial meningitis 16%, septicemia 10.1% and encephalitis 4.2%) accounted for the largest number of cases. Infections remain one of the major problems in PICU and are the leading cause not only of admission, but also mortality (51.3%) in developing countries.[1] Another similar type of study from Pakistan shows that infections were associated with 58.5% admission and 55.6% deaths in PICU.[2]

Sepsis is a systemic illness caused by microbial invasion of normally sterile parts of the body. It is a serious, life-threatening infection that gets worse very quickly due to the spread of microorganisms and their toxins in the blood. It can arise from infections throughout the body, including infections in the lungs, abdomen, and urinary tract. Blood stream infections are very common in the pediatric age groups which are one of the common causes of morbidity and mortality in neonates and children. Infants and children are among the most vulnerable population groups to contract illnesses because of their weak immune barrier.[3] Sepsis in children remains to be a significant cause of morbidity and mortality worldwide. Watson et al. reported frequency of pediatric severe sepsis to be more than 42000 cases annually and associated mortality rate to be 10% in the United States. Recently published report from the United Kingdom showed that 17% of children die from with severe sepsis and septic shock in Pediatric Intensive Care Unit (PICU).[4] The largest part of the global sepsis burden occurs in middle and low income countries. Around 70% of the 7.6 million global deaths in neonates and infants are attributable to sepsis, with the majority of cases occurring in Asia and Sub-Saharan Africa.[5]

Timely and adequate diagnosis and treatment of bacterial infections with antibiotics are critical to reduce global childhood mortality. Diagnosis of pediatric sepsis is challenging in low resource settings where little or no capacity for etiological diagnosis or laboratory testing exists, and providers must often rely on clinical symptoms and algorithms alone.[6] To reduce childhood mortality caused by infections, strong surveillance activities on diagnosis, etiology and optimal management must be made at all levels of health system. The uncertainty surrounding the clinical approach to treatment of pediatric sepsis can be minimized by periodic epidemiological survey of etiological agents and their antibiotic sensitivity pattern leading to recognition of the most frequently encountered pathogens in a particular intensive care setting.[7]

To improve the outcome of pediatric sepsis, World Federation of Pediatric Intensive Critical Care (WFPICC) sepsis initiative in developing countries emphasized the importance of simple interventions like early rapid fluid administration, early antibiotics therapy, oxygen supplementation and early use of inotropes through peripheral intravenous access. Several recent studies from PICUs have shown that there was a significant reduction in the mortality rate of children with severe sepsis and septic shock. There is a need to document the outcome of children with severe sepsis and septic shock from an organized PICU.[2] The result of routine blood culture and antibiotic susceptibility tests take about a week thereby necessitating initial empirical treatment of suspected cases with broad spectrum antibiotics. Knowledge of pattern of common pathogens is therefore useful for guiding the initial treatment of patients.[8] Present study is aimed to the effectual management of sepsis in children by studying the changing bacteriological profile along with the antimicrobial sensitivity pattern in newly set Pediatric Intensive Care Unit (PICU).

MATERIALS AND METHODS

This descriptive observational study was conducted in the PICU of Chittagong Medical College Hospital, Chattogram. All the patients admitted in PICU of Department of Pediatrics of CMCH having features suggestive of systemic inflammatory response syndrome were enrolled in the study. Those who received parenteral antibiotics within 72 hours before admission were excluded. The study was carried out from March 2017 to February 2018. According to inclusion/exclusion criteria 146 pediatric patients were taken as sample by purposive sampling for this study. One group included the patients admitted in PICU in its 1st year of establishment i.e. 2016 and data were transferred from the hospital records. Another group data were collected by face-to-face interview from the parents or caregivers in the study period i.e. 2017-18. Clinical examination was done by researcher herself and blood culture was done in the laboratory of Department of Microbiology and in the Department of Clinical Pathology, Chittagong Medical College, for further processing. Data analysis was done with SPSS (Statistical Package for Social Science) Ver. 23 and by using the MS Excel. Ethical consideration: To conduct this study written permission was taken from ERC of CMCH.

RESULTS

Among 146 respondents the frequency of culture positive specimens was 19% (Table I). Among the culture positive patients, majority (48%) fall in infant age group. Only 11.1% culture positive patients fall in <3 months (Table I). There was no statistically significant difference between two groups in terms of treatment modalities and need of life support ($p>0.05$) (Table II). Table III shows that male to female ratio were 1.05:1, 1.24:1and 1.3:1 in 2016, 2017 and 2019 respectively. Majority of the patients (67.2%) were from rural

area in all 3 years. There was no significant difference in sex and area of living distribution between the years. Regarding different ICU modalities among the culture positive patients, oxygen hood was used for (48.3%) Cardiac monitor (24.1%) ventilator (44.8%) and inotrope (24.1%). There was no significant difference in provision of different ICU modalities between culture positive and negative patients. (Table IV). Among the 27 culture positive samples, majority of the isolated micro-organisms were gram negative bacteria (86.4%) followed by gram positive bacteria (13.6%) (Table V).

Table I Number of Studied Specimens and Positive Cultures

Year	Total patients	Positive culture
2016	45	8 (17%)
2017	71	14 (19%)
2019	30	5(16.6%)
Total	146	27 (19%)

Table II Age distribution of patients by culture result

Age (In month)	Culture result		Total
	Negative (n=119)	Positive (n=27)	
Age category			
<3 months	13 (9.19%)	3 (11.1%)	16 (10.3%)
3-12 months	65 (57.4%)	13 (48%)	78 (58.6%)
12-36 months	23 (18.3%)	5 (18.5%)	28 (17.2%)
>36 months	18 (14.9%)	6 (22.3%)	24 (13.8%)
Total	119 (81.6%)	27 (18.4%)	146 (100%)

Data are expressed as frequency (Percentage).

Table III Distribution of the patients by their sex and area of living and year of admission

Variables	Admission year			Total	p value
	2016	2017	2019		
Gender					
Male	23 (51.1%)	39 (54.9%)	17(56.6%)	79 (67.2%)	
Female	22 (48.9%)	32(45.1%)	13(43.3%)	67 (46.6%)	0.688*
Total	45 (38.79%)	71 (61.21%)	30(20.5%)	146 (100%)	
Area of living					
Rural	31 (98.9%)	47 (66.2%)	15(50%)	93(67.2%)	
Urban	13 (28.9%)	17 (23.9%)	10(33.3%)	40(25.9%)	0.294#
Slum	1 (2.2%)	7 (9.9%)	5(16.6%)	13 (8.9%)	
Total	45 (38.79%)	71 (61.21%)	30(20.5%)	146 (100%)	

Data are expressed as frequency (Percentage) *: Not significant by Chi-square test #: Not significant by Fisher's exact test.

Table IV Different modalities of ICU support by culture result

ICU modalities	Culture result		Total (n=146)	p value
	Negative (n=119)	Positive (n=27)		
Oxygen hood	56 (57.5%)	17 (48.3%)	74 (55.2%)	0.389*
Cardiac monitor	23 (26.4%)	7 (24.1%)	30 (25.9%)	0.807*
Ventilator	8 (5.7%)	13 (44.8%)	21 (15.5%)	0.601*
Inotrope	31 (33.3%)	16 (37.9%)	47 (34.5%)	0.652*
Syringe pump	119 (100%)	27 (100%)	146 (100%)	-

Data are expressed as frequency (Percentage) *: Not significant by Chi-square test

Table V Organisms isolated from the patients

Organism name and type	Admission year			Total (n=27)
	2016 (n=8)	2017 (n=14)	2019 (n=5)	
Isolated from blood culture				
Gram negative				
Acinetobacter sp.	3 (37.5%)	5 (26.3%)	0	8 (29.6%)
Pseudomonas sp.	2 (25.0%)	3 (16.6%)	2(40%)	7 (25.9%)
Klebsiella sp.	2 (25.0%)	4 (28.5%)	1(20%)	7 (25.9%)
E. coli	0 (0%)	1 (7.1%)	0 (0%)	1 (4.5%)
Burkholderia	0 (0%)	0 (0%)	1(20%)	1 (4.5%)
Gram positive				
Staphylococcus aureus	1 (12.5%)	1 (7.1%)	1 (20%)	3 (13.6%)
Total	8 (36.4%)	14 (51.8%)	5 (18.5%)	27 (100%)

DISCUSSION

The result of this hospital-based study showed that total available patients during the study period were 146. Among them the frequency of culture positive specimens was 19% (n = 27). This finding is consistent with finding of the study done in Addis Ababa by Negussie et al.[3]

The study also showed that majority of the patients in the 3 years was from 3 months to 12 months of age group. Median age was significantly higher in children who were admitted in 2017. Among the culture positive patients, majority (48%) fall in infant age group. This finding is nearly similar with the study by Nawshed et al. (38%) in Dhaka Shishu Hospital.[1]

Male babies outnumbered their female counterpart with a ratio of 1.24:1 (79 vs. 67) which is consistent to studies done by Negussie et al. and Haque.[3,9] Majority of the patients were from rural areas which implies that the suspicion for a grave condition is overlooked.

Regarding different ICU modalities provided to the patients' syringe pump was used for all of the patients. Other modalities were oxygen hood, inotrope, Cardiac monitor and ventilator. Among the culture positive patients, oxygen hood was used for (55.2%) Cardiac monitor (25.9%) ventilator

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(15.5%) and inotrope (34.5%). There was no significant difference in provision of different ICU modalities between culture positive and negative patients. Turner et al. found that some relatively inexpensive and simple critical care interventions dramatically improve patient outcomes, including the introduction of oxygen concentrators, oximetry monitoring, and supplemental oxygen in Papua New Guinea, which decreased pediatric pneumonia case fatality by 35%.[10]

Out of 146 blood samples, culture positivity was found only in 27 samples (19%). Among them, 8 cases (17%) were from 2016 and 14 (19%) from 2017 and 5(16.6%) from 2019. Daniela from Craiova found the average percentage of culture-positive cases of all patients diagnosed with sepsis was only 18% which is similar to this study, whereas Zaveri et al. from India found 65.66% positivity from blood culture.[11,12]

Out of total 27 culture positive samples, majority of the isolated micro-organisms were gram negative bacteria (86.4%) followed by gram positive bacteria (13.6%). Pathogens isolated from blood culture are Acinetobacter sp. (29.6%), Pseudomonas sp. (25.9%) Klebsiella sp. (25.9%) E. coli (4.5%) Burkholderia (4.5%) and S. aureus (13.6%). The study done in a PICU of a private hospital in Dhaka found nearly similar findings, their predominant isolates were E. coli, Klebsiella, Acinetobacter, Pseudomonas, Staphylococcus aureus & candida.[13] Zaveri et al. from Ahmedabad found similar result also.[12]

LIMITATIONS

Non-probability sampling method was used. The study was done in single center. The duration of study was short.

CONCLUSION

This study was undertaken in order to document the most common types of pathogens causing sepsis in children admitted in the newly established Pediatric Intensive Care Unit (PICU) of Chattogram medical college hospital and their outcome. From the current study, we found that majority of the organisms were gram negative in the PICU. If a specialized center like PICU has its own microbiological and antibiotic sensitivity pattern, then they can have their own protocol to establish.

RECOMMENDATIONS

Large scale study is needed. Validation study by extensive multi-centric method is recommended. Composite scoring is needed for predicting mortality.

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DISCLOSURE

All the authors declared no competing interest.

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