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ORIGINAL ARTICLE

Spectrum of Microorganisms Causing Colonization of Central Venous Catheter in Pediatric ICU

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ABSTRACT

Objective: To determine the spectrum of microorganisms causing colonization of central venous catheter in pediatric ICU.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Pediatric ICU, the Children's Hospital & the Institute of Child Health, Lahore, from July 2018 to February 2020.

Material and Methods: 203 male and female children from 1 month to 15 years of age with a central venous catheter (CVC) during admission at the PICU were included. Specimens were taken from tip of catheter and sent to laboratory in a sterile container to identify the presence of microorganisms.

Results: Of the 203 pediatric patients included, 123 (60.6%) were male and 80 (39.4%) were female with mean age of 5.65 ± 1.374 years. Male to female ratio was 1:1.5 and age range was from 2-11 years. Organisms were identified in 88 patients (43.3%). Out of 88 cases positive cases, 22 (25%) had gram positive, 60 (68.2%) had gram negative and 6 (6.8%) had fungi isolated after culture. Klebsiella (30.7%) was the most common organism followed by Acinetobacter (21.6%) and Coagulase negative Staphylococci (17%).

Conclusion: The prevalence of microbial colonization of CVCs is significant, 43.3% in our PICU. Gram negative (68.2%) organisms are commonly isolated from CVCs, Klebsiella (30.7%) being the most prevalent.

Key Words: Central venous catheter, Colonization, Pediatric ICU

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INTRODUCTION

Central Venous Catheters (CVCs) are an essential component of patient care strategies in intensive care unit. They are usually inserted in critically ill patients for administration of fluids, medications, blood products, parenteral nutrition, hemodialysis, chemotherapy, repetitive blood sampling and for hemodynamic monitoring. However, with the expansion of the indications for

the usage of catheters, complications linked to procedure are also developing. Such complications include mechanical, thrombotic and infectious complications.¹ According to World Health Organization (WHO) patient safety program 2014, among problems related to CVCs, blood stream infections are the most frequent and life threatening one.² A substantial attributable mortality is associated with CVC bloodstream infections; others have increased costs of

treatment and delayed hospital stay.³ It is estimated that each year CVCs cause almost 250,000 catheter associated bloodstream infections in ICUs of US hospitals,⁴

Infectious complications arise due to colonization of the catheter tip. In short term central venous catheter infections, skin organisms migrate from the site of insertion to the catheter tract and eventually colonize there. However, in case of long term central venous catheter infections, colonization occurs due to frequent handling of venous line. Colonization gets easier as a result of the attachment of the microorganisms to the host's fibronectin and other proteins that commonly lie on the catheter tip.⁵

The prevalence CVC colonization has been documented from 7.7% to 53.72% by various studies.^{6,7} Gram positive microbes (60%) are the most common organism responsible for infection followed by Gram negative bacteria (17.7%) and *Candida* species (11.8%).⁴ In order to prevent the incidence of catheter related infections, the most effective measures are those that reduce colonization at insertion site of catheter. Surveillance for such infections in hospital setting has been linked with a decreased incidence of nosocomial infections. A study in 2014 by Brañas *et al* proved that the use of surveillance cultures significantly prevented catheter related bloodstream infections.⁸ It helps in timely recognition of occurrence pattern changes and infectious organism susceptibility for antibiotic.

Most of the published literature on the surveillance of colonization of CVCs in intensive care units is from developed countries and from adult patients. This data will help in surveillance, prevention and appropriate empirical therapy for catheter related infections in pediatric patients. Therefore, we conceived this prospective study to determine microorganisms, causing colonization of CVCs, in our settings.

MATERIALS AND METHODS

This study was conducted in the department of Pediatric ICU (PICU) of the Children's Hospital & the Institute of Child Health, Lahore from July 2018 to February 2020. The PICU unit comprises of 27 beds and is part of Institute of Child health. ICH is a large tertiary care hospital with 1050.

pediatric patients below 18 years of age are admitted from medical wards and allied sub-specialties as well as from the Accident and Emergency department. The number of patients admitted to PICU averages about 87 patients per month.

After approval from hospital ethical committee, data was collected using non-probability sampling technique. Informed consent was taken from parents. Children from 1 month to 15 years of age were enrolled for study. Sample size of 203 was calculated with confidence interval of 95%, margin of error as 3.5%.⁷ Basic demographic information of patient was recorded. Patients who were receiving antibiotic therapy before admission to hospital or in whom a catheter was inserted at other hospital, were excluded from study.

Catheter was inserted in subclavian vein, internal jugular or femoral vein during admission CVC, when removed from the patient, was cut at its tip with a sterile blade and sent to laboratory in a sterile container for study. The catheter line tip was poured into brain heart Infusion (BHI) with sodium polyanethol sulfonate (SPS) in standard aerobic bottles and placed in incubator for 24 hour at 37°C.

After incubation, the bottles were checked for microorganism growth. Once growth was obtained, streaking was done on blood and MacConkey agar plates and again 24 hour incubation at 37°C. Blood agar plates were placed in CO₂ incubator. Next day, organism identification was done with the help of microscope.

All of this information was recorded through pre-designed data collection form. Colonization of central line catheters was labeled according to operational definition.

Data was entered in SPSS version 22. Descriptive statistics were used to describe frequencies and percentage of colonization of central line catheters. Age was described as mean and standard deviation.

RESULTS

We studied 203 patients with CVC. The mean age was 5.65 ± 1.374 years with a range from 2-11 years. 39.4% (n=80) patients were female while

60.6% (n=123) were male. Male to female ratio was 1:1.5. Insertion of catheter was done in the subclavian vein (47.3%, n=96), jugular vein (37.4%, n=76) or femoral vein (15.3%, n=31). The average hospital stay was 6.5 days.

Out of 203 patients 43.3% (n=88) patients showed colonization. And among these positive cultures, 22 (25%) had gram positive, 60 (68.2%) had gram negative and 6 (6.8%) had fungal growth (table 1.)

TABLE 1: Basic characteristics of CVC sources (n=203)

Items	Frequency	Percentage
Gender		
Male	123	60.6
Female	80	39.4
Site		
Subclavian	96	47.3
Internal Jugular	76	37.4
Femoral vein	31	15.3
Organism		
Gram Positive	22	25.0
Gram Negative	60	68.2
Fungi	06	06.8

Individual frequencies of microorganism cultures are shown in table 2.

TABLE 2: Frequency of organisms in culture (n=203)

Microbiological agents	Patient number (n)	Percentage
Klebsiella	27	30.7
Acinetobacter	19	21.6
Coagulase negative Staphylococci	15	17
Pseudomonas	11	12.5
Candida	6	6.8
Staphylococcus aureus	4	4.5
Escherichia coli	3	3.4
Vancomycin-resistant Enterococcus	2	2.3
Methicillin-resistant Staphylococcus aureus	1	1.1

DISCUSSION

CVCs have become necessary tools for the successful management of patients with critical illnesses or with chronic diseases. In fact, CVCs

are the most frequently used indwelling medical devices in modern medicine.⁹ But their extensive use has led to increased incidence of infection in children and neonates, which has been reported to be higher than in adults.¹⁰ A combination of clinical signs and symptoms and simultaneous culture of the catheter and blood are required to make a definitive diagnosis of catheter related infection.¹¹

The mean age in our cohort was 5.65±1.374 years. Jayaweera et al performed a similar study and recorded a mean age of 7.82 ± 2.62 years.¹² 60.6% of our patients were male while 39.4% were female. These values are similar to Yu He et al who had 67.1% of male while 32.9% female patients.¹³ In our study of 203 subjects, 43.3% (n=88) showed CVC colonization. Hodzic S et al and Lambordi S et al did similar studies and found higher colonization rates of 53.72% and 59.90% respectively.^{7,14} While much lower colonization rate was recorded by Pérez-Granda MJ and colleagues.¹⁵ In our patients the most common site of CVC insertion was subclavian vein (47.3%) followed by internal jugular (37.4%) and femoral vein (15.3%). Similar to our studies more CVCs were placed in subclavian vein (72.5%) followed by internal jugular vein (20.1%) and femoral vein (7.4%) by Lona-Reyes JC and colleagues.¹⁶

In our cohort, gram negative organisms (68.2%) were the most common organisms cultured from CVCs followed by gram positive organisms (25%) and fungi (6.8%). Similar to our results Hodzic S and colleagues recorded gram negative organisms as most common colonizers (61.3%) followed by gram positive (33.67%) and fungi (5.94%).⁷ In contrast to our findings a recent study by Jayaweera et al recorded gram positive organisms as most common isolates followed by fungi and then gram negative organisms.¹² Klebsiella (30.7%) was the most common isolate followed by acinetobacter (21.6%). Similar to our findings Thomas et al observed that klebsiella pneumonia (19%) and coagulase negative staphylococci as the most common isolate in their series.¹⁷ He Y and colleagues also found gram negative organisms (44.1%) as most common isolates but Acinetobacter (19.8%) followed by Pseudomonas (9.8%) were most common isolates in their study.¹³ Among isolates of gram positive organisms in our study, coagulase negative

staphylococci were (17%) the most common. Similar to our study Kendirli T and colleagues recorded CONS (21.7%) as most common gram positive isolate in their series.¹⁸ Candida was found in 6.8% of our isolates which is similar to Jayaweera et al (4.5%) and kendirili et al (4.3%).^{12,19} However, Abdelmoneim HM et al recorded a higher percentage of candida (13.6%) in their isolates, which is in contrast to our findings.¹⁹

PICU staff should strictly adopt preventive measures to limit such high prevalence of CVC colonization. Staff should be trained for infection prevention practices and contact with CVCs should be limited to prevent contamination. Infection control committees must do regular audits of practices in PICUs and hospitals. To control widespread infections, asepsis of skin during inserting CVC, disinfection of external pathway of access and removal of CVC in case of positive culture, should be meticulously practiced.

Single center study, small sample size, non-determination of risk factors associated with CVC colonization and data only from PICU are shortcomings of our study. Multi center studies with larger sample size, determination of risk factors such as age of patient, duration of CVC insertion, type of medication/fluid being given through CVC and antibiotic susceptibility pattern of isolates are needed to improve the insight into the subject.

CONCLUSION

The prevalence of microbial colonization of CVCs is significant, 43.3% in our PICU. Gram negative (68.2%) organisms were isolated from CVCs, Klebsiella (30.7%) being the most prevalent.

Conflict of interest: The authors declare that there were no conflicting interests. All investigations were done at the Pathology laboratory of hospital.

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