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Research Article

Bacterial resistance and its impact on mortality in a population of people living with HIV at the Infectious Diseases ward of the Institut Professeur Daniel GAHOUMA in Libreville

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ABSTRACT

Background: Antibiotic resistance poses a growing threat to the management of sepsis in sub-Saharan Africa. The emergence of multidrug-resistant bacteria (MDR), particularly extended-spectrum beta-lactamase-producing Enterobacteriaceae (ESBL-producing Enterobacteriaceae), undermines the effectiveness of empirical antibiotic therapy. This study aimed to describe the antibiotic resistance profile of bacteria isolated from patients with sepsis, assess the prevalence of multidrug-resistant bacteria, and analyze their impact on in-hospital mortality.

Methods: A retrospective study of 154 patients hospitalized for sepsis. Microbiological data (blood cultures, pathogen identification, and antibiotic susceptibility testing for five classes of antibiotics) were analyzed. MDR bacteria was defined as resistance to ≥ 3 classes, including third-generation cephalosporins (3GC). The statistical analysis included the chi-square test, the Mann-Whitney test, and the calculation of odds ratios (OR) with 95% confidence intervals.

Results: Blood cultures were positive in 73.9% of patients (65/88). Resistance to third-generation cephalosporins (C3G) was 95.4%, (n=62/65), to fluoroquinolones 33.0%, to fourth-generation cephalosporins (C4G) 28.4%, to aminoglycosides 14.8%, and to carbapenems 12.5%. Klebsiella pneumoniae showed 100% resistance to C3Gs and a case-fatality rate of 52.6%. The prevalence of multidrug-resistant (MDR) bacteria was 23.9% among positive blood cultures (32.3% among identified pathogens). Mortality was significantly higher for each resistance class: C3G (35.4% vs. 4.6%, $p < 0.001$), carbapenems (50.0% vs. 17.5%, $p = 0.040$), and aminoglycosides (46.7% vs. 16.5%, $p = 0.016$). MDR-positive patients had a mortality rate of 47.6% compared with 25.4% for non-MDR patients (OR = 2.67; 95% CI [0.97-7.40]; $p = 0.097$).

Conclusion: Antibiotic resistance is a problem in our country. It is essential to develop local protocols that take into account epidemiological data on resistance.

KEYWORDS

Sepsis, Antibiotic resistance, Multidrug-resistant bacteria (MDR), Extended-spectrum beta-lactamase (ESBL).

Introduction

Sepsis is life-threatening organ dysfunction due to a dysregulated host response to infection [1]. According to data from the World Health Organization, it is one of the leading causes of in-hospital mortality worldwide, with an estimated 48.9 million cases and 11 million deaths per year [2]. Despite the deepening understanding of the pathophysiological mechanism of sepsis and the rapid development of multidisciplinary comprehensive management, including a 30-day mortality rate of up to 15.9-22.7% [3,4] and an in-hospital mortality rate of up to 15.0-28.1% [4,5]. In resource-limited countries, particularly in sub-Saharan Africa, the burden of sepsis is particularly high, exacerbated by inadequate intensive care infrastructure, limited access to second-line antibiotics, and a high prevalence of comorbidities such as HIV infection and tuberculosis [6,7]. The coexistence of these infections with sepsis results in complex clinical presentations, making the prognosis even more uncertain. In fact, when compared with that of HIV-negative patients, the incidence rate of sepsis is significantly increased in HIV-positive patients [8]. When compared with HIV-negative patients, HIV-positive patients also have an increased risk of sepsis mortality [9]. However, in Gabon, HIV infection influences the spectrum of bacterial infections and sepsis [10] with an HIV prevalence of 3.4% [11]

However, the prognosis for sepsis depends largely on the timeliness and appropriateness of antibiotic therapy, which must initially be empirical while awaiting microbiological results. In sub-Saharan Africa, particularly in Gabon, the rapid emergence of multidrug-resistant bacteria poses a major obstacle to this strategy. Extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae are becoming increasingly common, both in community settings and in hospitals [12]. Resistance to third-generation cephalosporins (3GC), the primary first-line antibiotic for sepsis, has reached alarming levels in some African countries, affecting 50 to 70 percent of the strains isolated from cases of bacteremia [13,14]. The emergence of resistance to carbapenems, antibiotics of last resort, has also been reported, further limiting treatment options [15].

In this context, knowledge of the local resistance profile is essential for tailoring recommendations for empirical antibiotic therapy. However, data specific to our context remain scarce and insufficiently documented. The objective of this study was therefore to describe the antibiotic resistance profile of pathogens isolated from patients with sepsis in the Infectious Diseases Ward at the Institut Professeur Daniel GAHOUMA, to assess the prevalence of multidrug-resistant bacteria, and to analyze their impact on in-hospital mortality.

Methodology

Study design and setting

This was a retrospective, single-center cohort study conducted from October 2024 to December 2025 in the Infectious Diseases Department of the Institut Professeur Daniel GAHOUMA, a leading HIV care facility in Libreville, Gabon.

Study population

All adult patients (aged ≥ 18 years) hospitalized for sepsis were consecutively enrolled. Sepsis was diagnosed according to the Sepsis-3 Consensus Conference criteria (2016), defined as a SOFA score ≥ 2 in the context of an infection [16]. Patients whose medical records were incomplete or who had been hospitalized for less than 24 hours were excluded.

Data collection and variables

The data were extracted from medical records and included: (i) sociodemographic characteristics (age, sex, education level, marital status, health insurance); (ii) medical history and comorbidities (HIV, diabetes, hypertension, tuberculosis, viral hepatitis, syphilis); (iii) clinical parameters at admission (fever, chills, hypotension, qSOFA score); (iv) laboratory parameters (complete blood count, creatinine, blood glucose, liver function tests, CD4 count, viral load); (v) hospital outcome (survival or death); and (vi) microbiological data (blood culture results, pathogen identification, antibiotic susceptibility testing).

The bacteria were identified using conventional methods (API gallery, Gram staining). Antibiotic susceptibility was tested using a standardized antibiotic susceptibility test. For this study, we included data for five classes of antibiotics: third-generation cephalosporins (3GC), fourth-generation cephalosporins (4GC), fluoroquinolones, aminoglycosides, and carbapenems. Broad-spectrum resistance (BMR) was defined as resistance to at least three classes of antibiotics, including 3G cephalosporins.

Statistical analysis

Qualitative variables were expressed as counts and percentages, while quantitative variables were expressed as the median and interquartile range (IQR). Comparisons were performed using the chi-square test (or Fisher's exact test) for categorical variables and the Mann-Whitney test for continuous variables. Crude odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated. The significance threshold was set at $p < 0.05$. The analyses were performed using Python 3.11

Ethical considerations

This study is part of the epidemiological and clinical surveillance activities conducted by the Center for Research on Infectious Pathogens and Associated Diseases (CREIPA), in collaboration with the National Program for the Control of HIV and STIs. Ethical approval was granted by the Ministry of Health. Administrative authorization was obtained from the medical director of the Institut Professeeur Daniel GAHOUMA, and the head of the Infectious Diseases Department. A unique anonymous identifier was assigned to each patient, and all data were processed in accordance with the principles set forth in the Declaration of Helsinki.

Results

General Characteristics of the cohort

A total of 154 patients were included. The median age was 41 years (IQR: 33-48), with a predominance of women (56.5%; n = 87). The vast majority of patients were from urban areas. Gabonese Economically Disadvantaged (GEF) health coverage was present in 63.6% of patients. All patients were HIV-positive; however, HIV serostatus was known for 68.2% of the patients (n = 105), of whom only 32.4% (n = 34) were receiving antiretroviral therapy at the time of admission. Among comorbidities, diabetes (22.7%), hypertension (22.1%), and active tuberculosis (9.1%) were the most common. The qSOFA score was 3 in 51.9% of patients. The overall in-hospital mortality rate was 20.1% (31/154). The median length of hospital stay was 21 days (IQR: 18-24). General characteristics are presented in Table 1.

Table 1: General characteristics.

	N	(%)
Age in years		
≥ 18 -30	21	13,6
>30-50	100	64,9
>50	33	21,4
Sexe		
Women	87	56,5
Men	67	43,5
Matrimonial statut		
In couple	84	54,5
Single	60	39,0
Widowed	10	6,5
Education		
High school	100	64,9
University	38	24,7
Elementary school	12	7,8
Not school	4	2,6
Occupation		
Workers	85	55,2
Middle manager	23	14,9
Student	14	9,1
Retired	12	7,8
Unemployed	10	6,5
WHO stage/mm³		
1	41	26.6
2	41	26.6
3	35	22.8
4	37	24.0
CD4 T- cell/mm³		
<50	20	13.0
50-200	82	53.2
201-350	39	25.3
> 350	13	8.5

Blood culture results

Positive blood cultures were obtained in 88 patients (57.1%). Of these, 65 (73.9%) were identified as bacterial and 23 (26.1%) were sterile. The most frequently isolated bacteria were *Escherichia coli* (33.8%; n = 22), Klebsiella pneumoniae (29.2%; n = 19), Staphylococcus aureus (10.8%; n = 7), and Enterobacter sp. (9.2%; n = 6).

Antibiotic resistance profile

Among the 65 positive blood cultures, the rate of resistance to C3G was 95.4% (62 out of 65). This rate was 100% for K. pneumoniae, Enterobacter spp., and other Gram-negative bacteria. Resistance to fluoroquinolones was 33.0%, and resistance to C4G was 28.4%. Aminoglycosides were resistant in 14.8% of cases. The carbapenem resistance rate was 12.3% (8/65), primarily involving Acinetobacter baumannii and Serratia sp. Table 2 details the results by pathogen.

Multi-resistant bacteria (MDR)

The prevalence of MDR was 32.3% among the identified bacteria (21 out of 65). The distribution of the number of resistance classes showed that 16 patients (18.2%) were resistant to 4 or 5 classes simultaneously, suggesting pan-resistance in certain strains. Table 2 summarizes the impact of resistance on mortality by antibiotic class.

Factors associated with resistance to C3G

Regarding factors associated with resistance to C3G, in univariate analysis, no clinical, epidemiological, or demographic variable was significantly associated with resistance to C3G. In particular: HIV status (OR = 1.16; p = 0.849), prior hospitalization (p = 0.257), a

Table 2: Antibiotic resistance profile by isolated pathogen (identified pathogens, n = 65).

Germ	n	C3G	FQ	4G	Amino.	Carba.	MDR	Mortality
E. coli	22	91%	45%	32%	27%	14%	27%	18,2%
K. pneumoniae	19	**100%**	26%	26%	16%	16%	16%	**52,6%**
Staph. aureus	7	86%	29%	29%	0%	0%	29%	**0%**
Enterobacter sp.	6	**100%**	50%	67%	0%	0%	50%	16,7%
Staph. coag-nég.	4	**100%**	**100%**	75%	50%	0%	75%	**50,0%**
Proteus sp.	3	**100%**	67%	33%	33%	0%	33%	33,3%
Acinetobacter b.	1	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Serratia sp.	1	**100%**	**100%**	**100%**	0%	**100%**	**100%**	**100%**
Pseudomonas sp	2	**100%**	**100%**	**100%**	0%	0%	**50%**	**100%**

C3G: third-generation cephalosporins; FQ: fluoroquinolones; C4G: fourth-generation cephalosporins; Amino.: aminoglycosides; Carba.: carbapenems; MDR: multidrug-resistant bacteria (≥ 3 classes, including 3G). In red: high resistance (≥66%); in green: retained susceptibility.

Table 3: Hospital mortality by antibiotic resistance status.

Class	Résistant+ (%)	Résistant– (%)	OR brut	IC 95%	p
C3G	**35,4%**	4,6%	**11,32**	[3,19-40,11]	**< 0,001**
Fluoroquinolones	35,5%	15,2%	3,08	[1,23-7,71]	0,027
C4G	37,0%	15,5%	3,14	[1,25-7,89]	0,027
aminoglycosides	**46,7%**	16,5%	4,38	[1,27-15,13]	0,016
Carbapenems	**50,0%**	17,5%	4,71	[1,25-17,75]	0,040
MDR (≥3 classes)	47,6%	25,4%	2,67	[0,97-7,40]	0,097

qSOFA score of 3 (p = 0.292), median age (41 years vs. 40 years; p = 0.23), diabetes (p = 0.52), and hypertension (p = 0.29) were not associated with resistance. The length of hospital stay also did not differ between resistant and susceptible patients (21 days in both groups; p = 0.23).

Discussion

Although there have been numerous studies on antibiotic resistance among people living with HIV in sub-Saharan Africa, data specific to Gabonese populations within this vulnerable group are scarce. This retrospective descriptive study, the first of its kind in this patient group in Gabon, fills this gap by providing a brief analysis of the resistance profiles of pathogens isolated from hospitalized HIV patients with sepsis and their impact on mortality in the infectious diseases ward at the Institut Professeur Daniel GAHOUMA in Libreville.

The median age of 41 years (18-75) in our cohort contrasts sharply with that observed in European and North American sepsis cohorts, where the median is generally between 60 and 70 years [17,18]. This difference primarily reflects the demographic structure of sub-Saharan African countries, which are characterized by a much younger population [19]. A key explanatory factor is that our study population consists solely of HIV-positive patients. HIV infection primarily affects adults of reproductive age (20-45 years) in sub-Saharan Africa and is the main risk factor for opportunistic infections leading to sepsis [20]. Several African studies report similar profiles: a study conducted in Nigeria by Iregbu et al. reported a median age of 38 years in a hospital-acquired sepsis cohort, and another conducted in Cameroon by Mboudou et al. reported that 72% of patients were HIV-positive with a mean age of 40 years [21,22]. The predominance of female patients observed in our cohort (56.5%) contrasts with most international sepsis series, in which males typically constitute the majority (approximately 55-60% men) [23]. This finding is, however, frequently reported in African cohorts with a high proportion of HIV-positive patients [20,24].

Our C3G resistance rate was 95.4% among positive blood cultures. This rate is significantly higher than that reported in developed countries (10–25%) [25] and also exceeds the figures published in several sub-Saharan African countries (40–60%) [25,26]. This could be explained by the inappropriate use of antibiotics combined with behavioral factors [27]. This alarming prevalence could indicate a widespread circulation of BLSE-producing strains in our setting, both in the community and in hospitals.

The absence of clinical or demographic factors associated with resistance is a key finding. This implies that resistance cannot be predicted based on an individual patient's profile, but rather reflects endemic contamination of the environmental and community microbial reservoir. This finding is consistent with the results of studies conducted in East and West Africa, which show that the circulation of BLSE is primarily community-based in those regions [28,29]. Preventive measures should therefore not focus on "high-risk patients" but should instead emphasize systematic surveillance and the regulation of antibiotic prescribing at the community level.

The impact of resistance on mortality is clinically highly significant. Resistance to C3G increases the risk of death by nearly 11-fold in univariate analysis (OR = 11.32). The mortality rate for carbapenem-resistant bacteremia is 50%. These figures are comparable to those published in the international literature [30,31] and illustrate the direct impact of inappropriate empirical antibiotic therapy on patient survival.

Klebsiella pneumoniae, with 100% resistance to C3G and a case-fatality rate of 52.6%, is the most concerning pathogen in this series. This bacterium is known for its ability to acquire resistance determinants through horizontal gene transfer, which contributes to its progression toward pan-resistance [32]. The emergence of Acinetobacter baumannii and Serratia sp. that are completely resistant is also a cause for concern, even though their prevalence remains low in this series. especially for Acinetobacter baumannii, which has already been described in other studies [33].

Paradoxically, Staphylococcus aureus, despite an 86% resistance rate to C3G, showed zero case fatality (n = 7). This observation may reflect the nature of staphylococcal infections in our setting (less invasive bacteremias of cutaneous origin) or may sometimes be due to contamination during sample collection for analysis.

However, this study has certain limitations. The retrospective nature of the study, the lack of data on the antibiotic therapy received and its appropriateness, the small sample size, and the single-center nature of our cohort mean that the sample is not representative at the national level.

However, despite these limitations, this study documents a pattern of antibiotic resistance in sepsis, with a 95.5% resistance rate to C3G antibiotics and a 23.9% prevalence of BMR. These data invalidate the empirical use of C3G antibiotics as first-line therapy for severe sepsis in our setting.

Conclusion

Antibiotic resistance remains a pressing issue in our country. Urgent recommendations must be implemented. These include revising protocols for empirical antibiotic therapy for sepsis. They also involve establishing a local, continuous microbiological surveillance system. It is also necessary to strengthen measures to prevent cross-transmission. Finally, these data must be incorporated into a national policy on antimicrobial resistance. All of these measures are essential to combating antibiotic resistance in our country.

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