# Prevalence of pathogens causing bacteraemia in tertiary care hospital

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## Abstract

**Introduction:** Bacteraemia means presence of microorganisms in circulating blood or blood stream. Septicaemia means multiplication of microorganisms and production of toxins in blood stream. Bacteraemia may be transient, intermittent or continuous. The two categories of blood stream infections are intra vascular and extra vascular. Early microbiological diagnosis and determination of antimicrobial sensitivity pattern have been shown to improve treatment outcome.

**Aim:** To isolate the causative agents and determine the antimicrobial sensitivity pattern from the blood sample of patients with bacteraemia/septicaemia.

**Materials and Methods:** Hospital based prospective cross sectional study conducted at SRM Medical College Hospital and Research Centre, Potheri, Kancheepuram District. Total 765 blood sample were collected during March 2012 to February 2013 from bacteraemia diagnosed cases. The blood samples were collected and processed by standard methods. Isolation and identification of organisms was done as per standard guidelines. Antimicrobial sensitivity was determined by Kirby Bauer's Disc diffusion method as per CLSI guidelines.

**Observation and Result:** Among 765, 416 (54.37%) were male and 349 (45.62%) were female. Among the total sample of 765, 114 (14.9%) showed positive. Present study showed predominance of Gram positive organisms i.e. 60 (52.66%) over Gram negative organisms, i.e. 51 (44.73%) and 3 (2.63%) Fungal isolates.

**Conclusion:** Timely detection and appropriate treatment will help to reduce the morbidity and mortality of patients. Also, such studies will helps in developing guidelines and antibiotic policy for better outcome of the patients.

**Keywords:** Bacteraemia, Antimicrobial sensitivity testing.

## Introduction

Bacteraemia means presence of microorganisms in circulating blood or blood stream. Septicaemia means multiplication of microorganisms and production of toxins in blood stream. Bacteraemia may be unimicrobial or polymicrobial. Common pathogens causing bacteraemia are Staphylococcus aureus, Coagulase Negative Staphylococci, Streptococci pneumonia, Enterococcus species, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris, Enterobacter cloacae, Salmonella species etc., and rare organisms are Brucella species, HACEK groups (Haemophilus species, Actinobacillus actinomyatem comitans, Cardiobacterium hominis, Ekinella species and Kingella Kingae), Candida species etc.,

The frequency of blood stream infection has been increasing steadily.[1] The incidence of sepsis is increasing all over the world leading to high morbidity and mortality rates. The detection of pathogens causing bacteraemia can be done by blood culture but detection of bacteraemia or fungaemia by blood culture is critical in managing patients with infection and directs the appropriate selection of antimicrobials.[2]

National health statistics report has documented an increase in age-adjusted death rates due to septicaemia from 4.2 per 100,000 in 1980 to 13.2 per 100,00 in 1992. According to recent surveillance report a mortality rate of 35–50% from bacteraemia alone despite emergence of newer antibiotics and improvements in supportive care have been reported.[3]

Among pathogens isolated from blood stream infection (BSI), gram negative bacteria were the most frequent isolates of community acquired primary BSI (70.6%), community acquired secondary BSI (71.2%) nosocomial primary BSI (71.4%) and nosocomial secondary BSI (58.3%).

Majority of the community acquired primary BSI was due to salmonella typhi (29.4%) while E.coli was the most common pathogen in community acquired secondary BSI (36.5%). Burkholderia cepacia was the most common nosocomial primary blood stream isolates (57.1%). It is also the overall leading organisms causing BSI comprising 20% of the total isolates. Pseudomonas aeruginosa and Klebsiella pneumonia were the leading causes of nosocomial secondary BSI. Among the gram positive pathogens, Staphylococcus aureus was the most common isolate and was the leading cause of nosocomial primary and secondary BSI in this group. Streptococcus pneumonia was the most frequent isolate in community acquired secondary bacteraemia. There were eight reported cases of candidemia, all of which were acquired nosocomiality.[4]

Community acquired Bacteraemia is defined as a positive blood culture done within the first 48 hours after admission. Nosocomial bacteraemia is defined as a positive blood culture done 48 hours after admission. Primary blood stream is when the bacteria are isolated only in blood and not from any other site. When commensal organisms like Coagulase Negative Staphylococci (CoNS), Diptheroids or Propioni bacterium are isolated from repeated culture in necessary to confirm pathogenicity.

Primary bacteraemia is a confirmed BSI without positive cultures from another site. The isolated microorganism is a Coagulase negative staphylococcus,

Corrynebacterium species isolation of the microorganism from at least two blood cultures is necessary. Organisms isolated from patients with intravascular lines are labeled as primary bacteraemia. Secondary bacteraemia is a culture confirmed blood stream infection when there is a positive culture with the same species from another body site.[5]

Between 1960 and 1970, gram negative organisms were most frequently isolated from neutropaenic patients with cancer who had blood stream infection (BSI). However, during the past 20 years, gram positive organisms have become increasingly common.[6] The most commonly isolated organisms causing bacteraemia are, Staphylococcus aureus, Coagulase negative staphylococci, Streptococci pneumonia, Enterococcus species, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Proteus species, Enterobacter cloacae, anaerobic bacteria (Bacteroides and Clostridium).[7]

The timely detection of bacteraemia, followed by expeditious identification of pathogens and determination of susceptibility to antimicrobial agents can have great diagnostic and prognostic importance. Prompt initiation of appropriate antimicrobial therapy is demonstrably important for preventing morbidity and mortality.[8]

The isolation of a bacterium from the blood of a patient is valuable firstly in indicating the urgent need for antibacterial therapy, secondly in revealing the species of bacterial agent against which therapy should be directed and finally in providing a culture for the performance of in vitro antibiotic susceptibility tests.[9] The present study was thus undertaken to know the prevalence of pathogens causing bacteremia along with antibiotic sensitivity pattern in a tertiary care setting to guide clinicians to initiate empiric antibiotic therapy and to formulate antibiotic policy.

## Materials and Methods

Hospital based prospective cross sectional study conducted at SRM Medical College Hospital and Research Centre, Potheri, Kancheepuram District, Tamil Nadu, India, during March 2012 to February 2013. The study group of patients was clinically diagnosed blood stream infections admitted in various units such as Intensive care units (ICU) and health care units (wards). The blood samples were collected and processed by standard methods.[10] Isolation and identification of organisms was done as per standard guidelines. Antimicrobial sensitivity was determined by Kirby Bauer's Disc diffusion method o as per CLSI guidelines. [(11)] Staphylococcus aureus (ATCC 25923), E. coli (ATCC 25922) and Pseudomonas aeruginosa (ATCC 27853) were used as quality control throughout the study for culture and antimicrobial susceptibility testing.

Antibiotic discs used for sensitivity testing were Amikacin (30µg), Ampicillin (10 µg), Ceftriaxone (30µg), Ceftazidime (30 µg), Cefoxitin (30 µg), Cefuroxime (30 µg), Cephalothin (30µg), Cephalexin (30µg), Cefeperazone/sulbactum (30µg), Cefepime (30µg), Cotrimoxazole (30µg), Ciprofloxacin (30µg), Clindamycin (2µg), Chloramphenicol(30µg), Erythromycin (15 µg), Gentamicin(10µg), Imipenem (10 µg), Linezolid (30µg), Penicillin(10units), Ofloxacin (5 µg), 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.

### Statistical Analysis

The results were expressed as percentages for analysis of various epidemiological details and for analyzing the distribution of different bacterial isolates and their sensitivity pattern. Microsoft excel was used for the interpretation of these results.

## Result

Total 765 blood sample was collected during March 2012 to February 2013 from bacteraemia diagnosed cases. In those 416 (54.37%) male populations were more than female 349 (45.62%). Among the total samples 40–60 age group 281(36.73%) were comparatively high (Table 1). From 765 sample, 114 (14.9%) culture positive and 651 (85.09%) were culture negative. Out of 114 positive cultures, Gram Positive Organisms 60 (52.66%) were predominant followed by Gram Negative Organisms 51 (44.73%) and Fungal isolates 3 (2.63%) (Tables 2-4). Gram positive organisms shows high level of resistance to Penicillins 33 (55%), Co-trimoxazole 25(41.66%), Erythromycin 19 (31.66%) but were sensitive to Linezolid 46 (76.66%), Chloramphenicol 43 (71.66%) & Clindamycin 42 (70%), while Gram negative organisms were resistant to Ceftriaxone 33 (64.70%), Amikacin 33 (64.70%), Cefeperazone/sulbactum 31 (60.78%) but sensitive to Ofloxacin 30 (58.82%), Piperacillin/Tazobactum 29 (56.86%) & Imipenem 27 (52.94%) (Tables: 5, 6).

**Table 1: Age and Sexwise distribution of patients**

| | **< 15 *Years*** | | **15 – 40 Years** | | **40 – 60 Years** | | **> 60 Years** | |
|---|---|---|---|---|---|---|---|---|
| | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| No. of patients (n=765) | 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%) | |

**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%) |

**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

Bacteraemia/Septicaemia is the leading infectious disease; consisting of 16% of world population and 21% of the world global burden of the diseases.[12] Recent world-wide laboratory based surveillance report said that an attributable mortality rate of 35–50% from bacteraemia alone despite emergence of newer antibiotics and improvement in supportive care.[3] The prevalence of bacteraemia, the common causative organisms causing this infection and its antibiotic resistant pattern, the morbidity and mortality in a rural population are under reported in most of the developing countries including India.

In the present study the prevalence of bacteraemia was 14.90% among 765 patients of all age groups. The prevalence of bacteraemia varies from place to place and country to country, via: New Delhi 42.1%, Chandigarh 13.17%, Jordan 58.6% reported and Kenya 12.5%.[13-15]

In the present study, 57.01% of male patients were affected by bacteraemia, as compare to female patients 42.98%. Most of the patients were in the age group of 40 – 60 years (36.73%), followed by 0-15 years (35%). Samples received from various ICU's (49.41%) had more positive cultures (59.64%) compared to other units.

Many studies reported the similar observation. A study has observed and analyzed the incidence and predictors of bacteraemia in the ICUs of the three hospitals in Malaysia, incidence of 29.3% were observed in this study. When compared with the studies available from the region, the incidence was found to be higher than that reported by Agodi et al (17.1%) and lower than that observed by Barba et al (39%). The Malaysian study done by Rozaidi et al was 23% and Hughes et al was 13.9%.[16-19]

In the present study, prevalence rate in neonatal age group was 8.7% admitted in NICU. The most organisms isolated in blood culture were Pseudomonas species were (40%) followed by Klebsiella pneumoniae (20%), CoNS (20%), Streptococci species (10%) and Enterococci species (10%). A recent study shows, septicaemia continues to be a major cause of neonatal mortality and morbidity worldwide. In India, the National Neonatal Prenatal Database (NNPD) reported an incidence of 8.5 per 1000 live births for blood culture proven sepsis for the year 2002–2003. As high as 47.5% - 64% incidence of bacteraemia were reported in neonates previously with gram negative organisms such as Klebsiella being the main isolate.[20-23]

In study, out of 114 blood culture positive samples, Gram positive organisms were predominant (52.66%) followed by gram negative organism (44.73%). General trends are an increase in Gram positive bacteraemic episodes in the literature; some studies showed a high incidence of Gram negative bacteria in blood stream infections. Chaudhury et al said that gram positive and gram negative bacteraemia ratio was 1:1 (51.7%:48.3%) in blood culture and CoNS was predominant (29.8%) followed by Pseudomonas aeruginosa (19.9%).[24-28]

The present study reports that among Gram positive organisms, Coagulase negative staphylococci were the predominant isolate (60%), followed by Staphylococci aureus (18.33%), Streptococci pyogens (5%), Streptococci pneumonia (3.33%), other Streptococci species (3.33%) and Enterococci species (10%). Among Gram negative organisms, Escherichia coli was predominant pathogen (33.33%), followed by Klebsiella pneumonia (17.64%), Citrobacter species (5.88%), Enterobacter species (5.88%), Pseudomonas aeruginosa (21.56%), Acinetobacter species (5.88%), Salmonella typhi (3.92%) and Brucella species 1.96%.

In recent south Indian study the gram positive organisms were 51.7% and Gram negative organisms were 48.3% in blood culture samples. In the same study, CoNS were most frequent isolates (29.8%) followed by pseudomonas aeruginosa (19.9%). Other organisms isolated in decreasing order of frequency were staphylococci aureus (16.9%), Nonfermentive gram negative rods (9.9%), E.coli (7.55%), Klebsiella pneumoniae (6.9%), Streptococci species 4.5%), Salmonella typhi (3.5%) and one each of Proteus mirabilis and Streptococci pneumoniae.[28]

The present study shows that 2.63% of fungal organisms isolated from septicaemia patients, in which Candida albicans were predominant. All the isolates and proved organisms were subjected to antibiotic susceptibility test for the commonly used antimicrobials using modified Kirby Bauer disc diffusion method. The patients diagnosed for Gram positive and Gram negative organisms were treated according to the sensitivity pattern mainly with the sensitive drugs such as Linezolid, Fluroquinolone, cephalosporins and carbapenems for gram negative organisms. Gram positive organisms shows high level of resistance to Penicillins, Co-trimoxazole, Erythromycin and some of the multidrug resistant gram positive organisms were resistance to Linezolid, Clindamycin, Ofloxacin. Gram negative organisms were resistant to Ceftriaxone, Amikacin, Cefeperazone/Sulbactum, Ceftazidime, but sensitive to Ofloxacin, Piperacillin/Tazobactum, Imipenem, Ampicillin.

## Conclusion

Timely detection and appropriate treatment will help to reduce the morbidity and mortality of patients. Also, such studies will aid in developing management guidelines and antibiotic policy for better outcome of the patients with bacteraemia.

**Conflict of Interest:** None.

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