Original Research Article

A study on catheter associated blood stream infections at a tertiary care hospital of Bihar

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Abstract

Introduction: Intravascular catheters are indispensable in modern-day medical practice, particularly in intensive care units (ICUs). The incidence of CRBSI varies considerably by type of catheter, frequency of catheter manipulation, and patient related factors (e.g., underlying disease and acuity of illness). **Materials and Methods:** It was case-control study conducted in the Department of Microbiology, Darbhanga Medical College, Laheriasri, Bihar, India from January 2020 to December 2020. The number of participants in this study was 100 cases and 100 controls. Patients aged >18 yrs, admitted in intensive care units with intravascular catheters, were included. Skin was cleaned with 70% alcohol prior to catheter removal. Drying was avoided by sealing the tube and transporting the same to the laboratory as soon as possible. In blood processing, blood was collected within 48 hours of catheter collection under all aseptic precautions in a BacT bottle and analyzed using the BacT ALERT system. Antibiotic sensitivity pattern was done by Kirby-Bauer disk diffusion method as recommended by Clinical Laboratory Standard Institute (CLSI). Statistical analyses were done using SPSS 16.0 and strength of association is expressed as odds ratio which was derived using logistic regression analysis. **Results:** Out of 100 samples, 81% of the isolates were bacteria, while 17% of the pathogens were Candida species and only 2% were polymicrobial. While majority (70.4%, 19/27) of the organism of CRBSI was Gram positive, majority (61.6%, 45/73) of the organism of CRLI were Gram negative.The commonest pathogen of CRBSI was Staphylococcus aureus (12/27) and the least common was Acinetobacter baumannii (1/27). Candida spp. **Conclusions:** The increasing rate of CRBSI is a matter of concern to our hospital set up. This work will help both the clinicians as well as microbiologists in better management of patients as well as in prevention of nosocomial bloodstream infection, especially due to multidrug resistant organisms.

Key Words: Catheter associated blood stream infections

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Introduction

Intravascular catheters are indispensable in modern-day medical practice, particularly in intensive care units (ICUs). Although such catheters provide necessary vascular access, their use puts patients at risk for local and systemic infectious complications, including local site infection, catheter related blood stream infections (CRBSIs), septic thrombophlebitis, endocarditis, and other metastatic infections (e.g., lung abscess, brain abscess, osteomyelitis, and endophthalmitis).

The incidence of CRBSI varies considerably by type of catheter, frequency of catheter manipulation, and patient related factors (e.g., underlying disease and acuity of illness). Peripheral venous catheters are the devices most frequently used for vascular access. Although the incidence of local or bloodstream infections (BSIs) associated with peripheral venous catheters is usually low, serious infectious complications produce considerable annual morbidity because of the frequency with which such catheters are used. However, the majority of serious catheter-related infections are associated with central venous catheters (CVCs), especially those that are placed in patients in ICUs. In the ICU setting, the incidence of infection is often higher than in the less acute in-patient or ambulatory setting. In the ICU, central venous access might be needed for extended periods of time; patients can be colonized with hospital-acquired organisms; and the catheter can be manipulated multiple times per day for the administration of fluids, drugs, and blood products.

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Moreover, some catheters can be inserted in urgent situations, during which optimal attention to aseptic technique might not be feasible. Certain catheters (e.g., pulmonary artery catheters and peripheral arterial catheters) can be accessed multiple times per day for hemodynamic measurements or to obtain samples for laboratory analysis, augmenting the potential for contamination and subsequent clinical infection.

Bloodstream infections may be either primary or secondary. Secondary infections are related to infections at other sites, such as the urinary tract, lung, postoperative wounds, and skin. Primary BSIs comprise the majority (64%) of nosocomial BSIs reported to the CDC's National Nosocomial Infection Surveillance (NNIS) system, and most are due to infected intravascular, mostly central venous catheters. The remaining patients with primary BSIs have bacteremia with no identifiable source. More than 250,000 vascular catheterrelated bacteremia and fungemia occur annually in the USA with an attributable mortality ranging from 12% to 25% in critically ill patients[1, 2].

Defining Criteria for Catheter Related Blood Stream Infections (CRBSI) and Catheter Associated Blood Stream Infections (CABSI) CRBSI:

Bacteremia/fungemia in a patient with an intravascular catheter with at least one positive blood culture obtained from a peripheral vein, clinical manifestations of infections (i.e., fever, chills, and/or hypotension), and no apparent source for the BSI except the catheter. One of the following should be present: a positive semiquantitative (>15 CFU/catheter segment) or quantitative (>102 CFU/catheter segment catheter) culture whereby the same organism (species and antibiogram) is isolated from the catheter segment and peripheral blood. CABSI. Vascular access device terminates at or close to the heart or one of the great vessels. An umbilical artery or vein catheter

is considered a central line. BSI is considered to be associated with a central line if the line was in use during the 48-hour period before development of the BSI. If the time interval between onset of infection and device use is >48 hours, there should be compelling evidence that the infection is related to the central line.

Materials and Methods

It was case-control study conducted in the Department of Microbiology, Darbhanga Medical College, Laheriasri, Bihar, India from January 2020 to December 2020. The number of participants in this study was 100 cases and 100 controls. Patients aged >18 yrs, admitted in intensive care units with intravascular catheters, were included. Patients with fever prior to catheter placement and proven source for sepsis other than the intravascular catheter of interest were excluded from this study. The following definitions were used to describe cases and controls:

Case. Any patient with proven localized catheter colonization, exit site infection, or bloodstream infection (as per CDC guidelines).

Control. Any patient in whom intravascular catheter grows no organism on semi quantitative cultures.

Method of Collection of the Catheter Specimen[3]

Skin was cleaned with 70% alcohol prior to catheter removal. The proximal end of catheter was held and carefully removed from the patient with a sterile instrument, taking care to avoid contact with the skin. The distal end was held over a sterile tube, and tip was cut with a sterile scissors and the terminal 2 to 3 inches dropped into the tube. Drying was avoided by sealing the tube and transporting the same to the laboratory as soon as possible. Catheter tip processing was done by Maki's Roll over plate method and catheter flush culture[4, 5]. In blood processing, blood was collected within 48 hours of catheter collection under all aseptic precautions in a BacT bottle and analyzed using the BacT ALERT system.

Antibiotic sensitivity pattern was done by Kirby-Bauer disk diffusion method as recommended by Clinical Laboratory Standard Institute (CLSI). Screening method for the detection of MDR (MRSA, ESBL, and so forth) organism was done by using Oxacillin (1 μg) disk in Mueller Hinton agar plate for MRSA detection and double disc approximation or double disk synergy using Amoxicillin-Clavulanic acid (20/10 μg) and Ceftriaxone (30 μg) at a distance of 30 mm between centers of the two disks. American type culture collections (ATCC) were used as control strains.

Statistical analyses were done using SPSS 16.0 and strength of association is expressed as odds ratio which was derived using logistic regression analysis.

Results

The commonest pre-morbidity among the controls and cases with CRBSI was renal failure while that among the patients with local catheter infections was diabetes and the commonest purpose of cannulation was for administration of IV fluids and parenteral antibiotics as shown in Table 1. Local signs of inflammation like erythema, warmth, induration, tenderness, and purulence at exit site were seen among all patients with CRBSI and among majority of patients with local catheter infections.

Table 1: Clinical profile of study population

Clinical profile	Controls (100)	CRBSI (27)	CRLI (73)
Gender (Male)	72	16	44
Mean age (years)	44.7	48.2	45.6
Mean hospital stay (days)	21.7	22.5	25.7
Pre-morbidities			
Diabetes	13	7	21
Renal failure	37	14	19
Malignancies	2	3	1

81% of the isolates were bacteria, while 17% of the pathogens were Candida species and only 2% were polymicrobial. While majority (70.4%, 19/27) of the organism of CRBSI was Gram positive, majority (61.6%, 45/73) of the organism of CRLI were Gram negative.

The commonest pathogen of CRBSI was Staphylococcus aureus (12/27) and the least common was Acinetobacter baumannii (1/27). Candida spp. and Pseudomonas aeruginosa both accounted for about 7/27cases while rests were caused each by E. coli, K. pneumonia, and coagulase-negative Staphylococcus spp. The commonest pathogen of CRLI was CONS (15/73) and the least common were polymicrobials (4/73). Both Pseudomonas and Acinetobacter showed growth in 11/73 of the cases followed by Staphylococcus aureus (10/73) and E. coli (9/73). Klebsiella pneumoniae and Candida spp. each showed growth in 8 cases.

Antibiotic Sensitivity Pattern in Catheter Related Local Infection

All resistant Staphylococcus (MRSA and MRCONS) isolated from local catheter infections were 100% sensitive to vancomycin, teicoplanin, and linezolid and all sensitive Staphylococcus (MSSA, MSCONS) were 100% resistant to ciprofloxacin. The most sensitive routine antibiotic for Pseudomonas aeruginosa strains isolated in CRLI was piperacillin and the most sensitive reserved antibiotics were cefoperazone-salbactum, piperacillin-tazobactum, ticarcillin-clavulanic acid and meropenem. The most sensitive routine antibiotic for E. coli isolated in CRLI was cefuroxime and the most sensitive reserved antibiotic was meropenem while the most sensitive routine antibiotic for K. pneumoniae isolated in CRLI was amikacin and the most sensitive reserved antibiotic was meropenem. In case of A. baumannii isolated in CRLI, the most sensitive routine antibiotic used was amikacin and cefoperazone-salbactum in reserved antibiotic.

Antibiotic Sensitivity Pattern in CRBSI

All resistant Staphylococcus (MRSA) isolated from CRBSI were 100% sensitive to cotrimoxazole and chloramphenicol among routine antibiotic and 100% sensitive to vancomycin, teicoplanin, and linezolid among reserved antibiotics. All sensitive Staphylococcus (MSSA and MSCONS) were 100% resistant to ciprofloxacin. The most sensitive routine antibiotics for P. aeruginosa isolated from CRBSI were piperacillin and ciprofloxacin. Among the reserved antibiotics the most sensitive were cefepime, cefoperazone-salbactum, piperacillin-tazobactum, ticarcillin-clavulanic acid, and meropenem. There were no routine antibiotics sensitive for E. coli isolated from CRBSI and both were ESBL producers and among reserved antibiotics meropenem was most sensitive. For K. pneumoniae isolated from CRBSI, the most sensitive routine antibiotics were gentamicin, netilmicin, amikacin, and meropenem among reserved antibiotics. Only one strain of A. baumannii isolated from CRBSI was resistant to all routine and reserved drugs (multidrug resistant).

Predisposing factors

There is no role for empirical antibiotics as the majority of patients developed infections despite being under antibiotic cover. The incidence of catheter-related infections was the highest among patients with a femoral venous line (42%). This was followed by patients with subclavian, basilic and jugular venous accesses (21% versus 19% versus 18%) as compared to controls. In subjects with triple lumen catheters, 44% cases had catheter related infections as

compared with 26% of controls whereas, in patients with double lumen catheters and single lumen catheters it was only 31% and 25% respectively. The incidence of CRBSI was highest in patients with triple lumen catheter as compared in patients with double and single lumen catheters in situ. Duration of catheter in situ is a predisposing risk factor for the development of catheter-related infections. The mean duration of catheter in situ (in days) was higher among cases than controls (11.7 versus 8.1).

Discussion

Our study investigated the incidence, clinical profile, microbiological profile and possible factors of catheter-related infections in a tertiary care hospital. The commonest isolates among the patients with CRLI were Gram-negative organisms while Gram-positive organisms caused the majority of the CRBSI. Overall, in the entire study S. aureus was the commonest pathogen isolated followed by CONS, P. aeruginosa, A. baumannii, Candida species, E. coli, K. pneumoniae, and polymicrobial. Overall multidrug resistant organisms accounted for 42.8% of the infections.

Candida species were isolated from 17% of the patients. Although this is lower than available Indian statistics[6, 7], it is still higher than the data published by The National Nosocomial Infections Surveillance System in the United States.

CRBSI was resistant to all routine and reserved drugs (multidrug resistant).The CRBSI incidence density at our hospital is 9.2 per 1000 catheter days. This is similar to observations from meta-analyses by the National Nosocomial Infections Surveillance System in the United States which reported an incidence density ranging between 2 and 11.3 per 1000 catheter days. Pawar et al[6]. reported a CRBSI incidence density of 4.01 per 1000 catheter days in their study done with one thousand three hundred fourteen participants admitted into a cardiac ICU at New Delhi. the number of MRSA isolated in our study is higher than that observed by Pawar et al[6]. Nearly one-third of enteric bacilli (E. coli and K. pneumoniae) were ESBL producers. Overall 42.8% were multidrug resistant strains.

Several variables have been quoted as contributing to catheterrelated infections. These include the number of catheter lumens, cannulation site, and duration of catheterization. In our study, femoral venous access was associated with a significantly higher incidence of local catheter infections and CRBSI than jugular and subclavian access; jugular access was associated with a significantly higher incidence of local catheter infections than subclavian access. In our study the incidence of catheter-related infection was highest with triple lumen catheters when compared with double and single lumen catheters. The duration of catheterization was a significant factor that determined the development of catheter-related infections. Although previous studies have confirmed that central venous catheterization longer than 5 to 7 days was associated with a higher risk of catheter-related infection[8–11], the mean duration of catheterization in our study was 11.7 days and no attempts were made to replace catheters as the CDC guidelines of 1996[12] and 2002[1] recommended against routinely replacing CVCs to prevent catheter-related infections. The risk of infection for catheters placed for more than 12 days was higher.

Conclusion

The increasing rate of CRBSI is a matter of concern to our hospital setup.This work will highlight the common microorganisms responsible for CRBSI, their antibiotic susceptibility pattern and also will correlate the clinical significance. This work will help both the clinicians as well as microbiologists in better management of patients as well as in prevention of nosocomial bloodstream infection, especially due to multidrug resistant organisms.

Conflict of Interest: Nil Source of support: Nil

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