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Bacteriological Profile of Positive Cultures from the Distal Ends of Non-Tunneled Central Venous Catheters at a Hemodialysis Center in Conakry

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Abstract

Introduction: The objective was to determine the prevalence of positive cultures from the distal ends of non-tunneled central venous catheters and to identify the causative pathogens. **Materials and Methods:** This was a prospective, descriptive study conducted over a 12-month period, during which we included all hemodialysis patients who had had a central venous catheter in place for at least 48 hours and who had undergone a bacterial culture of the distal end of the catheter. **Results:** Of the 87 catheter tips analyzed, 48 yielded a positive bacterial culture, representing a prevalence of 55%; these included 30 men and 18 women with a mean age of 36 years. *Staphylococcus aureus* (25%) was the predominant organism, followed by *Staphylococcus epidermidis* (19%), with a statistically significant association between redness ($p = 0.01$), fever ($p < 0.001$), chills ($p = 0.001$), the presence of pus ($p = 0.001$), and the occurrence of central venous catheter infections. *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* ssp. were the strains producing extended-spectrum β-lactamases encountered in our setting. **Conclusion:** Positive cultures from the distal ends of central venous catheters in hemodialysis patients were predominantly caused by *Staphylococcus aureus*, underscoring the importance of adhering to preventive measures and rigorous clinical monitoring of patients with catheters.

Keywords

Central Venous Catheter, Distal End Culture, Hemodialysis, Guinea

1. Introduction

Central venous catheters are essential tools in hemodialysis because they provide

immediate vascular access for urgent hemodialysis indications or in cases of temporary or permanent loss of arteriovenous fistula function [1].

Local infections associated with central venous catheters are defined as infections at the catheter insertion site without systemic spread, accompanied by a positive bacterial swab; whereas central venous catheter-related bacteremias are defined by the presence of positive blood cultures taken from the dialysis circuit during a session, in the absence of any other source of infection [2].

When a central venous catheter is used for hemodialysis, the risk of infection is three (3) times higher than with a prosthetic fistula (PF) and seven (7) times higher than with an arteriovenous fistula (AVF) [3].

In Morocco, in 2012, Alaoui reported a 43.3% rate of infections associated with temporary hemodialysis catheters [4].

In Senegal, Diagne reported a 34.5% incidence of infections associated with tunneled hemodialysis catheters in 2022 [5].

The objective was to determine the prevalence of positive cultures from the distal ends of non-tunneled central venous catheters and to identify the causative pathogens.

2. Materials and Methods

1. Study Setting:

The Donka National Hemodialysis Center served as the setting for this study.

2. Methods:

a. Study Design and Duration:

This was a descriptive cross-sectional study conducted from November 1, 2023, to October 30, 2024.

b. Overall population:

We included all patients on hemodialysis at the Donka National Hemodialysis Center.

c. Inclusion criteria:

We included all hemodialysis patients who had had a non-tunneled central venous catheter in place for at least 48 hours and who underwent a bacterial culture of the distal end of the catheter at the time of its removal.

Each patient was included only once.

d- Recruitment:

We conducted an exhaustive recruitment of all patients meeting our inclusion criteria.

e- Variables studied:

The variables studied were:

- epidemiological: (gender, age, occupation, marital status, catheter insertion site, catheter duration);

- clinical: (fever, redness and pain at the catheter insertion site, chills, soiled dressing and presence of pus, comorbidities);

- paraclinical: (positive or negative culture of the distal end of the catheter, type

of microorganism isolated).

- A culture was considered positive if bacterial growth was ≥ 10^3 colony-forming units per milliliter (CFU/mL).

- Procedure for sampling the distal end of the catheter:

a- Strict aseptic technique: hand hygiene, wearing a mask, a hairnet, and sterile gloves; disinfect the catheter insertion site before handling.

b- Catheter removal: Remove the catheter in one smooth motion without touching the distal end; avoid any contact between the distal end and the skin or other surfaces.

c- Catheter sectioning: Using sterile forceps and scissors, cut the final distal segment of the catheter (approximately 5 cm long) and place this segment into a sterile tube without additives.

d- Labeling and transport: All samples were correctly identified (patient name, date, time, catheterization site, catheter type) and promptly transported to the laboratory within two hours.

e- Culture technique for distal ends of central venous catheters:

Bacteriological analyses were performed at the Ignace Deen Pneumology and Phthisiology Laboratory. The VITEK 2 automated bacteriology analyzers and the BRUN Buisson quantitative method were used.

f- Data Analysis

Data entry, data collection, and the creation of tables and figures were performed using Word 2010 and Excel 2013.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 20. For quantitative variables, we calculated the mean and standard deviation; for qualitative variables, we examined the association between a variable and other parameters. The association was considered significant when the p-value was < 5%.

g- Limitations and Challenges

The unavailability of laboratory staff after 6:00 p.m. and the lack of a metagenomics facility limited the detection of certain microorganisms that are difficult to culture.

The lack of blood cultures prevented the identification of a catheter-related infection.

h- Ethical considerations: Informed consent was obtained from patients, and the data were used for purely scientific purposes.

3. Results

At the conclusion of our study, of the 87 catheter segments analyzed, 48 tested positive in bacterial culture, representing a prevalence of 55% (**Figure 1**).

The mean age of the patients in our study was 36 years; the majority were male (30 men and 18 women), accounting for 62% of the total; 41% were self-employed; and 93% were married (**Table 1**).

The main clinical symptoms were fever (47%), followed by redness (45%), pain

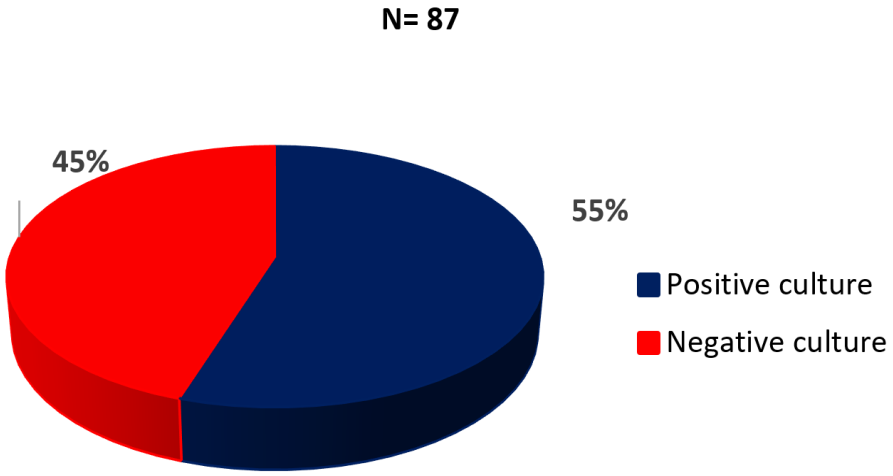

Figure 1. Prevalence of central venous hemodialysis catheters with positive culture results.

Table 1. Distribution of patients by sociodemographic characteristics.

Sociodemographic Characteristics	Sample Size (N = 48)	Percentage (%)
Age in years		
<20	3	7
20 - 39	20	41
40 - 59	18	38
≥ 60	7	14
Gender		
Male	30	62
Femal	18	38
Occupation		
Self-employed	20	41
Housewives	17	35
Civil servant	8	17
Student	3	7
Marital status		
Married	45	93
Single	2	4
Widower/Widow	1	3

at the catheter insertion site (38%), chills (38%), a soiled dressing (35%), and the presence of pus (29%).

Comorbidities were dominated by hypertension and diabetes, with prevalence rates of 31% and 22%, respectively.

Suspected infection was the leading reason (46%) for catheter removal, followed by the placement of a tunneled catheter and a functional arteriovenous fistula, with prevalence rates of 33% and 10%, respectively.

The average duration of single-lumen catheters was 38 days.

Gram-positive cocci were the most frequently isolated microorganisms, with *Staphylococcus aureus* being the most common (25%), followed by *Staphylococcus epidermidis* (19%), Staphylococcus haemolyticus (13%), and 6% each of *Staphylococcus cohnii* ureolyticus and *Kocuria rosea*.

Sphingomonas paucimobilis (13%) topped the list of Gram-negative bacilli, followed by *Rhizobium radiobacter*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*, each at a frequency of 6% (Table 2).

Table 2. Breakdown of patients by isolated pathogens.

Isolated Sprouts	Sample Size (n = 48)	Percentage (%)
Staphylococcus aureus	12	25
Rhizobium radiobacter	3	6
Sphingomonas paucimobilis	6	13
Staphylococcus cohnii ssp. Urealyticus	3	6
Staphylococcus epidermidis	9	19
Staphylococcus haemolyticus	6	13
Pseudomonas aeruginosa	3	6
Klebsiella pneumoniae ssp.	3	6
Kocuria rosea	3	6

These cocci are the most commonly isolated bacteria from catheter-related infections and colonization due to their ability to adhere to surfaces and form a biofilm.

We found no statistical association between age, sex, occupation, marital status, diabetes, hypertension, duration of catheterization, pain at the insertion site and the occurrence of central venous catheter colonization.

A positive culture from the distal end of the catheter was significantly associated with the presence of redness at the insertion site ($p = 0.01$), fever ($p < 0.001$), chills ($p = 0.001$) and purulent discharge ($p = 0.001$).

Pseudomonas aeruginosa and *Klebsiella pneumoniae* ssp. were the strains producing extended-spectrum β-lactamases encountered in our setting.

4. Discussion

In total, we recorded 87 central venous catheters that were cultured, of which 48 had positive cultures, representing a prevalence of 55%.

In France, Leou reported a prevalence of 17.6% in 2013, while Neji reported a rate of 30% for central venous catheter-related infections in 2021 [2] [6].

In Senegal, Diagne reported a prevalence of 34.5% in 2022 [5].

This shows that central venous catheter infections remain prevalent in hemodialysis, with rates varying by country.

The mean age of our patients is lower than that reported by Faisail in 2006 and by Rafik in 2016, who reported mean ages of 75.6 years and 55 years, respectively [7] [8].

This difference may be due to the fact that kidney disease tends to occur in younger individuals in developing countries, whereas in developed countries it tends to occur in older individuals.

As in our study, Rafik observed a male predominance with a sex ratio of 2.08, in contrast to Diagne in Senegal, who noted a female predominance (sex ratio of 0.88) [5] [8].

The main comorbidities were hypertension and diabetes, with prevalence rates of 31% and 22%, respectively. In France in 2021, Neji reported rates of 54% for hypertension and 43% for diabetes [6].

-The primary reason for catheter removal was suspicion of infection (46%), as reported by Izoard, where 8.5% of central venous catheters were removed due to infection, compared with 1.2% for kidney transplantation [3].

Among the identified pathogens, *Staphylococcus aureus* ranked first (25%), followed by *Staphylococcus epidermidis* (19%), with *Sphingomonas paucimobilis* and Staphylococcus haemolyticus each accounting for 13% of cases.

As noted in our study, Nasri (2025) observed in his study that *Staphylococcus aureus* was the most frequently isolated microorganism (23.5%), and Izoard (2017) also reported that *Staphylococcus epidermidis* and *Staphylococcus aureus* accounted for 73% of the bacteria responsible for catheter-related bacteremias [3] [9].

In contrast, Rafik noted that *Staphylococcus epidermidis* was the most commonly implicated pathogen, accounting for 44.4% of cases involving infected catheters [8].

In accordance with the data from our study, Randriamanantsoa reported in 2011 that the occurrence of catheter-related infections was not associated with age ($p = 0.51$), gender ($p = 0.71$), or sex ($p = 0.22$) [1].

We did not observe a statistically significant association between a positive culture of the distal end of the catheter and the duration of catheterization ($p = 0.54$), consistent with the findings of Izoard *et al.* (2017), who found no significant difference between catheters left in place for less than 45 days and those used for 45 days or more [3].

A positive culture of the distal end of the catheter was significantly associated with the presence of redness at the insertion site ($p = 0.01$), fever ($p < 0.001$) and purulent discharge ($p = 0.001$).

5. Conclusion

We found positive bacterial cultures in 55% of the catheters analyzed, with *Staphylococcus aureus* being the most common (25%), followed by *Staphylococcus epidermidis* (19%). Given the statistical association between clinical symptoms and positive culture results, emphasis should be placed on clinical monitoring.

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Author Contributions

All authors contributed to this study.

Conflict of Interest

There is no conflict of interest.

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