Risk factors and microbial profile of central venous catheter related blood stream infection in medical cardiac care units, National Heart Institute, Egypt

Ghada Mahmoud Khalila, Mahmoud Mostafa Azqulb,⇑

⇑Corresponding author.
E-mail address: mahmoudms@zu.edu.eg (M.M. Azqul).

1. Introduction

Central venous Catheters (CVCs) play an important role in facilitating infusion, drug administration, repeated sampling and close monitoring in seriously ill patients. The prevalence of CVCs utilization in intensive care patients was reported as forty eight percent. Use of CVCs has been associated with many complications. The most common one is increased risk of catheter-related blood-stream infections (CRBSIs). Incidence rate was reported as a function of total CVC count or CVC-days as 4.3–26% and 0.46–30 per 1000 catheter-days, respectively. Several risk factors of CRBSI has been identified and were broadly classified into patient related factors, catheter related factors, or medical staff related factors. The medical staff can manage their related factors by the strict use of antiseptic techniques and close adherence to the guidelines recommended by the Centers for Disease Control and prevention (CDC).

2. Aim of work

To improve the safety of patients with central venous catheter in (NHI) medical cardiac care units, through the following objectives:

A. Identification of common risk factors associated with CRBSI.
B. Characterization of the causative organisms associated with CRBSI in (NHI).

Those will help in putting a protocol to decrease CRBSI. Protocol contains items like (regular medical staff training on bundle care elements, establishing a modified sheet with contents of CVC insertion steps, rules and auditing)

3. Patients and methods

3.1. Patient selection

A prospective cohort study was conducted on one hundred and eleven cardiac patients in cardiac care units, (NHI) from August...
2017 to February 2018. All patients subjected to (CVC) were included except:

1. Patients with obvious source of infection (fever, pneumonia, urinary tract infection, cellulitis, and septicemia). Identification was done through history, clinical examination, blood culture, chest X-ray, urine examination, and relevant investigations.
2. Immunocompromised patients
3. Patients having infective endocarditis
4. Referred patients whose catheter was put outside NHl.

3.2. Methods

Surveillance Methodology: The collection of data for BSIs was performed using active, patient-based, prospective surveillance of the population at risk (i.e., patients who have central line). This means that the infection was sought out during a patient's stay by screening a variety of data sources, such as microbiology reports, patient records, clinical notes, temperature charts which were recorded in our questionnaire.

CRBSI: It was identified by occurrence of the following. Patients with CVC for more than 48 h with clinical signs or symptoms of infection which may be local signs such as erythema, pus drainage, swelling, pain and tenderness at site of insertion and/or systemic signs such as temperature ≥38 °C, chills, oliguria, hypothermia and hypotension with no other obvious source of infection confirmed laboratory when a culture of the catheter tip demonstrated substantial colonies of an organism is the same to those found in the peripheral blood stream culture.

CRBSI: It was identified by occurrence of the following. Patients with CVC for more than 48 h with clinical signs or symptoms of infection which may be local signs such as erythema, pus drainage, swelling, pain and tenderness at site of insertion and/or systemic signs such as temperature ≥38 °C, chills, oliguria, hypothermia and hypotension with no other obvious source of infection confirmed laboratory when a culture of the catheter tip demonstrated substantial colonies of an organism is the same to those found in the peripheral blood stream culture.

Observation of risk factors: The observation included the conditions of care bundle elements recommended by CDC (hand hygiene by inserter, maximal barrier precautions, use of chlorohexidine gluconate and handling care after insertion).

Specimen collection: To identify the microorganisms associated with CRBSI, blood cultures were performed when were clinically indicated by sampling blood from a peripheral blood vessel. The bottles were incubated less than or equal to 6 days using an automated blood culture system (Bactec). The central lines were removed, the distal 5 cm of the CVC tip were amputated, deposited in a sterile container and cultured within 18–24 h after removal using a semi quantitative standardized roll plate method.

An official permission to conduct the study at the cardiac care unit was obtained from the NHI and faculty of medicine, Zagazig University institutional review board. The title and objectives of this study were explained to them to insure their cooperation. The local authority and manager of NHI was informed about this study were explained to them to insure their cooperation. The local authority and manager of NHI was informed about the study and verbal informed consent was taken before interview. The study group was informed about the nature and the purpose of the study and written consent was taken, the study group was informed about the nature and the purpose of the study and written consent was taken, the study group was informed about the nature and the purpose of the study and written consent was taken, the study group was informed about the nature and the purpose of the study and written consent was taken.

The study showed that the median and IQR of participants' age with CRBSI was 36(29–75) years, while in patients with no CRBSI was 38 (11–53) years with no statistically significant difference since p = 0.356 (Table 1).

This table compares between patients with CRBSI and patients with no CRBSI regarding the occurrence of CRBSI (Table 2).

4.2. The level of health care providers adherence to evidence based guidelines recommended by CDC during insertion and handling of central venous catheter in patients with and with no CRBSI (Table 2)

4.3. Types of isolated micro-organisms

The isolated micro-organisms in patients with CRBSI are Acinetobacter, alcaligenes faecalis Enterobacter, klebsiella and the most common was coagulase –ve Staphylococci (see Fig. 1).

5. Discussion

CVCs usage is common in intensive care units with critically ill patients. CRBSI is the main complication of CVC insertion. In the current study, the investigators studied the compliance of health care providers to CVC care bundle elements recommended by (CDC) and its impact on CRBSI occurrence.
5.1. Relation between sociodemographic characteristics of studied sample of patients in cardiac care units and occurrence of CRBSI.

The study did not find that gender represents a risk factor for CRBSI occurrence. The same result as reported in Wang et al. study who reported that gender was not a significant risk factor for CRBSI occurrence. While in contrast Inamdar et al. reported that gender is a risk factor for occurrence of CRBSI as their study reported there was statistically significant difference between males and females, as female’s gender was a risk factor for CRBSI occurrence.14

Also, the study showed no statistical significant difference between the participants’ age and CRBSI occurrence, a result which is consistent with Wang et al.15

5.2. Relation between the level of health care providers adherence to evidence based guidelines recommended by CDC during insertion and handling of central venous catheter in studied sample and occurrence of CRBSI

The current study showed significant difference between patients with CRBSI and patients with no CRBSI regarding the level of compliance with care bundle elements of CVC recommended by CDC. Decrease in level of compliance as a risk factor is associated with increase in number of CRBSIs. Abdelsalam et al. showed same results.16 While, Salama et al. showed that there was no significant difference between patients with CRBSI and patients with no CRBSI regarding the level of compliance with care bundle elements of CVC recommended by CDC.2

5.3. Isolated micro-organisms in studied sample

The current study showed that the isolated micro-organisms with CRBSI were coagulase –ve staphylococci, S. aureus, klebsiella and Acinetobacter as the staphylococci were the most common isolated pathogens. Pamela et al, Weber et al. presented the same results as coagulase negative staphylococci, S. aureus and aerobic Gram negative were the more frequently isolated.10,17 While, Hajjej et al. presented that 74% of the pathogens causing CRBSI were Gram negative with the commonest pathogen was Pseudomonas aeruginosa while in the current study were 46% of micro-organisms Gram negative with the most common one was klebsiella.18

Table 2
The level of health care providers adherence to evidence based guidelines recommended by CDC during insertion and handling of central venous catheter in patients with and with no CRBSI.

| Variables                                      | CRBSI N = 11 | No CRBSI N = 100 | P value |
|------------------------------------------------|--------------|------------------|---------|
|                                                | Yes (n, %)   | No (n, %)        | Yes (n, %) | No (n, %) |         |
| Perform hand hygiene before insertion          | 4 (36.36)    | 7 (63.64)        | 85 (85)  | 15 (15)  | .000    |
| Over head                                      | 3 (27.27)    | 8 (72.73)        | 90 (90)  | 10 (10)  | .000    |
| Mask                                           | 3 (27.27)    | 8 (72.73)        | 70 (70)  | 30 (30)  | .005    |
| Gown                                           | 3 (27.27)    | 8 (72.73)        | 87 (87)  | 13 (13)  | .000    |
| Perform skin anti-sepsis with 7.5% Chlorhexidine with alcohol | 3 (27.27) | 8 (72.73) | 95 (95) | 5 (5) | .000 |
| Cover the site with sterile gauze              | 4 (36.36)    | 7 (63.64)        | 94 (94)  | 6 (6)    | .000    |
| Perform Hand Hygiene Before handling with catheter | 4 (36.36) | 7 (63.64) | 67 (67) | 33 (33) | .045    |
| Scrub the access port prior to each use with an appropriate antiseptic | 1 (9.09) | 10 (90.91) | 84 (84) | 16 (16) | .000 |
| Access catheters only with sterile devices     | 3 (27.27)    | 8 (72.73)        | 99 (99)  | 1 (1)    | .000    |

* P value by Chi-Square test. Statistically significant.

Fig. 1. Types of isolated micro-organisms.
6. Conclusion

Health care providers should adhere to care bundle elements recommended by CDC during insertion and handling of CVC.

Conflicts of interest

The authors have no conflicts of interest. No funding was received for this study.

References

1. Ren H, Colletta A, Koley D, et al. Thromboresistant/anti-biofilm catheters via electrochemically modulated nitric oxide release. Bio Electro Chem. 2015;104:10–16.
2. Salama MF, Jamal W, Al Mousa H, et al. Implementation of central venous catheter bundle in an intensive care unit in Kuwait: effect on central line-associated bloodstream infections. J Infect Publ Health. 2016;9:34–41.
3. Lona-Reyes JC, Lopez-Barragan B, De La Rosa AJ, et al. Central venous-catheter related bacteremia: incidence and risk factors in a hospital in western Mexico. Boletín Médico del Hospital Infantil de México (English ed.). 2016;73(2):105–110.
4. Napalkov P, Felici DM, Chu LK, et al. Incidence of catheter-related complications in patients with central venous or hemodialysis catheters: a health care claims database analysis. Bio Medical Center Cardiovascular Disorder. 2013;13(1):86.
5. Wang TY, Lee KD, Chen PT, et al. Incidence and risk factors for central venous access port-related infection in Chinese cancer patients. J Formos Med Assoc. 2015;114:1055–1060.
6. Abdelsalam N, El Nemri W, Fahmy H, et al. An interventional Study to Decrease Central Venous Catheter Related Blood Stream Infections in Intensive Care Units, Zagazig University Hospital, MD thesis in Public Health and Community Medicine, Faculty of Medicine, Zagazig University; 2013.
7. Weber DJ, Rutala W. Central line-associated bloodstream infections: prevention and management. Clin Inf Dis. 2011;51(1):77–102. North America.
8. Mozaffari K, Bakhshandeh H, Khalaj H, et al. Incidence of catheter-related infections in hospitalized cardiovascular patients. Res Cardiovasc Med. 2013;2(2):59–103.
9. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; seventeenth informational supplement Antimicrobial Susceptibility Testing (AST) Recommendations M100-S17; 2007.
10. Pamela P, Antonio A, Elena SR, et al. Risk factors and biofilm detection on central venous catheters of patients attended at tertiary hospital. Micron. 2015;78:33–39.
11. Wagner J, Schilcher G, Zollner-Schweitz I, et al. Microbiological screening for earlier detection of central venous catheter-related bloodstream infections. Stich Eur Soc Clin Invest J Found. 2013;43:964–969.
12. Centers for Disease Control and Prevention (CDC). Guidelines for the Prevention of Intravascular Catheter-Related Infections: United States, vol. 51(10); 2002. p. 1–26.
13. Inamdar DP, Tatkilar S, Baveja S. Universal precautions in preventing central venous catheter associated blood stream infections. A study at tertiary care hospital of ‘Central line Bundles’ in MICU. Int J Curr Microbiol Appl Sci. 2018;7(1):2484–2491.
14. Wang TY, Lee KD, Chen PT, et al. Incidence and risk factors for central venous access port-related infection in Chinese cancer patients. J Formos Med Assoc. 2015;114:1055–1060.