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# To determine the microbial profile of catheter related sepsis in ICU

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***Abstract*---**Background: Intravenous catheter-related blood stream infections (PVC-BSIs) are one of the common causes of death and illness in hospitals worldwide. Failure to practice adequate aseptic techniques is a leading cause of blood stream infections caused by catheters. The aim of this study to identify the microbiological makeup of catheter-related sepsis in the intensive care unit. Materials and methods: Participants comprised all intensive care unit (ICU) inpatients who had a peripheral venous catheter (PVC) implanted and who showed symptoms of septicemia within 48 hours after PVC implantation. Kirby-Brauer disc diffusion technique was used to test the antibiotic susceptibility of the bacterial isolates, as recommended by the CLSI. Results: Twenty percent of patients had identical bacterial growth in PVC tip cultures and blood cultures, suggesting peripheral venous catheter-related blood stream infection (PVC- BSI), while twenty-five percent of patients were colonised and thirty percent of patients had blood stream infections unrelated to the catheter. For one-quarter of patients, (25%) no organism development was identified. Among the 20 patients diagnosed with PVC-BSI, 8 (40%) were found to have infections caused by Staphylococcus aureus, 4 (20%) by Klebsiellaspecies, 4 (20%) by CONS, 2 (10%) by Enterococcus species, and 1 (5%) by both Acinetobacter and Pseudomonas species. Conclusion: Catheterization for an extended period of time, repeated catheterization attempts, or emergency situations all increase the risk of developing PVC- BSI, the authors write. An increasing danger is posed by Staphylococcus aureus, the leading cause of PVC-BSI because to the prevalence of MRSA. The most common kind of catheter used for IV assessment, polyvinyl chloride (PVC), is also associated with a high risk of infection spreading throughoutthe body.

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## Introduction

In the ICU specifically, intravenous catheters are crucial to daily patient care. Infection of the bloodstream caused by bacteria introduced via an intravenous catheter is known as catheter-related bloodstream infection (CRBSI). [1] Catheters like this are used to get access to the blood vessels, but they put patients at risk for a variety of diseases both locally and systemically. These include catheter-related blood stream infections, septic thrombophlebitis, endocarditis, and other metastatic infections (e.g lung abscess brain abscess, osteomyelitis and endophthalmitis). [2] The peripheral venous catheter (PVC) is the most popular kind of intravenous catheter since its insertion does not need for a specialised device or phlebotomist and because it is readily accessible even in the most basic medical settings. Because PVC are so often used in intensive care units and general wards, patients are more likely to get a nosocomial blood stream infection by having a venous catheter placed in their body. While research on central catheter-related BSI is available, data on PCV-related BSI is scarce.[3] Potential risk factors for CRBSI include preexisting conditions, catheter insertion technique, catheter placement, catheter length of stay, and catheterization's ultimate goal. Antimicrobial resistance may be facilitated by biofilm growth in catheters, which has been linked to device-related infections. Most common types of nosocomial infections are CRBSIs, which are also among the "preventable" types of infections. To ensure that all patients get high-quality treatment in a hospital, it is important to monitor the prevalence of infections caused by central venous catheters in a specific location.[4] The aim of this study to identify the microbiological makeup of catheter-related sepsis in the intensive care unit.

## Material and Methods

The department of department conducted this prospective research. Participants comprised all intensive care unit (ICU) in patients who had a peripheral venous catheter (PVC) implanted and who showed symptoms of septicemia within 48 hours after PVC implantation.[5] Patients admitted to the intensive care unit (ICU) with bacteremia and in whom the catheter was withdrawn within the first 48 hours were not included; neither were patients who died or were transferred out of the ICU during this period.[6] After obtaining informed permission from each patient or patient's attendant and concerned physician, a complete medical and treatment history was compiled. Upon admittance to the intensive care unit, blood samples were taken from each patient in order to rule out a blood stream infection.

## Methodology

The area surrounding the catheter insertion site was cleansed with 70% alcohol prior to collecting the tip. In order to prevent infection, the catheter was withdrawn without touching the patient's skin. With sterile scissors, we removed

the distal 2–3 cm of the catheter and placed it in a sterile tube with 10 ml of BHI broth. Sonication at 55,000 Hz for 1 minute followed by 15 seconds of vortexing. To further dilute this soup, 0.1 ml of broth was added to 9.9 ml of saline. [7] Now, loops were used to distribute 0.1 ml of both undiluted and diluted soup over MacConkey agar and Blood agar plates. At 37 degrees Celsius and 5% carbon dioxide, these culture plates were kept in an incubator. These individuals also had peripheral blood samples taken under sterile conditions from a non-catheterized vein. We performed a blood culture on the blood specimen. Catheter colonisation is defined as the growth of an organism in a catheter, whereas PVC-BSI is defined as the development of the same organism in culture broth from a PVC tip and peripheral blood. Multiply the total number of colonies found on the plate of undiluted broth culture by 102 CFU. The number of colonies on the diluted culture plate was multiplied by 105 if there were too many to count. If a catheter is the source of an infection, the CFU count must be higher than 102. [8] Colony morphology, Gram staining, and biochemical responses were used to determine the genus and species of the organism. Kirby-Brauer disc diffusion technique was used to test the antibiotic susceptibility of the bacterial isolates, as recommended by the CLSI. Cefoxitin disc on Muller Hinton agar with 3% NaCl was used for the screening of Methicillin-resistant Staphylococcus aureus (MRSA). According to the criteria established by the CLSI, a screening for ESBLs was conducted. [9,10]

**Results**

One hundred patients were recruited in the trial, and PVCs were left in place for an average of 5.1 days (range: 3-6). In all, the catheters were left in place for 500 study days. In this research, all of the participants were aged 25 and above, and they had all shown symptoms of septicemia after the catheter had been in place for at least 48 hours. The two largest age groups are those between the ages of 35 and 45 (with 38 and 30 patients, respectively) and those between the ages of 45 and 55. The research included 63 men and 37 females for a male-to-female ratio of 1.8:1. (Table 1).

Table 1: Age and sex distribution of the study group

| Age group | Male | Female | Total |
|---|---|---|---|
| 25-35 | 7 | 5 | 12 |
| 35-45 | 20 | 10 | 30 |
| 45-55 | 25 | 13 | 38 |
| Above 55 | 11 | 9 | 20 |
| Total | 63 | 37 | 100 |

Patients were divided into four groups according to the types of bacteria and yeasts that multiplied in their peripheral catheter tips and blood cultures. Colonization was found in 25% of patients, blood stream infections unrelated to the catheter were found in 30% of patients, and peripheral venous catheter-related blood stream infections were found in 20% of patients when the same bacteria grew in the PVC tip culture and the blood culture. For one-quarter of patients, (25%) no organism development was identified.

Table 2: Categories of infections based on isolation from PVC tip and peripheral blood culture

| Categories | Growth in PVC tip | Growth in blood | Number of cases (%) |
|---|---|---|---|
| PVC-BSI | + | + | 20 |
| Colonization | + | -- | 25 |
| BSI | -- | + | 30 |
| No growth | -- | -- | 25 |

Staphylococcus aureus was the most prevalent causal agent, accounting for 8 (40%) of the 20 patients with PVC-BSI, followed by Klebsiella species (4/20%), CONS (4/20%), Enterococcus species (2/10%), and Acinetobacter species (1/5%) and Pseudomonas species (1/5%). (Table3).

Table 3: Bacterial isolates of PVC-BSI samples (n=20)

| Isolated bacteria | No. of isolates | % |
|---|---|---|
| *Staphylococcus aureus* | 8 | 40 |
| *Klebsiella species* | 4 | 20 |
| *CONS* | 4 | 20 |
| *Enterococcus species* | 2 | 10 |
| *Acinetobacter species* | 1 | 5 |
| *Pseudomonas species* | 1 | 5 |

25 instances of colonisation were caused by Gram-positive bacteria, including 10 cases of S.aureus, 6 cases of Enterococcus species, and 3 cases of CONS. In three of the instances, a Candida species was identified (Table 4)

Table 4: Bacterial isolates of colonized samples (n=25)

| Isolated organisms | No. of isolates | (%) |
|---|---|---|
| *Staphylococcus aureus* | 10 | 40 |
| *Enterococcus species* | 6 | 24 |
| *CONS* | 3 | 12 |
| *Pseudomonas species* | 3 | 12 |
| *Candida species* | 3 | 12 |

Of the 17 PVC-BSI instances, the greatest number of patients are between the ages of 56 and 70, followed by those who are older than 70. PVC-BSI affected more men than women, and the elderly were at the greatest risk. It was shown that the rate of PVC-BSI dramatically rises in correlation with the length of time a patient is catheterized. There seemed to be a clear correlation between the length of time a catheter was in place and the number of PVC-BSI cases: there was only one case after 48 hours, four cases at 72 hours, six cases at 96 hours, and seven instances after 120 hours.

Table 5: Risk of PVC-BSI in cases catheterized under emergency condition

| | No. of PVC inserted | Developed PVC-BSI |
|---|---|---|
| Inserted under emergency condition | 35(35%) | 12 (60%) |
| Inserted in ICU | 65(65%) | 8 (40%) |
| Total | 100 (100%) | 20 (100%) |

People who had been catheterized urgently before to intensive care unit admission had a greater risk of developing PVC-BSI. Thirty-five patients were catheterized in an emergency situation, and 12 of them (or 60% of all positive cases) had PVC-BSI S. (Table 5). Colonization was most often associated with a blocked catheter. Out of 25 colonised patients, 17 (68%) had had catheter obstruction or flushing issues (Table 6).

Table 6: Risk factor for colonization

| Total number of colonized Cases | Catheter blockage and flushing done | No blockage |
|---|---|---|
| 25 | 17 (68%) | 8 (32%) |

Vamcomycin was shown to be active against all Gram-positive bacterial isolates, but only 62% of Staphylococcus aureus, 75% of Conus, and 50% of Enterococcus spp. In vitro testing showed that 85.5% of S. aureus, 75.0% of CONS, and 50% of Enterococcus species were susceptible to amikacin. For Gram-positive bacteria, vancomycin proved to be the most effective antibiotic. Fifty-one percent of S. aureus isolates tested positive for methicillin resistance (Table 7).

Table 7: Antibiotic sensitivity pattern of Gram positive bacteria

| Organism | No. of isolates | AS | OX | AK | CD | CIS | VA |
|---|---|---|---|---|---|---|---|
| *Staph. aureus* | 8 | 4 (50%) | 4(50%) | 7 (87.5%) | 6 (75%) | 5 (62.5%) | 8(100%) |
| CONS | 4 | 1 (25%) | 1 (25%) | 3 (75%) | 3 (75%) | 3(75%) | 4(100%) |
| *Enterococcus spp.* | 2 | 2 (100%) | 1 (50%) | 1 (50%) | 1 (50%) | 1 (50%) | 2 (100%) |
| Total | 14 | 7 | 6 | 11 | 10 | 9 | 14 |

Table 8: Antibiotic sensitivity pattern of Gram negative bacteria.

| Organism | No. of isolates | AS | CIS | AK | IPM | CPM | PIT |
|---|---|---|---|---|---|---|---|
| *Klebsiella spp.* | 4 | 3(75%) | 1 (25%) | 3 (75%) | 4(100%) | 3 (75%) | 1 (25%) |
| | | CAZ | CIS | AK | IPM | CPM | PIT |
| *Acinetobacter spp.* | 1 | - | - | 1 | 1 | - | - |
| | | CAZ | CIP | AK | IPM | CPM | PIT |
| *Pseudomonas spp.* | 1 | - | 1 | - | 1 | - | 1 |

Among Gram-negative bacteria, Acinetobacter spp. was shown to be resistant to the vast majority of medicines tested. Impenem showed 100% susceptibility against Klebsiella isolates, whereas ampicillin sulbactam, cefepime, and amikacin only showed 75% susceptibility. Three Klebsiella isolates were shown to produce ESBLs (Table 8).

**Discussion**

This research looked at the frequency of PVC-BSI, as well as its microbial make-up and potential causes. Over the course of the trial, 100 individuals aged 25 and over who had a PVC implanted and shown indications of septicemia within 48 hours were enrolled. There were 500 catheter days of observation for these 100 individuals. Most of the patients in the research group belonged to 45-55 years age groups patients accounting for 38% of all cases. Thus 70 % of the PVC-BSI patients belongs to age group more than 45 years which coincides to the age distribution of our research group demonstrating favourable association between the old age and incidence of PVC-BSI. There is a correlation between age and risk, suggesting that the elderly are at a greater risk due to their compromised immune systems. Parameswaran et al. found that 61.1% of the study population had some kind of immune system dysfunction. 2 Malepredominance was detected with male: female ratio of 1.8:1.

Among the 100 patients included in the research group there were 20 incidences of PVC-BSI which account for PVC-BSI rate of 43/1000 catheter days. Gahlot et al., the National Nosocomial Infection Surveillance System, and Almuneef et al. all found a CVC-BSI incidence of 11 per 1000 catheter days; another study found a range of 1.9 to 5.3 per 1000 catheter days. [1,11,12] Nosocomial septicemia is a serious complication that may be caused by PVC catheters because of the much higher infection incidence compared to CVC catheters. Our research found that 25% of participants were colonised, with 70% of those instances being caused by Gram-positive bacteria. A review of the literature reveals a colonisation rate spectrum from 31.58% to 76%. [13-15]

Staphylococcus aureus was determined to be the most prevalent etiological agent in the current investigation, with a prevalence of 40%, similar to that of 53% in a study by Pujol M et al.[16] Among the Gram negative bacterial isolates Klebsiella species was most prevalent accounting for 20%. S. aureus, C. necatrix, and E. faecium (together known as "Gram-positive cocci") were shown to be the principal causal agents, accounting for 70% of PVC-BSI cases, while Gram-negative bacteria were responsible for the remaining 30%.

The mean length of catheterization in our research was 4.9 days identical to that of 4.9 days of Pujol M et al.[16] Despite the CDC's recommendation that all PVC be replaced within 96 hours, no such effort was undertaken. [17] Incidence of PVC-BSI rose consistently with length of catheterization, peaking at 96-120 hours of catheter retention. This finding indicates that the risk of infection from the catheter rises in tandem with the duration of catheterization. The rate of infection rose within 4-7 days after catheterization, as was also seen in a research by Sato et al. [18] Other risk variables detected in our research included catheterization under emergency circumstance and several tries for catheter placement. PVC-BSI

was shown to be more common in patients who had been catheterized in an emergency setting prior to intensive care unit admission. While 35% of our individuals were catheterized in an emergency situation, 42% of the cases in the research by Pujol et al. tested positive for PVC-BSI. Inadequate asepticprecautions or less experienced workers may contribute to the higher risk of catheter infection in emergency situations.[16]

The most prevalent risk factor for colonisation was a blocked catheter, and the most common bacteria found were Gram-positive cocci such S. aureus and Enterococcus species. Possible contributors to colonisation include poor personal cleanliness, occlusive dressings, and dampness surrounding the exit site. Vamcomycin was shown to be active against all Gram- positive bacterial isolates, but only 62% of Staphylococcus aureus, 75% of Conus, and 50% ofEnterococcus spp. In vitro testing showed that 85.5% of S. aureus, 75.0% of CONS, and 50% of Enterococcus species were susceptible to amikacin. For Gram-positive bacteria, vancomycin proved to be the most effective antibiotic. In contrast to the 26.7% found in the research by Parameswaran et al., methicillin resistance was found in 5 of 8 S. aureus isolates. 2 Imipenim was shown to be effective against all gram-negative isolates. The Acinetobacter genus of bacteria proved particularly difficult to treat. The negative impact on illness outcome from the rising MRSA detection rate is cause for worry.

## Conclusion

PVC had a major role in the emergence of catheter-related infection, which increased patient morbidity, mortality, and length of hospital stay. The risk of PVC- BSI increases with the length of time a catheter is in place, the number of times a catheter is attempted, and the urgency with which the procedure is performed. An increasing danger is posed by Staphylococcus aureus, the leading cause of PVC-BSI because to the prevalence of MRSA. The most common kind of catheter used for IV assessment, polyvinyl chloride (PVC), is also associated with a high risk of infection spreading throughout the body. Hence its insertion under asepticenvironment and prompt replacement are the key to minimise PVC-BSI.

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