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BACTEREMIA: BACTERIOLOGICAL PROFILE AND ANTIBIOTIC RESISTANCE

Mohamed Wali Alami*, Iraqui Houssaini Zineb, Hadi Imane, Zarhloul Sami, Bighouab Youssef, Btiti Marouane, Benouda Amina

***Corresponding Author: Mohamed Wali Alami**

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INTRODUCTION

The term "bacteremia" is used to refer to the presence of pathogenic microorganisms in the blood, including bacterial and fungal episodes. These infections, often associated with healthcare, are among the most serious, with mortality rates reaching up to 69%, leading to prolonged hospital stays and high costs.[1,2] Blood culture remains the reference standard for their diagnosis, allowing the identification of the responsible microorganisms and their resistance to antibiotics, a crucial element for appropriate antibiotic therapy.[3] Faced with the increasing emergence of multidrug-resistant bacteria and the evolution of epidemiological profiles, it is essential to have precise local data to optimize empirical treatment.[4] However, in Morocco, studies on the epidemiology of bacteremia and their resistance to antibiotics remain rare. This study, conducted at the Cheikh Zaid International University Hospital, aims to determine the prevalence of positive blood cultures and to characterize the bacteria isolated to guide the initial management of bacteremia according to the local epidemiological context.

MATERIELS ET METHODES

1. Framework of the study

This retrospective, descriptive and analytical study was carried out within the various departments of the Cheikh Zaid International University Hospital (HUICZ) over a period of two years, from January 2022 to December 2023.

2. Target Population

- **Bacteriological profile:** 267 blood cultures, excluding contaminated ones.
- **Antibiotic resistance:** 249 blood cultures, excluding contaminated ones, unidentified BGN and those without antibiogram.
- **Demographic and clinical profile:** 231 positive blood cultures.

2.1 Inclusion Criteria

- Patients hospitalized within the HUICZ.
- Patients with one or more positive blood cultures.

2.2 Exclusion Criteria

- Contaminated blood cultures (e.g., coagulase-negative Staphylococcus isolated once or isolated twice without concordant resistance phenotype).
- Patients who died or were discharged before treatment was adapted.
- Incomplete medical records.

3. Sample Selection

Table 1: Sample selection.

Steps	Name
Total blood cultures performed	2310
Positive blood culture	277
Contaminated blood culture	110
Patient died before adaptation	7
Patient discharged before adaptation	6
Incomplete medical records	5
Blood cultures retained	267
Without antibiogram	9
BGN not identified	9
Blood cultures retained	231

4. Data Collection

Data were collected from patients' medical records using a standardized operating sheet.

5. Factors studied

- Bacteremia.
- Blood cultures.
- Isolated microorganisms.
- Antibiotic resistance.

6. Analyse statistique

Data were entered into Excel and analyzed using JAMOVI software. Descriptive statistics include:

- Frequencies, percentages.
- Means, medians.
- Standard deviations and quartiles.

7. Ethical Aspect

The study protocol was validated by the HUICZ Ethics Committee. Data collection respected patient anonymity and confidentiality.

RESULTS

1. Rate of positive blood cultures

During the study period, 2310 blood cultures were performed on patients hospitalized at HUICZ. Of these, 377 blood cultures were positive, of which 110 were discarded due to contamination (i.e. 5%). Finally, 267 positive blood cultures were retained, which corresponds to a positivity rate of 11%.

2. Demographic and clinical data

2.1 **Distribution by gender**

Among the 267 positive blood cultures:
- 145 men (55%)
- 122 women (45%)

Sex ratio (M/F) = 1.18.

2.2 Age distribution

Age ranged from 0 to 92 years, with a median age of 57 years (interquartile range: 37-70 years).

2.3 Services d'hospitalisation
- Medicine: 83%
- Resuscitation: 10%
- Surgery: 7%

2.4 Main reasons for hospitalization
- Management of neoplasia
- Shock
- Infectious syndromes
- Hematopoietic stem cell transplants

2.5 Presence of fever
- 71% (165 patients): blood cultures performed during fever peaks.
- 29% (66 patients): absence of fever.

3. Bacteriological data

3.1 Bacteriological profile of the 267 blood cultures
- Gram-negative bacilli (GNB): 56% (n=150)
- Gram-positive cocci (GPC): 22% (n=58)
- Yeasts: 22% (n=59)

Main microorganisms isolated
- Escherichia coli: 16.4% (n=44)
- Candida non albicans: 14.2% (n=38)
- Klebsiella sp: 12% (n=32)
- Staphylococcus aureus: 8.2% (n=22)
- Candida albicans: 7.8% (n=21)

3.2 Distribution of isolates by department
- Medicine: Escherichia coli, Candida non albicans, Klebsiella sp.
- Resuscitation: Acinetobacter sp, Escherichia coli, Candida non albicans.
- Surgery: Escherichia coli, Klebsiella sp, Candida non albicans.

3.3 Beta-lactamase and carbapenemase-producing strains
- ESBL (n=32): Predominance in patients hospitalized for neoplasia (n=20).
- Carbapenemase: Exclusively identified in patients in neoplasia care.

4. Antibiotic susceptibility

4.1 Gram-negative bacilli (GNB)

Enterobacteria (n=105):
- Amoxicillin: 85.9%
- Amoxicillin + clavulanic acid: 57.29%
- Ceftriaxone/Ceftazidime: ~55%
- Gentamicin: 27.4%
- Amikacin: 9.5%
- Imipenem: 11.4%

Escherichia coli subgroup
- Amoxicillin resistance: 71%
- Amoxicillin + clavulanic acid: 47.61%
- Imipenem: 4.6%

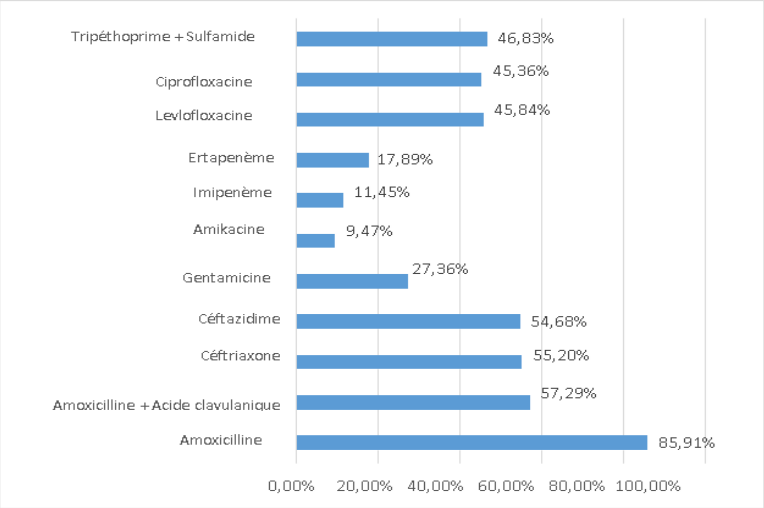

Figure 1: Susceptibility Profile of Enterobacteria.

Non-fermenting BGN
• Acinetobacter sp: High resistance to Ceftazidime (100%) and Imipenem (80%).
• Pseudomonas sp: Low overall resistance.

4.2 Gram-positive cocci (GPC)
• Staphylococcus aureus: Low resistance to Cefoxitin (14.3%). Preserved sensitivity to Vancomycin.
• Streptococcus pneumoniae: Sensitive to all antibiotics tested.

5. Clinical evolution
5.1 Treatment adaptation
• Adapted to the antibiogram: 75% (n=173)
• Not adapted: 25% (n=57)

5.2 Patient outcome
• Died: 36% (n=83)
• Discharged home: 64% (n=147)

5.3 Impact of treatment adaptation
• Patients alive with adaptation: 48.3%
• Patients who died despite adaptation: 27%

5.4 Deaths according to reasons for hospitalization
• Neoplasia: 55 cases
• Shock: 18 cases
• Infectious syndrome: 4 cases
• Stem cell transplant/stroke: 2 cases

5.5 Deaths and beta-lactamase production
• 43% of deceased patients had beta-lactamase-producing strains.
• 57% of patients with these strains were alive.

CONCLUSION OF RESULTS

These results show a bacteriological profile dominated by GNB with an alarming rate of resistance, particularly for ESBL and carbapenemase producers. The preserved sensitivity to Vancomycin in GBCs remains encouraging. The data on clinical evolution highlight the positive impact of treatment adaptation.

DISCUSSION

Blood cultures play a key role in microbiological diagnosis, particularly when an infectious site is deep or difficult to access.[5] However, their usefulness may be limited in certain contexts, such as acute pyelonephritis, where a cytobacteriological examination is often sufficient.[6] Their interpretation remains complex and can sometimes lead to overuse of antibiotics, promoting bacterial resistance, prolonging hospitalizations and increasing the workload of laboratories.[7][8]

In our study, the positivity rate of blood cultures (excluding contamination) was 11%, a result consistent with similar studies conducted in Morocco and sub-Saharan Africa[9][10], but lower than the rates observed in other hospital settings.[7][11][12] These variations are attributed to factors such as differences between hospital departments and sampling criteria.[13] The observed contamination rate (5%) is comparable to that of some Moroccan studies[14] but remains lower than results reported in Europe.[15][16] The main causes of contamination include inadequate practices during the pre-analytical phase, including an incorrect blood volume or insufficient disinfection.[17][18]

The objective of this analysis was to better understand the microbiological profiles of positive blood cultures in order to effectively guide antibiotic treatments. In our study, Gram-negative bacilli (GNB) represented 56% of bacterial isolates, confirming their predominance over Gram-positive cocci (GPC), which represented 22%. This trend is also observed in similar studies, notably in Morocco (CHU Mohamed VI, Marrakech) with 86% of GNB[19], in Tunisia (55.7% GNB) (3), and in India (80.96% GNB).[20] Conversely, in some regions such as the United States (78.1% CGP)[21] or Cameroon (56.2% CGP)[22], CGP predominate, illustrating epidemiological variations linked to local specificities.

Among the GNB, Enterobacteria were the most frequent (70%), followed by non-fermenting GNB (21%). Escherichia coli (16.4%) was the most isolated pathogen, followed by Klebsiella spp. (12%) and other Enterobacteria such as Raoultella terrigena, Enterobacter spp., and Serratia spp. These results are close to those reported in Morocco[11], Algeria[12], and Japan[23], although variations are observed, particularly in India where Klebsiella spp. predominated over E. coli.[24]

Non-fermenting BGN were mainly represented by Pseudomonas spp. (5.9%) and Acinetobacter spp. (4.8%). These pathogens, known for their nosocomial character, are often associated with hospital environmental reservoirs and hand-borne transmissions. The results vary according to the regions: in India and Japan, Pseudomonas spp. is more frequent [20][23], while in Marrakech, Acinetobacter spp. is the majority (10.37%).[11] These observations highlight the importance of local characteristics in the epidemiology of bacteremia and the need to adapt prevention and control strategies in hospital settings.

In our study, Gram-positive cocci (GPC) were dominated by staphylococci (12%), with a predominance of Staphylococcus aureus (8.2%) over coagulase-negative staphylococci (CNS, 2.6%). Similar trends are observed in Morocco, particularly at the Avicenne military hospital in Marrakech (27.5% S. aureus versus 7.54% CNS)[11], as well as in India (42.14% S. aureus versus 14.55% CNS).[20] Conversely, in Japan and Senegal, CNS were in the majority, representing 27.18% and 23.3%[23][25] of isolates, respectively, often linked to samples taken from colonized intravascular catheters. CNS are also frequently considered contaminants (>85% clinically insignificant).

Concerning yeasts, their rate in our study (22%) is higher than that reported in Algerian studies (12.34% and 6.04%)[26][27] but remains lower than the 46.1% observed at the Mohamed V military hospital in Rabat.[28] This difference could be attributed to a high proportion of patients in poor general condition, including immunocompromised patients, those with intravascular catheters or receiving parenteral nutrition.

We identified Candida non albicans (14.2%) as predominant compared to Candida albicans (7.8%), a finding similar to that of a study conducted in Rabat[28] where Candida non albicans represented 63.5% of cases. This predominance could be explained by its nosocomial nature and its frequency in oncology and hematology departments. Candida spp., particularly in the context of immunosuppression, broad-spectrum antibiotic therapy (including vancomycin), or neutropenia, remains a worrying infectious agent, reinforcing the need for increased vigilance in hospital environments.[29]

In our study, enterobacteria were dominated by Escherichia coli and the KES group (Klebsiella, Enterobacter, Serratia), with high resistance rates: 85.91% to amoxicillin and 57.29% to amoxicillin + clavulanic acid. These results are comparable to those reported at the Avicenne Military Hospital in Marrakech (83.72% and 67.44%, respectively).[11] Resistance to third-generation cephalosporins (C3G) reached 55%, a figure consistent with a recent study at Ibn Tofail Hospital in Marrakech (54%) (30). Regarding fluoroquinolones, resistance was 45%, similar to that found in the Moroccan literature (52%)[30], but higher than in Tunisia (33%).[31]

For gentamicin, the resistance rate recorded in our study was lower (27.36%) than that reported in Morocco (50%) and Tunisia (37.9%).[30][31] Finally, resistance to imipenem was 11.45%, a figure similar to that found in Tunisia[31] but higher than in Ibn Tofail Hospital (3%).[30] These high resistances are mainly attributed to penicillinases acquired from Escherichia coli and natural beta-lactamases in the KES group[32], highlighting the impact of institution-specific therapeutic practices.

Regarding Acinetobacter sp, alarming resistance rates were observed: 100% to C3G, 80% to imipenem, 81% to gentamicin and 91% to ciprofloxacin. These results are consistent with those reported in other regions, such as Greece (88.95% resistance to imipenem), Iran and Egypt (100%)[33][34], while lower rates were noted in Vietnam (57.58%).[35] Acinetobacter sp represents a formidable nosocomial pathogen, often associated with epidemics and infections that are difficult to treat due to its high capacity to develop resistance. The progressive decrease in the efficacy of imipenem, once a treatment of choice, reflects the emergence of resistant strains. These data call for strengthening measures to combat nosocomial infections, including screening, isolation of patients carrying multidrug-resistant bacteria, strict disinfection of hospital environments and rational use of antibiotics.[36][37]

Pseudomonas sp bacteremia, mainly nosocomial, has a moderate resistance rate in our study: 15.38% to ceftazidime and imipenem, and 7.14% to ciprofloxacin and amikacin. These results are generally lower than those reported in other countries (Senegal, Italy)[25][38] and consistent with local data in Marrakech.[11]

For Staphylococcus aureus, resistance to methicillin (MRSA) is 14.28%, compared to 60% for SCN, low rates compared to those in Algeria or Senegal.[39-40] The absence of resistance to vancomycin, gentamicin and ciprofloxacin is encouraging, making it possible to avoid the systematic use of glycopeptides. These results reflect a limited prevalence of multiresistant bacteria in our context, highlighting the importance of hospital hygiene and reasoned antibiotic prescription to limit their spread.[41]

CONCLUSION

This work highlights a low positivity rate, emphasizing the need to improve pre-analytical practices and strengthen the training of medical and paramedical staff. Antibiotic resistance remains a major challenge, making it imperative to control resistant strains and rationalize antibiotic prescriptions.

The bacteriological profile varies according to the context, but the resistance rate observed in our series remains moderate compared to the literature. These results can guide probabilistic antibiotic therapy and strengthen hospital hygiene measures, while limiting the excessive use of broad-spectrum antibiotics to slow the spread of multiresistant germs.

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