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Short Communication **Open Access**

Microbiological profile of bacteraemia in febrile patients receiving chemotherapy: Experience of the Alassane Ouattara National Center of Oncology and Radiotherapy (CNRAO), 2024

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Abstract:

Background: Febrile episodes in patients undergoing chemotherapy pose a major risk for bloodstream infections (BSIs). Prompt microbiological diagnosis is essential to guide targeted therapy and minimize the emergence of antimicrobial resistance.
Methodology: A six-month cross-sectional study (July–December 2024) was conducted at the Alassane Ouattara National Center of Oncology and Radiotherapy (CNRAO), Abidjan, Côte d'Ivoire. All chemotherapy patients presenting with fever (≥38.5°C) were included. Blood cultures were processed using the BACT/ALERT system, and bacterial identification with antimicrobial susceptibility testing followed CA-SFM 2022 guidelines. ESBL and carbapenemase production in Gram-negative isolates was detected in line with CA-SFM/EUCAST guidelines while methicillin resistance (MR), macrolide-lincosamide-streptogramin B (MLS_B), and kanamycin-tobramycin-gentamicin (KTG) resistance phenotypes in Gram-positive isolates were detected in line with CLSI/CA-SFM standard.
Results: Fifty patients were enrolled (mean age of 53.7±12.2 years; 82.0% females). Breast cancer was the most frequent malignancy (64.0%). Blood cultures were positive in 8.0% (4/50) of cases, with 2 (50.0%) *Staphylococcus aureus* and 2 (50.0%) *Salmonella* spp isolates. All isolates were fully susceptible to tested antibiotics, with no resistance phenotypes observed. Clinical outcomes were favorable in all cases after targeted antimicrobial therapy.
Conclusion: The prevalence of bacteremia among febrile chemotherapy patients at CNRAO was 8.0%, which is lower than previously reported prevalence in the general populations in Côte d'Ivoire. However, due to the small sample size, this finding should be interpreted with caution. Nevertheless, routine blood culture remains crucial for optimizing antimicrobial management, preventing resistance, and improving outcomes in oncology care, as highlighted in this study.

Keywords: Bacteremia; Chemotherapy; Blood culture; Antimicrobial resistance; Côte d'Ivoire

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Profil microbiologique des bactériémies chez les patients fébriles sous chimiothérapie: Expérience du Centre National d'Oncologie et Radiothérapie Alassane Ouattara (CNRAO), 2024

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Résumé:

Contexte: Les épisodes fébriles chez les patients sous chimiothérapie présentent un risque majeur d'infections sanguines (ISB). Un diagnostic microbiologique rapide est essentiel pour orienter le traitement ciblé et minimiser l'émergence de résistances aux antimicrobiens.

Méthodologie: Une étude transversale de six mois (juillet-décembre 2024) a été menée au Centre national d'oncologie et de radiothérapie Alassane Ouattara (CNRAO), à Abidjan, en Côte d'Ivoire. Tous les patients sous chimiothérapie présentant une fièvre (≥38,5°C) ont été inclus. Les hémocultures ont été traitées à l'aide du système BACT/ALERT, et l'identification bactérienne par antibiogramme a été réalisée conformément aux recommandations CA-SFM 2022. La production de BLSE et carbapénémases dans les isolats à Gram négatif a été détectée conformément aux recommandations du CA-SFM/EUCAST, tandis que les phénotypes de résistance à méthicilline (MR), macrolide-lincosamide-streptogramine B (MLS_B) et kanamycine-tobramycine-gentamicine (KTG) dans les isolats à Gram positif ont été détectés conformément à la norme du CLSI/CA-SFM.
Résultats: Cinquante patients ont été inclus (âge moyen: 53,7±12,2 ans; 82,0% de femmes). Le cancer du sein était la tumeur maligne la plus fréquente (64,0%). Les hémocultures étaient positives dans 8,0% (4/50) des cas, avec 2 isolats (50,0%) de *Staphylococcus aureus* et 2 isolats (50,0%) de *Salmonella* spp. Tous les isolats étaient entièrement sensibles aux antibiotiques testés, sans phénotype de résistance observé. L'évolution clinique était favorable dans tous les cas après un traitement antimicrobien ciblé.
Conclusion: La prévalence de la bactériémie chez les patients fébriles sous chimiothérapie au CNRAO était de 8,0%, ce qui est inférieur à la prévalence précédemment rapportée dans la population générale ivoirienne. Cependant, compte tenu de la petite taille de l'échantillon, ce résultat doit être interprété avec prudence. Néanmoins, l'hémoculture systématique reste essentielle pour optimiser la gestion des antibiotiques, prévenir la résistance et améliorer les résultats en oncologie, comme le souligne cette étude.

Mots-clés: Bactériémie; Chimiothérapie; Hémoculture; Résistance aux antibiotiques; Côte d'Ivoire

Introduction:

Bloodstream infection (BSI) is a severe condition defined as the host's systemic response to invading microorganisms and is characterized by dysfunction of organs distant from the primary site of infection (1). Bacteria are the most frequently implicated pathogens (2). Bacteremia refers to the presence of microorganisms in circulating blood, which is normally sterile (3). Clinical manifestations range from transient, asymptomatic or mildly symptomatic bacteremia to life-threatening BSI with high mortality (4). Accurate microbiological diagnosis of BSI relies primarily on blood culture, the gold-standard method for pathogen detection (5,6).

Infections in immunocompromised patients represent a major medical concern due to their heightened susceptibility to pathogens. Immunosuppression, whether primary (genetic or congenital) or secondary (resulting from medical treatments, infections or chronic diseases) impairs host defense mechanisms and increases both morbidity and mortality (7). For example, a 2004 study in the United States reported that cancer patients had a 3- to 4-fold higher risk of hospitalization for severe BSI compared to the general population (8). Cancer patients receiving chemotherapy are particularly vulnerable, as immunosuppression often blunts typical inflammatory signs of infection (9). In a 2017 study from Saudi Arabia, 13% of immunocompromised oncology patients required admission to intensive care units (10,11).

Early identification of the causative pathogen is crucial for guiding appropriate treatment, enabling rapid infection control, and minimizing unnecessary antibiotic use, thereby reducing the risk of antimicrobial resistance (12). Despite this, previous studies have highlighted the underuse of blood cultures in febrile patients in low- and middle-income countries (LMICs) (13). Barriers include financial, logistical, and infrastructural challenges, as well as concerns about low sensitivity (14). For instance, a 2017 study in Germany reported a blood culture positivity rate of 50.6% among patients with septicemia who had not received prior antibiotics (15).

In Côte d'Ivoire, the prevalence of bacteremia was estimated at 22.5% in a 2015 study conducted in Bouaké, mainly among a young population (16). However, data on bacteremia in patients undergoing chemotherapy remain scarce, leaving a critical gap in knowledge regarding this vulnerable group. This study aimed to evaluate whether the systematic use of blood cultures in febrile patients undergoing chemotherapy allows for rapid control of bacterial infections and, consequently, reduces inappropriate antibiotic use in this population. In this context, evaluating the microbiological profile of bacteremia among febrile cancer patients receiving chemotherapy is of major clinical importance. Such data provide essential insights into local epidemiology, inform the choice of empirical antibiotic therapy, and ultimately improve the management of immunocompromised patients.

The present study was therefore conducted at the National Center for Medical Oncology and Radiotherapy Alassane Ouattara (CNRAO) with the objectives of determining the prevalence of bacteremia, identifying the causative organisms, and assessing their antimicrobial resistance patterns.

Materials and method:

Study design and setting:

We conducted a cross-sectional descriptive study at the National Center for Medical Oncology and Radiotherapy Alassane Ouattara (CNRAO) in Abidjan, Côte d'Ivoire. CNRAO is a specialized oncology center offering outpatient consultations, chemotherapy and radiotherapy services, an in-house medical analysis laboratory, and inpatient care facilities. The study

was carried out over a six-month period, from July to December 2024.

Ethical consideration:

The study protocol was approved by the Ethics and Scientific Committee of the Faculty of Health Sciences, Félix Houphouët-Boigny University, Abidjan, Côte d'Ivoire.

Study population:

The study population comprised all patients undergoing chemotherapy who presented with fever and were either admitted to or consulted at the CNRAO during the study period.

Inclusion and exclusion criteria:

Patients were included if they provided informed consent, were undergoing chemotherapy with complete medical records, and had a febrile episode. Patients were excluded if blood sample collection was not feasible due to poor venous access or if they had a confirmed fungal or viral infection.

Sampling method and data collection:

An exhaustive sampling approach was used, including all eligible patients during the study period. Data were collected in three stages. First, patients presenting to the emergency consultation unit were screened, and those with fever ≥38.5 °C were selected. Second, medical records were reviewed to confirm chemotherapy status, and clinical and hematological data were recorded using a standardized questionnaire. Third, blood samples for culture were obtained after patient consent, and laboratory results were systematically linked to patient records.

The following data were collected for analysis; sociodemographic data (age, sex, tumor site, histology), clinical data (temperature, WHO performance status, presence of metastases, clinical outcome after bacteremia treatment), haematological data (complete blood count including leukocytes and neutrophils), therapeutic information (chemotherapy protocols, cycles, interval between cycles, and antibiotic use), and microbiological results (blood culture positivity, pathogen identification, and resistance phenotypes).

Blood culture and microbiological procedures:

Blood samples (10–20 mL) were collected by venipuncture under strict aseptic conditions into aerobic and anaerobic culture bottles. Samples were immediately transported to the microbiology laboratory and incubated in the BACT/ALERT automated system (BioMérieux, France). Positive cultures were examined by Gram staining, microscopy, and sub-cultured on appropriate media (blood agar, cooked blood agar/chocolate agar, and *Salmonella-Shigella* agar when indicated). Bacteria were identified based on morphological and biochemical characteristics.

Antibiotic susceptibility testing was performed using the disk diffusion method on Mueller-Hinton agar, following 2022 French Society for Microbiology (CA-SFM) guidelines. Bacterial suspensions were standardized to 0.5 McFarland, inoculated on MH agar plate, antibiotic discs applied, and plates incubated aerobically at 37°C for 24 hours. Inhibition zones were then measured and interpreted using CA-SFM guideline (17).

Phenotypic resistance screening:

ESBL and carbapenemase production were screened in *Salmonella* spp. according to EUCAST/CA-SFM recommendations (17,18). For *Staphylococcus aureus*, MRSA, MLS_B, and KTG aminoglycoside phenotypes were detected using disc diffusion methods in line with CLSI/CA-SFM standards (19).

Data analysis:

Data were entered and analyzed using EPI INFO software version 7.0. Tables and graphs were generated with Microsoft Excel 2016. Statistical analyses included the Chi-square and Fisher's exact tests where appropriate, with a significance level set at $p < 0.05$

Results:

Sociodemographic characteristics:

During the 6-month study period, a total of 50 febrile patients undergoing chemotherapy were included. The mean age was 53.7 ± 12.2 years (range: 28–70 years), with most patients (62.0%, n=31) aged 40–65 years. Females predominated (82.0%, n=41/50), resulting in a sex ratio (F/M) of 4.5. The most common cancer sites were the breast (64.0%, n=32), prostate (12.0%, n=6), and cervix (8.0%, n=4) (Table 1).

Table 1: Distribution of patients by cancer sites

Organ affected	Frequency (n)	Percentage (%)
Breast	32	64
Prostate	6	12
Cervix	4	8
Lung	3	6
Ovary	2	4
Liver	2	4
Salivary gland	1	2
Total	**50**	**100**

Clinical and haematological findings:

Most patients (54.0%, n=27) presented with moderate fever (38.5–38.9 °C), while 4.0% (n = 2) had temperatures of ≥40 °C. Based on the WHO performance status, 58.0% (29/50) had a score of 1, and 12.0% (6/50)

had a score of 3, indicating severe functional impairment. Metastatic disease was present in 72.0% (36/50) of patients. Haematological analysis showed leukopenia in 50.0% (25/50) and neutrophilia in 42.0% (21/50) of cases (Table 2).

Table 2:Clinical and haematological characteristics of patients

Variable	Category	N	%
Temperature (°C)	38.5–38.9	27	54.0
	39.0–39.4	12	24.0
	39.5–39.9	9	18.0
	≥ 40	2	4.0
WHO score	0–1	30	60.0
	2	14	28.0
	3	6	12.0
Metastases	Yes	36	72.0
	No	14	28.0
White blood cell count	Leukopenia	25	50.0
	Normal	18	36.0
	Hyperleukocytosis	7	14.0
Neutrophil count	Neutropenia	13	26.0
	Normal	16	32.0
	Neutrophilia	21	42.0

Microbiological findings:

Blood cultures were performed in all 50 patients, with 4 positive results (8.0% prevalence). Gram staining showed an equal distribution of Gram-positive cocci (50.0%, 2/4) and Gram-negative bacilli (50.0%, 2/4). The isolates were *S. aureus* (50.0%, n = 2) and *Salmonella* spp. (50.0%, n = 2). All isolates were susceptible to the antibiotics tested, with no resistance phenotypes observed, including MRSA, ESBL, carbapenemases, or KTG phenotype (Table 3).

Table 3: Microorganisms isolated from positive blood cultures

Pathogen	Frequency (n)	Percentage (%)
Staphylococcus aureus	2	50.0
Salmonella spp	2	50.0
Total	**4**	**100.0**

Clinical outcomes:

All patients with bacteremia received targeted antibiotic therapy guided by susceptibility results. Clinical outcomes were favorable in all cases, with no deaths recorded at two weeks post-treatment.

Discussion:

This study examined the microbiological profiles of bacteremia in febrile chemotherapy patients at the Alassane Ouattara National Center of Oncology and Radiotherapy (CNRAO), highlighting the enduring challenge of bloodstream infections in oncology care amid rising antimicrobial resistance. The prevalence of bacteremia observed in our cohort aligns with previous reports from sub-Saharan Africa,(20,21) although direct comparisons remain challenging due to variations in diagnostic capacity, patient populations, sample size and antibiotic use prior to blood culture collection. A study in Côte d'Ivoire conducted in Bouaké in 2015, reported a prevalence of 22.5% (16), whereas our findings among chemotherapy patients suggest a distinct epidemiological pattern.

Internationally, research indicates that immunocompromised patients, particularly those receiving chemotherapy, are at heightened risk of bloodstream infections due to neutropenia, mucosal barrier disruption, and repeated hospital exposures. Recent studies in Ghana and Nigeria, 2022–2024 confirm variable prevalence, highlighting regional epidemiological diversity (22,23). Our results align with international findings, high risk in immunocompromised patients, with emerging multidrug-resistant organisms (24-27).

A 2017 study in Saudi Arabia reported that 13.0% of immunocompromised oncology patients required admission to intensive care (10), which is consistent with the high morbidity associated with bacteremia in this population. Similarly, a German study showed positivity rates above 50.0% in patients with bloodstream infection prior to antibiotic initiation (15). The prevalence of bacteremia in our cohort is consistent with recent findings in oncology settings. Lopera et al., (24) in 2024 reported a high prevalence of multidrug-resistant organisms (MDROs) among blood cultures of patients with solid tumors, highlighting the growing challenge of resistance in bloodstream infections.

Our study revealed the presence of both Gram-positive and Gram-negative organisms. Recent studies show that Gram-negative bacilli are becoming more prevalent in immunocompromised patients. Herrera et al., (25) reported that Gram-negative pathogens are the leading cause of bacteremia in haematological patients, with many strains showing resistance to multiple antibiotic classes. A multicenter study by Falcone et al., (27) demonstrated that MDRO-related bacteremia leads to significantly higher mortality compared to susceptible strains (27–30%).These findings emphasize the clinical threat posed by resistant organisms in oncology care. A 2025 meta-

analysis further confirmed that *Escherichia coli*, *Klebsiella pneumoniae* and *Acinetobacter baumannii* exhibited alarmingly high resistance rates to third- and fourth-generation cephalosporins and even carbapenems in cancer patients (26). These recent data reinforce the relevance of our findings in Côte d'Ivoire.

Our findings suggest that systematic blood culture testing in febrile chemotherapy patients is essential not only for accurate diagnosis but also for guiding rational antibiotic therapy. Early pathogen identification allows clinicians to tailor antimicrobial regimens, thereby reducing unnecessary exposure to broad-spectrum drugs and limiting the risk of resistance (5,6). This study provides evidence supporting the integration of systematic blood culture protocols in oncology centers in Côte d'Ivoire and similar settings. Such measures could improve patient outcomes by enabling earlier and more targeted therapy (2,4). Additionally, surveillance data generated through routine blood culture use can inform local antibiograms, which are critical tools for guiding empiric therapy (12).

This study was conducted in a single institution with a limited sample size, which may restrict generalizability and calls for caution in interpreting our findings. Prior antibiotic exposure likely reduced culture positivity rates, consistent with recent international findings (25,26). Additionally, resource constraints limited the detection of fastidious and anaerobic organisms, potentially underestimating pathogen diversity.

Conclusion:

This study showed the significant burden of bacteraemia among febrile patients on chemotherapy at CNRAO. Our findings mirror recent global trends of bacteremia in febrile chemotherapy patients caused by Gram-negative and Gram-positive bacteria, increasingly resistant to multiple antibiotic classes, and associated with high mortality.

The results reinforce the importance of systematic blood culture use for improving diagnosis, guiding treatment, and informing antimicrobial stewardship policies. Such measures are essential to improve patient outcomes, curb antimicrobial resistance, and align oncology care in Côte d'Ivoire with international best practices. Future multicenter studies with larger cohorts are needed to capture the full epidemiological spectrum of bacteraemia in oncology patients across Côte d'Ivoire and the wider West African region

Contributions of authors:

CB designed the study and supervised data collection. AK and YT performed the laboratory analyses. JN carried out the statistical analysis. All authors contributed to drafting and revising the manuscript and approved the final version.

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Conflicts of interest:

The authors declare no conflict of interest in relation to this study.

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