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

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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.

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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.

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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.

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

In 2019 there were 56 positive blood cultures, 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.

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 |
|----------------------------------|--------|------------|
| Staphylococcus aureus            | 21     | 37.5%      |
| Escherichia coli                 | 8      | 14.29%     |
| Klebsiella pneumonia             | 7      | 12.5%      |
| Pseudomonas aeruginosa           | 6      | 10.71%     |
| Group B streptococcus            | 4      | 7.14%      |
| Acinetobacter baumannii          | 3      | 5.36%      |
| Serratia marcescens              | 2      | 3.57%      |
| Proteus mirabilis                | 2      | 3.57%      |
| Enterobacter cloacae             | 2      | 3.57%      |
| Enterococcus faecalis            | 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, Uslan 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 pneumonia* [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 pneumonia*. 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 |
|-----------------------------------|--------|------------|
| Coagulase-negative *staphylococcus* | 33     | 25.19%     |
| *Staphylococcus aureus*            | 30     | 22.90%     |
| *Pseudomonas aeruginosa*           | 18     | 13.74%     |
| *Escherichia coli*                 | 12     | 9.16%      |
| *Klebsiella pneumonia*             | 11     | 8.40%      |
| Acinetobacter baumannii            | 6      | 4.58%      |
| *Brucella*                         | 5      | 3.82%      |
| Group B *streptococcus*            | 4      | 3.05%      |
| *Enterobacter cloacae*             | 4      | 3.05%      |
| *Enterococcus faecalis*            | 3      | 2.29%      |
| *Serratia marcescens*              | 2      | 1.53%      |
| *Proteus mirabilis*                | 2      | 1.53%      |
| *Enterobacter aerogenes*           | 1      | 0.76%      |
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).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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