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Original Article

Catheter Related Infections in Medical Intensive Care Units

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Abstract

Background: To determine the frequency of different isolates from samples taken from catheter tips of tracheal suction catheters, endotracheal tubes and central venous pressure line catheters among the patients of medical intensive care units

Methods: In this descriptive cross sectional study a total of 200 patients were checked for bacterial or fungal growth. Included samples were 140 from suction catheters, 51 from endotracheal tubes and 9 from CVP catheters cultured for bacterial or fungal growth. Different organisms were identified on the basis of colony morphology, Colony staining and Biochemical reactions.

Results: Out of 200 patients, majority (72.5%) patients were found to be positive for bacterial or fungal growth. Out of which 89(62.2%) were male and 54(37.8%) were females. One hundred and one (69.7%), 38(26.2%), 6(4.1%) growth cultures were obtained from samples of tracheal suction catheter tips, ETT tips and CVP catheter tips respectively. Microorganisms isolated were Acinetobacter species 62(42.8%), Klebsiella species 43(29.7%), Pseudomonas species 19(13.1%), E.coli 8(5.5%), MRSA 5(3.4%), Candida albicans 4(2.8%), Proteus 2(1.4%) and Staphylococcus aureus 2(1.4%).

Conclusion: Acinetobacter, Klebsiella and Pseudomonas were the most frequent infectious agents isolated from catheter tips in settings of medical intensive care units.

Key words: Catheter related infections, Intensive care units, Acinetobacter, Klebsiella, Pseudomonas,E.coli, MRSA, Candida albicans

Introduction

In 1929, Forssmann introduced one of the first techniques for central venous catheterization and shared the 1956 Nobel Prize for Medicine along with 2 other colleagues for pioneering work in this field.[1]Since then, various catheter insertion techniques and indications for placement have evolved and currently about more than 450 million catheter devices are used every year in the world. In intensive care units (ICU), multiple invasive devices are installed into patients. Tracheal suction catheters, endotracheal tubes (ETT) and central venous pressure(CVP) catheters are most commonly used. They provide secure access to the central circulation for infusion therapy, nutritional support, hemodynamic monitoring, plasmapheresis, apheresis and hemodialysis. [1-4]

The issue in catheter insertion which has gained increasing attention in recent years is the associated infection with catheter placement. Catheter-related infections occurring in the intensive care unit are common, costly and potentially lethal. Patients with catheters are at risk of developing local as well as systemic infectious complications like local insertion-site infection, Catheter related blood stream infections (CRBSI), septic thrombophlebitis, endocarditis and other metastatic infections. CRBSIs are considered among the first and most "preventable" classes of nosocomial infections especially in ICU. The most serious complications in these catheter related infections are bacteremia, sepsis and death. The definitive diagnosis of catheter infection can be made by using a combination of clinical signs and symptoms together with the quantitative culture techniques.[2-5]

The organisms most commonly encountered in catheter related infections in ICU in initial days are gram positive organisms while in later stages gram negative organisms are more prevalent with Acinetobacter, Klebsiella and Pseudomonas as the most notoriously known for causing hospital acquired pneumonias, ventilator associated pneumonias, septicemias and many other infections.[6]Patients with prolonged hospital stays, critical conditions, open wounds, especially those on ventilators and patients with multiple invasive devices are most likely to have a greater risk of reinfections by these organisms leading to multiple drug resistant strains.[7] Air, person to person contact and contaminated hands and surfaces are common modes of transmission of these organisms.

Maintenance of proper sterilization techniques, sterilization of taps, disinfectant bottles and other materials, hand washing of visitors, paramedics, nurses and doctors along with continuous subglottic suctioning can reduce the chances of patients acquiring nosocomial infections by these organisms and can also decrease the cost of health care management.

Patients and Methods

This descriptive cross sectional study was conducted in Medical Intensive Care Unit of Holy Family Hospital (HFH) from July-Dec 2016 after ethical approval from Institutional Research Forum of Rawalpindi Medical College. A total of 200 (126 male and 74 female) patients were checked for bacterial or fungal growth. Majority (70%) samples from Tracheal suction catheters, 51(25.4%) from Endotracheal tubes and 9(4.5%) from CVP line catheters.Inclusion criteria included all those patients admitted in Medical ICU for minimum of two weeks and having Tracheal Suction catheters, ETT tube or CVP line passed after admission in MICU. Patients having admission duration less than two weeks in medical ICU and suction catheters, ETT tube or CVP line installed before admission to medical ICU of HFH were excluded from our study. The samples included initial 2-3cm of catheter tips which were then cultured for bacterial or fungal growth. Different organisms were identified on the basis of colony morphology, Colony staining and Biochemical reactions. The data was analyzed using SPSS v 22 and descriptive statistics were applied.

Results

Majority (145/200;73%) of samples taken from catheters of patients of Medical ICU showed positive growth for different microorganisms. One hundred and one out of one hundred and forty (72.1%), 38/51 (74.5%) and 6/9 (66.6%) samples taken from tracheal suction catheter tips, ETT tips and CVP catheter tips showed positive results for growth cultures. Acinetobacter, Klebsiella and Pseudomonas were the most common microorganisms to be isolated. (Table 1 &2).All the organisms were almost equally distributed in both genders except for Acinetobacter and Klebsiella. Acinetobacter was found to be more common in females (35.1%) as compared to males (28.6%) while Klebsiella was found to be more common in males (27.0%) as compared to females (12.2%) (Table 2).Mean age for isolation of Acinetobacter, Klebsiella and Pseudomonas from catheter tips of patients of Medical ICU was 40.9, 39.7 and 32.3 years respectively. Acinetobacter and Klebsiella

Table 1. Organisms Cultured

Organisms isolated	%Prevalence
Acinetobacter	31.0%
No growth	27.5%
Klebsiella	21.5%
Pseudomonas	9.5%
E.coli	4.0%
MRSA*	2.5%
Candida	2.0%
Staphyloccus	1.0%
Proteus	1.0%

*MRSA=Methicillin resistant Satph aureus

Table 2 : Percentage of organisms at culture sites

ORGANISM	CULTURE SITE					
	CVP		ETT		SUCTION CATHETER	
	Count	%age	Count	%age	Count	%age
Acinetobacter	4	44.4%	14	27.5%	44	31.4%
Candida	0	0.0%	1	2.0%	3	2.1%
E.coli	0	0.0%	2	3.9%	6	4.3%
Klebsiella	2	22.2%	6	11.8%	35	25.0%
MRSA*	0	0.0%	1	2.0%	4	2.9%
N0 growth	3	33.3%	13	25.5%	39	27.9%
Proteus	0	0.0%	2	3.9%	0	0.0%
Pseudomonas	0	0.0%	10	19.6%	9	6.4%
Staphylococcus (Methicillin sensitive)	0	0.0%	2	3.9%	0	0.0%

Table 3. Gender wise distribution of Organisms

Organism	Gender			
	Female		Male	
	Count	Column N %	Count	Column N %
Acinetobacter	26	35.1%	36	28.6%
Candida	2	2.7%	2	1.6%
E.coli	4	5.4%	4	3.2%
Klebsiella	9	12.2%	34	27.0%
MRSA	5	6.8%	0	0.0%
No growth	20	27.0%	35	27.8%
Proteus	0	0.0%	2	1.6%
Pseudomonas	8	10.8%	11	8.7%
Staphylococcus	0	0.0%	2	1.6%

were found to be more common in two age groups i.e, young (20-40yrs old) and elderly (60-onwards). Such pattern wasn't observed in Pseudomonas and other microorganisms).The period prevalence rates were calculated for Acinetobacter, Klebsiella and Pseudomonas. 3 out of every 10, 2 out of every 10 and 1 out of every 10 patients was found to be culture positive for Acinetobacter, Klebsiella and Pseudomonas respectively.

Discussion

In the early 20th century various people started thinking of invasive devices for better hemodynamic monitoring and patient outcome. In 1929, Forssmann introduced one of the first techniques for central venous catheterization and shared the 1956 Nobel Prize for Medicine along with 2 other colleagues for pioneering work in this field.[1] Since then a lot of work has been done on it and multiple invasive techniques have been invented. Later on attention was diverted to the infection associated with these devices leading to huge increase in amount of money spent on patient care.

In the growth cultures obtained from tracheal suction catheter tips, it was seen that gram negative bacteria were more common than gram positive bacteria. Among gram negative bacteria, the most common isolates were obtained of Acinetobacter, Klebsiella and Pseudomonas which is in accordance with the study conducted to determine the etiological profile in patients with ventilator associated pneumonias in India. [2]

Early-onset VAP, which occurs between 48 to 72 hours after intubation, is usually the result of aspiration and is often due to *S* aureus, Haemophilus influenzae, *or* Streptococcus pneumoniae.while Late-onset Ventilator Associated Pneumonia has been attributed to antibiotic-resistant organisms, like Pseudomonas aeruginosa, *MRSA*, Acinetobacter species, and Enterobacter species. [3] The mean duration of intubation before sampling in our study was 7 days which might be responsible for the diversity of organisms found.It has been stated that the rapid colonization of endotracheal (within 12–36 hours after intubation) is by gram-positive bacteria from the mouth. [4-5]

Cardenosa Cendrero et al found an 89% prevalence of tracheal colonization. In their study, it was observed that within 24 hours of mechanical ventilation, only Gram positive bacteria were found while later during the course of intubation only Gram-negative bacteria, antibiotic-resistant organisms, and yeast were found which is in accordance with our study. Since all our samples were taken during later course of intubation hence Gram negative microorganisms were more commonly found.[6]

In a study conducted to determine the antimicrobial susceptibility of various bacteria, it was stated that Recurrent infections with same strains of bacteria at same site have led to development of resistance against rare antibiotics like colistin and tigecycline.[7]

New endotracheal tubes have been introduced to provide continuous aspiration of subglottic secretions and have been effective in reducing the occurrence of VAP[8-10] Merrer et al conducted a Randomized Controlled Trial so that patients were randomly assigned to undergo insertion of central venous catheter at either Subclavian vein or Femoral vein. Various microorganisms were recovered from colonized central venous catheter or catheter related clinical sepsis with or without blood stream infections and the results were compared between subclavian and femoral group.

Staphylococcus and Enterobacteriaceae were the most common microorganisms to be isolated from both sites followed by Entertococcus and Pseudomonas from femoral site. In our study central venous catheters inserted only at subclavian vein or internal jugular vein were included and Pseudomonas could not be isolated which is in accordance with the study done by Merrer et al.[11]

In our study, Acinetobacter and Klebsiella were the most common gram negative bacterias to be isolated from the central venous catheters which in accordance with the study done by Parameswaran et al on intravascular catheter related infections.[12]

It has been stated that central venous catheterization longer than five to seven days was associated with a higher risk of catheter-related infection[13-16]It has been suggested that the order for punction, to minimize CVC-related infection risk, should be subclavian (first order), jugular (second order) and femoral (third order).[15-16]. Deshpande et al. reported that there was no statistically significant difference in the incidence of infection and colonization at the subclavian, internal jugular and femoral sites.[23]

Cobb found that 21% of the catheters studied were positive on semiquantitative culture (SQC), of which 16% were associated with local catheter associated infection (CAI) and 5% with bloodstream infection.[24] Charalambous et al. found that 34% of the catheters studied were positive on SQC.[25] According to Fortun et al., the rate of incidence of tip colonization was 2.9 per 1000 catheter-days and of bacteremia was 1.2 per 1000 catheter-days.[23]

A cohort and quasi-experimental multicenter study study was conducted to compare the effectiveness of alcoholic chlorhexidine with povidine idonine for cutaneous antispectic use in prevention of central venous catheter related infections, it was observed that povidone iodine was more effective than 2% Chlorhexidine (p=0.037).[18]

It has also been stated that the disinfectants like chloroxylenol (Dettol) and chlorhexidine gluconate(Savlon) can be used as alternatives to phenol and sodium hypochloride solution.[19]Abele-Horn et al found that in patients receiving mechanical ventilation for more than 4 days, oropharyngeal decontamination reduced the rate of colonization and infection significantly.[20]

Conclusion

1.Acinetobacter, Klebsiella and Pseudomonas are the most frequent infectious agents isolated from catheter with course of intubation longer than 7 days in settings like medical intensive care units.

2. The antimicrobial sensitivity patterns of common isolates can be used to provide guidelines for the intensivist in critical care medicine to start appropriate empirical antibiotic therapy depending upon the clinical scenario. This can be cost-effective and can prevent indiscriminate use of antibiotics.

4.The importance of strict asepsis and ideal catheter care has to be reinforced to minimize these infections.

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