



The Prevalence of Bacteremia among Patients Admitted to a Military Hospital in Alkharj

Nehad J. Ahmed^{1*}, Salwa Mahmoud² and Menshawy A. Menshawy^{3*}

¹Department of Clinical Pharmacy, College of Pharmacy, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia.

²Department of Pathology, Alkharj Military Industrial Corporation Hospital, Alkharj, Saudi Arabia.

³Department of Medicinal Chemistry, College of Pharmacy, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. Author NJA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SM and MAM managed the analyses of the study. Authors NJA and SM managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2020/v32i3030910

Editor(s):

(1) Dr. Dharmesh Chandra Sharma, G. R. Medical College & J. A. Hospital, India.

Reviewers:

(1) Theocharis Koufakis, Aristotle University of Thessaloniki, AHEPA University Hospital Thessaloniki, Greece.

(2) Maryam Amini, Shahed University, Iran.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/62482>

Original Research Article

Received 17 August 2020
Accepted 22 October 2020
Published 27 November 2020

ABSTRACT

Aim: The aim of this study is to determine the prevalence of bacteremia among patients admitted to a military hospital in Alkharj and to know the causative organisms.

Methodology: Bacteria culture results were collected from the laboratory of the military hospital after the approval of the study by IRB ethical committee. The data were collected and analyzed using Excel spreadsheet 2016 and the descriptive data were represented as frequencies (n) and percentages (%).

Results: The total number of positive blood culture were 131 cultures, about 53.44% of the causative bacteria were gram positive bacteria. Generally, a high percentage of bacteremia was caused by *Staphylococcus* species, especially *Coagulase-negative staphylococcus* (25.19%) and *Staphylococcus aureus* (22.90%).

Conclusion: It can be concluded that the incidence of bloodstream infection in the present study is high and that the most common causative pathogens were *Coagulase-negative staphylococcus*

*Corresponding author: E-mail: n.ahmed@psau.edu.sa, ma.mohamed@psau.edu.sa, pharmdnehadjaser@yahoo.com;

and *Staphylococcus aureus*. It is important to know the incidence of bloodstream infection and to know the causative organisms both for clinical practice, especially to evaluate the effectiveness of interventions and also for research activities.

Keywords: Prevalence; bacteremia; bloodstream infection.

1. INTRODUCTION

Bacteria are living things that have only one cell. Most bacteria are harmless and less than 1 % of the different types lead to infection. Only infectious bacteria can cause illness. Many of these bacteria give off toxins, which can harm tissue and cause sickness such as *Staphylococcus*, *Escherichia coli* and *Streptococcus* [1].

Bacteremia is defined as the existence of viable bacteria in the circulating blood. These bacteria are usually cleared from the blood within minutes, but if the immune system of the patient is weak, microbes persist in the blood and results in bacteremia associated symptoms [2]. Bacteremia is a common problem that is associated with major morbidity and mortality globally [3-10].

Kim et al reported that the rate of bloodstream infections was high in patients admitted to long term care hospitals (20.4%) [11]. Goto et al reported that in North America and Europe, bacteremia is one of the top seven reasons of death [12].

There are several factors affect the epidemiology of bacteremia including shifts in healthcare, advances in medicine such as increased use of intravascular devices, invasive procedures, use of immunosuppressive treatment and changing with ageing of the people [13].

Numerous bacteria cause bacteremia, *Staphylococcus aureus* is the most common gram-positive organism causes bacteremia, while *Escherichia coli* is the most common cause of gram-negative associated bacteremia [14-16].

It is important to know the epidemiology of bacteremia in order to assess its impact on public health; additionally it is important to know the causative organisms of bacteremia in order to guide the health care workers in treating bacteremia appropriately. Therefore, the aim of this study is to determine the prevalence of bacteremia among patients admitted to a military hospital in Alkharj and to know the causative organisms.

2. METHODOLOGY

In this retrospective study, we included all bacterial cultures of patients of all age groups (children, adults or elderly patients) that were collected from blood in 2018 and 2019. So the exclusion criteria included other types of cultures such as wound, urine cultures. Moreover, the cultures that were collected before 2018 or after 2019 were excluded. The study was conducted in a military hospital in Alkharj that was established in 1983 to contribute to health and well-being of military and civilian employees of ministry of defense and their dependents.

Bacteria culture results were collected from the laboratory of the military hospital after the approval of the study by IRB ethical committee. The data included prevalence of bacteremia in 2018 and 2019 in addition to percentage of gram positive and gram negative organisms that cause bacteremia.

The data were collected and analyzed using Excel sheet 2016 and the descriptive data were represented as frequencies (n) and percentages (%).

3. RESULTS

In 2018, there are 75 positive blood cultures; the majority of them were gram positive. Number and percentage of gram positive and gram negative bacteria that cause bacteremia in 2018 are shown in Table 1.

Table 1. Number and percentage of gram positive and gram negative bacteria that cause bacteremia in 2018

Bacteria	Number	Percentage
Gram positive	44	58.67%
Gram negative	31	41.33%

In 2018, 44% of the bacteremia cases were caused by *Coagulase negative staphylococcus*. Number and percentage of different bacteria that cause bacteremia in 2018 were shown on Table 2.

Table 2. Number and percentage of different bacteria that cause bacteremia in 2018

Bacteria	Number	Percentage
<i>Coagulase negative staphylococcus</i>	33	44.00%
<i>Pseudomonas aeruginosa</i>	12	16.00%
<i>Staphylococcus aureus</i>	9	12.00%
<i>Brucella</i>	5	6.67%
<i>Escherichia coli</i>	4	5.33%
<i>Klebsiella pneumonia</i>	4	5.33%
<i>Acinetobacter baumannii</i>	3	4.00%
<i>Enterococcus faecalis</i>	2	2.67%
<i>Enterobacter cloacae</i>	2	2.67%
<i>Enterobacter aerogenes</i>	1	1.33%

In 2019 there were 56 positive blood culture, 53.57% of these cultures were gram negative bacteria. Number and percentage of gram positive and gram negative bacteria that cause bacteremia in 2019 are shown in Table 3.

Table 3. Number and percentage of gram positive and gram negative bacteria that cause bacteremia in 2019

Bacteria type	Number	Percentage
Gram Positive	26	46.43%
Gram Negative	30	53.57%

About 37.5% of the causative bacteria in 2019 were *Staphylococcus aureus* bacteria. Number and percentage of different bacteria that cause bacteremia in 2019 were presented in Table 4.

The total number of positive blood culture were 131 cultures, about 53.44% of the causative bacteria were gram positive bacteria. The total number and percentage of gram positive and negative bacteria that cause bacteremia in 2 years are shown in Table 5.

Generally, a high percentage of bacteremia was caused by *Staphylococcus species*, especially *Coagulase-negative staphylococcus* (25.19%) and *Staphylococcus aureus* (22.90%). The total number and percentage of different bacteria that cause bacteremia in the 2 years were shown in Table 6 and in Fig. 1.

4. DISCUSSIONS

In 2018, there are 75 positive blood cultures out of 747 cultures (10.04%); the majority of them were gram positive. About 44% of the bacteremia cases were caused by *Coagulase-negative staphylococcus* followed by *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

In 2019, there were 56 positive blood cultures out of total 992 cultures (5.64%). Nearly, 53.57% of these cultures were gram negative bacteria. About 37.5% of the causative bacteria in 2019 were *Staphylococcus aureus* bacteria followed by *Escherichia coli* and *Klebsiella pneumonia*.

Table 4. Number and percentage of different bacteria that cause bacteremia in 2019

Bacteria	Number	Percentage
<i>Staphylococcus aureus</i>	21	37.5%
<i>Escherichia coli</i>	8	14.29%
<i>Klebsiella pneumonia</i>	7	12.5%
<i>Pseudomonas aeruginosa</i>	6	10.71%
<i>Group B streptococcus</i>	4	7.14%
<i>Acinetobacter baumannii</i>	3	5.36%
<i>Serratia marcescens</i>	2	3.57%
<i>Proteus mirabilis</i>	2	3.57%
<i>Enterobacter cloacae</i>	2	3.57%
<i>Enterococcus faecalis</i>	1	1.79%

Table 5. Total number and percentage of gram positive and negative bacteria that cause bacteremia in 2 years

Bacteria	Number	Percentage
Gram positive	70	53.44%
Gram negative	61	46.56%

As a total there were 131 bacteremia cases out of 1739 infections (7.53%). Generally, a high percentage of bacteremia was caused by *staphylococcus* species, especially *Coagulase-negative staphylococcus* (25.19%) and *Staphylococcus aureus* (22.90%) in both years.

Similarly, Kessler et al. reported that the annual incidence of *Staphylococcus aureus* bloodstream infection has been estimated to be very high [17]. Moreover, Deku et al stated that *Staphylococcus aureus* was the leading causative agent of bacteremia for the 6 years, in 2009–2011 (38.9%) and in 2012–2014 (42.2%) while *Coagulase-negative staphylococcus* (50.5%) was predominant for 3 years from 2015 to 2017, followed by *Staphylococcus aureus* (28.8%) [18].

Grace et al. stated that *Staphylococcus aureus* is regarded as pathogenic with high morbidity and mortality while *Coagulase-negative staphylococci* are often regarded as a contaminant and not a true cause of bacteremia despite its rising occurrence [19].

Fukui et al. reported that 28.5% of the patients had positive blood culture results and that the highest incidence was for patient aging >60 years, female sex, patient with pulse rate >90 bpm and neutrophil percentage >80% [20]. Buetti et al. stated that *Escherichia coli* Bacteria were

the predominant pathogens causing bloodstream infections [21].

Aliyu et al. informed that the prevalence for bloodstream infection present on hospital admission (BSI-POA) was 1.7% and that the largest proportion of BSI-POA presented with *Staphylococcus aureus* (48.4%) [22]. Moreover, Usulan et al informed that the overall incidence rate of bloodstream infection is 189 per 100 000 and that the most common isolates were *Escherichia coli*, *Staphylococcus aureus* and *Coagulase-negative staphylococcus* [5].

Sogaard et al. reported the incidence of bacteremia in Northern Denmark between 1992 and 2006 was 153 per 100 000 per year and that the most common etiologies were *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus pneumoniae* [23]. Wilson et al reported that in England, the incidence of bacteremia was 189 per 100 000 populations and that the most common etiologies were *Escherichia coli*, *Coagulase-negative staphylococcus* and *Staphylococcus aureus* [24]. Additionally, Laupland reported that The three most common etiologies of bloodstream infection are *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus pneumoniae* [25].

Regarding gram negative bacteria, *P. aeruginosa* was the most common cause of bacteremia followed by *Escherichia coli* and *Klebsiella pneumoniae*. In contrast to that, several studies showed that *Klebsiella pneumoniae* is the second most common cause (after *Escherichia coli*) of community- and hospital-acquired Gram-negative bloodstream infection [8,22,26].

Table 6. Total number and percentage of different bacteria that cause bacteremia in 2 years

Bacteria	Number	Percentage
<i>Coagulase-negative staphylococcus</i>	33	25.19%
<i>Staphylococcus aureus</i>	30	22.90%
<i>Pseudomonas aeruginosa</i>	18	13.74%
<i>Escherichia coli</i>	12	9.16%
<i>Klebsiella pneumoniae</i>	11	8.40%
<i>Acinetobacter baumannii</i>	6	4.58%
<i>Brucella</i>	5	3.82%
<i>Group B streptococcus</i>	4	3.05%
<i>Enterobacter cloacae</i>	4	3.05%
<i>Enterococcus faecalis</i>	3	2.29%
<i>Serratia marcescens</i>	2	1.53%
<i>Proteus mirabilis</i>	2	1.53%
<i>Enterobacter aerogenes</i>	1	0.76%

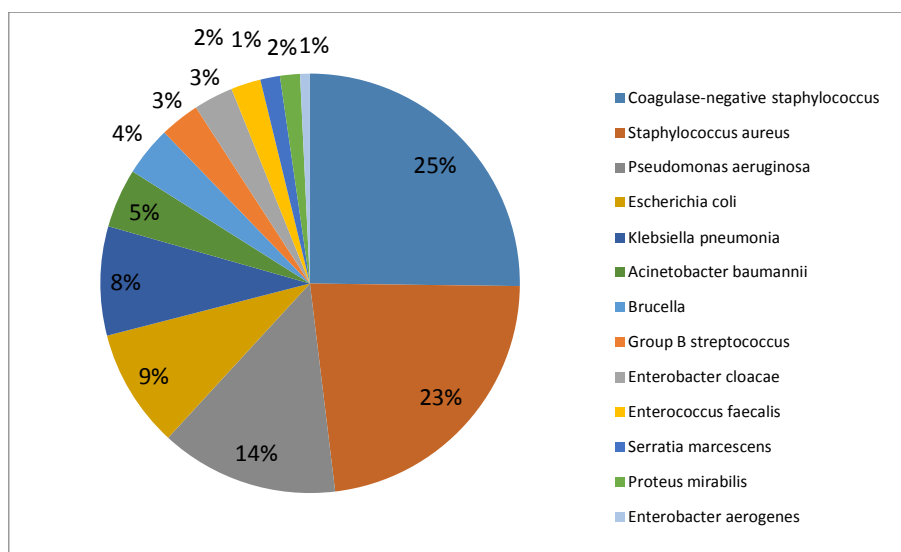


Fig. 1. The percentages of different bacteria that cause bacteremia

The hospital started the implementation of several interventions to decrease the rate of infections caused by bacteria or other microorganisms such as using masks and hand hygiene in addition to the implementation of infection control guidelines and policies.

One of the limitations of this study was that the available results were not divided according to the age because the incidence and the causative organism differ between adult, children or elderly. Moreover, there was no available data about specific factors about the patients such as if the patient has comorbidities or chronic diseases and also the diagnosis was not written in the cultures' results.

5. CONCLUSION

It can be concluded that the incidence of bloodstream infection in the present study is high compared to other studies and that the most common causative pathogens were *Coagulase-negative staphylococcus* and *Staphylococcus aureus*. It is important to know the incidence of bloodstream infection and to know the causative organisms both for clinical practice, especially to evaluate the effectiveness of interventions and also for research activities.

CONSENT

As per international standard or university standard, patient's consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written approval of the study by IRB ethical committee has been collected and preserved by the author(s).

ACKNOWLEDGEMENTS

"This Publication was supported by the Deanship of Scientific Research at Prince Sattam bin Abdulaziz University"

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Medlineplus. Bacterial Infections. Accessed 11 OCT 2020. Available: <https://medlineplus.gov/bacterialinfections.html>
2. Mehrotra A, Mishra S. Determination of the causative agents of bacteremia in children under 5 years and their susceptibility pattern to the antibiotics. GJMR-C. 2014; 14(1):18-24.
3. Madsen KM, Schonheyder HC, Kristensen B, Sorensen HT. Secular trends in incidence and mortality of bacteraemia in a Danish county 1981-1994. APMIS. 1999; 107(3):346-352.

4. Laupland KB, Gregson DB, Flemons WW, Hawkins D, Ross T, Church DL. Burden of community-onset bloodstream infection: A population-based assessment. *Epidemiol. Infect.* 2007;135:1037–1042.
5. Uslan DZ, Crane SJ, Steckelberg JM, Cockerill 3rd FR, St Sauver JL, Wilson WR et al. Age- and sex-associated trends in bloodstream infection. a population-based study in olmsted county, Minnesota. *Arch. Intern. Med.* 2007;167(8):834–839.
6. Diekema DJ, Beekmann SE, Chapin KC, Morel KA, Munson E, Doern GV. Epidemiology and outcome of nosocomial and community-onset bloodstream infection. *J. Clin. Microbiol.* 2003;41(80):3655–3660.
7. Bearman G, Wenzel RP. Bacteremias: A leading cause of death. *Arch Med Res.* 2005;36(6):646-659.
8. Skogberg K, Lyytikäinen O, Ruutu P, Ollgren J, Nuorti JP. Increase in bloodstream infections in Finland, 1995–2002. *Epidemiol. Infect.* 2008;136(1):108–114
9. Pedersen G, Schonheyder HC, Sorensen HT. Source of infection and other factors associated with case fatality in community-acquired bacteremia--a Danish population-based cohort study from 1992 to 1997. *Clin. Microbiol. Infect.* 2003;9(8):793–802.
10. Filice GA, Van Etta LL, Darby CP, Fraser DW. Bacteremia in charleston county, South Carolina. *Am. J. Epidemiol.* 1986;123:128–136.
11. Kim S, Jo S, Lee JB, Jin Y, Jeong T, Yoon J et al. Incidence of bacteremia and antimicrobial resistance, and associated factors among patients transferred from long-term care hospital. *Am. J. Emerg. Med.* 2019;37:1516-1526.
12. Goto M, Al-Hasan MN. Overall burden of bloodstream infection and nosocomial bloodstream infection in North America and Europe. *Clin. Microbiol. Infect.* 2013;19(6):501-509.
13. Kirn TJ, Weinstein MP. Update on blood cultures: how to obtain, process, report, and interpret. *Clin. Microbiol. Infect.* 2013;19(6):513-520.
14. Munro APS, Blyth CC, Campbell AJ, Bowen AC. Infection characteristics and treatment of *Staphylococcus aureus* bacteraemia at a tertiary children's hospital. *BMC Infect. Dis.* 2018;18:387.
15. Antonio M, Gudiol C, Royo-Cebrecos C, Grillo S, Ardanuy C, Carratalà J. Current etiology, clinical features and outcomes of bacteremia in older patients with solid tumors. *J. Geriatr. Oncol.* 2019;10(2):246-251.
16. Woll C, Neuman MI, Pruitt CM, Wang ME, Shapiro ED, Shah SS et al. Epidemiology and etiology of invasive bacterial infection in infants ≤60 days old treated in emergency departments. *J. Pediatr.* 2018;200:210-217.e1.
17. Kessler M, Hoen B, Mayeux D, Hestin D, Fontenaille C. Bacteremia in patients on chronic hemodialysis. A multicenter prospective survey. *Nephron.* 1993;64:95–100.
18. Deku JG, Dakorah MP, Lokpo SY, Orish VN, Ussher FA, Kpene GE. The epidemiology of bloodstream infections and antimicrobial susceptibility patterns: a nine-year retrospective study at st. dominic hospital, Akwatia, Ghana. *J. Trop. Med.* 2019;2019:6750864.
19. Grace JA, Olayinka BO, Onaolapo JA, Obaro SK. Staphylococcus aureus and coagulase-negative staphylococci in bacteraemia: the epidemiology, predisposing factors, pathogenicity and antimicrobial resistance. *Clin. Microbiol.* 2019;8:325.
20. Fukui S, Uehara Y, Fujibayashi K, Takahashi O, Hisaoka T, Naito T. Bacteraemia predictive factors among general medical inpatients: a retrospective cross-sectional survey in a Japanese university hospital. *BMJ open.* 2016;6(7):e010527.
21. Buetti N, Atkinson A, Marschall J, Kronenberg A. Incidence of bloodstream infections: a nationwide surveillance of acute care hospitals in Switzerland 2008–2014. *BMJ open.* 2017;7:e013665.
22. Aliyu S, Cohen B, Liu J, Larson E. Prevalence and risk factors for bloodstream infection present on hospital admission. *J. Infect. Prev.* 2018;19(1):37-42.
23. Søgaard M, Nørgaard M, Dethlefsen C, Schönheyder HC. Temporal changes in the incidence and 30-day mortality associated with bacteremia in hospitalized patients from 1992 through 2006: a population-based cohort study. *Clin. Infect. Dis.* 2001;52(1):61-69.
24. Wilson J, Elgohari S, Livermore DM, Cookson B, Johnson A, Lamagni T et al.

- Trends among pathogens reported as causing bacteraemia in England, 2004–2008. *Clin. Microbiol. Infect.* 2011;17(3): 451-458.
25. Laupland KB. Incidence of bloodstream infection: A review of population-based studies. *Clin. Microbiol. Infect.* 2013;19(6): 492-500.
26. Yinnon AM, Butnaru A, Raveh D, Jerassy Z, Rudensky B. *Klebsiella* bacteraemia: community versus nosocomial infection. *QJM.* 1996;89:933-942.

© 2020 Ahmed et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/62482>