Original article

Comparison of Bacterial Etiology with Antibiogram of Blood Stream Infection between Adult and Paediatric Group at a Tertiary Care Hospital in Bangladesh

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Abstract:

Background: Timely understanding of bacterial profiles and the change of antimicrobial resistance provide an important guidance for effective and optimized use of antibiotics in local healthcare systems. ***Objective:*** The purpose of this study was to compare of bacterial etiology with antibiogram of blood stream infection between adult and paediatric**.** ***Methodology:*** This cross-sectional study was conducted in the department of Microbiology at Monno Medical College, Manikganj, Bangladesh during the period from January 2019 to December 2019 for duration of one year. In adult and pediatric patient blood was collected according to blood collection guidelines and inoculated into BacT/ALERT FA plus and BacT/ALERT PF plus aerobic blood culture bottles respectively. After collection these bottles were immediately incubated in BacT/ALERT 3D (manufactured by bioMerieoux, France) a fully automated blood culture system. Antimicrobial susceptibility test was done for all isolated bacteria by disc diffusion method. ***Result:*** A total number of 178 patients were recruited, among them 12 (7%) yielded growth of different bacteria. The culture positive cases were found in 7 (4%) in Paediatric group and 5 (3%) in adult age group. The most predominant identified bacteria in Paediatric group was *Escherichia Coli* which showed highly sensitive to imipenum, amikacin, linezolid, gentamicin (n=3, 100%). In adult group the most predominant isolated bacteria was *Streptococci* species which showed high sensitive to imipenum, linezolid, gentamicin 4 (80%) considerable sensitive to ciprofloxacin, tetracycline, cefotaxime, cefuroxime 3(60.0%). ***Conclusion:*** In conclusion the most common bacteria isolated from blood stream infection in adult and paediatric group are *Streptococci* species and *Escherichia Coli* respectively.

Keywords: Blood cultures; blood stream infections; bacterial isolates; antibiotic sensitivity; BacT/ALERT

Bangladesh Journal of Medical Science Vol. 22 No. 04 October'23 Page : 869-875
DOI: https://doi.org/10.3329/bjms.v22i4.67126

Introduction:

The effectiveness of antibiotics is threatened globally for the reason of widespread resistant bacteria. Blood stream infections range from self-limiting infections to life threatening sepsis that requires rapid and aggressive antimicrobial treatment. For blood stream infections, wide spectrum of organisms has been described and this spectrum is depend

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to geographical alteration[1]. The wide spread of resistant bacteria has become a major threat to reduce the effectiveness of antibiotics worldwide[2]. Especially in the developing world the emergence of multi resistant organisms is escalating[3]. Annually approximately 200,000 cases of bacteremia occur with mortality rates ranging from 20-50% worldwide. Blood stream infection is the eighth leading cause of mortality where in the United States 17% of death occurs in every year[4]. However BSI also accounts for about 10-20% of all nosocomial infections[4]. In many studies a wide range of bacteria has been described in febrile patients including Gram negative bacteria such as *Escherichia coli*, *Pseudomonas aeroginosa*, *Klebsiella* species, *Neisseria meningitidis*, *Haemophilus influenzae*, and Gram positive such as Coagulase negative *Staphylococci* (CONS), *Staphylococcus aureus, Streptococcus pneumoniae, Streptococcus pyogenes, Streptococcus agalactiae* and *Enterococcus faecium*.

The knowledge of epidemiological and antimicrobial susceptibility pattern against common pathogens is elucidating for selection to antibiotics. Geographical location and changes in time is influence the predominance of either the Gram positive or Gram negative bacterial. Whenever it also is influence the antibiotic susceptibility pattern by location and time. Some bacteria commonly isolated include *Escherichia coli, Klebsiella pneumonia, Enterobacter species, Pseudomonas aeruginosa* and *Staphylococcus aureus*[5]. In almost all cases, before the reports of blood culture are available antimicrobial therapy is initiated empirically (irrational use of antibiotics). To reduce the high mortality and morbidity associated with septicemia, appropriate choice of empiric therapy is of importance[6]. The circumstance may have been effective prior to the wide spread of resistant microorganisms.

Antimicrobial resistant bacteria cause different kind of infection which are responsible for prolong the hospital stay with the risk of death leading to requirements of more expensive antibiotics for their treatment. However, a guide for the selection of appropriate antibiotics for treating patient is mandatory, due to robust the serious risks of multidrug resistant organisms. The assistance of an effective laboratory helps to prevent AMR instead of depending on empirical therapy. Effectiveness of antibiotics becomes rapidly deteriorated due to increase antimicrobial resistance (AMR) globally. Mortality and morbidity become high due to treatment failures and a lack of effective therapy as because of AMR. Information on infection epidemiology and antimicrobial resistance patterns is a condemnatory to aid physicians empirically treats life-threatening infectious illnesses. High use of antibiotics correlates with the increasing rate of AMR[7]. As required by the WHO, there is a global demand to increase awareness about antimicrobial resistance[8]. This awareness and monitoring of AMR will decrease the bacterial resistance rate, will help for the selection of suitable antibiotics, and will reduce hospitalization, treatment costs as well as the death rate[9]. The purpose of this study was to compare of bacterial etiology with antibiogram of blood stream infection between adult and Paediatric.

Methodology:

Study Settings and Population: This cross-sectional study was conducted in the department of Microbiology at Monno Medical College, Manikganj, Bangladesh. This study was carried out during the period from January 2019 to December 2019 for duration of one year. A total number of 178 patients were selected both outdoor & indoor patient irrespective of age, sex, growth positivity and antibiotic susceptibility. Adult and Paediatric group was selected on the basis of age demarcation which was 12 years. Patients who were taking antibiotics within last 14 days those were excluded in this study. Informed written consent was taken from all patients or their legal guardians before specimen collection.

Study Procedure: In adult patient 20ml blood was collected from patient using strict aseptic precautions and inoculated immediately into BacT/ALERT FA plus aerobic blood culture bottles with 0.025% of sodium polyanethol sulfonate (SPS) as anticoagulant. In pediatric cases blood was collected based on weight of the patient and blood to broth ratio (1:10) which was inoculated in BacT/ALERT PF plus pediatric blood culture bottles. After collection these bottles were immediately incubated in BacT/ALERT 3D (manufactured by bioMerieoux, France) a fully automated blood culture system for detection of growth in blood culture. In case of a positive growth, the BacT/ALERT automatically gives an alert. The positive bottles were then subculture on Blood Agar, Chocolate Agar and MacConkey Agar (HiMedia Laboratories Pvt.

Limited, India) and then incubated aerobically at 37°C for 24 h. Standard microbiological methods were applied for the identification of the bacterial species[10]. All the isolated organisms were identified by their colony morphology, staining characters and further confirmed by relevant biochemical tests. Susceptibility to antimicrobial agents of all isolates was done by Kirby Bauer modified disc diffusion technique using Mueller Hinton agar plates and zones of inhibition were interpreted according to CLSI guidelines[11,12]. Antibiotic discs such as cefotaxime(30µg), ceftriaxone (30µg), amoxicillin (20µg), ciprofloxacin (5µg), cefuroxime (30µg), amikacin (30µg), azythromyin (15µg) , gentamicin (10µg), doxycycline (30µg), nalidixicacid (30µg), tetracycline (30µg), cefixim (30µg), imipenem (10µg), nitroflurantoin (300µg), vancomycin (30µg⁄disc), linezolid (30µg⁄disc), sulphamethozazole+trimethoprim (25 µg).

Statistical Analysis: All data were processed and analyzed with the help of IBM SPSS (Statistical package for Social Sciences) Version 22.0. Quantitative data were expressed as mean and standard deviation and qualitative data as frequency and percentage. Association was analyzed by Pearson's Chi square (X^2) test. A probability (p) value of <0.05 was considered statistically significant. Binary Logistic regression has been done to calculate crude odds ratio. The significance level was established as P less than 0.05 and 95% confidence intervals (CI) were used as odds ratio (OR) estimates.

Ethical Clearance: Approval of the research protocol and ethical permission were obtained from the Ethics Review Committee of Monno Medical College, Manikganj with Letter No: momc/erc/2018/19707.

Result:

A total number of 178 patients were recruited after fulfilling the inclusion and exclusion criteria. Among them adult participants were predominant 91(51%) and Paediatric participants were 87(49%) (Figure I)

Among 87 Paediatric patients male participants were predominant than female which was 54(62.1%) and 33(37.9%) respectively. About 91 adult patients male participants were predominant than female which was 47(51.6%) and 44(48.4%) respectively. The association between gender and Paediatric & adult group did not differ statistically significantly (P =0.161) (Table 1).

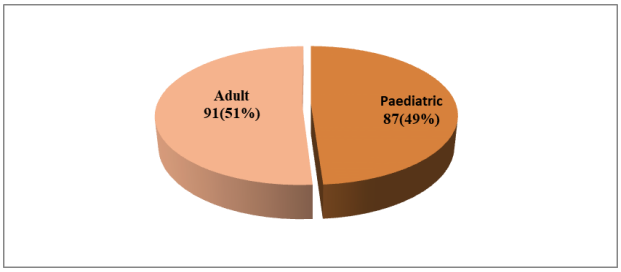

Figure I: Pie chart showing Distribution of Participants.

Table 1: Distribution & percentage of gender among child & adult group

Gender	Group		Total	P value
	Paediatric	Adult		
Female	33(37.9%)	44(48.4%)	77(43.3%)	0.161
Male	54(62.1%)	47(51.6%)	101(56.7%)	
Total	**87(100.0%)**	**91(100.0%)**	**178(100.0%)**	

Chi- Square (X^2) test was performed to see the association. P≤0.05 was determined as level of significance.

Among 178 cases, 12 (7%) yielded growth of different bacteria (Figure II). Among them culture positive cases were found 7 (4%) in Paediatric group and 5 (3%) in adult group. On statistical analysis the association between culture findings in Paediatric and adult age group did not differ significantly (P= 0.73).

Table2: Showing the culture positivity among group

Culture Findings	Group		Total	P value
	Paediatric	Adult		
Culture Negative	80(92.0%)	86(94.5%)	166(93.3%)	0.73
Culture Positive	7(8%)	5(5.5%)	12(7%)	
Total	**87(100.0%)**	**91(100.0%)**	**178(100%)**	

Chi- Square (X^2) test was performed to see the association. P≤0.05 was determined as level of significance.

The most frequently isolated bacteria in Paediatric group were *Escherichia coli* 3(100%) and in adult group were *Streptococcus* 3(60%). *Staphylococcus aureus* were in equal number in both groups (Table 3).

Table 3: Bacterial isolates in Child & Adult group

Isolated Bacteria	Group		Total	P value
	Child	Adult		
Staphylococcus aureus	2(50.0%)	2(50.0%)	4(100.0%)	0.229
Streptococci	2(40.0%)	3(60.0%)	5(100.0%)	
Escherichia coli	3(100.0%)	0(0.0%)	3(100.0%)	
Total	**7(58.3%)**	**5(41.7%)**	**12(100.0%)**	

The most predominant identified bacteria in Paediatric group was *Escherichia Coli* which showed highly sensitive to imipenum, amikacin, linezolid, gentamicin 3(100%).They showed moderate sensitive to sulfamethoxzole 2 (66.7%) and low sensitive to amoxycillin, ciprofloxacin, tetracycline, cefotaxime, cefuroxime 1(33.3%).(Table:4)

Table 4: Showing antibiotic sensitivity pattern of the isolated bacteria.

Name of Antibiotics	Name of bacteria			Total
	Staphylococcus aureus (4)	*Streptococci* (5)	*Escherichia coli* (3)	
Amikacin	0(0.0%)	2(40.0%)	3(100.0%)	5
Amoxycillin	1(25.0%)	0(0.0%)	1(33.3%)	2
Azythromyin	0(0.0%)	3(60.0%)	0(0.0%)	3
Cefixim	2(50.0%)	0(0.0%)	0(0.0%)	2
Cefotaxime	1(25.0%)	3(60.0%)	1(33.3%)	5
Ceftriaxone	3(75.0%)	3(60.0%)	1(33.3%)	7
Cefuroxime	2(50.0%)	0(0.0%)	0(0.0%)	2
Ciprofloxacin	3(75.0%)	3(60.0%)	1(33.3%)	7
Doxycycline	3(75.0%)	1(20.0%)	0(0.0%)	4
Gentamicin	4(100.0%)	4(80.0%)	3(100.0%)	11
Imipenum	3(75.0%)	4(80.0%)	3 (100.0%)	10
Linezolid	3(75.0%)	4(80.0%)	3(100.0%)	10
Nalidixic Acid	1(25.0%)	0(0.0%)	0(0.0%)	1
Nitroflurantoin	2(50.0%)	2(40.0%)	0(0.0%)	4
Sulphamethoxazole	0(0.0%)	1(20.0%)	2(66.7%)	3
Sulphamethozazole+ Trimethoprim	1(25.0%)	0(0.0%)	0(0.0%)	1
Tetracycline	2(50.0%)	3(60.0%)	1(33.3%)	6
Vancomycin	1(25.0%)	1(20.0%)	0(0%)	2
Total	**4**	**5**	**3**	**12**

In adult group the most predominant isolated bacteria was *Streptococci* which showed high sensitive to imipenum, linezolid, gentamicin 4 (80%). They showed moderate sensitive to ciprofloxacin, tetracycline, cefotaxime, cefuroxime 3 (60%) and low sensitive to amikacin, nitroflurantoin 2 (40%) and considerable towards vancomycin, sulfamethoxzole, doxycycline, 1(20%). Another isolated bacteria was *Staphylococcus aureus* which found in equal number in both group. They showed highly sensitive to gentamicin 4(100%) and considerable towards to imipenum, linezolid, ciprofloxacin, cefuroxime, doxycycline (N=3, 75%). Moderate sensitive to tetracycline, cefixim, cefuroxime, nitroflurantoin 2(50%) and low sensitive to vancomycin, amoxycillin,cefotaxime, nalidixic acid, sulphamethozazole +trimethoprim 1(25%). (Table:4)

Table 5: Comparism of Gram positive & Gram negative bacteria isolated from blood in relation with antibiotic sensitivity.

Name of Antibiotics	Gram positive bacteria	Gram Negative bacteria	Odds Ratio
Amikacin	2	3	2.50(0.85-7.31)
Amoxycillin	1	1	4.00(0.16-95.75)
Azithromycin	3	0	0.66(0.42-1.05)
Cefixime	2	0	0.70(0.46-1.05)
Cefotaxime	4	1	0.62(0.40-9.65)
Ceftriaxone	6	1	0.25(0.16-3.99)
Cefuroxime	2	0	0.70(0.46-1.05)
Ciprofloxacin	6	1	0.25(0.01-3.99)
Doxycycline	4	0	0.62(0.36-1.06)
Gentamicin	8	3	1.37(0.95-1.97)
Imipenum	7	3	1.42(0.95-2.14)
Linezolid	7	3	1.42(0.95-2.14)
Nalidixic Acid	1	0	0.72(0.50-1.04)
Nitroflurantoin	4	0	0.62(0.36-1.06)
Sulphamethoxazole	1	2	16(0.66-383.02)
Sulphamethozazole+ Trimethoprim	1	0	0.72(0.50-1.04)
Tetracycline	5	1	0.40(0.26-6.17)
Vancomycin	2	0	0.70(0.46-1.05)

Binary Logistic regression has been done to calculate crude odds ratio

Discussion:

Blood culture is the most widely used diagnostic tool for the detection of bacteremia. It is the most important way to diagnose the etiology of bloodstream infections and sepsis and has major implications for the treatment of those patients. Blood stream infections are among the most common infections both in the community and hospital. However the

treatment in community-acquired patients is usually planned empirically. Especially in hospitalized patients infections antibiotic susceptibility tests are particularly obtained for the management of infection. The success of treatment depends on the results of antibiotic susceptibility tests provided by clinical microbiology laboratories.

Blood culture positivity has been seen quite similar to Gohel et al (9.2%)[13] and Mehta et al. (9.94%)[14]. In this study the adult participants were predominant than child participants. About 87 patients were child of which male were predominant than female. The culture positive cases were found 7 (4%) in Paediatric group. The incidence of neonatal septicemia is variable because it depends on various factors like gestational age, fetal birth weight, maternal nutrition, perinatal care, hygienic conditions, child health care facilities.[15] blood culture is the gold standard for diagnosis of septicemia for the isolation of bacterial agent. The prevalence of bacterial profile of blood cultures and their susceptibility patterns in an area, provide guidance to start empirical treatment which is the cornerstone in the management of sepsis.

In this study 91 patients were adult among them male are predominant and culture positive cases 5 (3%). The association between gender and Paediatric & adult group did not differ significantly (P =0.161). A positive blood culture either establishes or confirms that there is an infectious etiology for the patient's illness. A positive blood culture also provides the etiologic agent for antimicrobial susceptibility testing, enabling optimization of antibiotic therapy. Sepsis is one of the most significant challenges in critical care, and early diagnosis is one of the most decisive factors in determining patient outcome. Early identification of pathogens in the blood can be a crucial step in assuring appropriate therapy, and beginning effective antibiotic therapy as early as possible can have a significant impact on the outcome of the disease.

In this study 12 (7%) yielded growth of different bacteria. Among them 7 (4%) were found in Paediatric group. The most predominant identified bacteria in Paediatric were *Escherichia Coli* 3 (100%*), Staphylococcus aureus* and *Streptococcus* 2 (50%). Similarly, prevalence of Gram negative bacterial etiology of septicemia in children has been recorded by several other authors[16-17]. On the other hand, some study has been recorded preponderance of *S. aureus* as bacterial cause of septicemia in neonates [16,18]. Thus, predominance of either the gram positive or gram negative bacteria isolates is influenced by geographical location and changes in time.[16] In adult group the most frequently isolated bacteria were *Streptococcus* 3 (60%), *Staphylococcus aureus* 2 (50%) and none are Gram negative bacteria. The study of Gohel et al has been reported that the positive blood cultures were obtained in 9.2% of cases of which Gram positive bacteria accounted for 58.3% of cases with *S. aureus* predominance.

According to antimicrobial susceptibility pattern to different antibiotics, *Escherichia Coli* was showed highly sensitive to imipenum, amikacin, linezolid, gentamicin 3(100%) and low sensitive to amoxycillin, ciprofloxacin, tetracycline, cefotaxime, cefuroxime 1(33.3%). The most sensitive drugs for Gram negative bacteria were imipenum, gentamicin[19] and low sensitive to quinolones, penicillins, and cephalosporins[13]. In adult group the most predominant isolated bacteria was *Streptococci* which showed high sensitive to imipenem, linezolid, gentamicin 4 (80%) and subsequent sensitive to ciprofloxacin, tetracycline, cefotaxime, cefuroxime 3 (60%). Badulla et al[20] and other study has been showed that the most sensitive drugs for Gram positive isolates were tetracycline, clindamycin, daptomycin, linezolid, carbapenems, colistin, and aminoglycosides. This finding is an indication of the irrational use of new and strong antibiotics for simple infectious or even viral diseases that leads to widespread bacterial resistance to these antibiotics. This result is aligned with 2014 WHO reports[21].

The resistance to the antibiotics is used in the treatment of these infections that causes treatment failure. Regular surveillance studies will enable the identification of ideal option in the treatment and prevention of treatment failures that caused by AMR. In order to perform a successful surveillance, the antibiogram data should be obtained with a sensitive, specific and reliable method[22].

Conclusion:

In the present study male participants are predominant in both Paediatric & adult group. The most predominant identified bacteria in Paediatric group were *Escherichia Coli* and in adult group were *Streptococci* which showed highly sensitive

to imipenem, amikacin, linezolid, and gentamicin. However most of the pathogens isolated from blood showed high rate of resistance to most commonly used antibiotics. The study indicates the common antibiotic resistance pattern in the study area, and potentially helps in prescribing decisions avoiding the misuse of appropriate antibiotics. A rational use of antibiotics especially in this tender age group in order to achieve a relative high level antibiotic activity against the offending bacterial organisms was recommended.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Conflict of interests: Authors declare that they have no conflict of interests.

Contribution to authors: Tarana Jahan had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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