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Bacterial spectrum and antibiotic susceptibility among hospitalized pediatric cardiac patients: A cross sectional study

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***Abstract*---**Aim: To determine the bacterial spectrum and antibiotic susceptibility among hospitalized pediatric cardiac patients. Material and Methods: A cross sectional study was conducted at at Department of Paediatrics Cardiology, National institute of Cardiovascular Disease Karachi in the duration from January, 2023 to June, 2023. Total 146 cardiac patients admitted in cardiology department having age between 1 to 16 years of either gender. Bacterial spectrum and antibiotic susceptibility were determined. Results: Escherichia Coli, Staphylococcus aureus and Klebsiella pneumonia were the most prevalent bacterial isolates. Meropenem, Linezolid and Clindamycin showed high sensitivity against majority of the bacterial isolates. Conclusion: From our study we conclude that Escherichia Coli and Klebsiella pneumonia were the most prevalent gram negative isolates

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while Staphylococcus aureus was the most prevalent gram positive isolate in hospitalized cardiac children in our study. We found Meropenem, Linezolid and Clindamycin showed high sensitivity against majority of the gram positive and negative isolates.

***Keywords*---**bacterial spectrum, antibiotic susceptibility, cardiology, pediatrics.

Introduction

In current circumstances, the development of pathogens that are resistant to antibiotic treatment has emerged as one of the most critical dangers facing the medical field. The prevalence of multidrug-resistant microorganisms (MDR) that are highly pathogenic, can kill people, and present a very serious risk to human health is growing every day. In the past, antibiotic-resistant bacterial strains of this type were exceedingly uncommon and were restricted to being found solely in nosocomial infections; but, in today's world, they are extremely prevalent. This problem is more common among Gram-positive and Gram-negative bacterial species. Gram-negative bacterial species include A. baumannii, E. coli, P. aeruginosa, and K. pneumonia. Gram-positive bacterial species include S. aureus, S. pneumoniae, E. faecium, and E. faecalis. It was discovered that these bacterial species developed resistance to antibiotics as a result of the acquisition of plasmids via the transmission of resistance genes [1-5].

This was the cause of the antibiotic resistance. Certain bacterial species have developed various specialized mechanisms, such as efflux pumps, decreased permeability of the LPS layer, release of degrading enzymes, and change of targets, in order to protect themselves from the potentially detrimental effects of antibiotics [6]. A worldwide development, overexploitation of antibiotics, extreme usage of broad-spectrum medications, and shortage of target-oriented antimicrobial drugs are some of the variables that may be responsible for the increase in antibiotic resistance [7].

Additionally, it is believed that the psychological and financial impacts are of a significant magnitude, particularly among emerging nations [8, 9]. Immature innate and adaptive immunity, which becomes even more impaired in the presence of infections, as well as congenital heart disease, are key risk factors for infections in children. In addition, children with congenital heart problems are more likely to have infections. According to the statistics collected in the region, the prevalence of blood culture positive among admitted youngsters is between 78 and 86 percent [10, 11].

In order to effectively treat blood-stream infections in hospitalized children, healthcare providers must have up-to-date information regarding the occurrence of these infections, as well as the patterns of the infectious agents responsible for them and their antibiotic sensitivities. There is a lack of local data demonstrating microbial trends and antimicrobial susceptibility from cardiac daycare health centers. Among inpatient children, gram-negative bacteria have historically made up a disproportionately large share of the causal agents. The purpose of this

research was to determine whether or not there were any patterns in the types of bacteria found in blood cultures taken from pediatric cardiac patients admitted to our hospital setup.

Material and Methods

This cross sectional study was done at at Department of Paediatrics Cardiology, National Institute of Cardiovascular Disease Karachi in the duration from January, 2023 to June, 2023. It was approved by the Institutional Ethical Committee Parents or guardians of everyone who took part in the study were asked for written permission.

We enrolled 146 patients of both genders having age between 1 to 16 years who were admitted and had blood samples submitted for blood culture. Laboratory criteria for asking a blood culture included a leukocyte count of less than 4,000/mm^3 or more than 10,000/mm^3, a CRP of more than 10 mg/L, a slow or fast heart rate, shortness of breath, infiltrates on a chest X-ray, cloudy urine, painful urination, thrombophlebitis, or pain or tenderness in the abdomen.

Before starting any sort of antibiotic treatment, a 5 ml blood sample was taken under strict aseptic circumstances. For this study, all of the blood samples were sent to a central institution laboratory to test for culture and sensitivity. All blood cultures were done with a standard bottle and a five-day incubation time. Gram staining was used to figure out what kind of organisms were isolated. As per normal protocol, the lab at the institution did a blood culture and sensitivity test. The "Kirby Baur Disc Diffusion" method was used to test the susceptibility pattern of known bacteria to the most commonly used antimicrobials. All the study's data was written down on proforma made just for this study. All the data was analyzed in IBM SPSS 25. Age was presented as mean and standard deviation while other categorical data was presented as frequencies and percentages. Chi Square test was applied for association keeping P value < 0.05 as significant.

Results

We conducted this study on 146 patients aged between 1 to 16 years. Patients' mean age was 8.09±4.53 years. The frequency of male patients was 65.75% while the frequency of female patients was 34.25%. According to the pattern of bacteriological spectrum we found that Escherichia coli was present in 34.2% patients, Staphylococcus aureus was present in 28.1% patients, Klebsiella pneumonia was present in 17.1% patients, Pseudomonas aeruginosa was present in 10.3% patients, Neisseria meningitides and staphylococcus epidermidis were present in 4.1% patients and Haemophilus influenzae b was present in 2.1% patients. Antibiotic susceptibility can be seen at table no 2, we found that Meropenem, Linezolid and Clindamycin showed high sensitivity against majority of the bacterial isolates. We did not find any significant association between bacterial spectrum with gender.

Figure 1. Gender distribution

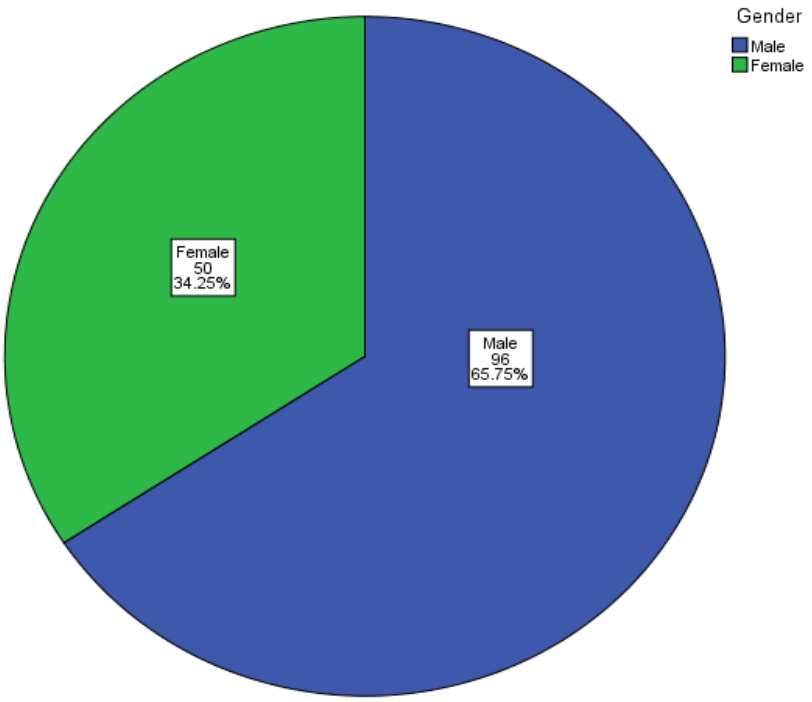

Table 1. Bacteriological spectrum

Bacteriological spectrum	Frequency	Percent	Valid Percent	Cumulative Percent
Escherichia coli	50	34.2	34.2	34.2
Staphylococcus aureus	41	28.1	28.1	62.3
Klebsiella pneumoniae	25	17.1	17.1	79.5
Pseudomonas aeruginosa	15	10.3	10.3	89.7
Neisseria meningitidis	6	4.1	4.1	93.8
staphylococcus epidermidis	6	4.1	4.1	97.9
Haemophilus influenzae b	3	2.1	2.1	100.0
Total	146	100.0	100.0	

Table 2. Antibiotic susceptibility

		Meropenem		Linezolid		Clindamycin		Piperacillin	
		S	R	S	R	S	R	S	R
Bacteriological spectrum	Escherichia coli	98.0%	2.0%	94.0%	6.0%	82.0%	18.0%	84.0%	16.0%
	Staphylococcus aureus	95.1%	4.9%	82.9%	17.1%	87.8%	12.2%	75.6%	24.4%
	Klebsiella pneumoniae	96.0%	4.0%	72.0%	28.0%	88.0%	12.0%	80.0%	20.0%
	Pseudomonas aeruginosa	100.0%	0.0%	93.3%	6.7%	86.7%	13.3%	93.3%	6.7%

	Neisseria meningitidis	100.0%	0.0%	100.0 %	0.0%	100.0%	0.0%	66.7%	33.3%
	staphylococcus epidermidis	100.0%	0.0%	100.0 %	0.0%	83.3%	16.7%	83.3%	16.7%
	Haemophilus influenzae b	100.0%	0.0%	100.0 %	0.0%	100.0%	0.0%	33.3%	66.7%

Table 3 Association of Bacteriological spectrum with gender

		Gender		Total	P value
		Male	Female		
Bacteriological spectrum	Escherichia coli	32	18	50	0.20
		64.0%	36.0%	100.0%	
	Staphylococcus aureus	29	12	41	
		70.7%	29.3%	100.0%	
	Klebsiella pneumoniae	17	8	25	
		68.0%	32.0%	100.0%	
	Pseudomonas aeruginosa	7	8	15	
		46.7%	53.3%	100.0%	
	Neisseria meningitidis	6	0	6	
		100.0%	0.0%	100.0%	
	staphylococcus epidermidis	3	3	6	
		50.0%	50.0%	100.0%	
	Haemophilus influenzae b	2	1	3	
		66.7%	33.3%	100.0%	
Total		96	50	146	
		65.8%	34.2%	100.0%	

Discussion

Multidrug-resistant (MDR) diseases are on the rise around the world and are a major cause of illness and death in children. People think that blood stream infections have serious effects and kill between 3 and 18% of children. People also think that the emotional and financial effects will be very big, especially in poor countries. Children are more likely to get infections because their immune systems aren't fully developed. This makes it harder for them to fight off infections, and congenital heart problems make it even harder. Regional statistics shows that between 78% and 86% of admitted children have a positive blood culture.[12]

In order to treat blood-stream infections in hospitalized children, it is very important to know how common the infection-causing agents are, how they spread, and how sensitive they are to antibiotics. There is no local data from any cardiac childcare health facilities that shows trends of microorganisms and how well they respond to antibiotics.[13] Traditionally, most of the things that cause heart problems in children who are hospitalized are caused by gram-negative bugs.[14]

Regional data from Saudi Arabia that looked at bloodstream infections in children who were going to have heart surgery showed that 8.6% of their blood cultures

were positive. In the past, studies were done at different places that care for children's heart health.[15] They found that the culture positivity rate was between 6% and 8%. However, there isn't enough local data to show what the positive blood culture rate is for patients who are brought to pediatric cardiology units. Local general data on children show that 24% of blood cultures are positive, while data from Palestine show that 13.2% of blood cultures are positive. Data from India shows that there is a lot of variation, with good culture rates ranging from 78 to 89%. This difference in the rate of positive blood cultures could be caused by different etiological agents, the use of antibiotics in the past, or different ways of analyzing blood cultures in different settings.[11]

We conducted this study on 146 hospitalized cardiac patients having age range between 1 to 16 years. The mean age of the patients turned out to be 8.09±4.53 years. Male patients outnumbered the female patients. Similar findings were observed by a study which reported that majority of their hospitalized cardiac patients were male as compared to female patients.[16]

In our study we found that Escherichia Coli was the most prevalent gram –ve isolate (34.2%), the second most prevalent gram +ve isolate was Staphylococcus aureus (28.1%) while Klebsiella pneumonia a gram –ve isolate was found in 17.1% patients. In a study of 268 children with microbiologically proven bloodstream bacterial infections, the most common bacterial isolates were coagulase-negative staphylococci (19.8%), Staphylococcus aureus (16.4%), and Acinetobacter spp. (8.2%).[17] Pseudomonas aeruginosa was the most common type of bacteria found in 11.6% of acute leukemia cases in China.[18] All of these data show that there are big differences in how the most common etiological agents are spread among children with ALL. Because of this, the most common pathogens must be analyzed often to get first-hand information about the trends of the most common microorganisms involved.

We found that Meropenem, Linezolid and Clindamycin were highly sensitive to the majority of the gram positive and negative bacterias, similar reports have been shown by a study which concluded that Meropenem, Linezolid and Clindamycin were highly sensitive to gram positive and negative bacterial isolates in their study.

Conclusion

From our study we conclude that Escherichia Coli and Klebsiella pneumonia were the most prevalent gram negative isolates while Staphylococcus aureus was the most prevalent gram positive isolate in hospitalized cardiac children in our study. We found Meropenem, Linezolid and Clindamycin showed high sensitivity against majority of the gram positive and negative isolates.

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