Central Line-Associated Blood Stream Infections: Surveillance And Incidence In Intensive Care Unit At A Malaysian Medical Centre

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Citation

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Abstract

Background: Intravascular catheters are indispensable for modern healthcare especially among Intensive Care Unit (ICU) patients and predispose them to central line-associated bloodstream infection (CLABSI). Objective: To conduct a survey and report the incidence of CLABSI in ICU. Methods: A cross section observational study was conducted in a 24-bed multi-disciplinary intensive care unit of 874-bed Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur. Results: The infection rate was calculated per 1000 catheter-days. A total of 20 CLABSI cases were identified among 155 central venous catheters in 100 patients with 3106 catheter-days. The overall rate of CLABSI was 6.4 per 1000 catheter-days and device-utilization (DU) ratio of 0.81. The mean length of ICU stay for CLABSI and non-CLABSI cases was 37.2 days and 17.4 days respectively, while the median length of ICU stay for CLABSI cases was 16.0 days and for non-CLABSI cases was 10.0 days. Gram-negative bacteria accounted for 50% of the CLABSI cases whereas gram-positive cocci and fungi caused 30% and 20% of these infections respectively. Conclusions: Our CLABSI rate of 6.4 per 1000 catheter-days is found to be lower than the INICC 2003-2008 studies with 7.4 CLABSI per 1000 catheter-days.

INTRODUCTION

Healthcare-associated infections (HAIs) constitute a large economic and social burden. In 2002, an estimated 1.7 million HAIs occurred in the United States (1). Of these, an estimated 92 000 were CLABSIs (2). Intravascular catheters are indispensable for modern healthcare especially among ICU patients however these predispose them to risk of CLABSI. CLABSIs are the most serious and frequently occurring complications of central venous catheter (CVC) use, carrying a high morbidity and mortality, and increasing the costs of medical treatment and length of hospitalization (3). CLABSI has been shown to increase both ICU and length of hospital stay (4). Central venous catheterization may cause complications such as arterial puncture, major bleeding, occlusive thrombosis and systemic sepsis. CLABSIs are of particular interest as indwelling vascular catheters have been shown to be responsible for about 62% of ICU acquired blood stream infections (5) which added to the morbidity and mortality of ICU stay (6,7).

MATERIALS AND METHODS

The main aim of this study was to conduct a survey and report the incidence of CLABSI in ICU during 10-month period from April 2008 to January 2009. A cross section observational study was conducted in a 24-bed multi-disciplinary ICU of 874-bed Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur. We included all patients with central line hospitalized in ICU for more than 48 hours. The insertion and maintenance of catheters were performed according to the following protocols. Insertion was carried out under full aseptic technique (hand washing, sterile gowns, gloves and masks). The skin insertion site was cleaned using chlorhexidine 2 % in 70% isopropyl alcohol and was allowed to dry. A sterile field around the insertion site was bordered by a large drape.

There was no routine replacement of central line. Catheters were removed when they were no longer needed. Catheter-site dressings were changed when clinically indicated or during catheter replacement. If CLABSI was suspected, central line would have been removed. The peripheral blood samples were taken and catheter tips were sent for culture and sensitivity. Medical records were traced in all patients with central line in situ more than 48 hours inserted in ICU. Further followed up of all the patients were done until 48 hours after the catheter tip were removed from the patients. All the microbiological data of their blood cultures specimen

were retrieved via the computerized hospital information system. Further microbiological data of their catheter tips result were traced from the laboratory results and also via the computerized hospital information system.

Criteria for exclusion were defined as:

• patients with preexisting central line at the time of admission (except from operation theatre) before transfer to the ICU;

• patients in ICU with central line whom developed sepsis in less than 48 hours of ICU admission;

• patients with emergency catheter insertion without sterile conditions.

Criteria for the diagnosis of CLABSI were defined as the presence of either one of the following situations (8):

• Clinical sepsis: patient had at least one of following clinical signs with no other recognized cause. Fever (>38oC) or hypotension (systolic pressure <90 mm Hg) or oliguria (<20 mL/hr) and blood culture was not done. At the same time no organism detected in blood with no apparent infection at another site. Patient has central-line >48 hours and physician institutes treatment for sepsis.

• Laboratory confirmed CLABSI:

a. bacteraemia/ fungaemia in a patient with an intravascular catheter with at least one positive blood culture obtained from peripheral vein, clinical manifestations of infections and no apparent source for the bloodstream infection except catheter.

b. One of the following should be present:

i. a positive semiquantitative (>15 CFU/catheter segment) or;

ii. quantitative (>103 CFU/catheter segment catheters) culture whereby the same organism (species and antibiogram) was isolated from the catheter segment and peripheral blood or;

iii. simultaneous quantitative blood cultures with a ≥ 5:1 ratio central-line; versus peripheral blood culture positivity of > 2 hours.

Statistical analysis was performed with SPSS 20.0.

ETHICAL CONSIDERATION

The study was approved by the Research and Ethical Committee of Medical Faculty, UKM

RESULTS

A total of 20 CLABSI cases were identified among 155 central venous catheters in 100 patients with 3106 catheter-days (Table 1). Only 10 cases had both positive peripheral blood culture and catheter tip or differential time to positivity. The overall rate of CLABSI was 6.4 per 1000 catheter-days and device-utilization (DU) ratio of 0.81 (Table 1).

Table 1

CLABSI incidence and device-utilization ratio

2008/2009	a. Catheter-days	b. Patient-days	Device-utilization (DU) ratio = a/b	CLABSI incidence (no of cases)	CLABSI rates (per 1000 catheter-days)
April 08	328	415	0.79	3	9.1
May 08	354	389	0.91	3	8.5
June 08	350	420	0.83	2	5.7
July 08	262	438	0.60	1	3.8
Aug 08	278	443	0.63	3	10.8
Sept 08	323	387	0.84	3	9.3
Oct 08	310	351	0.88	3	9.7
Nov 08	275	288	0.96	0	0
Dec 08	299	399	0.75	0	0
Jan 09	324	368	0.88	2	6.2
Total	3106	3898	Average 0.81	20	Average 6.4

However laboratory-confirmed CLABSI is 3.4 per 1000 catheter-days. The mean length of ICU stay for CLABSI and non- CLABSI cases was 37.2 days and 17.4 days respectively, while the median length of ICU stay for CLABSI cases was 16.0 days and for non- CLABSI cases was 10.0 days (Table 4). This contributed to 6 extra days of ICU stay in CLABSI cases. Central venous catheters inserted via the femoral vein were associated with higher infection rate of 22.2% followed by those of internal jugular vein (15.4%) and subclavian vein (5.1%) (Table 2). Gram-negative bacteria accounted for 50% of the CLABSI cases whereas gram-positive cocci and fungi caused 30% and 20% of these infections respectively (Table 3). The causative microorganisms isolated were Pseudomonas aeruginosa (n=3), methicillin-resistant Staphylococcus aureus (n=2), Proteus species (n=1), Acinetobacter species (n=1), Staphylococcus aureus (n=1), Candida albicans (n=1) and Candida parapsilosis (n=1).

Table 2

CLABSI versus site of insertion

Types of vein	Number of CLABSI cases	Percentage (%)
Subclavian	2/39	5.13
Femoral	2/9	22.22
Jugular	16/104	15.38
Total	20	

Table 3

Microorganisms isolated from CLABSI cases

Organisms	Number (%)
Pseudomonas aeruginosa	3 (30)
Proteus species	1 (10)
Acinetobacter species	1 (10)
Methicillin-resistant *Staphylococcus aureus*	2 (20)
Staphylococcus aureus	1 (10)
Candida albicans	1 (10)
Candida parapsilosis	1 (10)
Total	10 (100)

Table 4

CLABSI versus duration of ICU stay

Days in ICU	Mean	Median
CLABSI	37.2	16.0
No CLABSI	17.4	10.0

DISCUSSION

Our CLABSI incidence was 6.4 per 1000 catheter-days. Based on the data compiled from International Nosocomial Infection Control Consortium (INICC) report from 2003 to 2008 studies showed pool mean data for medical / surgical patients was 7.4 per 1000 catheter-days (9). National Healthcare Safety Network (NHSN) report data summary from 2006-2008 showed that the pool mean incidence rate were 2.1 per 1000 catheter-day for medical/surgical ICU (major teaching hospital) (10). National Nosocomial Infections Surveillance (NNIS) by CDC 2004 pooled mean data January 2002 to June 2004 showed the incidence of CLABSI for medical / surgical patient account 4.0 per 1000 catheter-days (major teaching hospital). It seems our incidence rate is found to be within the range of international incidence rate. If compared the incidence rate of CLABSI in Pediatric ICU, (11) showed the CLABSI incidence was 3.1/1,000 central line-days. Our DU ratio was 0.81 which is higher comparing to the INICC result of 0.73 (9), NNIS result of 0.57 (12) and also NHSN DU ratio which 0.59 for medical/surgical (major teaching hospital) (10).

CVCs inserted via the femoral vein were associated with higher infection rate of 22.2% followed by those of internal jugular vein (15.4%) and subclavian vein (5.1%). For adults, lower extremity insertion sites are associated with a higher risk for infection than upper extremity sites. The density of normal skin flora at the catheter insertion site is a major risk factor for CRBSI (8). Based on 5-Million Lives Campaign (13), one of the central line bundles suggested that subclavian vein as the preferred site for insertion. This campaign highlights the optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters in adults (13). In a recent prospective observational study by (14) assessing catheters placed by a critical care medicine department conclude that the site of insertion was not a risk factor for infection when experienced physicians insert the catheters with strict sterile technique is used and trained intensive care unit nursing staff perform catheter care. Another study by Mermel et al. shown that the site of insertion is a risk factor for infection (15). Mermel et al. were able to demonstrate that the great majority of infections develop at the site of insertion (15). Another study by Merrer et al. showed that femoral venous catheterization is associated with a greater risk of infection and thrombotic complications than subclavian catheterization in ICU patients (16).

The mean length of ICU stay for CLABSI and non- CLABSI cases was 37.2 days and 17.4 days respectively, while the median length of ICU stay for CLABSI cases was 16.0 days and for non-CLABSI cases was 10.0 days. This contributed to 6 extra days of ICU stay in CLABSI cases. Barnett et al. showed the excess length of stay due to a CLABSI varied between ICUs and also depended on the sickness of the patient (4). This suggests that it may be difficult to generalize these results to other ICUs, and that the value of preventing a CLABSI in a certain ICU ideally would be based on data from that specific ICU (4).

In our study, gram-negative bacteria were accounted for 50% of the CLABSI cases whereas gram-positive cocci and fungi caused 35% and 15% of these infections respectively. Study was done by Tan et al. reported the most common organism was gram-negative organism with the percentage of 80.5% (17). He also reported the most common organism was Klebsiella pneumoniae (38.9%) (17). However others reported most of the responsible organisms in trauma-surgical intensive care unit were gram-positive bacteria (71.2%) (18).They reported the most common organism was Staphylococcus epidermidis (46.8%) followed by Staphylococcus aureus (11.7%) (18). However in our study, we isolated Pseudomonas aeruginosa as the most common organism. Gram-negative bacilli are responsible for a higher proportion of CRBSIs in ICU than in non-ICU patients (19). They are due to colonization of invasive monitoring pressure systems, complicated remote infections, or a high degree of orotracheal colonization (19). Candida spp. has emerged as important pathogens of CRBSIs and account for a high proportion of the dramatic increase in the rate of candidemia over the last decades (20). They represented more than 30%

of pathogens reported from 1992 to 1998 in 204 mixed ICUs participating in the NNIS system (21), confirming that intravascular devices constitute the leading source of nosocomial candidaemia.

The limitations of the study include time constraint and limited personnel resources to get the best or most accurate output possible, particularly for assessment of compliance. The weakness of this study also includes smaller number of study population (one centre) compare with other international multi-centre study, probably giving relatively fluctuating rates over the month.

CONCLUSION

Catheter-related bloodstream infections are a preventable cause of morbidity and mortality in critically ill patients. Our CLABSI rate of 6.4 per 1000 catheter-days is within the range of international studies but our DU ratio was 0.81 which is higher compare to other studies. Cases of CLABSI resulted to 6 extra days of ICU stay. Hence, interventions aimed at improving outcomes related to central venous catheters should seriously be considered.

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DECLARATION

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