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Original Article

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

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ABSTRACT

Introduction: Catheter related blood stream infection (CRBSI) is the main complication of central venous catheter (CVC) use. The aim of the study is to improve the safety of patients with central venous catheter in National Heart Institute (NHI) medical cardiac care units.

Methods: A Prospective cohort study was conducted on one hundred and eleven cardiac patients in (NHI) cardiac care units from August 2017 to February 2018. All patients subjected to central venous catheter (CVC) in cardiac care units, NHI, were included except: 1. Patients with obvious source of infection, 2. Immunocompromised patients, 3. patients having infective endocarditis, 4. patients whose catheter was put outside NHI.

Results: Noncompliance of health care providers to care bundle elements of CVC of Centers for Disease Control and Prevention (CDC) represents a risk factor for CRBSI occurrence. Coagulase negative staphylococci was the most common isolated organism.

Conclusion: Health care providers should adhere care bundle elements recommended by CDC during insertion and handling of CVC. This will in turn decrease CRBSI.

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1. Introduction

Central venous Catheters (CVCs) play an important role in facilitating infusion, drug administration, repeated sampling and close monitoring in seriously ill patients.¹ The prevalence of CVCs utilization in intensive care patients was reported as forty eight percent.² Use of CVCs has been associated with many complications. The most common one is increased risk of catheter-related blood-stream infections (CRBSIs).³ 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.^{4,5}

Several risk factors of CRBSI has been identified and were broadly classified into patient related factors, catheter related factors, or medical staff related factors.⁶ 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).⁷

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

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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 NHI.

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.⁸

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.^{9,10,11,12}

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 , . . .).^{10,11,13}

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.⁷

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 the nature and steps of the study and written consent was taken, the study group was informed about the nature and the purpose of the study and verbal informed consent was taken before interview. The study group was not exposed to any harm or risk and Patients' data was confidential.

3.3. Statistical analysis

Data were analyzed using SPSS software (version 21). Quantitative data were initially tested for normality. Quantitative data were expressed as mean \pm standard deviation (SD) if normally distributed or median and interquartile range (IQR) if not. Independent-Samples *t*-test was used if data were normally distributed in both groups. The non-parametric alternative Mann-Whitney *U* test was used if not. Qualitative data were expressed as count and percent and Chi-Square test was used for it. Results were considered statistically significant if P value ≤ 0.05 .

4. Results

4.1. Sociodemographic characteristics of studied sample of patients in cardiac care units

This study included 111 cardiac patients with CVC; 55% of patients were males, 45% were females. 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). The table shows also that 61 of patients were males, 50 were females with no statistically difference regarding occurrence of CRBSI.

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)

This table compares between patients with CRBSI and patients with no CRBSI regarding the adherence to care bundle elements of CVC recommended by CDC and shows that there was a significant difference between the compliance of health care providers with care bundle elements recommended by CDC and occurrence of CRBSI.

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.¹⁰ 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.

Table 1
Sociodemographic characteristics of studied sample of patients in cardiac care units.

	CRBSI (n = 11)		No CRBSI (n = 100)		P value
	n	%	n	%	
Gender					.509*
Male (n = 61)	5	8.2	56	91.8	
Female (n = 50)	6	12	44	88	
Age (years)					
Median (Range)	36 (29–75)		38 (11–53)		.356**

* P value by Chi-Square test. statistically not significant.

** P value by Mann Whitney *U* test. statistically not Significant.

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.

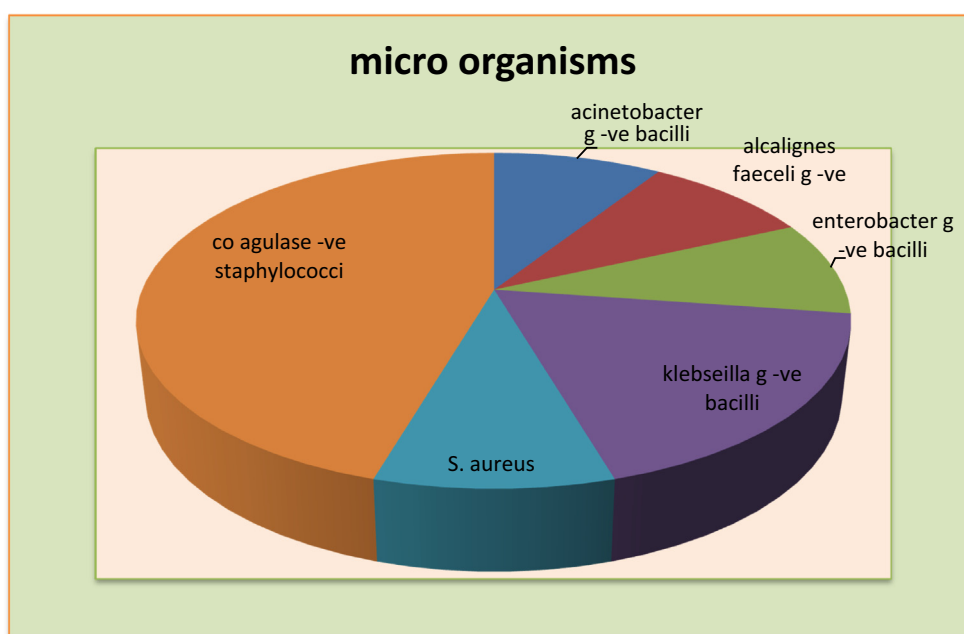


Fig. 1. Types of isolated micro-organisms.

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, hajjejj 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

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.

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