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Original Research Article

Bloodstream infections in cardiac intensive care units from a tertiary care center

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ABSTRACT

Background: Blood stream infections (BSIs) occur more frequently in patients hospitalized in Intensive care units (ICUs). Intravascular devices are the most frequent predisposing factor causing BSI.
Objective: To compare the proportion, risk factors, microbiological profile of Blood stream Infections and Central line associated bloodstream infection in Cardiology Intensive care units (CICU) and Cardiothoracic Intensive care units (CTICU).
Methodology: This is a prospective study conducted by the Dept. of Microbiology along with Cardiology Intensive care unit(CICU), and Cardiothoracic Intensive care unit (CTICU) of a tertiary care centre, from June 1st 2017-Oct 31st 2018.Laboratory confirmed BSIs (LCBSI's), occurring more than 48hrs after ICU admission were included in the study. Identification of pathogens were done by standard methods.
Results: A total of 1640 blood cultures were analyzed (CICU=890,CTICU=750).73 Primary BSIs were observed with male preponderance.68/73 diagnosed to have non CLABSI (CTICU=35/68 51.4%, CICU=33/68, 48.5%) and 5/73 cases diagnosed to have CLABSI (CTICU=5/73, 6.84% CICU=0%) 47.94% of our isolates were Gram negative pathogens with *Klebsiella pneumoniae* as the predominant followed by 35.6% of Gram positive with *Enterococci faecium* as the major pathogen & 16.4% were Candida spp. 20.5% were multi drug resistant and 10% were ESBL producers. Prevalence and incidence rates were high in CTICU (5.3% & 1.5%) compared to CICU (3.7% & 0%) of BSI & CLABSI respectively.
Conclusion: BSI is preventable costly complication that occur with greater frequency in the ICU settings. Strict adherence to Infection control measures such as hand hygiene, aseptic precautions during blood culture collection and bundle care measures can decrease the BSI and CLABSI incidence rates.

1. Introduction

Infections are major challenge in the intensive care units (ICUs). Patients in ICUs account for about 25% of all hospital acquired blood stream infections (BSI's).[1] BSIs have far-reaching consequences like prolonged length of hospital-stay, high cost and at times loss of life. BSIs are ranked tenth leading cause of death in the United States. BSI accounts for over 1% of all hospitalizations in the United States and the rate of mortality directly attributable to BSIs in these populations has been estimated to be 16%–40.[2]

BSI, as a complication of critical illness, occurs in approximately 5% of all patients admitted to ICUs.[3] Approximately 200,000 cases of bloodstream infection occur annually with mortality rates ranging from 20-50% in India.[4] Risk factors associated with any nosocomial infections include, immune status (extremes of age), acute disease (surgery, trauma, severity score), treatment (antibiotic therapy) and patients in intensive units (total duration of hospital stay) ,apart from these overall risk factors the presence of central line has shown specific association of 87% in primary bloodstream infections.[5] Other risk factors for BSI, includes invasive procedures,

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mechanical ventilation, urethral catheter, administration of blood and plasma, pleural drainage, tracheostomy, bronchoscopy, parenteral nutrition. Thus, BSI may be a marker of illness severity and pre-morbid condition as well as a direct contributor to adverse outcome.[6] Approximately 48% of patients in ICUs have a central line, accounting for 15 million central line-days per year.[7] Central line catheters disrupt the integrity of the skin, increasing the susceptibility to BSIs including central line-associated bloodstream infections, (CLABSI). CLABSI are important, deadly and are associated with increased morbidity, mortality and healthcare costs. Vascular catheter is the most important risk factor for hospital-acquired bacteremia with central venous catheter associated to up to 90.0% of these infections.[8]

CLABSI have recently demonstrated to increase length of stay in the ICU by an average of 2.4 days and increase total hospital length of stay by 7.5 days.The reported mortality with CLABSI is 12%–25%.[9] The rates of CLABSIs in the International Nosocomial Infection Control Consortium (INICC) ICUs (i.e. in Africa, Asia, Europe and Latin America) were reported to be 4.9 infections per 1000 central-line-days, almost five times higher than that reported from ICUs in the USA.[10] Clinical signs, biomarker and other serological tools are less specific in determining true BSI. Blood culture remains the best approach to identify the incriminating microorganisms when a bloodstream infection is suspected, hence Blood cultures are considered gold standard in the diagnosis and treatment of BSIs.

2. Aims and Objectives

1. To compare the proportion, risk factors and microbiological profile of Blood stream Infections in Cardiology Intensive care units (CICU) and Cardiothoracic Intensive care units (CTICU).
2. To determine the incidence of CLABSI
3. To determine the microbial spectrum and antimicrobial resistance pattern of pathogens
4. Analysis of risk factors.

3. Materials and Methods

3.1. Study design

Prospective observational study.

3.1.1. Study setting

Department of Microbiology, in collaboration with Department of cardiology and cardiothoracic surgery, Nazism's institute of medical sciences, Panjagutta, Telangana State, India. It is a hospital-based study.

3.2. Study duration

1 June 2017 to 31st October 2018.

The study period was extended beyond the mentioned date of 30^{th} June 2018 as the required sample size was not met. However even after extending the time period the required number of sample size was not reached hence 73 culture positive, meeting the inclusion criteria were included instead of 145.

3.3. Ethical consideration

The study was started after getting clearance from institutional ethics committee, The NIMS Foundation and Research Center (NFRC). The study subjects were explained the purpose of the study and assured confidentiality. Patient information sheet was provided to all of them detailing the information about the project. Written informed consent was taken before data collection. In case of pediatric age group and those patients who were not able to communicate consent was obtained from guardian and attendants respectively. These forms are attached in the annexure.

3.4. Sample size calculation & justification

Sample size (n) = $\frac{Z^2 \times P\,(1-P)}{C}$ = 145

Where, n = sample size

Z = 1.96 for 95% confidence level

P = Population proportion (0.1).

C = Confidence interval expressed as decimal (0.05)

3.5. Sample size

145, only non-duplicate samples included.

3.6. Study population

All patients admitted to cardiac intensive care units in NIMS.

3.7. Inclusion criteria

1. Admission in ICU greater than or equal to 48 hrs.
2. The culture positive cases of BSI with significant pathogen isolated from even single set.
3. The culture positive cases of BSI with skin contaminants isolated at least from two sets collected within 24 hours along with one of the following signs and symptoms of sepsis (fever>38^{o}c ,chills, rigors, and hypotension) within 24 hours of a positive blood culture being collected.

3.8. Exclusion criteria

1. Admission in ICU less than 48hrs.
2. The blood cultures which did not fit in the above mentioned criteria.

All the blood culture samples received from cardiac ICUS were taken in consideration. Repetitive samples were excluded from the study.

3.9. Data collection

Baseline data was collected from the laboratory blood requisition form duly filled by the treating doctor. Detailed history and other required data as per the proforma was collected personally after taking written informed consent from patient or his/her attendant.

3.10. Microbiological work up

Minimum two sets of Blood cultures, (two FA plus for each set) (biomeriux, Marcy-l Etoile, France) were received by microbiology dept. from cardiac ICUs of each subject ,in case of suspected central line associated bloodstream infection two sets were collected simultaneously , one set from central line and other set from peripheral vessel.

Central and peripheral blood culture bottles were labeled with distinct codes to prevent the confusion. Unique laboratory identification numbers were given to each set as per routine and then blood culture bottles were incubated until flagged as positive or for 5 days in BacT/Alert 3D system (Biomerieux, Marcy-l Etoile, France), in case of suspected Fungemia or infective endocarditis incubation period was increased to four weeks and in culture negative cases blind subculture was done once weekly for four weeks before discarding them.

Positively flagged blood bottles were unloaded, time to detection was noted and blood broth mixture was subcultured onto the 5% sheep blood agar (cos-Biomerieux) and chrome agar (CPS-Biomerieux) . Gram smear was prepared simultaneously. Identification and susceptibility testing for the pathogens was done by Vitek 2C system. (Biomerieux, Marcy-l Etoile, France) using IDGN, IDGP and YST panel for identification of GNBs, GPCs and yeast respectively. Whereas antimicrobial sensitivity was determined by using panel N281/N280, P628/ST03 and YS08 for GNBs, GPCs and yeast respectively. The sensitivity was interpreted as per the CLSI guidelines. The panels used in our study were processed as per the manufacturer instruction. (Biomerieux, Marcy-l Etoile, France).

3.11. Organisms showing identification percentage

>90% were considered as very good identification,

>95% were considered excellent identification.

Any isolate showing identification percentage below 90 were subjected to repeated identification by Vitek 2C system.

Negative blood culture bottles at the end of the 5 days of incubation period were subjected to Blind subculture on to the 5% sheep blood agar plate, which were incubated with 5% CO2 at 37°C for minimum period of two days.

3.12. Statistical analysis

Fisher's exact test was used to determine the statistical association between categorical data and unpaired t test was used to analyze the statistical association between continuous data.

4. Observations and Results

A total of 1640 (CTICU= 750 & CICU= 890) non repetitive samples analyzed in this study out of which 73 met the inclusion criteria. Male patients in our study contributed to 63.01% and females 36.98%. The male to female ratio in CTICU was found 1.8: 1 and CICU 1.5:1, with an overall ratio of 1.7:1 in cardiac ICUs. The association of gender with BSI in both groups is statistically insignificant.(Figure 1)

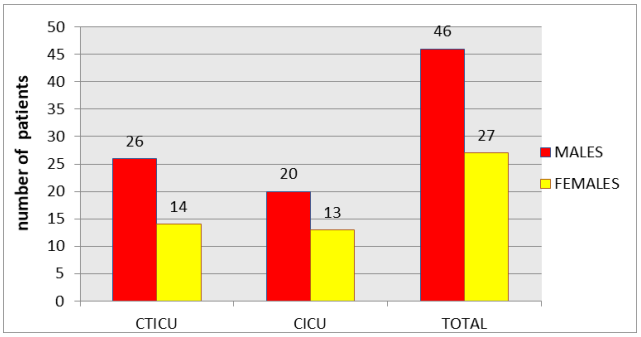

Figure 1: Column chart showing distribution of males and females in CTICU & CICU

Age ranged from 0.4 to 80 years in CTICU and 21 to 88 years in CICU. (Figure 1) The mean age (SD) in CTICU was noted as 37.05 (±24.4) and in CICU 58.45(±15.5). The association of age in two groups was statistically significant with p value<0.0005.(Tables 1 and 2)

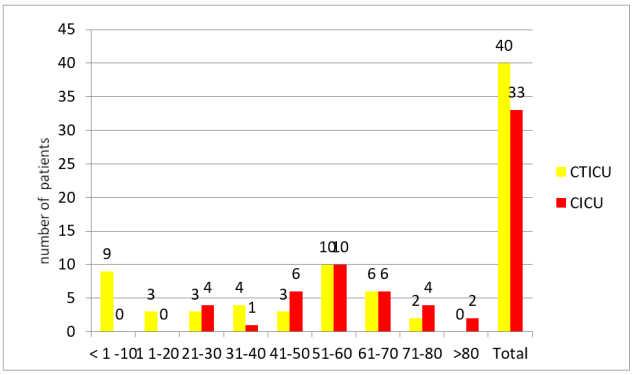

Figure 2: Column chart showing age distribution in CTICU & CICU

Table 1: Showing association of Demographic and clinical variables

Group	CTICU n=40	CICU n =33	P value
Age	37.050 ±24.4	58.45 5 ±15.5	0.0001
Males n (%)	26 (65%)	20 (60.0%)	1.00
Females n (%)	14 (35.0%)	13(40.0%)	
Direct ICU admission n (%)	1(2.5%)	24 (72.72%)	<.0001
Indirect ICU admission n(%)	39 (97.5%)	09(27.27%)	
Patients underwent surgery n (%)	39(97.75%)	05 (15.15%)	<.0001
Patients who did not undergo surgery n (%)	01 (2.5%)	28 (84.84%)	
Central line present n (%)	39 (97.5%)	03(9.09%)	<0.0001
Central line absent n (%)	01(2.5%)	30(90.90%)	
No. of days on central line	7.51 ±2.48	0.48 ±1.56	<0.0001

Table 2: Showing association of clinical parameters and co-morbidity

Groups	CTICU n=40	CICU n =33	P Value
Diabetics n (%)	10 (25.0%)	11 (33.33%)	0.45.1
Non Diabetics n (%)	30 (75.0%)	22 (66.66%)	
Steroid used n(%)	12 (30%)	08 (24.24%)	0.6
Steroid not used n(%)	28 (60%)	25 (75.75%)	
WBC >12500 n(%)	28 (70.0%)	23 (69.69%)	
WBC <12500 n(%)	12 (30.0%)	10 (30.03%)	1
Platelet count<1.5 n(%)	18(45.0%	18(54.54%)	
Platelet count >1.5 n(%)	22(55.0%)	15(45.45%)	0.48
Hypotension present n(%)	21(52.5%)	14(42.42%)	0.482
Hypotension absent n(%)	19(47.5%)	19(57.57)	
Hypothermia n(%0	18(45.0%)	12(36.36%)	0.4705
Hyperthermia n(%)	22(55.0%)	21(63.63%)	

4.1. Risk factors

Factors like, direct/indirect admission to ICUs, duration of ICU stay, total period of hospitalization, presence / absence of central line, number of days on central line, analyzed to determine the association with BSIs and were observed extremely statistically significant with P value <0.0001.

In CTICU 97.5% patients had undergone surgery and in CICU 15.15%.

The mean ICU duration (SD) in CTICU was observed as 8.85 (±2.15) days and in CICU 5.97(±1.05) days. The longest ICU stay in CTICU was 14 days and 8 days in CICU.

The mean hospitalization stay (SD) in CTICU was 15.55 (±0.84) days and in CICU 7.94 (±1.87) days. Indirect admission in CTICU was observed to 97.5% (n=39) and in CICU 27.27% (n=09).

97.5% of patients in CTICU had central line and mean duration of central line was observed 7.51 ±2.48 days, in CICU 09.09% of patient had central line with mean duration of 0.48±1.56 days.

The co morbid conditions, steroid use, and clinical parameters like white blood cell (WBC) count, platelet counts, neutropenia, hypotension, hypothermia/ hyperthermia (signs of sepsis) were also analyzed between the cases of the two units. The association was determined to be statistically insignificant with P value >0.05.

Association of prior antibiotic treatment found statistically insignificant between two units. Commonly used prophylactic antibiotic was ceftriaxone followed by ceftazidime.

Hypertension, chronic kidney disease, malignancy, and other conditions (SLE, COPD, hypothyroidism, asthma, congenital anomalies, CRHD etc) observed among the patients of both CTICU and CICU (Figure 3).

Various demographic and clinical variables between cases and controls of each unit (CTICU & CICU) were statically analyzed to determine the association.

Insignificant statistical (P value>0.05) association was observed in variable like age, number of days in ICU, surgery, direct ICU admission, diabetes, WBC count >12500, steroid, neutropenia.

However, the variables like gender, hypotension, hypothermia /hyperthermia, platelet counts showed statistically significant association among the cases and controls of CTICU (Tables 3 and 4).

In CICU the statistically significant association was observed for variables like duration of ICU stay, direct ICU

Table 3: Showing demographic and clinical variable of cases & controls of CTICU

CTICU	Cases n =40	Controls n=60	P value
Males n (%)	26(65.0%)	52 (86.6%)	0.014
Females n(%)	14 (35.0%)	8 (13.33%)	
No. of days in ICU	8.85 ± 2.15	8.19± 2.29	0.151
Direct ICU admission n(%)	1(2.5%)	5(8.33%)	0.3973
Indirect ICU admission n(%)	39 (97.5%)	55(91.66%)	
Patients underwent surgery n (%)	39(97.75)	06(10.0%)	0.2375
Patients who did not undergo surgey n(%)	1 (2.5)	54 (90.0%)	

Table 4: Showing clinical variable of cases & controls of CTICU

CTICU	Cases n =40	Controls n = 60	P value
Diabetics n (%)	10 (25.0%)	09 (15.0%)	0.2981
Non Diabetics n(%)	30 (75.0%)	51 (85.0%)	
Steroid used n(%)	12 (30%)	09 (15.0%)	0.0838
Steroid not used n(%)	28 (60%)	51 (85.0%)	
WBC >12500 n(%)	28 (70.0%)	41 (68.33%)	1.00
WBC <12500 n(%)	12 (30.0%)	19 (31.66%)	
Platelet count<1.5 n(%)	18(45.0%)	8 (13.33%)	0.0009
Platelet count >1.5 n(%)	22(55.0%)	52 (86.66%)	
Hypotension present n(%)	21(52.5%)	10(16.66%)	0.0003
Hypotension absent n(%)	19(47.5%)	50(83%)	
Hypothermia n(%)	18(45.0%)	11(18.33%)	0.0065
Hyperthermia n(%)	22(55.0%)	49(81.66)	
Serum creatinine >2	6(15.0%)	9(15.0%)	1.00
Serum creatinine < 2	34(85.0%)	51(85.0%)	
Neutropenia	8(20.0%)	12(20.0%	1.00
non neutropenic	32(80.0%)	48(80.0%)	

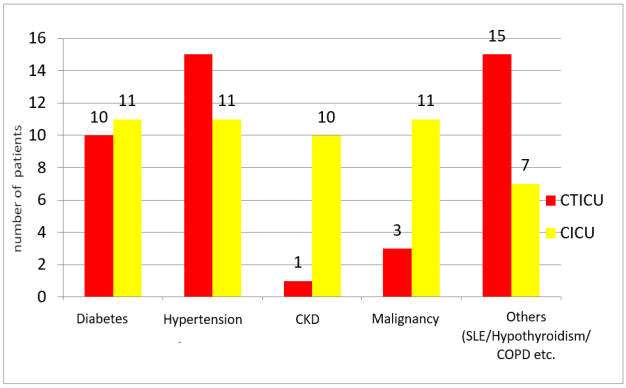

Figure 3: Column chart showing distribution of co-morbidities in CTICU and CICU

admission, diabetes, hypertension, hypothermia, platelet count. Whereas statistically insignificant association was determined for age, gender, surgery, steroids, WBC counts, neutropenia.(Tables 5 and 6)

The association of prior antibiotic treatment among the cases and controls of both units statistically insignificant.

In our study the overall 73 cases out of 1640 were diagnosed to have laboratory proven BSI. Rate of BSIs in cardiac ICUs was determined as 4.45% (73/1650).

In CTICU, 40 (5.33%) out of 750 were diagnosed to have laboratory proven BSI and in CICU 33 (3.70%) out of 890.

16 (21.91%) patients out of 73 had co infection (respiratory tract infection, urinary tract infection, wound infection etc) and remaining 57(78.10%) had primary BSI with 5 cases of CLABSI.

During the study period the total number of central line days calculated in CTICU was 3300 and 5 patents were diagnosed to have CLABSI. The incidence of CLABSI in CTICU was 1.5 (5÷3300 x 1000) and no case of CLABSI was observed in CICU, hence, CLABSI incidence was zero (0) in CICU.

4.2. Microbiology

Gram-negative bacteria isolated more than Gram-positive bacteria. The ratio of gram-negative to gram positive bacteremia 1.3:1. A total of 35 (47.94%) of 73 recovered isolates are Gram-negative organisms, 26 isolates (35.61%) of 73 Gram-positive and 12 isolates (16.43%) yeast. *Klebsiella pneumoniae*, the

Table 5: Ahowing demographic and clinical variable of cases & controls of CICU

CICU	Cases n=33	Controls n =67	P value
Age	58.455 ±15.5	54.00±13.59	0.3947
No. of days in ICU	6.00 ± 1	4.99± 1.2	0.0002
Males n (%)	20(60.6%)	52(77.61%)	0.0980
Females n(%)	13(39.39%)	15(22.38%)	
Direct ICU admission n(%)	24 (72.72%)	14(20.0%	0.0001
Indirect ICU admission n(%)	09(27.27%)	53(79.10%)	
Patients underwent surgery n (%)	05(15.15%)	6(08.9%)	0.4975
Patients who did not undergo surgery n(%)	28 (84.84%)	61(91.04%)	

Table 6: Showing clinical variable of cases & controls of CICU

CICU	Cases n=33	Controls n =67	P value
Diabetics n (%)	11 (33.33%)	9(13.43%)9	0.0317
Non Diabetics n(%)	22 (66.66%)	58(86.56%)	
Steroid used n(%)	08 (24.24%)	7(10.44%)	0.0812
Steroid not used n(%)	25 (75.75%)	60(89.55%)	
WBC >12500 n(%)	23 (69.69%)	49(73.13%)	0.8137
WBC <12500 n(%)	10 (30.03%)	18(26.86%)	
Platelet count<1.5 n(%)	18(54.54%)	7(10.44%)	0.0001
Platelet count >1.5 n(%)	15(45.45%)	60(89.5%)	
Hypotension present n(%)	14(42.42%)	11(16.41%)	0.0069
Hypotension absent n(%)	19(57.57%)	56(83.58%)	
Hypothermia n(%0	12(36.36%)	10(14.92%)	0.021
Hyperthermia n(%)	21(63.63%)	57(76.11%)	
Neutropenia	4(12.12%)	9(13.43%)	1.00
Non neutropenic	29(87.87%)	58(86.56%)	

most common Gram-negative pathogen, accounting for 12(16.43%) of73 isolates, followed by *Escherichia coli* (8 [10.95%]) *Pseudomonas aeruginosa* (7 [9.5%]), *Acinetobacter baumannii* (4[5.4%]), The most common Gram-positive microorganism *Enterococcus faecium (11[15.06]), Staphylococcus epidermidis (6[8.21%]), Staphylococcus aureus (5[6.8%])*Among yeast *Candida tropicalis* (7[9.58%]), *Candida albicans* (3[4.10%]), *Candida parapsilosis*.

4.3. Antimicrobial susceptibility pattern

Multi drug resistant isolates predominantly observed in Gram negative bacilli (GNB) 34.24% (n=25). The antibiotic sensitivity among GNB, highest for Colistin (100%) and Tigecycline (93.8%). There is an alarming increase in resistance for cephalosporins and carbapenems, which are the commonly used antibiotics across the hospital.

All isolates of Gram-positive bacteria found 100% sensitive to Vancomycin, Daptomycin, Tigecycline, Teicoplanin and Linezolid. However high resistance was observed for Fluoroquinolones, Clindamycin, and Benzyl penicillin. *Staphylococcus aureus* accounted for 19.23% of Gram positive bacteria and all negative for cefoxitin screening (MSSA), no case of Methicillin resistant *Staphylococcus aureus* was observed in Table 8 for sensitivity of other antibiotics.

100% sensitivity observed in yeast for Amphotericin B, whereas 91.66% (11 of 12) isolates were sensitive to Echinocandins and Voriconazole. The Highest level of resistance was observed for Fluconazole (Table 9).

5. Discussion

Hospital acquired bloodstream infections constitute a serious health problem and are associated with high morbidity and mortality particularly among the critically ill patients admitted in ICUs. The present work is aimed to study the rate of bloodstream infection, incidence of CLABSI, evaluate the associated risk factors, contamination rate, microbiological profile, and antimicrobial susceptibility pattern, in cardiac intensive care units.

A study has demonstrated almost similar rate of BSI from ICU,[11] while Several studies were contradictory.[12,13] However the individual BSI rate in CTICU is quite similar to other studies.[14,15] Few studies from India showed small variation in rate of BSI.[1,16]

In our study no case of CLABSI was reported from CICU, whereas the incidence of CLABSI from CTICU was

Table 7: Showing Susceptibility pattern of GNB

Antibiotic	**Gram Negative Bacteria**						
	Klebsiella	**Escherichia**	**Pseudomonas**	**Acinetobacter**	**Serratia**	**Enterobacter**	**Total**
	Pneumonia	Coli	Aeruginosa				Sensitivity
	n=12	n=8	n=7	n=5	n=2	n=1	n =35
Cefepime	25%	25%	28.50%	20%	100%	100%	28.50%
Ceftazidime	25%	25%	28.50%	20%	100%	100%	28.50%
TZP	25%	62%	28.50%	20%	100%	100%	37%
Amikacin	25%	75%	57.14%	20%	100%	100%	40%
Gentamicin	30.33%	75%	57.14%	20%	100%	100%	48.50%
Meropenem	25%	87%	28.50%	20%	100%	100%	42.80%
Imipenem	25%	87%	28.50%	20%	100%	100%	42.80%
Doripenem	25%	87%	28.50%	20%	100%	100%	42.80%
Levofloxacin	8.30%	37%	14.20%	20%	100%	100%	22.80%
Ciprofloxacin	0%	50%	28.50%	20%	100%	100%	25.70%
CFS	23%	62%	28.50%	20%	100%	100%	37.10%
TMP/SMX	33%	75%	IR	20%	100%	100%	50.00%
Tigecycline	100%	100%	IR	100%	100%	100%	100%
Colistin	100%	100%	100%	100%	IR	100%	100%

Table 8: Susceptibility pattern of Gram positive

Antibiotic	***Enterococcus***	***S***	***S***	***S***	***S***	**Total**
	Faecium	*Epidermidis*	*Aureus*	*Hominis*	*Haemolyticus*	sensitivity
	n=11	n=6	n=5	n=3	n=1	n=25
Benzlypenicillin	18.18%	0%	40%	33.33%	0%	20%
Oxacillin	not tested	0%	100%	0%	0%	35%
Gentamicin	not tested	66.60%	40%	33.33%	100%	57.14%
Ciprofloxacin	9.00%	33.33%	40%	0%	0%	20%
Levofloxacin	18.80%	33.33%	40%	0%	0%	24.00%
Clindamycin	not tested	16.66%	40%	33.33%	100%	29%
Eythromycin	18.80%	33.33%	40%	33.33%	0%	28.57%
Linezolid	100%	100%	100%	100%	100%	100%
Daptomycin	not tested	100%	100%	100%	100%	100%
Teicoplanin	100%	100%	100%	100%	100%	100%
Vancomycin	100%	100%	100%	100%	100%	100%
Tetracycline	100%	83.33%	100%	100%	100%	96%
Tigecycline	100%	100%	100%	100%	100%	100%
TMP/SMX	not tested	100%	60%	100%	100%	78.57%

Table 9: Susceptibility pattern of yeast

Antifungal	***Candida***	***Candida***	***Candida***	***Trichosporon***	**Total**
	Tropicalis	*Albicans*	*Parapsilosis*	*Asahii*	Sensitivity
	n=7	n=3	n-1	n=1	n =12
Fluconazole	42,8%	66.60%	1000%	100%	58%
Voriconazole	85.75%	100%	1000%	100%	91.66%
Caspofungin	85.75%	100%	1000%	100%	91.66%
Micafungin	85.75%	100%	1000%	100%	91.66%
Amphotericin B	100%	100%	1000%	100%	100%
Flucytosine	85.75%	66.60%	1000%	100%	91.66%

reported as 1.5. A study done by Caroline O'Neil et al, also reported almost similar incidence of CLABSI (1.6) ,while a study done by Dubbink-Verheij et al reported incidence rate of 5.3 which was not inline with our study.[17,18]

The present study broadly illustrates the BSI pathogenic spectrum and antimicrobial resistance pattern in cardiac ICUs.

Pathogenic profile of our study was similar to the other study.[19] However a study by Aynur SÜNER et al, observed predominance of Gram positive bacteria.[20]

Antimicrobial resistance levels for the gram-negative is high. Colistin and Teigecyclin was seen 100% sensitive among Gram negative organisms, Cephalosporin and carbapenem resistance was commonly observed in our study, Similar findings are noted in other studies.[21,22] In our study 45.7% GNB isolates were sensitive to amikacin but this finding was not consistent with Nikita Vasudeva et al.[21]

In our study all Gram positives were sensitive to Vancomycin, Daptomycin, Teigecycline, Teicoplanin and Linezolid. The results are supported by other studies.[19,22] However, the results were inconsistent with the study done by Kaur and Singh.[23]

In our study 16.4% patients had Fungemia, *Candida tropicalis* was the commonest yeast. 100% sensitivity was reported to amphotericinB whereas 91.6% sensitivity was reported for voriconazole, micafungin and caspofungin. 83.3% for flucytosine. However only 58.3% isolates were sensitive to fluconazole. Findings of the study conducted by Reddy GR et al. in India are quite similar to our study.[24] However, in contrast to our study sensitivity to fluconazole was reported as 89.5% by Badiee P, et al.[25]

6. Conclusion

In this study the BSI rate in cardiac ICUs was around 4% with male preponderance.

Although in other studies the infection rates reported from surgical ICUs were more than medical ICUs but in this study we concluded that there was no significant difference between the two units .The primary blood BSI rate in our study was 78.0% (57/73) whereas secondary BSI was 21.91% (16/73). The CLABSI cases were only reported from CTICU and incidence of CLABSI was 1.5. Patients admitted in CTICU had longer duration of hospitalization, presence of central line and had undergone major surgeries. Co-morbid conditions like diabetes mellitus, chronic kidney disease, CHRD, malignancy and other metabolic disorders were seen in both groups. In this study patients with heart valve surgeries and extremes of age were at higher risk for BSIs.

Predominance of Gram negative bacilli with multi drug resistance in ICUs is a major concern, making the treatment more challenging; with limited number of drugs to treat the infection. The emergence of multi drug resistant organisms (MDROS) has been attributed to irrational use of broad-spectrum antibiotics. The occurrence of antibiotic-resistant pathogens in ICU can be controlled by rigorous adherence to infection control guidelines and prevention of antibiotic misuse. Antibiotic restriction policies clearly result in judicious use of antibiotics, slow the emergence of drug resistance and reduced drug costs. The antimicrobial pattern and microbiological profile in turn will help in formulating antibiotic policy (antimicrobial stewardship programme).

7. Source of Funding

None.

8. Conflict of Interest

None.

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