



Study of Management Practices of Bacteremia in a Referral Service in Dakar, Senegal (2018–2022)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: bacteremia remains a public health problem worldwide. Unfortunately, none of the studies carried out on this subject in our context has looked at how bacteremia is managed. We therefore undertook this study to assess the management practices of bacteremia at the infectious and Tropical diseases department.

Methods: this was a retrospective and descriptive study based on the analysis of records of patients hospitalized at Infectious and Tropical diseases department of Fann national university

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hospital in Dakar, Senegal. This study covered a five-year period, extending from January 1st 2018, to December 31 2022.

Results: During our study period, 213 patients were enrolled. The sex ratio was 1.13. The average age was 45.6 ± 17.5 years. Most patients (63.4%) had at least one comorbidity. Thirty-two percent (32%) had a history of recent hospitalization, and 25% had received recent antibiotic therapy. During the study period, 231 bacterial strains were isolated. Gram-positive cocci accounted for 68%, and Gram-negative bacilli for 32%. The main bacteria isolated were *Staphylococcus aureus* (30.3%). Empiric antibiotic therapy had been initiated in 81% of patients. Following antibiotic susceptibility testing, 61% of patients had their antibiotic therapy readjusted. In 61% of cases, the therapeutic protocol was deemed unsuitable, in line with the recommendations of Senegal's national antibiotic guide and international recommendations.

Conclusion: Bacteremias are common infections with significant morbidity and mortality that require a thorough understanding to improve management strategies and reduce AMR. In our context of low-income countries, following treatment guidelines is key to reducing AMR.

Keywords: Bacteremia; infectious diseases; bloodstream infections; HIV.

1. INTRODUCTION

In Africa, the prevalence of bacteremia ranged from 4.2% to 38.2% [1]. It is estimated that nearly two million episodes of bacteremia and almost 250,000 deaths are attributable to these infections every year in Europe and North America [2]. This situation is likely to increase considerably over the next ten years, given the rise in life expectancy and the impact of age on the occurrence of bacteremia [3].

In addition, the emergence of antimicrobial resistance (AMR) has become a global challenge, posing a growing threat to public health worldwide [4,5,6].

Bacteremia also poses a problem of therapeutic inadequacy, the prevalence of which varies between 23% and 36% of patients depending on the study [7,8]. This inadequacy prolongs hospital duration and increases risk of complications and death [9,10].

Unfortunately, none of the studies carried out on this subject has looked at how bacteremia is managed in our context and whether it complies with recommendations. We therefore undertook this study to assess whether the management of bacteremia at the SMIT of Fann complied with national and international standards.

2. METHODS

This was a retrospective and descriptive study based on the analysis of records of patients hospitalized at the SMIT of Fann national university hospital in Dakar, Senegal. This study covered a five-year period, extending from January 1st 2018, to December 31 2022.

All patients, hospitalized at the SMIT of Fann, diagnosed with bacteremia confirmed by a positive blood culture with an available antibiogram were included.

To facilitate the retrospective collection of information contained in the files, the following definitions have been adopted:

- **Bacteremia:** presence of viable bacteria in the bloodstream, confirmed by positive blood cultures.
- **Recent antibiotic therapy:** when the patient has received antibiotic therapy in the three months prior to hospitalization.
- **Recent hospitalization:** when the patient has been hospitalized in the six months prior to admission.
- **Adapted treatment:** to assess treatment adaptation, we used the following parameters [11-13]
 - o Duration of treatment: considered appropriate if:
 - A minimum of 14 days for *Staphylococci*.
 - Between 7 and 14 days for coagulase-negative *Staphylococci*, *Streptococci* and *Enterococci*.
 - 7 days for gram-negative bacilli (GNB).
 - 21 days for septic thrombophlebitis.
 - Four to six weeks for cases of associated infective endocarditis.
 - o Type of molecule: depending on the germ and its sensitivity, as reported by the antibiogram.
 - o Number of antibiotics: dual therapy is considered appropriate for *P. aeruginosa* infections, sepsis (qSOFA ≥ 2), or infections with multi-resistant bacteria.

Otherwise, monotherapy is more appropriate.

- Dosage: based on patient's weight. Dosage may be increased in cases of severe or complicated bacteremia.
- Route of administration: the intravenous route is generally used, except when the molecule is more bioavailable orally.

Data was entered using Epi Info software version 7.2.5.0 and processed using Microsoft Office 365 Excel version 2021. For descriptive analysis, categorical variables were expressed as absolute frequency and proportion. Quantitative variables were expressed by their position (mean, median) and dispersion (standard deviation, inter-quartile range,) parameters according to their distribution. Patient confidentiality was strictly respected.

3. RESULTS

3.1 Epidemiological and Clinical Aspects

During our study period, 213 patients had bacteremia diagnosed with a positive blood culture, representing a hospital frequency of 5.9%. The study population was predominantly male (53.1%), with a sex ratio of 1.13. The average age was 45.6 ± 17.5 years. More than half the patients (53%) were from urban regions. Most patients (63.4%) had at least one comorbidity. The main comorbidity was HIV infection (42.7%), hypertension (11.3%) and diabetes (7%). Thirty-two percent (32%) had a history of recent hospitalization, and 25% had received recent antibiotic therapy. Among patients who had received antibiotic therapy, the most frequently were ceftriaxone (23%), ciprofloxacin (18%) and amoxicillin clavulanic acid (15%). Clinically, the most common signs were fever (73%), altered general condition (64%), cough and pulmonary condensation (38%). The qSOFA score was assessed in 70% of patients and was greater than or equal to 2 in 37%. A primary site was identified in 26% of cases, and a secondary site in 16%. The main routes of entry were cutaneous (47%), urinary (25%) and digestive (14%). The main secondary sites were pulmonary (47%), urinary (37%) and neurological (8%).

3.2 Paraclinical and Bacteriological Aspects

Hyperleukocytosis ($WBC \geq 12,000/mm^3$) was present in 26% of patients, and C-Reactive

Protein (CRP) was greater than 96 mg/L in 60% of patients. Procalcitonin was measured in 12% of patients, with a mean of 9.3 ± 24.9 $\mu g/L$.

At least two blood culture sets were performed in 30% of patients. Blood cultures were monomicrobial in 98% of cases. During the study period, 231 bacterial strains were isolated. Gram-positive cocci accounted for 68%, and Gram-negative bacilli for 32%. The main bacteria isolated were *Staphylococcus aureus* (30.3%), *Staphylococcus saprophyticus* (26.0%), *Enterobacter spp.* (7.8%), *Klebsiella pneumoniae* (6.9%), *Staphylococcus epidermidis* (5.6%) and *Escherichia coli* (5.2%). Among Gram-positive cocci, over half (57%) were methicillin-resistant strains, and among Gram-negative bacilli, half (51%) were extended-spectrum betalactamase-secreting (ESBL), methicillin-resistant staphylococci aureus (MRSA) accounted for 62% of bacterial isolates.

3.3 Therapeutic and Evolutionary Aspects

Empiric antibiotic therapy had been initiated in 81% of patients. Of these, 41.3% had received dual antibiotic therapy. The most frequently prescribed molecule was ceftriaxone (41.6%). Empiric treatment was less than 7 days in 35% of patients, between 7 and 14 days in 56%, and more than 14 days in 9%. Following antibiotic susceptibility testing, 61% of patients had their antibiotic therapy readjusted. Monotherapy was prescribed in 42.3% of patients, while dual therapy was prescribed in 35.4%. The main antibiotic was vancomycin (19.6%). The mean duration of readapted treatment was 9.9 ± 6.4 days. The total duration of antibiotic therapy (probabilistic and readjusted) averaged 13.1 ± 9 days. Most patients (42%) were treated for more than 14 days. In 61% of cases, the therapeutic protocol was deemed unsuitable, in line with the recommendations of Senegal's national antibiotic guide [13] and international recommendations. The unsuitability of the protocol concerned the type of molecules (18.5%), the number of antibiotics administered (9.2%), the dosage (6.2%) and the duration of treatment (41.5%). The route of administration was not affected.

The average length of hospital stay was 21.7 ± 14.1 days. During hospitalization, 39% of patients developed sepsis and 8% septic shock. Hospital mortality was 33%.

Table 1. Therapeutic data

Therapeutic data		Number (n)	Percentage (%)
Probabilistic treatment and molecules	Yes	172	81
	Ceftriaxone	148	41.6
	Gentamicin	53	14.9
	Spiramycin	42	11.8
	Metronidazole	24	6.7
	Amoxicillin clavulanic acid	16	4.5
	Vancomycin	14	3.9
	Ciprofloxacin	11	3.1
	Imipenem	9	2.5
	Levofloxacin	9	2.5
	Azithromycin	8	2.2
	Amikacin	7	2.0
	Cefepime	4	1.1
	Re-adapted treatment and molecules	Yes	130
Vancomycin		46	19.6
Imipenem		32	13.6
Ciprofloxacin		24	10.2
Ceftriaxone		23	9.8
Gentamicin		20	8.5
Amikacin		17	7.2
Levofloxacin		10	4.3
Metronidazole		9	3.8
Lincomycin		7	3.0
Spiramycin		7	3.0
Fusidic acid		7	3.0
Cefepime		6	2.6
Total duration of antibiotic therapy		< 7 days	33
	[7 - 14 days].	80	41
	> 14 days	82	42
Therapeutic protocol	Adapted	65	31
	Not suitable	130	61
	No treatment	18	8
Causes of therapeutic inadaptation	Molecule type	24	18.5
	Number of antibiotics	12	9.2
	Dosage	8	6.2
	Duration	54	41.5

4. DISCUSSION

The incidence of bacteremia varies according to population, bacterial ecology and infection control practices in the geographical area studied. In our study, an incidence of 5.9% was found. This is higher than the 4.11% found in Senegal four years earlier [14] but lower than the bacteremia rates found elsewhere in the subregion: in Gambia in 2005 (10.7%) [15] and in Côte d'Ivoire in 2014 (22.5%) [16]. We found a male predominance. However, gender does not appear to be a common factor in the occurrence of bacteremia [14,17]. As in many studies carried out in Africa [14,18] bacteremia is mainly found in adults, with an average age of 45.6 ± 17.5 years in our study. The main comorbidity found in our patients was HIV infection (42.7%). SMIT is the national referral center for the care of HIV-infected patients, which explains the high rate of PLWHA. Furthermore, immunodepression during HIV infection favors the occurrence of invasive infections [19]. Most of bacteremia were skin-derived. Seydi et al., made the same observation in their study [20]. Secondary sites were mainly pulmonary and urinary. In fact, the type of secondary site varies according to the causative germ. Bacteremia caused by *Staphylococcus aureus* are the biggest source of secondary sites (47 to 87% of cases), which are generally osteoarticular, pulmonary, cutaneous and cardiac, whereas BGN are often responsible for urinary or digestive secondary sites [21].

The main clinical signs in our patients were fever, altered general condition and respiratory signs. These signs are frequently found in HIV-infected patients [22]. Hyperleukocytosis was present in 26% of our patients. Hill et al., reported that patients with hyperleukocytosis were at greater risk of bacteremia, with an odd ratio of 1.81 [15]. Most of our patients (89%) had a positive CRP, while procalcitonin was positive in all patients in whom it was performed. Procalcitonin is more specific than CRP and has a better prognostic value.

In recent years, the bacterial ecology involved in bacteremia has changed, and we are witnessing a decrease in the isolation of Gram-negative bacteria in favor of Gram-positive bacteria [9,23]. A similar conclusion was reached in our study, wherein 68% of the isolates were identified as Gram-positive cocci, and 32% as Gram-negative bacilli.

Most of patients (81%) had received probabilistic antibiotic therapy, and the most commonly

prescribed antibiotics was ceftriaxone as is the case throughout Africa [14,16,24]. Unfortunately, this practice risks increasing AMR and limiting our therapeutic choices. Unlike developed countries, we don't have a wide choice of antibiotics. Sixty-one percent (61%) of the patients in our study had their antibiotic therapy readjusted following the results of the susceptibility test. Vancomycin was the main antibiotic administered (19.6%). Vancomycin remains the antibiotic of choice for the treatment of MRSA infections [25].

The therapeutic protocol was not appropriate for 61% of patients. This was related to the fact that some patients had died or been discharged from hospital before the antibiogram was available. In our countries, antibiotic susceptibility test results can be delayed by several factors (logistical issues, availability of reagents, limited resources, etc.). Thus, antibiotic treatment is often empiric. This practice could contribute to therapeutic failure and the development of bacterial resistance. Studies showed that, antibiotic therapy in hospitals is useless or inappropriate in 30 to 50% of cases [26].

The inappropriate protocol in our study concerned the treatment duration in 41.5%. These results are in line with those of the literature, which has shown that the main explanation for this therapeutic inadequacy lies in the excessive duration of antibiotic therapy [26], despite well-defined standards for treatment duration [27]. The new recommendations, suggest a reduction in the duration of antibiotic therapy whenever possible [26-28]. However, in certain cases, reducing the duration of treatment is deleterious: when the probabilistic antibiotic therapy was not readapted, when the portal of entry or secondary site is poorly managed, or when the patient is immunocompromised [28].

The second parameter involved in this therapeutic inadequacy was the type of molecules used. Antibiotics prescribed after the results of the susceptibility test are generally narrow spectrum.

In 9.2% of cases, the number of antibiotics administered was inappropriate. The choice between mono- or poly-antibiotic therapy is crucial, as it contributes to bacterial selection pressure and subsequent antibiotic resistance [28]. Some studies indicate that combination therapy offers no advantage over monotherapy when the latter is adequate. However, in cases of bacteremia or septic shock complications, antibiotic combinations have proven more

effective than monotherapy [28]. Furthermore, it is important to de-escalate therapy promptly upon receipt of antibiogram results, and after reassessment of antibiotic therapy within 48 to 72 hours of initiation. This practice has demonstrated positive outcomes and helps curtail the use of broad-spectrum antibiotics [28].

The average hospital stay in our study was 21.7 ± 14 days. Previous studies of bacteremia in the same department showed higher mean hospital stays [14]. Shorter hospital stays are beneficial because they reduce the risk of exposure to nosocomial infections and improve patients' emotional and social well-being.

5. CONCLUSION

Bacteremia remains a major public health issue worldwide. Adopting appropriate therapeutic practices in the management of bacteremia could help mitigate the rise of antimicrobial resistance (AMR). In our context of low-income countries, adherence to recommendations, especially regarding treatment duration, remains crucial for reducing AMR.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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