

Frequency and Pattern of Colonization of Intravenous Cannula in an ICU of Public Sector Hospital

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ABSTRACT

Objective: To determine the frequency of colonization of intravenous (IV) cannula by microorganism in patients admitted to intensive care unit (ICU) and to determine the frequency of common organisms involved in colonization of IV-cannula.

Methodology: A total of 369 patients of age more than 12 years, and meeting inclusion criteria of the study were included from in medical ICU after taking informed consent. Staff nurse introduced intravenous cannula of appropriate bore after proper disinfection of the insertion site with povidone iodine solution and alcohol. The cannula was removed for culture within 48 hours of insertion if clinical signs i.e. redness and swelling was present.

Results: Mean age was 41 (± 16.7) years. Male to female ratio was 1.07:1. Presence of colonization in IV-cannula was seen in 31 (8.4%) cases. Coagulase-Negative Staphylococci was the most common microorganism seen in 24 (77.4%) patients.

Conclusion: The incidence of IV cannula colonization is low in this study. Bacterial colonization occurs in the indwelling intra vascular cannula despite, adequate precautions. Coagulase-Negative Staphylococci and *S. Aureus* were the common organisms.

KEY WORDS: Cannula, Colonization, Coagulase-Negative *Staphylococci*, *Staphylococci Aureus* (MRSA), *Pseudomonas Aureginosa*.

Pak J Med Sci April - June 2011 (Part-II) Vol. 27 No. 3 660-663

How to cite this article:

Kumar A, Memon AR, Zuberi BF, Qadeer R, Afsar S, Sadiq M. Frequency and Pattern of Colonization of Intravenous Cannula in an ICU of Public Sector Hospital. Pak J Med Sci 2011;27(3):660-663

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- * Received for Publication: October 21, 2010
- * Revision Received: May 10, 2011
- * Revision Accepted: May 16, 2011

INTRODUCTION

Insertion of intravenous cannulae is probably the most commonly performed invasive medical procedure. Failed attempts cause stress to patients and embarrassment to the provider and make subsequent attempts increasingly difficult. The use of indwelling cannula/catheters for reliable intra-vascular access is an essential feature of modern health care for both monitoring and intervention. Insertion of intra-vascular cannulae and catheters allows continuous and painless access to the circulation for administration of fluids and electrolytes, medications, blood products and nutritional support.^{1,2} In addition the intra-vascular access can be used for blood sampling, hemodynamic monitoring, hemodialysis and hemofiltration.

Each year millions of intra-vascular devices are used in acutely or chronically ill hospitalized patients around the world. Although the vast majority of these devices are cannulae for peripheral use, central venous or arterial catheters are also used especially in patients with difficult peripheral access or when hemodynamic monitoring is indicated. Intra-vascular device related blood stream infection is a significant clinical problem. More than 50% of all outbreaks of hospital acquired bacteremia or candidaemia reported in the world literature between 1965 and 1990 originated from vascular devices.³⁻⁵ Several guidelines have been formulated to prevent such events.^{6,7} Infection is a common complication of intravenous cannulation, yet the mechanisms whereby microorganisms colonize these cannulae remain uncertain. Recent in-vitro studies have suggested that surface defects in the cannulae favour bacterial attachment and subsequent colonization.⁸ The production of slime and the breakdown of catheter components by bacteria may promote such colonization.⁹ Moreover, it has been shown that intravenous cannulae provoke a tissue response that results in the formation of a fibrin sleeve around the cannula.¹⁰ Attachment of microorganisms to the fibrin rather than the cannula surface may also be important in establishing colonization.

Catheter colonization refers to the microbiological growth found on the catheter tip after removal. Colonization is a precursor to Catheter Related Blood Stream Infection (CRBSI); if a colonized catheter is not removed, microbial growth will continue, invade the bloodstream and CRBSI will result.¹¹ The exact mechanism of transition from colonization to infection is not known; however the process is presumably related to the number of organisms and is time dependent as infection usually occurs at least 48 hours after catheterization.¹² The current interpretation by the CDC is that colonization requires a microbial count of >15 colony forming units (CFU), and is considered colonization regardless of CRBSI status.

The current study was conducted to determine the frequency of colonization of intravenous cannula in an ICU and to see the micro-organism involved in colonization. There is no data regarding IV cannula colonization from our area and this study will help to formulate future strategies in management of these cases.

METHODOLOGY

The study was conducted in ICU of medical unit-II of Civil Hospital Karachi. Informed consent was

obtained and all patients admitted during the period of January 2009 to June 2009 were inducted. Patients with immunodeficiency states and skin infections were excluded. Intravenous cannula of appropriate bore was introduced by staff nurse after proper disinfection of the insertion site with povidone iodine solution and alcohol. The cannula was removed after 48 hours of insertion. A 2.0 cm of tip of removed cannulae was cut off into a sterile container using sterile scissor and transported immediately to laboratory for culture. Colonization was defined as growth of >15 colony forming units of microorganism from cannula segment on semi-quantitative culture.

RESULTS

A total of 369 newly admitted patients in medical ICU during the study period were included in this study. Mean age \pm SD was 41 \pm 16.7 years. Out of 369 cases, 191 (51.8%) were male and 178 (48.2%) were female with M: F = 1.07: 1. Mean age of male was 41.9 \pm 15.9 years, and that of female was 40 \pm 17.5 years. Insignificant difference of mean age was seen between genders (P-value = 0.279). Out of 369 cases, presence of colonization in IV-cannula was seen in 31 (8.4%) cases.

Out of 31 cases with colonization, 17 (54.8%) were female and 14 (45.2%) cases were male with M: F = 1: 1.2. Out of 31 cases, 14 (45.2%) cases had age between 41-60 years, 10 (32.2%) cases 21-40 years old. Average (\pm SD) was 46.5 (\pm 16.2) years.

Coagulase-negative *Staphylococci* was the most common microorganism seen in 24 (77.4%) patients followed by *Staphylococci Aureus* (MRSA) in 3 (9.6%) cases, *Pseudomonas Aureginosa* in 2 (6.5%) cases while 2 (6.5%) cases had other microorganism.

DISCUSSION

There has been an upsurge in the use of intravascular cannulae over past decade or so and a sequel to it was an improvement in the technique of insertion. Colonization of intravascular cannulae are dependent on the duration of insertion.¹³ The cannulae are either infected at the time of insertion, or shortly thereafter and the risk may or may not be related to the duration of canalization. In all probability the cannula is contaminated when the skin is punctured.¹¹ Infusion of antibiotics apparently does not decrease the risk of colonization as all patients were treated with I.V. antibiotics during the period of canalization.¹⁴

Overall infection rate from world literature for intravascular cannulae were 3.8% to 57%, whereas

the overall colonization rate in this study was 8.4%, as compared to 3.8% to 34% from world literature.¹⁴ Many of the factors contributing to cannulae-associated inflammation are still uncertain, yet it appears that there is a causal relationship between inflammation and infection of cannulae wounds.¹⁵ Colonization has been reported internationally at rates from 14%-71% for standard cannula, 33 with lower incidence for newer types of antimicrobial coated cannulas.¹⁶

Second common microorganism was *Staphylococcus Aureus* (MRSA) in 9.6% cases, as compared with Global MRSA-resistance proportion in western world 34.2%.¹⁷⁻¹⁹ Rates of *S aureus* colonization are high among intravenous drug abusers and in patients with diabetes, on hemodialysis, with acquired immunodeficiency syndrome, with dermatologic conditions, and in intensive care.²⁰⁻²² In humans, *S. aureus* is an opportunistic pathogen. Both methicillin-sensitive and methicillin-resistant strains can be found as normal commensals on the skin, nasopharynx, anterior nares, and perineum of some of the population.

Pseudomonas aeruginosa is a major cause of nosocomial infection. Despite advances in sanitation facilities and the introduction of a wide variety of antimicrobial agents with antipseudomonal activities, life-threatening infections caused by *Pseudomonas aeruginosa* continue to be hospital infections. ICU patients are particularly susceptible to nosocomial infection because the normal skin and mucosal barriers to infection are commonly compromised by the use of invasive devices.²³ The distribution of isolates is significantly affected by the type of hospital (general, teaching or specialized). It is reported that isolation due to nosocomial infection changes from 3% to 16% in multi-center studies. *Pseudomonas aeruginosa* is the most common pathogen in nosocomial infections. It is the leading cause of nosocomial respiratory tract infections.²⁴

The hazards of iatrogenic infection in intravenous therapy are well characterized. No study prospectively examined the risk of infection caused by arterial cannulae until Gardner and co-workers cultured 200 consecutive radial artery cannulae and found 8 cannulae positive for growth in broth; none was considered to have produced septicemia.²⁵ Most of them had been in-situ for less than four days and had been used to monitor patients who had undergone cardiovascular surgery.²⁵ Many of the factors contributing to cannulae-associated inflammation are still uncertain, yet it appears that there is a causal relationship between inflammation and infection of cannulae wounds. There was not a single case with signs

of infection or inflammation at the site of insertion in this study. However, it must be mentioned that the absence of inflammation should not be used to exclude consideration of cannulae-related infection. It has been established that the experience of the physician who inserts the intravascular cannulae is inversely proportional to the number of infected cannulae causing extended hospital stay and overall cost.²⁶ Colonization also depends on the type of intravascular cannulae used, like metal cannulae have a lower incidence than do polyethylene cannulae. Studies from Pakistan showed that site of cannula did not have difference in frequency of complications with infection rates from 15-39%.^{27,28}

CONCLUSION

The incidence of IV cannula colonization is low in this study. Bacterial colonization occurs in the indwelling intra vascular cannula despite, adequate precautions; incidence is more in intravenous cannulae than any other cannulae. Coagulase-Negative *Staphylococci* and *aureus* are the common organisms, which becomes more virulent in the presence of a foreign body. Infusion of antibiotics does not decrease the incidence of infections.

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Authors contribution: Study was conceived and designed by BFZ, planning and data collection was done by AK and MS, draft writing was done by AK, ARM and RQ, final editing and approval was done by SA.