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An Unforeseen Offender: *Rhizobium radiobacter* Bacteremia in Catheterized Patients

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A B S T R A C T

Catheter-related bloodstream infections (CRBSIs) are a major cause of morbidity in patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis. We report the case of a 19-year-old female with bilateral grade IV CKD and end-stage renal disease (ESRD) on hemodialysis via a right internal jugular vein (IJV) catheter, who presented with fever, nausea, and vomiting. Blood cultures obtained from the central line and peripheral vein flagged positive with a 2.5-hour differential time to positivity. Gram staining and culture revealed Gram-negative bacilli, later identified by MALDI-TOF MS as Rhizobium radiobacter, an emerging opportunistic pathogen. Antimicrobial susceptibility testing demonstrated susceptibility to cotrimoxazole, fluoroquinolones, cefepime, meropenem, and minocycline, but resistance to ceftazidime and amikacin. The patient was treated with cefoperazone-sulbactam and catheter removal, following which repeat blood cultures were sterile. *R. radiobacter*, once considered a contaminant, is increasingly recognized as a true pathogen in immunocompromised hosts with indwelling intravascular devices due to its ability to adhere to silicone surfaces. This case highlights the importance of considering R. radiobacter as a potential cause of CRBSI in hemodialysis patients and emphasizes prompt diagnosis, appropriate antibiotic therapy, and catheter removal as critical components of management.

Introduction

Rhizobium species (previously classified as *Agrobacterium* species) are plant pathogens that typically cause tumorigenic disease. This genus includes five species: *Rhizobium radiobacter, Rhizobium rhizogenes, Rhizobium rubi, Rhizobium undicola,* and *Rhizobium vitis*. Among them, *Rhizobium radiobacter* is an opportunistic pathogen, that has been widely recognized in humans (Tiwari and Beriha, 2015). It is often associated with catheter-related bacteremia, septicemia, peritonitis related to dialysis, urinary tract infections and pneumonia (Chen *et al.,* 2008; Egemen *et al.,* 2012). Here we are reporting a case of catheter-related bloodstream infection (CRBSI) in a patient on dialysis.

Case report

A 19-year-old female, a known case of bilateral (B/L) grade IV chronic kidney disease (CKD) with end-stage renal disease (ESRD) on maintenance haemodialysis via a right internal jugular vein (IJV) un-tunneled catheter, presented with fever during dialysis, along with nausea and vomiting for one week.

Since childhood, she had a history of frothy urine and daily nocturnal enuresis, which had increased in frequency to five times per night. She also had bilateral eye disc coloboma with horizontal nystagmus, hypertension, and anaemia. On examination, the patient was conscious, oriented, and afebrile, with stable vitals except for elevated blood pressure (BP) of 148/90 mmHg. Laboratory investigations revealed hemoglobin-8.6g/dl, urine protein-545mg/day and protein/creatinine ratio-8.3, WBC count-3720/µL, platelet-218000/µL. Due to the high-grade fever during dialysis, paired blood samples were collected from the central line and a right venipuncture for culture. The two bottles flagged positive with a differential time to positivity of 2.5hours. Gram-staining and subcultures were performed on 5% sheep blood agar and MacConkey agar. Gram staining showed Gram-negative bacilli, circular, non-hemolytic colonies on 5% sheep blood agar and mucoid, non-lactose fermenting colonies on MacConkey agar (Figure 1).

Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) identified the organism as *Rhizobium radiobacter* and antimicrobial susceptibility testing (AST) was performed using the VITEK 2 system. The organism was susceptible to cotrimoxazole, levofloxacin, ciprofloxacin, cefepime, meropenem, and minocycline; resistant to ceftazidime and amikacin; and intermediate to cefoperazone-sulbactam. Based on the AST report, the patient was started on cefoperazone-sulbactam, the catheter was removed. A repeat blood culture was sent after 8 days and it was sterile.

Results and Discussion

Rhizobium species are aerobic, non-spore-forming, Gram-negative bacilli once thought to be lab contaminants or colonizers until the 1980s. They were later identified as true pathogens, especially in patients with silicone devices (Tiwari and Beriha, 2015).

Their ability to stick to silicone by forming strong slime, similar to *Staphylococcus aureus*, explains their link to indwelling devices (Chen *et al.,* 2008) Today, *Rhizobium* is seen as an emerging opportunistic pathogen, mainly affecting immunocompromised or chronically ill patients with conditions like cancer, chronic kidney disease, HIV, or bone marrow transplants. Corticosteroid use and diabetes are also risk factors (Tiwari and Beriha, 2015; Halas *et al.,* 2017; Ponnapula *et al.,* 2013).

Mastroianni *et al.,* (1996) reported 34 Rhizobium infections (1980–1996), and Paphitou *et al.,* (2003) added eight more (1996–2002) Of the 42 total cases, 71% (30) involved bacteremia; 77% of these had indwelling intravascular devices, including 40% (10) with a central venous catheter (CVC). These findings indicate that catheter-related bloodstream infections are the primary route of *Rhizobium radiobacter* infection, especially in immunocompromised patients with indwelling devices, even temporary CVCs.

A meta-analysis conducted by Guo *et al.,* (2024) assessed the correlation between renal disease and CRBSI, revealing that renal disease significantly increases the risk of CRBSI ($P = 0.0006$). However, the study showed a significant association ($P = 0.0002$) with dialysis and the risk increases with the duration. Compared to hemo-dialysis patients with arteriovenous fistulae, those with central venous catheters have a 15-fold higher risk of infection. The relationship between catheter type and the development of CRBSI is complex, as fibrin sheath formation begins within 24 hours of catheterization, and thrombus formation inside the catheter facilitates bacterial colonization and hematogenous seeding.

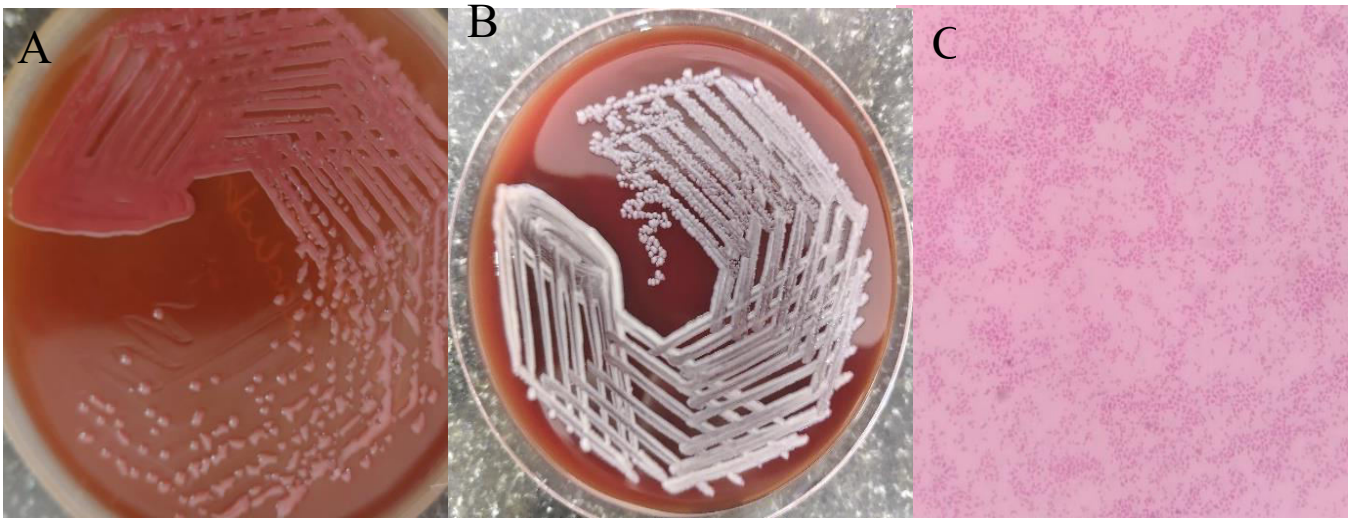
R. radiobacter bacteremia is usually community-acquired and linked to central venous catheters (CVCs). Though it's a soil-based plant pathogen, soil or plant exposure can't be ruled out in our case.

Blood cultures from both the central line and peripheral vein showed a 2.5-hour differential time to positivity, confirming catheter-related bloodstream infection (CRBSI). The patient's renal disease, dialysis, and internal jugular vein (IJV) catheter were additional CRBSI risk factors.

Currently, there is limited research to guide antibiotic treatment for *R. radiobacter* infections (Halas *et al.,* 2017). Lai *et al.,* (2004) analysed 13 isolates, which were susceptible to cefepime, piperacillin-tazobactam,

imipenem, meropenem, and ciprofloxacin, while susceptibility to ampicillin-sulbactam, ceftazidime, cefotaxime, aztreonam, and amikacin varied. Previous studies also report aztreonam resistance among *Rhizobium* species (Mastroianni *et al.,* 1996). Our isolate was susceptible to cotrimoxazole, levofloxacin, ciprofloxacin, cefepime, meropenem, and minocycline; resistant to ceftazidime and amikacin; and showed intermediate sensitivity to cefoperazone-sulbactam. Infectious Diseases Society of America (IDSA) guidelines recommend considering catheter removal in *Rhizobium* bacteremia, especially if it persists despite appropriate antibiotics or if the patient's condition worsens (Mermel *et al.,* 2001).

Figure.1 A-MacConkey agar showing pale pink mucoid colonies, B- blood agar showing non-hemolytic colonies, C-Gram stain showing gram-negative bacilli.



Rhizobium radiobacter is a Gram-negative bacillus that causes catheter-related bloodstream infections, with immunocompromised and chronically ill patients being at higher risk. There are no clear guidelines for antimicrobial therapy or the removal of foreign bodies in treatment. However, serious consideration should be given to catheter removal alongside antibiotic therapy to improve patient outcomes.

Author Contributions

Archana Murali: Investigation, formal analysis, writing—original draft. Jayagandan Sangitha: Validation, methodology, writing—reviewing. K. P. V. Hyma:—Formal analysis, writing—review and editing. A. Benedict Vinothini: Resources, investigation writing—reviewing. Divya Patale: Validation, formal analysis, writing—reviewing. Sreejith Parameswaran: Conceptualization, methodology, data curation, supervision, writing—reviewing the final version of the manuscript. Apurba Sankar Sastry: Investigation, formal analysis, writing—original draft.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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