Microbes and Infectious Diseases 2024; 5(4): 1343-1352

Microbes and Infectious Diseases

Journal homepage: https://mid.journals.ekb.eg/

Original article

The bacteriological profile and antimicrobial susceptibility patterns of central line-associated blood stream infections in surgical intensive care unit in Tanta University Hospital

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ARTICLE INFO

Article history:
Received 3 July 2024
Received in revised form 4 August 2024
Accepted 11 August 2024

Keywords:
Bacteriological profile
CLABSI
Intensive care unit

ABSTRACT

Background: Central line-associated bloodstream infections (CLABSI) are considered the third most frequent cause of healthcare-associated infections (HCAI). **Objectives**: This study aimed to detect the infection rate of CLABSI in surgical intensive care unit (ICU), and to identify bacteriological profile & antibiotic sensitivity of infecting organisms causing CLABSI. **Methods:** This study was carried out on 450 ICU patients with central venous catheter inserted for more than 2 days of admission in the hospital with no infection at the time of admission to the ICU, having the criteria of CLABSI [fever >38°C or high leucocytic count >10000/ml], and no remote site of infection who were admitted to the ICU for at least 48 hours. **Results:** CLABSI was present in 57 (12.67%) of all included patients. Diabetes mellitus, hypertension, renal failure , cancer , care of central line, and mortality rate were statistically significant risk factors in positive CLABSI patients (*p* value <0.05), while, age, gender, length of hospital stay, site of central line (Subclavian, jugular, femoral), and use of other associated devices were statistically insignificant between positive and negative CLABSI patients. **Conclusions:** Our study revealed that the prevalence of bacterial pathogens was high and caused by both Gram positive and Gram negative bacteria. Unfortunately, most of the pathogens were multi drug resistant organisms. CLABSI was significantly associated with care of central line and mortality rate.

Introduction

Healthcare-associated infections (HCAI) are considered as a major cause of morbidity and mortality, which affects about 1 in 25 hospitalized patients[1]. Healthcare-associated infections can affect patients with indwelling devices in hospitals and other healthcare facilities with higher rates of resistant microorganisms [2].

Central Line Associated Blood Stream Infections (CLABSI) are considered the third most frequent cause of HCAI [3]. Incidence of infection is more in developing countries as compared to developed countries [4]. Mortality rates from CLABSI are 12% to 25% and significantly increase cost and hospital length of stay [5]**.** CLABSI is defined as a laboratory-confirmed BSI which is not due to an infection at another body site in patients having at least one central line in place for more than 2 calendar days at the time of, or a day before, the onset of the event [6].

DOI: 10.21608/MID.2024.301491.2047
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Most common pathogens that cause CLABSI are *Staph. epidermidis* , methicillin-resistant *Staph aureus* (MRSA), *Candida spp*, Gram-negative bacteria as *Klebsiella* and Enterobacteriaceae [7].

Usually central venous catheter (CVC) is used for the administration of fluids, medications, blood products, collection of blood and haemo dialysis [8]. CLABSI is the most common complication of CVC , with an incidence of 4.1 per 1000 central line days [4].

There are several risk factors of CLABSI that include duration of CVC in the intensive care unit (ICU), non-operative cardiovascular disease, receipt of gastrostomy tube, receipt of parenteral nutrition, central line placement in the ICU, and receipt of a packed red blood cell transfusion[9]. Moreover, CLABSIs are associated with increased morbidity, mortality, and medical costs[10]. Also, CLABSI is considered one of the preventable HCAI when evidence-based guidelines for the insertion and maintenance of CVC s are followed and the condition of patients with blood stream infections in ICU s has improved [11].

Central venous catheter insertion bundle was approved by the infection control committee of institute. It includes: hand hygiene before catheter insertion, optimal catheter site selection with avoidance of the femoral vein for central venous access in adult patients, maximal barrier precautions upon insertion, and chlorhexidine skin preparation[12].

The aim of this work was to detect infection rate of CLABSI in surgical ICU, and to identify bacteriological profile & antibiotic sensitivity of infecting organisms causing CLABSI.

Material and Methods

This study was carried out on 450 ICU patients aged from 18 to 70 years old, both sexes, with CVC inserted for < 2 days of admission in the hospital with no infection at time of admission to the ICU, having the criteria of CLABSI [fever > 38°C or high leucocytic count >10000/ml], and no remote site of infection. Patients were admitted to the ICU for at least 48 hours according to CDC definition of CLABSI [6].

An informed written consent was obtained from the patient or relatives of the patients. The study protocol has been approved by the Ethical Committee, Faculty of Medicine, Tanta University Hospital (**Approval code:** 34823/8/21). Exclusion criteria were patients having signs of infection at body site other than the catheter. Also, patients with CVC discharged within 48 hours of admission, or patients under antibiotic treatment were excluded from the study.

Demographic and clinical data were collected from all patients including age, sex, clinical diagnosis of the underlying disease, date of admission to ICU, date of central line insertion, the intake of antibiotics, presence of signs of infection such as presence of fever or high leucocytic count >10000/ml, and history of chemical and laboratory investigation (Complete blood count, C- reactive protein, procalcitonin)], and microbiological investigation.

***Definitions*:**

* **Contamination** is the presence of a microorganism on a body surface or an inanimate object , while colonization is defined as growth and multiplication of a microorganism but without interaction between host and organism [13] .

* **Laboratory confirmed blood infections** (secondary infection) must meet at least *1* of the following criteria:

A patient with a recognized pathogen cultured from 1 or more blood cultures and organism cultured from blood is not related to an infection at another site.

A patient with at least 1 of the following signs or symptoms: fever (>38°C), chills, or hypotension and signs and symptoms and positive laboratory results are not related to an infection[14].

* **Multi drug resistant organism (MDR)**: Acquired non-susceptibility (resistant or intermediate) to at least one agent in three or more antibiotic categories [15].

Specimen collection:

Two blood samples were collected, one from peripheral vein and another one from central vein, blood to broth ratio will be 1: 10, before starting antimicrobial therapy, at the time of fever peak, it was done under complete aseptic precautions by applying a tourniquet on the arm, palpating the vein used for the sampling, and applying appropriate antiseptics at the place of sampling. After antisepsis, the vein has not be touched anymore unless wearing sterile gloves. Next, the vein was pierced with either a needle and syringe or a butterfly needle. A sufficient volume of blood from two different sites (about 10 ml) was aspirated either directly into the blood culture bottle

(with certain bottle types and use of butterfly needle) or into a syringe and next divided over the blood culture bottles. Blood was collected during febrile episodes or as soon as after the onset of fever and chills. It was also essential to collect blood samples before starting antibiotic therapy or end of a dosing interval. As the patients took an empirical treatment in ICU [16].

Collection of blood samples in automated blood culture bottles:

Identification was also performed using automated blood culture System Render BC32. (**Shenzhen Render Biotech Co. Ltd**).

Processing blood samples was done by cultivation on blood culture bottles then subculture as the following: The suitable volume of blood (10 ml) was collected into the blood culture bottles under complete aseptic conditions which were incubated at 37^0C. If any signs of growth were detected as hemolysis, turbidity of the media, discrete colonies on the surface. Subculture was done after 48 hours of incubation on blood agar (Himedia) and chocolate agar (Himedia) were incubated in the candle jar at 37°C for 24-48 hours, and Macconkey agar (Himedia) and nutrient agar (Himedia) were aerobically incubated at 37°C for 24-48 hours.

Growth of colonies on different culture media was identified in a systematic manner by colony morphology, microscopic gram staining, and biochemical reactions. Moreover, species identification was confirmed by automated Vitek 2 Compact system (bioMerieux, France),as per manufacturer's instructions.

Antimicrobial susceptibility testing is used to detection of antibacterial susceptibility of all isolated organisms was performed using disc diffusion method according to modified Kirby-Bauer technique on Mueller Hinton agar plates. The used antibiotics (Oxoid UK) were cefepime (CPM, 30 µg), cefoxitin (FOX, 30 µg), ceftriaxone (CRO, 30 µg), ceftazidime (CAZ, 30 µg), amikacin (AK, 30 µg), meropenem (MEN, 10 µg), imipenem (IMP, 10 µg), azithromycin (AZM, 15 µg), Aztreonam (AT, 30ug) ,gentamicin (GM, 10 µg), ciprofloxacin (CP, 5 µg), Co trimoxazole (COT, 25 µg), erythromycin (E, 15 µg), piperacillin/tazobactam, (PIT, 100/10 µg), amoxicillin clavulinic (AMC, 30 ug), colistin (CL 10 ug) , linezolid (30 µg),vancomycin (30 µg), oxacillin (OX 1ug) , novobiocin disc (NV, 30 ug) and bacitracin disc (B,10 ug) .The interpretation of zone diameters was done according to the clinical laboratory standard institute CLSI 2021[17].

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t- test. Qualitative variables were presented as frequency and percentage (%) and were analysed utilizing the Chi-square test or Fisher's exact test when appropriate. A two tailed p value < 0.05 was considered statistically significant.

Results

Regarding type of infection, CLABSI was present in 57 (12.67%) patients when peripheral blood sample and central blood sample were positive with similar isolate. While catheter tip colonization was present in 167 (37.11%) patients when peripheral blood sample was negative and central blood sample was positive. Secondary infection was present in 27 (6%) patients when peripheral blood sample was positive and central blood sample was negative. On the other hand, secondary infection was present in 46 (10.22%) patients when peripheral blood sample and central blood sample was positive different isolate. Sterile samples were present in 153 (34%) patients when peripheral blood sample and central blood sample was negative as shown in **table (1).**

Table 2 shows that diabetes mellitus (DM), hypertension (HTN), renal failure, cancer, care of central line, and mortality rate were significantly higher in positive CLABSI than in negative CLABSI (p value <0.05). Age, gender, length of hospital stays, central line, site of central line (Subclavian, jugular, femoral), other site infection, and use of other associated devices were insignificantly different between both groups.

Regarding types of growth of isolates, monomicrobial growth was represented in 87 (76.31%) of all positive isolates, 80 (70.17%) of these isolates were bacteria and 7 (6.14%) of them were fungi. While 27 (24.22%) of isolates were mixed growth with 2 organisms in 13 (11.40%) of total isolates, and with 3 organisms in 14 (12.82%) of mixed isolates. Regarding distribution of mixed 2 bacterial organisms; 5 (4.38%) of these mixed isolates were *Klebsiella* & *E coli*, 3 (2.63%) of these mixed isolates were *Klebsiella* & *Acinetobacter*, 2 (1.75%) of these mixed isolates were *Klebsiella* &

Pseudomonas, 1 (0.877%) of these mixed isolates was *Klebsiella* & *Proteus*, 1 (0.877%) of these mixed isolates was *Klebsiella*& *Staphylococcus*, and 1 (0.877%) of these mixed isolates was *Pseudomonas* & *Staphylococcus*. Regarding distribution of mixed 3 bacterial organisms; 3 (2.63%) of these mixed isolates were *Klebsiella* & *Pseudomonas* & *E. coli*, 5 (4.38%) of these mixed isolates were *Klebsiella* & *Acinetobacter* & *E coli*, 2 (1.75%) of these mixed isolates were *Klebsiella* & *Proteus* &*E coli*, 3 (2.63%) of these mixed isolates were *Klebsiella* & *Staphylococcus* & *E coli* and 1 (0.877%) of these mixed isolates was *Klebsiella* &*Pseudomonas* & *Staphylococcus*.

Regarding growth of organisms, the organisms were Gram positive in 50 (43.86%) patients and Gram negative in 57 (50%) patients and fungi in 7 (6.14%) patients. Regarding the distribution of Gram positive bacteria, we found that 10% of these isolates were *enterococcus* while 40% of these isolates were *staphylococcus aureus* and 50% of these isolates were *Staphylococcus epidermidis*.

Regarding the distribution of Gram negative bacteria, 40.35% of these isolates were *Klebsiella pneumoniae* ,21.05% of these isolates were *E coli* ,17.54% of these isolates were *Pseudomonas aeruginosa*. 17.54% of these isolates were *Acinetobacter baumannii* and 3.51% of these isolates were *Proteus*.

MRSA was present in 70% of all isolates. MRSE (methicillin resistant staph epidermidis) was present in 80% of isolates. Carbapenem resistant *Acinetobacter* was present in 90% isolates. *Klebsiella* (ESBL) was present in 100% of isolates. *E coli* (ESBL) was present in 100% isolates as shown in table **(3.)**

All *Enterococcus* isolates were sensitive to (oxacillin and linezolid), while they were resistant to vancomycin in 1 (20%) isolate, cefoxitin in 5 (100%) isolates, gentamycin in 1 (20%) isolate, ciprofloxacin 2 (40%) isolates and teicoplanine in 2 (40%) isolates. While all *Staphylococcus* sensitive to (linezolid and teicoplanine) while was resistant to oxacillin in 16 (80%) isolates, vancomycin in 6 (30%) isolates, cefoxitin in 14 (70%) isolates, gentamycin in 6 (30%) isolates and ciprofoxacin 6 (30%) isolates. While *staphylococcus epidermidis* isolates were sensitive to vancomycin while were resistant to oxacillin in 25 (100%) isolates, linezolid in 5 (20%) isolates, cefoxitin in 10 (40%) isolates, gentamycin in 5 (20%) isolate, ciprofoxacin 1 (4%) isolates and teicoplanine in 5 (20%) isolates as represented in **table (4).**

Klebsiella isolates were resistant to cefepime, ceftriaxone, cotrimoxazole, aztreonam, ampicillin sulbactam and cefotaxime in all isolates 23 (100%), Imipenem in 10 (43.48%) isolates, ceftazidime in 19 (82.61%) isolates and colistin in 10 (43.48%) isolates while *Klebsiella* isolates were sensitive to meropenem, amikacin, ciprofloxacin and piperacillin in all isolate. Moreover, *E coli* isolates were resistant to cefepime, imipenem, amikacin, aztreonam, ampicillin sulbactam and piperacillin in all isolates 12 (100%), ceftriaxone in 2 (16.67%) isolates, cotrimoxazole in 10 (83.33%) isolates, meropenem in 5 (41.67%) isolates, ceftazidime in 3 (25%) isolates, ciprofloxacin in 5 (41.67%) cefotaxime in 2 (16.67%) isolate and colistin in 2 (16.67%) isolates.

Concerning *Pseudomonas* , the isolates were resistant to cefepime in 6 (60%) isolates, ceftriaxone in 4 (40%) isolates, cotrimoxazole in 8 (80%) isolates, imipenem in 3 (30%) isolates, meropenem in 3 (30%) isolates, amikacin in 3 (30%) isolates, ceftazidime in 1 (10%) isolate, ciprofloxacin in 2 (20%) isolates, aztreonam in 1 (10%) isolate, ampicillin sulbactam in 6 (60%) isolates, piperacillin in 7 (70%) isolates and colistin in 2 (20%) isolate while *Pseudomonas* isolates were sensitive to cefotaxime in all isolate.

Acinetobacter isolates were resistant to cefepime, cotrimoxazole, ceftazidime, ampicillin sulbactam and cefotaxime in all isolates 10 (100%), ceftriaxone in 7 (70%) isolates, imipenem in 3 (30%) isolates, meropenem in 6 (60%) isolates, amikacin in 6 (60%) isolates, ciprofloxacin in 5 (50%) isolates, aztreonam in 9 (90%) isolates, piperacillin in 2 (20%) patients and colistin in 1 (10%) isolate.

Proteus isolates were resistant to cefepime in 1 (50%) isolate, cotrimoxazole in 1 (50%) isolate, amikacin in 1 (50%) isolate, ceftazidime in 1 (50%) isolate, ampicillin in 2 (100%) isolates, piperacillin in 1 (50%) isolate, cefotaxime in 2 (100%) isolates and colistin in 2 (100%) isolates while *Proteus* isolates were sensitive to ceftriaxone, imipenem, meropenem, ciprofloxacin and aztreonam in any isolate as illustrated in **Table (5).**

Table 1. Distribution of studied patients according to central line associated blood stream infection.

Type of infection	Peripheral blood sample	Central blood sample	N (%)
CLABSI	Positive	Positive (similar isolate)	57 (12.67%)
Catheter tip colonization	Negative	Positive	167 (37.11%)
Secondary infection	Positive	Negative	27 (6%)
Secondary infection	Positive	Positive (different isolate)	46 (10.22%)
Sterile	Negative	Negative	153 (34%)

Data is presented as frequency (%). CLABSI: Central line-associated bloodstream infections.

Table 2. Demographic data, risk factors, length of hospital stay, central line days, site of central line, other site infection, care of central line, use of other associated devices, and mortality rate of the studied patients

		Positive CLABSI (n=57)	**Negative CLABSI (n=393)**	***p* value**
Demographic data				
Age (years)		48.14 ± 14.15	47.54 ± 13.95	0.764
Gender	**Male**	34 (59.65%)	233 (59.29%)	0.959
	Female	23 (40.35%)	160 (40.71%)	
Risk factors				
DM		23 (40.35%)	103 (26.21%)	**0.026***
HTN		25 (43.86%)	109 (27.74%)	**0.013***
Renal failure		31 (54.39%)	158 (40.2%)	**0.043***
Cancer		13 (22.81%)	46 (11.7%)	**0.02***
Length of hospital stay and central line days				
Length of hospital stay (days)		3.56 ± 1.13	3.61 ± 1.14	0.748
Central line (days)		9.11 ± 4.17	8.69 ± 4.09	0.478
Site of central line, other site infection and care of central line				
Site of central line	**Subclavian**	4 (7.02%)	42 (10.69%)	0.974
	Jugular	7 (12.28%)	45 (11.45%)	
	Femoral	46 (80.7%)	306 (77.86%)	
Other site infection		32 (56.14%)	170 (43.26%)	0.068
Care of central line		21 (36.84%)	92 (23.41%)	**0.029***
Use of other associated devices				
Type of Other associated devices	**Urinary catheter**	33 (57.89%)	164 (41.73%)	0.060
	Tracheostomy	9 (15.79%)	102 (25.95%)	
	Cardiac stent	15 (26.32%)	127 (32.32%)	
Mortality	**Died**	12 (21.05%)	11 (2.8%)	**<0.001***
	Survived	45 (78.95%)	382 (97.2%)	

Data are presented as mean ± SD or frequency (%). CLABSI: Central line-associated bloodstream infections, DM diabetes mellitus, HTN: hypertension. *: significant as P value < 0.05

Table 3. Types of growth of isolates, distribution of growth in CLABSI positive patients, and distribution of multi drug resistance isolates.

Types of growth N=114		
Monomicrobial growth	87 (76.31%)	
	Bacteria	80 (70.17%)
	Fungi (*Candida albicans*)	7 (6.14%)
Mixed Bacterial growth	2 organisms	13 (11.40%)
	3 organisms	14 (12.82%)
Distribution of Gram-positive bacteria 50 (43.86%)		
Enterococcus (10%)		
Staphylococcus aureus (40%)		
Staphylococcus epidermidis (50%)		
Distribution of Gram-negative bacteria 57 (50%)		
Klebsiella pneumoniae (40.35%)		
Escherichia coli (21.05%)		
Pseudomonas aeruginosa (17.54%)		
Acinetobacter baumannii (17.54%)		
Proteus (3.51%)		
Distribution of multidrug resistance isolates No (%)		
MRSA (70%)		
MRSE (80%)		
Acinetobacter (carbapenem resistant) (90%)		
Klebsiella (ESBL) (100%)		
Escherichia coli (ESBL) *(40%)*		

Data is presented as frequency (%). MRSA=Methicillin-resistant Staphylococcus aureus, and ESBL=Extended spectrum beta-lactamases.

Table 4. Antibiotics resistance patterns of Gram-positive bacteria among CLABSI positive patients

	***Enterococcus*(n=5)**	***Staphylococcus aureus* (n=20)**	***Staphylococcus epidermidis* (n=25)**
Oxacillin	0 (0%)	16 (80%)	25 (100%)
Vancomycin	1 (20%)	6 (30%)	0 (0%)
Linezolid	0 (0%)	0 (0%)	5 (20%)
Cefoxitin	5 (100%)	14 (70%)	10 (40%)
Gentamycin	1 (20%)	6 (30%)	5 (20%)
Ciprofoxacin	2 (40%)	6 (30%)	1 (4%)
Teicoplanine	2 (40%)	0 (0%)	5 (20%)

Data is presented as frequency (%).

Table 5. Antibiotics resistance patterns of Gram-negative bacteria among CLABSI positive patients

	***Klebsiella pneumonae* (n=23)**	***Escherichia coli* (n=12)**	***Pseudomonas aeruginosa* (n=10)**	***Acinetobacter baumanii* (n=10)**	***Proteus* (n=2)**
Cefepime	23 (100%)	12 (100%)	6 (60%)	10 (100%)	1 (50%)
Ceftriaxone	23 (100%)	2 (16.67%)	4 (40%)	7 (70%)	0 (0%)
Cotrimoxazole	23 (100%)	10 (83.33%)	8 (80%)	10 (100%)	1 (50%)
Imepenem	10 (43.48%)	12 (100%)	3 (30%)	3 (30%)	0 (0%)
Meropenem	0 (0%)	5 (41.67%)	3 (30%)	6 (60%)	0 (0%)
Amikacin	0 (0%)	12 (100%)	3 (30%)	6 (60%)	1 (50%)
Ceftazidime	19 (82.61%)	3 (25%)	1 (10%)	10 (100%)	1 (50%)
Ciprofloxacin	0 (0%)	5 (41.67%)	2 (20%)	5 (50%)	0 (0%)
Aztreonam	23 (100%)	12 (100%)	1 (10%)	9 (90%)	0 (0%)
Ampicillin sulbactam	23 (100%)	12 (100%)	6 (60%)	10 (100%)	2 (100%)
Piperacillin	0 (0%)	12 (100%)	7 (70%)	2 (20%)	1 (50%)
Cefotaxime	23 (100%)	2 (16.67%)	0 (0%)	10 (100%)	2 (100%)
Colistin	10 (43.48%)	2 (16.67%)	2 (20%)	1 (10%)	2 (100%)

Data is presented as frequency (%).

Discussion

Critically ill hospitalized patients have a significant risk of developing a nosocomial bloodstream infection (BSI); most of these BSIs are primary and usually originate from an intravascular device [18]. CLABSI rates in intensive care units (ICUs) of developing countries are higher than in the developed world [19].

In the present study, CLABSI was present in 57 (12.67%) patients. Catheter tip colonization was present in 167 (37.11%) patients. Secondary infection occurred in 27 (6%) patients with positive peripheral blood sample but negative central blood sample and in 46 (10.22%) patients with positive peripheral and central blood samples (different isolate). 153 (34%) patients were sterile and CLABSI rate in our result was 14.48%. In agreement with our results, **Darji and Patel**, [20] showed that CLABSI was present in (26.7%) of patients. Catheter tip colonization was present in (30%) patients. Secondary infection was present in (2%) patients when blood culture was positive and tip culture was negative. Secondary infection was present in (5.33%) of patients when blood culture and tip culture was positive (different isolate). Sterile was present in (33.33%) patients.

In the current study, DM, HTN, renal failure and cancer were significantly higher in positive CLABSI group than in negative CLABSI group. **Ujesh et al** agree with our results as they showed that renal failure was present in (57.9%) positive CLABSI which is near to our findings (54.39%) [21].

According to the present study, length of hospital stay, central line was (9.11 ± 4.17 in positive CLABSI group). Site of central line and other sites of infection were insignificantly different between positive CLABSI group and negative CLABSI group. Site of central line was subclavian in 4 (7.02%) patients, jugular in 7 (12.28%) patients and was femoral in 46 (80.7%) patients in positive CLABSI. While care of central line was significantly higher in positive CLABSI than in negative CLABSI. Other devices used (urinary catheter, tracheostomy, and cardiac stent) were insignificantly different between positive CLABSI group and negative CLABSI group. Subclavian veins are considered to have a lower risk of infection as subclavian sites are typically less colonized by bacteria compared to other sites like the femoral or jugular veins. The skin flora in the subclavian area generally consists of fewer bacteria, which reduces the risk of pathogens entering the bloodstream during catheter insertion or through the catheter-skin interface [22].

Mortality rate was significantly higher in positive CLABSI with percentage 21.05% than negative CLABSI with percentage 2.8%. This was in accordance with **Malek et al**. who found that mortality rate among cases with CLABSI was 16.8%[23].

Concerning types of growth, monomicrobial growth percentage was 76.31% of all positive isolates ,in which 70.17% of these isolates were bacteria and (6.14%) of them were fungi (*Candida albicans*). However, 24.22% of isolates were mixed growth. Supporting our results, **Larsen et al.** who found that 52.8% of isolates were bacteria and fungal growth was in 5.3%., [24].

Furthermore, in the present study, the most common type of organism was Gram negative then Gram positive and fungi (*Candida albicans*) was the least common organism with percentages of 50%, 43.86% and 6.14% respectively. Supporting our results, **Negm et al.** found that the most common microorganism was Gram-negative bacteria then Gram positive and *Candida albicans* was the least common microorganism from various clinical samples from different ICUs [25].

As regard Gram negative bacteria, the most common isolated bacteria was *klebsiella pneumoniae* with 40.35% followed by *E coli*. These results were in accordance with **Negm et al**. who illustrated that *Klebsiella pneumoniae* was the most frequently identified isolate with an incidence of 33.51% followed by *E coli* with 19.3% incidence[25].

Regarding our results, all *Enterococcus* isolates were sensitive to oxacillin and linezolid, while they were resistant to cefoxitin , ciprofloxacin, teicoplanine, vancomycin and gentamycin in percentage of 100%, 40%, 40%, 20% and 20% respectively. Furthermore, **Glover et al.** showed that all *Enterococcus faecalis* isolates were sensitive to linezolid and vancomycin. However, In contrast to these results, all *E. faecium* was resistant to vancomycin and ciprofloxacin [26].This could be attributed to certain precautions that required for vancomycin testing and recommendations regarding type of media used and interpretation.

Regarding our results, all *Staphylococcus* were sensitive to linezolid but resistant to oxacillin

then cefoxitin, vancomycin, gentamycin and ciprofloxacin with a percentage of 80%, 70%, 30%, 30% and 30%. Moreover, **Glover et al**. showed that all *Staphylococcus* was sensitive to linezolid. But in disagreement with our result, all *Staphylococcus* was sensitive to vancomycin[26].

Regarding *Staph epidermidis*, all isolates were sensitive to vancomycin while they were resistant to the following oxacillin, cefoxitin, gentamycin, linezolid, and ciprofloxacin in percentage 100%, 40%, 20%, 20% and 4% respectively. Supporting our results, **Yousuf et al**. who showed that all CONS were sensitive to vancomycin while they were resistant to gentamycin in 23% of isolates. However, they disagree with our results as CONS was resistant to linezolid in (9.3%) isolates and ciprofloxacin in (59%) isolates. [27].

In the current study, *Klebsiella* isolates were resistant to cefepime, ceftriaxone, cotrimoxazole, aztreonam, ampicillin sulbactam and cefotaxime in all isolates 23 (100%) then ceftazidime in 19 (82.61%) isolates, imipenem and colistin in 43.48% isolates while *Klebsiella* isolates were sensitive to meropenem, amikacin, ciprofloxacin, and piperacillin) in all isolates. Similarly, **Glover et al**. showed that *Klebsiella pneumoniae* iolates were sensitive to amikacin in all isolates, cefepime in (66.7%) isolates, cefotaxime in (66.7%) isolates, imipenem in (33.3%) isolates, ceftazidime in (66.7%) isolates, meropenem in (33.3%) isolates, ciprofloxacin in (50%) isolates and piperacillin in (66.7%) isolates [26].

Regarding our results, *E coli* was resistant to cefepime, imipenem, amikacin, aztreonam, ampicillin sulbactam and piperacillin) in all isolates 12 (100%) then cotrimoxazole, meropenem, ciprofloxacin, ceftazidime, ceftriaxone, cefotaxime and colistin with the percentage 83.33%, 41.67%, 41.67%, 25%, 16.67%, 16.67% and 16.67% respectively. Similar findings were observed by **Ujesh et al**. who detect that *E coli* isolates were also resistant to cefepime, imipenem, amikacin, aztreonam, ampicillin and piperacillin in all isolates, ciprofloxacin in (50%) and meropenem in (50%) [21].

Regarding *P aeruginosa*, it was resistant to cotrimoxazole then piperacillin, ampicillin sulbactam, cefepime, ceftriaxone, imipenem, meropenem, amikacin, ciprofloxacin, colistin, ceftazidime and aztreonam with the following percentage 80%, 70%, 60%, 60%, 40%, 30%, 30%, 30%, 20%, 20%, 10% and 10% respectively. While *Pseudomonas* was sensitive to cefotaxime in all isolates. These results were in accordance with study of **Yousuf et al**. who showed that *Pseudomonas* was resistant to meropenem in (25%) isolates and ciprofloxacin in (24%) isolates [27].

Concerning *Proteus* isolates, they were resistant to ampicillin, cefotaxime and colistin in 2 (100%) isolates then cefepime, cotrimoxazole, amikacin, ceftazidime and piperacillin in 1 (50%) isolate. While *Proteus* isolates were sensitive to ceftriaxone, imipenem, meropenem, ciprofloxacin and aztreonam in all isolates. However, **Habyarimana et al.** who conducted a retrospective study on 2,910 cases from October 2017 to October 2018, only twelve percent (341/2,910) of blood culture results reviewed. *Proteus* was resistant to ceftriaxone in 1(100%) isolate. *Proteus* was sensitive to amikacin, ciprofloxacin and imipenem in 1 (100%) isolate[28]. The different sample size may explain the difference.

Regarding MDR organisms, MRSA was present in 70% of isolates. MRSE (Methicillin Resistant *Staph epidermidis*) was present in 80% of isolates. Carbapenem resistant *Acinetobacter* isolates were present in 90% of isolates. *Klebsiella* (ESBL)isolates were detected in 100% of isolates. *E. coli* (ESBL)isolates were found in100% of isolates. Supporting our results, **Darji and Patel** showed that MRSA was present in 66.67% patients [20].

We recommend strict implementation of the CLABSI prevention bundle in the ICU setting, further prospective multi center studies with larger sample size is needed, further studies are needed to better support appropriate antimicrobial prescribing for patients with CLABSI, and contribution of these results in antimicrobial stewardship program of Tanta University Hospital for elimination of multi drug resistance organisms.

Conclusions

The prevalence of bacterial pathogens in CLABSI was high and caused by both Gram positive and negative bacteria. Unfortunately, most of the pathogens cultured were multi drug-resistant organisms. CLABSI was significantly associated with longer hospital stay and mortality.

Financial support and sponsorship: Nil

Conflict of interest: Nil

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