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STUDY ON MICROORGANISM PROFILE AND COMPARATIVE RESISTANCE PATTERN AMONG CRBSI PATIENTS IN A TERTIARY CARE HOSPITAL OF EASTERN INDIA

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ABSTRACT

Central-venous-catheter-related bloodstream infection (CRBSIs) is the most important cause of hospital-acquired blood stream infection associated with morbidity, mortality, and cost. Consequences depend on resistance pattern of the pathogen , underlying co-morbid conditions, whether emergency or elective insertion of CVC, and appropriateness of the treatment/interventions received.

Objectives: To identify the prevalent bacteriological profile along with determine antimicrobial susceptibility and comparative resistance pattern of isolates from CVC and the peripheral blood .

Materials and Methods: The study was carried out in Department of Microbiology in collaboration with Department of Critical Care Medicine in a Medical college Hospital of West Bengal within Jan 2019- Jun 2019

Patients above 18 years of age, willing to give consent and in whom the CVC had been inserted in the Intensive care unit of IPGMER were included in this study.

Aerobic isolates were identified by Gram stain and Microscopy, routine biochemical tests as per standard protocol. Antimicrobial susceptibility of isolates was tested by modified KirbyBauer disk diffusion method as per the recommendations of Clinical and Laboratory Standards Institute (CLSI guidelines).

Result: Total of 52 patients with a cumulative 204 CVC days were included. Of this, 17 catheters (32.7 %) were positive for SQC. Among these 17 patients, 13 patients (76%) had developed CRBSI, and the same strain of organism with identical resistance pattern was isolated from both the blood and CVC tip. One patients(11.7%) had positive blood cultures with different organism growing on CVC tip culture . CRBSI rate was 8.3/1000 CVC days.

Discussion: Our study isolated around 60% Gram negative organisms responsible for CRBSI .All the Gram positive organisms isolated in our study found to be CONS,found to be 100% sensitive to Vancomycin , Linezolid and 67% sensitive to Teicoplanin.As per the Gram negative organisms are concerned , the predominant GNB is Klebsiella spp .Overall , Klebsiella spp in our study has poor sensitivity towards commonly prescribed broad spectrum antibiotics , and exerts sensitivity only to Polymyxin B (100%) , Carbapenems (60%) and Amikacin (40%). Acinetobacter spp & Psedomonas aeruginosa showed marked resistance pattern with 100% sensitivity to polymyxin B ,

Conclusion: Multiple measures have been implemented to reduce the risk for CRBSI, including maintenance of strict aseptic precautions during catheter insertion especially in case of emergency insertion, use of maximal barrier, effective cutaneous disinfectant, and preventive strategies based on inhibiting micro-organisms entering from the skin or catheter hub from adhering to the catheter.Further prospective studies with sufficient population size and the bigger study samples is required.

Keywords: Hospital-acquired infection, CRBSI, antimicrobial resistance

Introduction

Central venous catheter-related bloodstream infection (CRBSI) is a nosocomial infection responsible for increased morbidity and mortality, especially in critically ill patients in ICUs.(1) CRBSIs are determined by multiple factors such as any type of comorbidities present during the time of present hospitalization, types of catheter used, catheter insertion site, insertion technique ,dwelling time, techniques of catheter care methods, overall hospital control and colonization of the catheter by micro-organisms, and formation of Biofilms (2,3,4). Catheter related blood stream infections (CRBSI) independently increase healthcare costs and length of hospital stay. Knowledge about CRBSIs would help in improving hospital infection control practices and managing nosocomial sepsis.

OBJECTIVES

1. To identify the prevalent bacteriological profile along with determine antimicrobial susceptibility and comparative resistance pattern of isolates from CVC and the peripheral blood .
2.. To determine risk factors for development of CRBSI.
3. To study the prevalence of central venous catheter related blood stream infections and to identify clinical risk factors & the microbiological profile of organisms causing CRBSI.

MATERIALS AND METHODS

The study was carried out in Department of Microbiology in collaboration with Department of Critical Care Medicine in a Medical college Hospital of West Bengal.
Study Period - Jan 2019- Jun 2019

Study Population

Inclusion criteria:
Patients above 18 years of age, willing to give consent and in whom the CVC had been inserted in the Intensive care unit of IPGMER were included in this study.

Exclusion criteria:

Patients with tunneled central venous catheters, immunocompromised patients and those suspected to have infective endocarditis were excluded from the study.

Methods of Data Collection

A case record form (pre-tested, semi-structured) with informed consent was used for data collection. Relevant history was takenand important clinical finding was noted. Sample were collectedand processed following standard protocol (as mentioned in Mackie &McCartney). (5,6)

Microbiological Methods

Aerobic isolates were identified by Gram stain and Microscopy, routine biochemical tests as per standard protocol(6). Antimicrobial susceptibility of isolates was tested by modified KirbyBauer disk diffusion method as per the recommendations of Clinical and Laboratory Standards Institute (CLSI guidelines).(7)

Detailed clinical history of the patients including the factors like age, sex, indication for ICU admission, comorbidities and use of systemic antibiotics were documented. Details with regard to catheter insertion such as site of insertion, number of attempts, emergency/elective placement were also recorded. A peripheral blood sample was collected from all patients in the present study at the time of central venous catheter insertion to rule out existing bacteremia.

We followed up every patient on a regular basi for any new onset of sepsis. In any case of new sepsis, detailed physical examination and investigations forruling out other sources of infections were done.The details of the CVCs used in patients who died during the period of study were excluded. The skin surrounding the insertion site was carefully disinfected with chlorhexidine and the CVCs were removed under proper aseptic conditions. A 5-cm distal segment (tip) was collected in a sterile containerfrom all catheters. All catheter tips were sent to the microbiology laboratory for semi quantitative culture (SQC) as described by Maki et al. (5) In semi quantitative culture, the tip of the catheter was rolled minimum four times in a blood agar and then incubated at 37°C for 18 to 24 hours. Positive catheter tip culture was identified as a growth with 15 colony forming units. For all the cases a paired peripheral blood culture was also sent. The duration of central venous catheter insertion and the reason for removal were noted.

Antibiotic Susceptibility Testing was performed by "Kirby-Bauer's" disk diffusion method on Mueller Hinton agar plate. The test inoculum standardized with 0.5 McFarland standard then subjected to inoculate a Lawn culture on a Muller Hinton agar plate by making an even streaking of the cotton swab over the entire surface of the plate in three directions, rotating the plate through an angle of 60° after each application. With the help of a sterile forceps, the antibiotic discs were placed on the inoculated plates in such a way that they were 15mm away from the edge of the plate and the distance between each disc was not less than 25mm. Only 6 antibiotics discs were placed in every petri plate. The plates were incubatedovernight at 37º C aerobically. The diameter of the zones were measured and interpreted as "Susceptible(S), Intermediate(I), Resistant(R)" as per CLSI guidelines.

Result

Total of 52patients with a cumulative 204 CVC days were included. Of this, 17 catheters (32.7 %) were positive for SQC. Among these 17 patients, 13 patients (76%) had developed CRBSI, and the same strain of organism with identical resistance pattern was isolated from both the blood and CVC tip. One patients(11.7%) had positive blood cultures with different organism growing on CVC tip culture . CRBSI rate was 8.3/1000CVC days.

Table 1: Microbiological profile of SQC of CVC tip

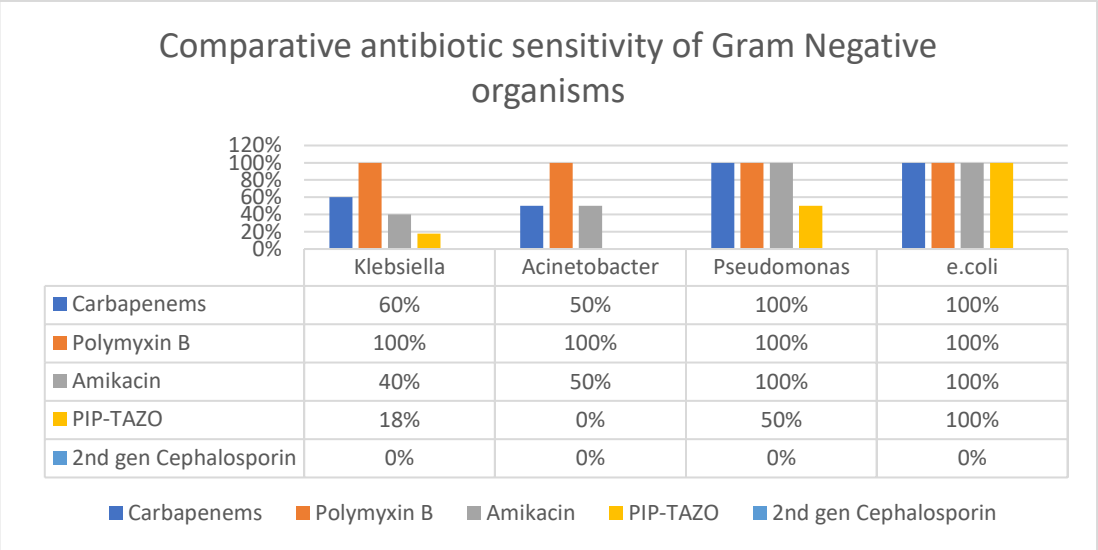
Organism	Total number of organisms in SQC positive CVP tip (n=17)	Percentage of SQC positive CVP tip (n=100%)
CONS	6	35%
Klebsiella spp	5	29.4%
Acinetobacter	2	17.6%
Pseudomonas	2	17.6%
Escherichia coli	1	5.8%
Candida	1	5.8%

Table 2: percentage of positive or negative culture

Result of SQC	Total number of cases (n =52)	Percentage
SQC Positive	17	32.7 %
SQC Negative	35	67.3%

Table 3 : Factors associated with CRBSI

Diabetes	Diabetic	10
	Non diabetic	7
Catheter dwelling time	More than 7 days	12
	Less than 7 days	5
Type of insertion	Emergency	13
	Elective	4



Discussion:

Numerous interrelated factors have been proposed for causation of CRBSI. The catheter itself can be involved in 4 different methodspathogenesis like colonization of the catheter tip and cutaneous tract with skin flora; colonization and occlusion of the catheter lumen caused by contamination; hematogenous seeding of the catheter from another infected site; and contamination of the lumen of the catheter with infuscate. Resistance to antibiotic therapy attributes to biofilm formation also plays a very important role in development of bacteremia. It is important to know that a negative catheter-related sample rules out CRBSI better than a positive sample indicating one. If the blood culture obtained from the catheter is positive for SQC growth, but the percutaneous blood sample is negative, most likely it points towards colonization of the catheter rather than actual CRBSI. However, if the causative pathogen is *S. aureus* or *Candida*, or if patient has preexisting valvular heart disease or neutropenia, infective endocarditis and metastatic infection has to be excluded with close monitoring of the patient's condition.

The Indian hospitals show a much higher incidence of CRBSI , on an average figure of 7.9 per 1000 catheter days , in respect to countries with smarter infection control practices like Netherlands (1.2 per 1000 catheter days).(7 ,8)Patil et al showed that 15 out of 54 suspected patients are positive for bacterial growth in SQC (27.88%).(9), but Juste et al reported 33.6% positivity in SQC of CVC , which is similar to our study.10 The overall variation in incidence rate might be due to the result of differences in duration of catheter dwelling , emergency vs elective insertion procedure, insertion site and choice of skin disinfectants. Comorbid conditions like diabetes has a significant correlation with the increased incidence of CRBSI as reported by Jia et al .(11)Patil et al showed significant correlation between CRBSI with emergency insertion of CVC .(9) Failure to stick to aseptic measures before insertion in case of emergency procedure may explain this incidence.

11 cases (64.7%) in our study , had indwelling CVC for more than seven days , which is similar with the significance highlighted by Charalambous et al .(12)

We did not consider changing the type of material used in CVC , neither we tried to change CVC on a regular basis , as this is against CDC recommendations .(13)

Our study isolated around 60% Gram negative organisms responsible for CRBSI , which is similar to the finding of Krishnan et al (14) , and the opposite finding of that of the Ramanathan Parameswaram et al who has isolated 64% pathogens of CRBSI as Gram positive (15). All the Gram positive organisms isolated in our study found to be CONS , which is again similar to the finding Rodrigo et al (16). Among the CONS in our study found to be 100% sensitive to Vancomycin ,Linezolid and 67% sensitive to Teicoplanin. As per the Gram negative organisms are concerned , the predominant GNB is Klebsiella spp . Among them 4 (80 %) found to be Klebsiella pneumoniae and 1 (20%) has been identified as Klebsiella oxytoca . Overall , Klebsiella spp in our study has poor sensitivity towards commonly prescribed broad spectrum antibiotics , and exerts sensitivity only to Polymyxin B (100%) , Carbapenems (60%) and Amikacin (40%). Acinetobacter spp also showed marked resistance pattern with 100% sensitivity to polymyxin B , 50% sensitivity to carbapenems and amikacin. Whereas Pseudomonas showed 100% sensitivity towardsPolymyxin B and carbapenems.
As because our study design needed a paired blood culture sample at the time of sepsis or at the time of CVC removal, patients who did not have any suspected primary BSI and the patients who expired during their course of illness in the hospital, were not included in the study. However, some of these patients might have had unrecognized blood stream infection .So an under-estimation of the rate of BSI in our study can't be excluded. Moreover the formation of biofilm and its correlation with the causation of CRBSI, especially by Klebsiella , Acinetobacter spp were not covered in our present study.Neutropenia is a well-known major risk factor for catheter-related complications in case of hematological malignancies (16).Toelle et al reported a much shorter time is needed for neutropenic patients with hematological malignancies (17). However, correlation this factor and others could not be established in our present study.The population in the present study sample is relatively small. So, further prospective studies of sufficient population size and the study samples, which can address all potential risk factors that might increase our understanding of the pathogenesis of CVC-related BSI and can guide us to develop more effective strategies for their prevention and control.

CONCLUSION:

Catheter-related bloodstream infection (CRBSI) is one of the commonest factors responsible for of nosocomial bacteremia and one of the most frequent, fatal complication of central venous catheterization, which also imparts high treatment cost ,increased ICU stay and subsequently , increased mortality. Early diagnosis and prompt treatment are essential to reduce the morbidity and mortality of the patients. Moreover, it is one of the most suitable situation to rationally apply antimicrobial stewardship , as most of the causative organism responsible for CRBSI are Multi drug resistant. Various National as well as international guidelines exist on the prevention of CRBSI, which should be followed whenever and wherever applicable, and central venous catheter must be checked daily for any new infection. Multiple measures have been implemented to reduce the risk for CRBSI, including maintenance of strict aseptic precautions during catheter insertion especially in case of emergency insertion, use of maximal barrier, effective cutaneous disinfectant, and preventive strategies based on inhibiting micro-organisms entering from the skin or catheter hub from adhering to the catheter. Continuous quality improvement programs, staff education, and training of health care workers, and adherence to standardized protocols for insertion and maintenance of intravascular catheters significantly reduced the incidence of catheter-related infections and represent the most important preventive measures. New technologies for prevention of infections directed at CVCsare in use and in the pipeline also , should be utilized rationally and judiciously.

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