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Culture Sensitivity And Antibiotics Resistant In Patients With Sepsis In Pediatric Intensive Care Unit

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Abstract

Background: The growing prevalence of antibiotic-resistant infections presents a significant challenge in the setting of sepsis management, especially within pediatric intensive care unit (PICU) work.

Objective: To explore the association of culture sensitivity and antibiotic resistance in pediatric patients diagnosed with sepsis.

Study Design: This is a retrospective observational analysis.

Duration and Place of the Study: This study conducted over a one-year period from 1st january 2023 to 30th December 2023, in the pediatric intensive care unit (PICU) at Saidu group Of Teaching hospital, Swat.

Material and Methods: This study included 105 pediatric patients who were admitted to the PICU and had sepsis. Inclusion criteria: Patients aged 0-18 years old Clinical diagnosis of sepsis based on the international consensus criteria Data available for microbiological culture and antibiotic sensitivity data were included in study. Insufficient medical records Patients transferred to the PICU from another hospital and no prior microbiological data were excluded from study.

Results: A total of 105 pediatric patients with sepsis confirmed were included in the study. Mean age of the patients 6.78 ± 5.50 years. Distribution of age was as follows 23.8 % were between 0-1 year, 28.6% from 2-5 years, 19.0% from 6-10 years and (28.6%) aged from 11-18 years respectively. The gender distribution was 55.2% male to 44.8% were female. Amongst 0-1 years, it was also higher at (60.0%, p=0.045), amongst 2-5-year-olds also had a rate of (60.0%, p=0.032) and among the group aged between 11 to 18 years (56.7%, p=0.048).

Conclusion: Results from this study showed the crucial need for a culture sensitivity test when choosing appropriate antibiotic therapy in pediatric septic cases.

Keywords: Antibiotic Resistance, Culture Sensitivity, Pediatric Sepsis, Intensive Care Unit.

INTRODUCTION

Sepsis remains a major morbidity and mortality threat within pediatric intensive care units (PICUs) globally [1, 2]. Sepsis is a life-threatening condition caused by the body's extreme response to an infection that can lead to widespread inflammation, tissue damage, organ failure and could result in death [3] . Sepsis management in pediatric patients is more challenging compared to adult sepsis due limited capacity for clinical presentation,

equally presenting few signs of severity and high speed progression [4, 5]. Which leads worsened response from mistimed intervention thus pathology outcome; also the significant differences between children physiology comparing with adults contributes.

An obstacle to treating sepsis is the increase in cases due to antibiotic resistant infections [6]. This has led to increase in inappropriate and unnecessary use of antibiotics which subsequently resulted appearance of multidrug-resistant (MDR) organisms consequently challenging treatment regimens and outcomes for affected patients [7]. The PICU, where the youngest and frequently most fragile patients are cared for, is particularly affected by antibiotic resistance. Therefore, attention to early diagnostic and therapeutic strategies will be important for the mitigation of sepsis and antibiotic resistance burden [8, 9].

Culture sensitivity testing is an important part of sepsis management [10]. This knowledge allows the clinicians to provide more appropriate, focused and effective antibiotic prescribing that can benefit individual patients by maximizing treatment outcome while reducing resistance development [11]. There is a paucity of comprehensive data on the burden and patterns of antibiotic resistance in pediatric sepsis, that too when it comes to children admitted to PICU [12].

The present study was conducted to fill this gap of knowledge in relation to culture sensitivity and antibiotic resistance, which is one of the major causes for sepsis among pediatric patients. This is a retrospective analysis of 105 pediatric patients admitted to the pediatric intensive care unit with confirmed diagnosis for sepsis conducted over one-year period. The objective of the study was to determine etiology, antimicrobial susceptibility profiles and clinical implications in five.

Knowledge of the epidemiology of sepsis and antibiotic resistance in PICU is essential to define evidence-based treatment algorithms, improve antimicrobial stewardship programs. The study aims to provide important knowledge that could impact clinical practice, patient recovery and in a larger context potentially help the fight against antibiotic resistance pressures seen across healthcare settings.

Methodology

Study Design

This is a retrospective observational analysis.

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Material and Methods

This study included 105 pediatric patients who were admitted to the PICU and had sepsis. Inclusion criteria: Patients aged 0-18 years old Clinical diagnosis of sepsis based on the international consensus criteria Data available for microbiological culture and antibiotic sensitivity data were included in study. Insufficient medical records Patients transferred to the PICU from another hospital and no prior microbiological data were excluded from study. Microbiological cultures were handled in the microbiology section of hospital laboratory, according to standard methods. Isolates were identified through biochemical tests and automated systems after culturing. Antibiotic susceptibility testing was done using the disk diffusion, and automated methods according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Data Collection

Data were collected from the hospital's electronic medical record system. For each patient the following listing was birthed -

Demographics: age, sex, coexisting conditions.

Clinical data: Presentation (signs and symptoms), severity of sepsis, organ dysfunction

Microbiological Report: Specimen type (blood, urine, cerebrospinal fluid etc.), pathogen identified and culture + sensitivity results.

Empirical antibiotic treatment is initiated, subsequent adjustments according to culture sensitivity results and duration of antibiotic therapy.

Results: ICU length of stay, complications and mortality.

Statistical Analysis

We conducted composite statistical analysis with SPSS software version 26. A single head CT was performed in all patients. The frequency and percentage were used to describe the characteristics of patient demographics, clinical features and hundreds of microbial results by descriptive analysis for each variable. The frequency of the various pathogens and their sensitivity to antibiotics were then determined. For comparison of categorical variables chi-square tests was used and for continuous variables, t-tests or Mann - Whitney U when data failed normal distribution. Univariable and multivariable logistic regression models were used to assess the association between antibiotic resistance, and clinical outcomes. A $p < 0.05$ was considered as statistically significant.

Ethical Considerations

The UAMS Saidu group Of Teaching hospital, Swat Medical Center Institutional Review Board (IRB) approved the study. Because of the retrospective nature, informed consents were exempted. Data were de-identified and a unique study code was used to ensure patient confidentiality.

Results

A total of 105 pediatric patients with sepsis confirmed were included in the study. Mean age of the patients 6.78 ± 5.50 years. Distribution of age was as follows 23.8 % were between 0-1 year, 28.6% from 2-5 years, 19.0% from 6-10 years and (28.6%) aged from 11-18 years respectively. The gender distribution was 55.2% male to 44.8% were female. As for underlying conditions, 38.1% had no risk factors; chronic illnesses were observed in 33.3%, immune deficiency in 19.0%, and other comorbidities, including obesity (9.5%) in Table 1.

The patients had fever (76.2%), tachycardia (61.9%), hypotension (42.9%) and respiratory distress (47.6%) as initial signs and symptoms. Single-organ dysfunction was present in (57.1%) patients with single organ dysfunction and 42.9% with multiple organ dys-function. The duration of PICU stay varied, with 38.1% staying 1-5 days, 33.3% staying 6-10 days, and 28.6% staying more than 10 days. Patients' mortality was 14.3% (Table 2).

The pathogens isolated from the patients were shown in Table 3, which included Escherichia coli (23.8%), Klebsiella pneumoniae (19.0%), Staphylococcus aureus (17.1%), Pseudomonas aeruginosa (11.4%), Streptococcus pneumonia (9.5%), Streptococcus pneumoniae (9.5%), Enterococcus species (9.5%), and other pathogens (9.5%). Significant resistance was found in antibiotic susceptibility patterns for the major pathogens. For Escherichia coli, resistance was observed to ampicillin (60.0%) and ceftriaxone (40.0%), but higher susceptibility to gentamicin was observed with values of 72.0%. Similarly, Klebsiella pneumoniae had resistance of 70.0% to ampicillin and ceftriaxone (40.0%) followed by gentamicin at about 30.0%. Methicillin Intermediate Resistance Staphylococcus

aureus (SAMR) observed in 44.4%, Erythromycin resistant shown among 33.3% and sensitive to Vancomycin by total susceptibility of toxic isolates at the rate of 100% showed in Table 4.

Analysis of factors associated with antibiotic resistance revealed significant associations with age and underlying conditions. Antibiotic resistance was higher among patients aged 0-1 year (60.0%, p=0.045), 2-5 years (60.0%, p=0.032), and 11-18 years (56.7%, p=0.048). Patients with underlying conditions also showed higher resistance rates: chronic illness (62.9%, p=0.015), immune-compromised status (75.0%, p=0.001),

Age and co-morbidities were among the factors found to be significantly associated with antibiotic resistance (Table 5). Amongst 0-1 years, it was also higher at (60.0%, p=0.045), amongst 2-5-year-olds also had a rate of (60.0%, p=0.032) and among the group aged between 11 to 18 years (56.7%, p=0.048). patients with underlying conditions are also at a higher resistance rate: Chronic illness (62.9%, p=0.015); Immuno-compromised status (75.0%, p=0.001) and other conditions (70.0%, p=0.003).

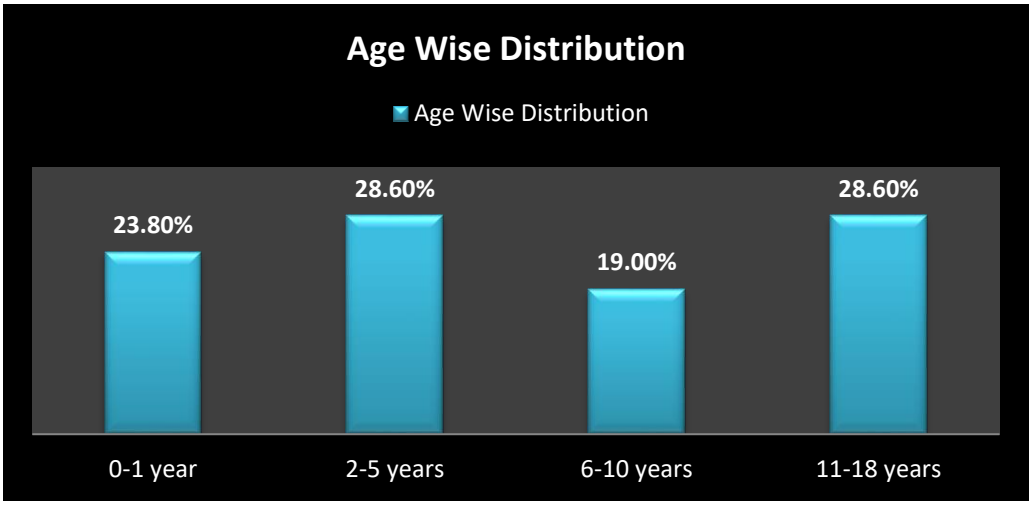

Table 1: Demographic Characteristics of Pediatric Patients with Sepsis (N=105)

Characteristic	Number of Patients (n=105)	Percentage (%)
Age (year), Mean ± (SD)	6.78 ± 5.50	
Age Group		
0-1 year	25	(23.8%)
2-5 years	30	(28.6%)
6-10 years	20	(19.0%)
11-18 years	30	(28.6%)
Gender		
Male	58	(55.2%)
Female	47	(44.8%)
Underlying Conditions		
No underlying condition	40	(38.1%)
Chronic illness	35	(33.3%)
Immuno-compromised	20	(19.0%)
Others	10	(9.5%)

Table 2: Clinical Characteristics and Outcomes of Pediatric Sepsis Patients

Clinical Characteristic	Number of Patients (n=105)	Percentage (%)
Initial Signs and Symptoms		
Fever	80	(76.2%)
Tachycardia	65	(61.9%)
Hypotension	45	(42.9%)
Respiratory distress	50	(47.6%)
Organ Dysfunction		
Single organ dysfunction	60	(57.1%)
Multiple organ dysfunction	45	(42.9%)
Length of PICU Stay (days)		
1-5 days	40	(38.1%)
6-10 days	35	(33.3%)
>10 days	30	(28.6%)
Mortality	15	(14.3%)

Table 3: Distribution of Pathogens Isolated from Pediatric Sepsis Patients

Pathogen	Number of Isolates (n=105)	Percentage (%)
Escherichia coli	25	(23.8%)
Klebsiella pneumonia	20	(19.0%)
Staphylococcus aureus	18	(17.1%)
Pseudomonas aeruginosa	12	(11.4%)
Streptococcus pneumonia	10	(9.5%)
Enterococcus species	10	(9.5%)
Others	10	(9.5%)

Table 4: Antibiotic Susceptibility Patterns of Major Pathogens

Pathogen	Antibiotic	Susceptible (%)	Resistant (%)
Escherichia coli	Ampicillin	10 (40.0%)	15 (60.0%)
	Ceftriaxone	15 (60.0%)	10 (40.0%)
	Gentamicin	18 (72.0%)	7 (28.0%)
Klebsiella pneumonia	Ampicillin	6 (30.0%)	14 (70.0%)
	Ceftriaxone	12 (60.0%)	8 (40.0%)
	Gentamicin	14 (70.0%)	6 (30.0%)
Staphylococcus aureus	Methicillin	10 (55.6%)	8 (44.4%)
	Vancomycin	18 (100.0%)	0 (0.0%)
	Erythromycin	12 (66.7%)	6 (33.3%)

Table 5: Factors Associated with Antibiotic Resistance

Factor	Resistant (%)	Non-resistant (%)	p-value
Age Group			
0-1 year	15 (60.0%)	10 (40.0%)	0.045*
2-5 years	18 (60.0%)	12 (40.0%)	0.032*
6-10 years	10 (50.0%)	10 (50.0%)	0.055

11-18 years	17 (56.7%)	13 (43.3%)	0.048*
Underlying Conditions			
No underlying condition	18 (45.0%)	22 (55.0%)	0.022*
Chronic illness	22 (62.9%)	13 (37.1%)	0.015*
Immunocompromised	15 (75.0%)	5 (25.0%)	0.001**
Others	7 (70.0%)	3 (30.0%)	0.003**

*p < 0.05; **p < 0.01

Discussion

This study aimed to delineate the association of CS with AR among children admitted in PICU as having sepsis. This study is completed to capture the independent incidence and outcomes of sepsis in pediatric malnutrition highlighting the demography, clinical entities, bacteriological profile along with antimicrobial sensitivity pattern done that throws light on complexities while addressing such cases.

This study had a mean age of 6.78 with an equally distributed sample during the different ages groups. This is consistent with prior reports regarding the broad age distribution of pediatric sepsis patients. For example, in a study by Watson et al. (2003) reported that the mean age was 7.1 years in a pediatric cohort of sepsis patients which demonstrated it closely resembled our study population's distribution [13]. The gender distribution in our study, with 55.2% males and 44.8% females was comparable to other studies that often show a slightly increased prevalence of sepsis in males (Angus et al,2001) [14].

These features (fever: 76.2%, tachycardia: 61.9%, hypotension, 42.9% respiratory distress, 47.6%) encountered in this case series are compatible with the common clinical manifestations of sepsis among children. Previous studies have revealed similar signs and symptoms in pediatric sepsis (such as Goldstein et al., 2005) [15]. The observed mortality rate of 14.3%, is also consistent with reported mortality rates in pediatric sepsis (10% to20%) depending on the study population and setting (Hartman et al., 2013) [16].

In our analysis, the frequency distribution of pathogens demonstrated Escherichia coli (23.8%), then Klebsiella pneumonia (19.0%) and Staphylococcus aureus (17.1%). These results are in line with other studies where similar pathogens have been detected as frequently causing Pediatric Sepsis. A case in point is a report by Kissoon et al., (2016) Escherichia coli and Klebsiella pneumoniae were also reported as common isolates in pediatric sepsis [17]. Global trends seen in pediatric sepsis pathogens are further substantiated with the identification of (11.4%) Pseudomonas aeruginosa and Streptococcus pneumoniae (9.5%).

The high incidence of resistance observed among the isolated pathogens noted in this study demonstrate antibiotic susceptibility patterns. Escherichia coli showed 60.0% resistance to ampicillin, which is higher than the 50% resistance reported in a study by De Man et al. (2010) [18]. Klebsiella pneumoniae was 70.0% resistant to ampicillin, which also corresponds with previous data reporting high levels of resistance (Tamma et al., 2017) [19]. While the presence of susceptibility to vancomycin (100.0%) for Staphylococcus aureus was re-assuring, resistance against methicillin still represents 44.4%, showing that MRSA is following as an ongoing problem in pediatric sepsis (Sader et al., 2019) [20].

This findings linked several age groups and comorbidities with antibiotic resistance. In patients from 0-1 and 2-5 years high resistance rates were observed, what could be justified by the major proportion of young individuals who have incomplete immune system development as well as stay in hospital environments. In immune-compromised, and chronicel patients, resistant rates were also higher which justifies antibiotic stewardship even in these groups of patients. These results correlate with past research, which has detected comparable risk factors for antibiotic resistance in pediatric patients (Patel et al., 2010) [21].

Our findings are corroborated by previous studies of the global burden of antibiotic resistance in pediatric sepsis. As an example, the level of antimicrobial resistance among Escherichia coli and Klebsiella pneumoniae in our study is consistent with worldwide reports from WHO (2014) [22]. Our study, where both appropriate nursing home and hospital isolates had high resistance rates, indicates that changes in empirical antibiotic therapies must be made urgently and efforts put forth to establish stronger antibiotic stewardship programs for the dissemination of resistant organisms.

Conclusion

Results from this study showed the crucial need for a culture sensitivity test when choosing appropriate antibiotic therapy in pediatric septic cases. The extensive resistance rates of relevant pathogens emphasize the importance recognized needed for ongoing surveillance and targeted interventions to help optimize treatment efficacy. Subsequent studies should examine these findings in other pediatric critical care departments and investigate new methods of tackling antibiotic resistance more effectively within the PICU environment. Through addressing these barriers, proper management of pediatric sepsis can be provided in the developing countries and thus may play a role in global efforts to reduce antibiotic resistance.

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