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**Original Research Article**

# Incidence of central venous and Foley's catheter related bacteraemia, organisms responsible and antibiotic sensitivity pattern: in cardio-thoracic intensive theraputic unit following elective surgery, in a tertiary care hospital of Kolkata, India

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## ABSTRACT

**Background:** Mortality from bacteraemia related to indwelling Central Venous Pressure (CVP) lines could be as high as 12 - 25% and that due to indwelling urinary catheters about 5%, in critically ill patients. Hence, initiation of early and aggressive antibiotic therapy, often even before the culture- sensitivity reports are available is necessary. Objectives of the study was to find out the incidence of bacteraemia related to indwelling CVP catheters &/or Foley's catheters in post-operative patients in Cardio-thoracic Intensive Theraputic Unit (ITU) and to understand the antibiotic sensitivity patterns against the organisms causing such bacteraemia

**Methods:** 48 hours after their insertion, CVP catheter tips, Foley's catheter tips and Peripheral blood samples were collected for cultures in 50 patients who underwent elective cardiothoracic surgery, over a period of one year and results were interpreted.

**Results:** Incidence of bacteraemia associated with indwelling CVP catheters was 8% and was caused by both - Gram positive (*Staphylococcus aureus, Enterococcus faecium*) and Gram negative (*Acinetobacter baumanii, Pseudomonas aeruginosa*) organisms. Foley's catheter was not related to such blood stream infection. Vancomycin and Linezolid were effective against the Gram positive organisms; while Piperacillin- Tazobactam, Meropenem, Polymyxin B and Colistin were effective against the Gram negative organisms.

**Conclusions:** Indwelling CVP catheters were associated with blood stream infection in 4 post-operative patients in our ITU. An idea about the organisms responsible, as well as their antibiogram may help in early initiation of antibiotics empirically before culture-sensitivity reports are available.

**Keywords:** Antibiogram, Bacteraemia, Catheter, Culture

## INTRODUCTION

Indwelling Central Venous Pressure (CVP) catheters and Foley's catheters are frequently used in managing patients in Intensive care setups. These however, are very common causes of nosocomial infections. Biofilm formation on the catheter surface is the main event behind the pathogenesis of such infections, which may also affect the blood stream. It has been shown in a study by Richards et al that among all case of blood stream infection in medical intensive care units in USA, 87% is related to indwelling CVP catheters.[1] The mortality from such blood stream infection could be as high as 12 -25%.[2] Urinary catheter associated Urinary Tract Infection (UTI) is the second most common reason for hospital acquired blood stream infection.[3] However, the mortality from

catheter associated UTI though less than those caused by CVP lines is still about 5%.[3] Due to this unacceptable morbidity and mortality associated with blood stream infections, early administration of an appropriate empirical antibiotic therapy is clinically very crucial, before the culture reports of critically ill patients are available. This is only possible by surveillance of blood stream pathogens and their antibiotic sensitivity patterns in a particular clinical scenario in a hospital. In this study authors have attempted to show whether blood stream infections in Cardio Thoracic Intensive Theraputic Unit(ITU) of Medical College and Hospital, Kolkata is related to indwelling CVP lines &/or Foley's catheters. authors have also tried to enumerate the organisms responsible for such blood stream infections and their antibiograms.

Aims and objectives of the study was to find out the incidence of blood stream infections related to indwelling CVP catheters &/or Foley's catheters, 48 hours after their insertion, in patients undergoing elective Cardio Thoracic operations in Medical College and Hospital, Kolkata and to understand the antibiotic sensitivity patterns against the organisms causing such bacteraemia, which will help to formulate an empirical antibiotic therapy protocol in such critically ill patients prior to the availability of their blood culture sensitivity reports.

## METHODS

This is a Cross sectional study conducted in Intensive Theraputic Unit (ITU); Department of Cardio Thoracic and Vascular Surgery (CTVS); Medical College and Hospital, Kolkata. Study population includes patients with central venous and urinary catheters, 48 hours after Cardio Thoracic Surgery in CTVS ITU for the study period of 1 year (August 2017 to July 2018). Sample size was of 50 patients, which included both sexes.

### *Inclusion criteria*

Patients who had central venous and urinary catheters in-situ, 48 hours after elective cardio thoracic surgery in CTVS ITU.

### *Exclusion criteria*

- Patients whose CVP/ Foley's catheter had been put in prior to the day of surgery.
- If CVP/ Foley's catheter had been put into the patient in a facility outside this institution.
- Immuno-suppressed patients (eg. Cardiac transplants, Myasthenia gravis etc.)
- Emergency surgeries (eg. Trauma, Oesophageal perforation etc.)

### *Study technique*

Prior to induction of anaesthesia all patients had a triple lumen CVP catheter put in through the internal jugular vein and a Foley's catheter put in per urethra maintaining utmost sterility. The CVP catheter was fixed with 3- 0 silk sutures and the insertion site was cleaned with 10% betadine and a covered dressing was done. The Foley's catheter balloon was filled up with 10 cc of distilled water. Every patient received 3 doses (one at induction of anaesthaesia and two more 12 hrs apart) of injection Cefoperazone (1gm) + Sulbactam (500mg) prophylactically. 48 hours after operation, the following were done.

*Collection of CVP catheter tip*

After washing hands and disinfection with 2.5% chlorhexidine gluconate + 70% ethanol hand rub solution, sterile pair of gloves were put on. The catheter site was cleared of any blood using alcohol pledget. The fixation sutures were cut using a sterile no.-11 scalpel blade. The catheter was withdrawn using sterile forceps, directing it away from the skin. The distal 5 cm of the CVP catheter was cut with a sterile pair of scissors and collected in a sterile test- tube. The test-tube was marked. Gloves were discarded.

*Collection of Foley's catheter tip*

Hand washing and disinfection was again done as described previously and a fresh pair of sterile gloves was put on. An assistant was asked to deflate the distilled water filled balloon with a sterile 10cc syringe maintaining aseptic precautions. After that the main operator took out the Foleys catheter in a sterile manner and the distal 5 cm of the catheter was collected in a sterile test-tube by cutting it with a sterile pair of scissors. The test tube was marked and the glove were discarded.

*Collection of blood culture samples*

After hand washing and disinfection sterile gloves were again put on. Two sets of blood culture were drawn in every patient via two different peripheral vene- puncture sites, 10 minutes apart. The sterile gloves were changed before drawing the second sample. The vene- puncture sites were prepared with tincture of iodine or 0.25% chlorhexidine in 70% ethanol solution. On each puncture 10 ml of blood was drawn and injected in aerobic blood culture bottles without changing the needle, taking strict aseptic precautions. The bottles were marked. The two test-tubes and the blood culture bottles were immediately sent to Microbiology laboratory. The CVP catheter specimen was semiquantitatively cultured in Blood agar and MacConkey's agar plates. Colony count > 15/plate or presence of confluent growth were considered significant. The Foley's catheter specimen was cultured by "roll-over" method in MacConkey's media. Those who showed positive growth were evaluated further. In these patients early morning mid-stream clean catch urine specimens were collected 48 hours after removal of Foley's catheter and cultured in MacConkey's media to look for growth after incubating for 24 hours. If the

growth in the catheter tip matched with that in urine with similar antibiogram pattern, then it was considered as nosocomial Urinary Ttract Infection (UTI). The blood culture bottles were were transferred to incubator at 370C. From these bottles, subcultures were done on Blood agar and MacConkey's agar after 24, 48 and 72 hours. These plates were incubated for 24 hrs at 370C. The incubation isolates were then identified by gram staining, colony character and biochemical reactions. All negative bottles were kept for 7 days and then discarded. Antimicrobial susceptibility testing for culture positive specimens of CVP/Foley's catheter and blood were done on Mueller Hinton agar by modified Kirby Bauer's disc diffusion method as per Clinical and Laboratory Standards Institute ( CLSI) guidelines and also by automated system(VITEK 2- compact).[4] Sensitivity was tested for the following drugs:- Cotrimoxazole, Cefotaxime, Ceftazidime, Cefepime, Ciprofloxacin, Cefoperazone-Sulbactam, Azithromycin, Meropenem, Vancomycin, Linezolid, Gentamicin, Piperacillin-Tazobactam, Cefoxitin, Ofloxacin, Nitrofurantoin, Penicillin-G, Tetracyclin, Amoxyclav, Polymyxin-B, Colistin, Imipenem, Tigecycline, Clindamycin, Levofloxacin, Amikacin, Doxycycline, Ceftriaxone. If the organisms isolated in the CVP or Foley's Catheter specimen matched that of the blood culture specimen, then Blood Stream Infection was considered to be present due to that indwelling catheter.

### *Data analysis*

Statistical analysis was done with SPSS version 20.0. For all statistical tests of significance, p value <0.05 was considered to reject the null hypothesis.

## RESULTS

It was seen that this patients had a mean age of 45.62±13.97 years. Authors had 35 male and 15 female patients. 22% of the patients were diabetic and 30% hypertensive. Only 2 patients had a pre-operative total leucocyte count of >11000/mm$^3$.

**Table 1: Patient profile and prevalence of blood stream / urinary tract infection (n = 50).**

| **Age groups (years)** | | **Frequency** | **Percentage** | | **Mean±SD (years)** |
|---|---|---|---|---|---|
| 11-20 | | 3 | 6 | | 45.62±13.97 |
| 21-30 | | 5 | 10 | | |
| 31-40 | | 8 | 16 | | |
| 41-50 | | 15 | 30 | | |
| 51-60 | | 14 | 28 | | |
| 61-70 | | 3 | 6 | | |
| 71-80 | | 1 | 2 | | |
| 81-90 | | 1 | 2 | | |
| **Gender (n = 50)** | | **Number** | **Percentage** | | |
| Males | | 35 | 70 | | |
| Females | | 15 | 30 | | |
| Diabetes | Present | 11 (22%) | Hypertension | Present | 15 (30%) |
| | Absent | 39 (78%) | | Absent | 35 (70%) |
| **Pre- operative total WBC count** | | **Frequency** | **Percentage** | | **Mean±SD ( /mm$^3$)** |
| <4000/mm$^3$ | | 0 | 0 | | 7862±1927.448 |
| 4000-11000/mm$^3$ | | 48 | 96 | | |
| >11000/mm$^3$ | | 2 | 4 | | |
| **Blood stream infection** | Present | 04 (8%) | **Urinary tract infection** | Present | 07 (14%) |
| | Absent | 46 (92%) | | Absent | 43 (86%) |
| **Cross tabulation of Blood stream infection (BSI) and diabetes** | | | | | |
| | | **BSI present** | **BSI absent** | | **Total** |
| Diabetes present | | 2 | 9 | | 11 |
| Diabetes absent | | 2 | 37 | | 39 |
| Total | | 4 | 46 | | **50** |
| **Cross tabulation of Urinary tract infection (UTI) and diabetes** | | | | | |
| | | **UTI present** | **UTI absent** | | **Total** |
| Diabetes present | | 5 | 6 | | 11 |
| Diabetes absent | | 2 | 37 | | 39 |
| Total | | 7 | 43 | | 50 |

Pre operatively 2 patients had leucocytosis. None had leucopenia.
Odds ratio (95%CI) = 4.111; [p-value: 0.092564]. Individuals with diabetes had 4.111 times increased risk of developing BSI, compared to non-diabetics. However, this finding was not statistically significant.
Odds ratio (95%CI) = 15.417; [p - value: 0.001905]. Individuals with diabetes, had 15.417 times increased risk of developing UTI, compared to non-diabetics. This finding was statistically significant.

Authors found the incidence of blood stream infection in our study population to be 8%. It was also seen that, individuals with diabetes had 4.111 times increased risk of developing blood stream infection, compared to non-diabetics. However, this finding did not achieve statistical significance [Odds ratio (95%CI) = 4.111; p-value: 0.092564]. It was also seen that the diabetic patients showed a 15.417 times increased risk of developing Urinary Tract Infection (UTI), compared to non-diabetics and this finding was statistically significant. [Odds ratio (95%CI) = 15.417; p - value: 0.001905] (Table 1).

**Table 2: Study population distribution based on types of surgeries done (n = 50).**

| Type of surgery | Numbers | Percentage |
|---|---|---|
| Atrial Septal Defect (ASD) closure | 06 | 12 |
| Aortic valve replacement | 04 | 08 |
| Coronary artery bypass grafting | 22 | 44 |
| Colon bypass for stricture oesophagus | 01 | 02 |
| Double valve replacement | 03 | 06 |
| Intra cardiac repair | 01 | 02 |
| Mitral Valve Replacement (MVR) | 10 | 20 |
| MVR + ASD closure | 01 | 02 |
| MVR + Tricuspid ring annuloplasty | 01 | 02 |
| Pulmonary valvotomy | 01 | 02 |
| Total | 50 | 100 |

The study population underwent a wide variety of surgeries. These included congenital cardiac surgeries for Atrial Septal Defect (ASD), pulmonary stenosis, Tetralogy of Fallot; adult cardiac surgeries for valvular heart diseases, coronary artery bypass grafting, as well as thoraco-abdominal operations like colon bypass for oesophageal stricture (Table 2).

**Table 3: Organisms found on CVP catheter tip.**

| CVP catheter tip organism | Number of patients affected (n=50) | Percentage of patients affected |
|---|---|---|
| *Acinetobacter baumanii* | 02 | 04 |
| *Candida albicans* | 01 | 02 |
| *Enterococcus faecium* | 01 | 02 |
| *Klebsiella pneumonie* | 01 | 02 |
| *Pseudomonas aeruginosa* | 02 | 04 |
| *Staphylococcus epidermididis* | 01 | 02 |
| *Staphylococcus aureus* | 03 | 06 |

It was seen that 11 (22%) of the CVP catheter tips showed growth of some organism with Colony count >15 CFU/ catheter segment.

These organisms included both bacteria (Gram positive as well as negative) and fungus like Candida species (Table 3).

**Table 4: Organisms found on Foley's catheter tip and their pattern of existence.**

| Foley's catheter tip organism with pattern of existence | Number of patients affected (n=50) | Percentage of patients affected | Foley's catheter tip organism overall | Number of patients having the organisms (n=50) | Percentage of patients having the organisms |
|---|---|---|---|---|---|
| *Candida sp.* | 01 | 02 | *Candida sp.* | 02 | 04 |
| *Candida sp. + Enterococcus sp.* | 01 | 02 | | | |
| *E. coli* | 02 | 04 | *E.coli* | 03 | 06 |
| *Enterococcus* | 04 | 08 | | | |
| *K. pneumoniae* | 02 | 04 | *Enterococcus sp.* | 06 | 12 |
| *S. aureus* | 15 | 30 | | | |
| *S. aureus + Acinetobacter sp.* | 01 | 02 | *Acinetobacter sp.* | 01 | 02 |
| *S. aureus + E.coli* | 01 | 02 | *K. pneumoniae* | 02 | 04 |
| *S. epidermididis* | 01 | 02 | *S. aureus* | 17 | 34 |
| *S. epidermididis + Enterococcus sp.* | 01 | 02 | *S. epidermididis* | 02 | 04 |

It was also seen that 29 (58%) cases had growth of some organism on their Foley's catheter. Infact simultaneously 2 organisms were isolated in same Foley's catheter tip in 3 cases. These organisms included various bacteria as

well as Candidda species (Table 4). Early morning mid-stream clean-catch urine samples from all these 29 pateints were cultured 48 hours after catheter removal and only 7 had evidence of UTI. 2 (4%) had *E.coli*, 2 (4%) had *K.pneomoniae*, 2 (4%) had *S.aureus* and 1 (2%) had growth of *E.faecium*.

Authors found that only 4 (8%) of the study population had blood stream infection [BSI]; (Table 5). It was also noted that these 4 patients had growth of the same organisms in their respective CVP catheter tip specimens as well, but not in their Foley's catheter specimens.

**Table 5: Aerobic organisms found in peripheral blood stream (n = 50).**

| Aerobic organisms in blood culture | Gram stain characteristics | No. | Percentage |
|---|---|---|---|
| *Acinetobacter baumanii* | Gram negative bacilli | 01 | 02 |
| *Enterococcus faecium* | Gram positive cocci | 01 | 02 |
| *Pseudomonas aeruginosa* | Gram negative bacilli | 01 | 02 |
| *Staphylococcus aureus* | Gram positive cocci | 01 | 02 |

In fact it was seen that in no patients BSI and UTI were evident simultaneously. Hence, these BSIs were possibly due to the CVP catheters; the incidence being 8%.

**Table 6: Sensitivity and resistance patterns of organisms which caused blood stream infection (BSI).**

| Organism causing BSI | Sensitivity pattern | Resistance pattern |
|---|---|---|
| *Acinetobacter baumanii* | Meropenem, Piperacillin – Tazobactam, Polymyxin B, Colistin | Ceftazidime, Levofloxacin, Doxycycline, Ceftriaxone |
| *Enterococcus faecium* | Vancomycin, Linezolid | Gentamicin, Piperacillin-Tazobactam, Penicillin |
| *Pseudomonas aeruginosa* | Meropenem, Piperacillin – Tazobactam, Polymyxin B, Colistin | Cotrimoxazole, Ciprofloxacin, Gentamicin, Ceftriaxone, Ofloxacin |
| *Staphylococcus aureus* | Vancomycin, Linezolid, Piperacillin-Tazobactam | Cotrimoxazole, Gentamicin, Levofloxacin, Cefoxitin |

Among the organisms implicated for the cases having bacteraemia; Gram positive cocci were *Staphylococcus aureus* and *Enterococcus faecium*; while Gram negative bacilli were *Acinetobacter baumanii* and *Pseudomonas aeruginosa*. The gram positive organisms were sensitive to Vancomycin and Linezolid; while the gram negative organisms were sensitive to Piperacillin - Tazobactam, Meropenem, Polymyxin B and Colistin (Table 6).

## DISCUSSION

Bacteraemia related to CVP lines can occur due to entry of organisms via four different routes:- 1.Colonisation of local insertion site; 2.Catheter hub, it's lumen or guide-wire contamination during insertion; 3. Haematogenous seeding; 4. Infusion of contaminated fluids.[5] As the bacteria reaches the CVP line, it adheres to it's surface, to colonize. A biofilm is formed on the externl/ internal surface of these catheters when the organism is irreversibly attached to it by producing extracellular polymers forming a structural matrix.[5] In developed countries like USA, UK, Germany etc. such catheter related blood stream infection varies widely in different institutions ranging from 1.12 to 4.2 per 1000 catheter days, with a mean incidence of 1.01%.[6]

In India, however, this incidence varies from 0.2-27%, with a range of 0.5- 47 per 1000 catheter days.[7-9] In our case, authors had a 8% incidence of blood stream infection related to CVP lines, which is similar with the result of Chopekar et al, who found an incidence of 7.6%.[8] In Indian scenario, Coagolase negative *Staphylococcus* (CoNS) and *S.aureus* are common gram positive organisms related to Central line associated bacteraemia. Among gram negative organisms *Klebiella sp*, *Enterobacter sp* and *E.coli* are most important.[7,10]

However, in the study, authors found only 4 cases of bacteremia (incidence = 8%) by *Acinetobacter baumanii*, *Enterococcus faecium*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* respectively; which could be attributed to the indwelling CVP lines.

Like CVP lines, Foley's catheter also has several routes of colonization, like:- 1.Extraluminal colonisation by direct contact, during insertion; 2. Late colonization by organisms ascending via the mucous film between catheter and urethra; 3.Intraluminal colonization by backflow of urine from a contaminated urine bag or by any breach in this closed system.[11] It has been shown that chance of developing high level bacteriuria in presence of an indwelling urinary catheter is about 5% per day.[12] These patients with bacteriuria, in 0.4 - 4% cases develop blood stream infection.[13,14]

This is in concurrence with our finding, where only 7 patients (14%) had evidence of bacteriuria (2 had *E.coli*, 2 had *K. pneomoniae*, 2 had *S. aureus* and 1 had growth of *E. faecium*) related to indwelling Foley's catheter; however, none of these patients developed blood stream infection. However, immunosuppressed patients, those who have received RBC transfusion, smokers, neutropenic patients, diabetics, those with malignancies,

liver disease or renal disease are at increased risk of developing such bacteremia.[15]

## CONCLUSION

Incidence of bacteraemia related to indwelling CVP lines 48 hrs after their insertion in patients undergoing elective Cardio Thoracic surgery in CTVS ITU at Medical College, Kolkata was found to be 8%. Among the organisms implicated for these cases; Gram positive cocci were *Staphylococcus aureus* and *Enterococcus faecium*; while Gram negative bacilli were *Acinetobacter baumanii* and *Pseudomonas aeruginosa*. The gram positive organisms were sensitive to Vancomycin and Linezolid; while the gram negative organisms were sensitive to Piperacillin - Tazobactam, Meropenem, Polymyxin B and Colistin.

Indwelling Foley's catheters could not be held responsible for development of such blood stream infections.

It is therefore worthwhile to understand the sensitivity patterns of these organisms causing bacteraemia related with indwelling CVP lines in order to formulate an empirical antibiotic protocol in critically ill patients, in order to treat them aggressively before the formal culture/ sensitivity reports are available.

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