e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(1); 961-965

Original Research Article

The Prevalence of Pathogens Causing Bacteraemia Along with Antibiotic Sensitivity Pattern in Tertiary Care Hospital

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Received: 25-10-2023 / Revised: 23-11-2023 / Accepted: 26-12-2023

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Conflict of interest: Nil

Abstract:

Background: Bacteraemia is the medical term for the presence of bacteria in the blood or bloodstream. Septicaemia is defined as the growth of bacteria and the release of toxins into the bloodstream. Bacteraemia can be temporary, sporadic, or persistent. Intravascular and extravascular infections are the two types of blood stream infections. It has been demonstrated that determining the antimicrobial sensitivity pattern and performing early microbiological diagnostics increase treatment outcomes. The purpose of this research is to identify the causing agents and ascertain the pattern of antimicrobial sensitivity from blood samples taken from individuals suffering from bacteremia or sepsis.

Methods: Prospective cross-sectional study carried out in a hospital setting at Turki Muzaffarpur, Bihar's RDJMMCH. Between May 2023 and October 2023, 765 blood samples from patients with bacteremia were taken. The blood samples were drawn and handled according to protocol. The organisms were isolated and identified in accordance with accepted practices. In accordance with CLSI recommendations, antimicrobial sensitivity was established using Kirby Bauer's Disc diffusion method.

Results: Of the 765, 349 (45.62%) were female and 416 (54.37%) were male. Out of the 765 samples in total, 114 (14.9%) had good results. The results of this investigation indicated that 60 (52.66%) Gram positive organisms were more common than 51 (44.73%) and 3 (2.63%) Gram negative organisms or fungal isolates.

Conclusion: Patients' morbidity and death can be decreased with prompt detection and adequate treatment. These studies will also aid in the development of policies and guidelines regarding antibiotics to improve patient outcomes.

Keywords: Bacteraemia, Antimicrobial Sensitivity Testing.

Introduction

When live bacteria are found in the bloodstream, the condition is known as a bloodstream infection (BSI). [1] Being the eighth top cause of death (15%) in the United States and accounting for 10-15% of all nosocomial infections, bloodstream infections (BSI) pose a significant global public health burden due to their high mortality rate. [2-4] Delays in therapy have a significant impact on the prognosis of patients with BSI, and prompt and precise pathogen tests significantly enhance patient care. [4] Despite the higher death risk that is related with BSI, reports of longer hospital stays and higher medical expenses have been made, and ineffective empirical therapy is typically linked to unfavorable results. [2]

Many healthcare institutions lack the mechanism to quickly identify infections (such as automated blood culture systems) and their susceptibility patterns in patients suffering from bacteraemia. Few healthcare facilities, particularly those in cities, still use the outdated technique of incubating blood culture bottles for several days before classifying them as negative. This process involves daily subcultures on solid media, which raises the possibility of false positives because of potential contamination. [5] As a result, wide spectrum antibiotics are frequently and excessively prescribed, which increases the emergence of resistance. When coupled with inadequate infection control procedures, resistance bacteria can spread quickly to other patients and the surrounding area. [6]

Antimicrobial resistance (AMR) represents a significant global public health issue. The widespread use of antibiotics to prevent and treat infectious diseases has led to the emergence and

spread of antibiotic resistance, which has influenced a particular force on susceptible bacteria leading to resistant strain survival. As a result, medical costs, illness, and mortality have increased in low- and middle-income countries (LMIC) where AMR monitoring is inadequate. [8] For this reason, monitoring bloodstream infections by blood cultures and associated patterns of antibiotic resistance are essential to patient treatment and BSI prevention. Extended spectrum beta lactamase (ESBL) generating strains and carbapenem-resistant strains are more common among blood infections, according to two studies. [7-9]

Material and Methods

A prospective cross-sectional study centered in a hospital was carried out from May 2023 to October 2023 at the Radha Devi Jageshwari Memorial Medical College & Hospital in Turki, Muzaffarpur, Bihar. Patients in the study group had been hospitalized to intensive care units (ICUs) and general medical units (wards) with a clinical diagnosis of blood stream infections. The blood samples were drawn and handled according to protocol. The organisms were isolated and identified in accordance with accepted practices. In accordance with CLSI recommendations, antimicrobial sensitivity was established using Kirby Bauer's Disc diffusion method. Throughout the investigation, Pseudomonas aeruginosa (ATCC 27853), E. coli (ATCC 25922), and Staphylococcus aureus (ATCC 25923) were utilized as quality control for antimicrobial susceptibility testing and culture.

Amikacin (30µg), Ampicillin (10µg), Ceftriaxone (30µg), Ceftazidime (30µg), Cefoxitin (30µg), Cefuroxime (30µg), Cephalothin (30µg), Cephalexin (30µg), Cefeperazone/sulbactum (30µg), Cefepime (30µg), Cotrimoxazole (30µg), Clindamycin (2µg), Gentamicin (10µg), Imipenem (10µg), Linezolid (30µg), Penicillin (10units), Ofloxacin (5µg), Pipercillin-Tazobactum (10/10µg), Staphylococcus aureus (ATCC 25923), E. coli (ATCC 25922), and P. aeruginosa (ATCC 27853) were used as quality control throughout the study for culture and antimicrobial susceptibility testing.

For the purpose of examining numerous epidemiological details as well as the distribution of various bacterial isolates and their sensitivity pattern, the results were expressed as percentages. These results were interpreted using Microsoft Excel.

Result

From patients with bacteremia, 765 blood samples were taken. There were more men in those populations than women, 416 (54.37%) compared to 349 (45.62%). There were 281 (36.73%) somewhat high samples out of the total samples in the 40–60 age range (Table 1).

Table 1: Age and Sex wise distribution of patients

No. of patients (n=765)	< 15 Years		15 – 40 Years		40 – 60 Years		> 60 Years	
	Male	Female	Male	Female	Male	Female	Male	Female
	153 (58.95%)	115 (42.9%)	87 (58.3%)	62 (41.6%)	149 (53%)	132 (46.97%)	27 (40.2%)	40 (59.7%)
Total	268 (35%)		149 (19.47%)		281 (36.73%)		67 (8.75%)	

Of the 765 samples, 651 (85.09%) had a negative culture and 114 (14.9%) had a positive culture. The majority of the 114 positive cultures were composed of 60 Gram Positive Organisms (52.66%), 51 Gram Negative Organisms (44.73%), and 3 Fungal Isolates (2.63%) (Tables 2-4).

Table 2: Distribution of gram positive organisms isolated from blood culture

Organisms (n=60)	Name of the isolates	No. of Isolates and Percentage
GPC	Staphylococcus aureus	11 (18.33%)
	Coagulase Negative staphylococci (CoNS)	3 (60%)
	Streptococcus pyogens	3 (5%)
	Streptococcus pneumoniae	2 (3.33%)
	Other streptococcus species	2 (3.33%)
	Enterococcus species	6 (10%)

Table 3: Distribution of gram-negative organisms isolated from blood culture

Organisms (n=51)	Name of the isolates	No. of Isolates and Percentage
GNB	Escherichia coli	17 (33.33%)
	Klebsiella species	9 (17.64%)
	Citrobacter species	3(5.88%)
	Enterobacter species	3(5.88%)
	Pseudomonas aeruginosa	11 (21.56%)
	Acinetobacter species	3(5.88%)
	Salmonella typhi	2 (3.92%)
	Proteus vulgaris	2 (3.92%)
	Brucella melitensis	1 (1.96%)

Table 4: The distribution of fungus isolated from blood culture

Organisms (n=3)	Name of the isolates	No. of Isolates and Percentage
Fungus	Candida albicans	2 (66.66%)
	Candida non albicans	1(33.33%)

While Gram negative organisms were resistant to Ceftriaxone 33 (64.70%), Amikacin 33 (64.70%), Cefeperazone/sulbactum 31 (60.78%), and Ofloxacin 30 (58.82%), Piperacillin/Tazobactum 29 (56.86%), and Imipenem 27 (52.94%), Gram positive organisms demonstrated a high level of resistance to Penicillins 33 (55%), Co-trimoxazole 25 (41.66%), Erythromycin 19 (31.66%), and Penicillins 33 (55%), while they were sensitive to Linezolid 46 (76.66%), Chloramphenicol 43 (71.66%), and Clindamycin 42 (70%). (Table 5,6)

Table 5: Antimicrobial sensitivity pattern of gram positive organisms (n= 60)

Antibiotics	No. of Sensitive	No. of Resistance
Cefoxitin (30 µg)	33 (55%)	14 (23.33%)
Cefuroxime (30 µg)	38 (63%)	16 (26.66%)
Ciprofloxacin (30 µg)	5 (8.33%)	4 (6.66%)
Ampicillin (10 µg)	5 (8.33%)	3 (5%)
Ceftriaxone (30 µg)	1 (1.66%)	2 (3.33%)
Cephalothin (30 µg)	3 (5%)	2 (3.33%)
Cephalexin (30 µg)	38 (63%)	9 (15%)
Clindamycin(2 µg)	42 (70%)	11 (18.33%)
Erythromycin(15 µg)	37 (61.66%)	19 (31.66%)
Penicillin (10 Units)	26 (43.33%)	33 (55%)
Chloramphenicol (30 µg)	43 (71.66%)	4 (6.66%)
Co-trimoxazole (30 µg)	33 (55%)	25 (41.66%)
Linezolid (30 µg)	46 (76.66%)	3 (5%)
Ofloxacin (5 µg)	36 (60%)	15 (25%)
Gentamicin (10 µg)	1 (1.66%)	5 (8.33%)

Table 6: Antimicrobial sensitivity pattern of gram negative organisms (n= 51)

Antibiotics	No. of Sensitive	No. of Resistance
Amikacin (30 µg)	15 (29.41%)	33 (64.70%)
Ampicillin (10 µg)	25 (49.01%)	24 (47.05%)
Ceftriaxone (30 µg)	17 (33.33%)	33 (64.70%)
Cefuroxime (30 µg)	23 (45.09%)	25 (49.01%)
Ciprofloxacin (30 µg)	20 (39.21%)	30 (58.82%)
Cephalothin (30 µg)	20 (39.21%)	28 (54.90%)
Gentamicin (10 µg)	24 (47.05%)	24 (47.05%)
Cefeperazone/Sulbactum (30 µg)	17 (33.33%)	31 (60.78%)
Ceftazidime (30 µg)	18 (35.29%)	30 (58.82%)
Cefipime (30 µg)	23 (45.09%)	25 (49.01%)
Chloramphenicol (30 µg)	1 (1.96%)	1 (1.96%)
Ofloxacin (5 µg)	30 (58.82%)	20 (39.21%)
Imipenem (10 µg)	27 (52.94%)	21 (41.17%)
Piperacillin / Tazobactum(10/10 µg)	29 (56.86%)	18 (35.29%)

Discussion

In the present study, 765 patients across all age groups had a 14.90% frequency of bacteraemia. The frequency of bacteraemia varies by location and nation, as seen by the following: New Delhi 42.1%, Chandigarh 13.17%, Jordan 58.6%, and Kenya 12.5%. [10–12] In the current study, bacteraemia affected 57.01% of the male patients while it involved 42.98% of the female patients. Ages 40 to 60 made up the largest percentage of patients (36.73%), followed by 0 to 15 years (35%). Compared to other units, samples from different intensive care units (49.41%) exhibited higher percentages of positive cultures (59.64%).

Similar findings were observed in numerous investigations. In the ICUs of the three hospitals in Malaysia, a study was conducted to observe and analyze the incidence and predictors of bacteraemia. The study found that the incidence of bacteraemia was 29.3%. The incidence was found to be higher than that reported by Agodi et al (17.1%) and lower than that detected by Barba et al (39%), when compared with the studies that were accessible from the region. In the Malaysian study, Hughes et al. found 13.9%, while Rozaidi et al. found 23%.13–16

In the current study, 8.7% of newborns in the age group were admitted to the NICU because to prevalence. Pseudomonas species accounted for 40% of

all organisms identified in blood culture, with Klebsiella pneumoniae (20%), CoNS (20%), Streptococci species (10%), and Enterococci species (10%) following closely behind. According to a recent study, septicemia is still a leading cause of newborn death and morbidity throughout the globe. According to data from the National Neonatal Prenatal Database (NNPD), blood culture-proven sepsis occurred in 8.5 out of every 1000 live births in India in 2002–2003. In the past, reports of bacteraemia in neonates have ranged from 47.5% to 64%, with the primary isolate being gram-negative bacteria like Klebsiella. [17–20]

Gram positive organisms predominated (52.66%) in the study's 114 blood culture-positive samples, followed by gram negative organisms (44.73%). Studies have indicated a significant incidence of Gram negative bacteria in blood stream infections, whereas general trends indicate an increase in Gram positive bacteraemic events in the literature. According to Chaudhury et al., the ratio of gram positive to gram negative bacteremia in blood cultures was 1:1 (51.7%:48.3%), with CoNS accounting for the majority of infections (29.8%), followed by Pseudomonas aeruginosa (19.9%). [21–25]

According to the current study, the most common isolates of Gram-positive organisms were Coagulase-negative staphylococci, which accounted for 60% of the isolates. Other common isolates included Enterococci species (10%), Streptococci pyogens (5%), Streptococci pneumonia (3.33%), and Staphylococci aureus (18.33%). The most common pathogen among Gram-negative organisms was Escherichia coli (33.33%), which was followed by Salmonella typhi (3.92%), Brucella species 1.96%, Pseudomonas aeruginosa (21.56%), Citrobacter species (5.88%), Enterobacter species (5.88%), and Klebsiella pneumonia (17.64%).

According to the current investigation, Candida albicans accounted for the majority of the 2.63% of fungal organisms isolated from septicemia patients. Using a modified Kirby Bauer disc diffusion method, all the isolates and proven organisms were tested for antibiotic sensitivity to widely used antimicrobials. Treatment for patients with both Gram positive and Gram negative organisms was based on sensitivity pattern, mostly using sensitive medications such carbapenems for gram negative organisms, fluroquinolone, linezolid, and cephalosporins for gram positive organisms. High levels of resistance to penicillins, co-trimoxazole, and erythromycin are shown in gram positive organisms; some multidrug-resistant gram positive organisms also exhibit resistance to linezolid, clindamycin, and ofloxacin. Gram-negative bacteria were susceptible to ofloxacin, piperacillin/tazobactum, imipenem, and ampicillin, but resistant to ceftriaxone, amikacin, cefeperazone/sulbactum, and ceftazidime.

Conclusion

Patients' morbidity and death can be decreased with prompt detection and adequate treatment. Additionally, these investigations will support the creation of antibiotic policies and management guidelines for improved outcomes for bacteremia patients.

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