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Case Report

Catheter-Related Bloodstream Infection in Hemodialysis Patient due to *Atlantibacter hermannii*

Preslava M. Hristova[a] Alexandra S. Alexandrova[b] Martin Lucanov[c] Hristina Y. Hitkova[a] Biser Kirilov Borisov[d]

[a]Department of Microbiology and Virology, Medical University – Pleven, Pleven, Bulgaria; [b]Department of Medical Microbiology, Medical University of Sofia, Sofia, Bulgaria; [c]Department of Cardiology, Medical University – Pleven, Pleven, Bulgaria; [d]Department of Nephrology and Dialysis, Medical University – Pleven, Pleven, Bulgaria

Keywords
Hemodialysis · *Atlantibacter hermannii* · Catheter-related bloodstream infection

Abstract
Atlantibacter hermannii, previously known as *Escherichia hermannii*, is a rare causative agent of human infections. Several reports testify that the most frequently infected patients are immunosuppressed, especially those undergoing hemodialysis. A 34-year-old man with an end-stage renal disease complained of chills, fever, and general fatigue at the end of a regular hemodialysis session. The echocardiographic examination showed vegetation located on the dialysis catheter in the right atrium. Empirical therapy was initiated with intravenous gentamicin, and after the isolation of the agent, the treatment was continued with intravenous imipenem/cilastatin. The blood cultures and the tip of the replaced catheter were positive for *A. hermannii*, identified by Vitek 2 Compact. Verification of the automated identification was performed using 16S sequencing. The 16S sequence product was used to query the NCBI bacterial database and revealed 99.75% identity to that of *A. hermannii* strain CIP 103176 16S ribosomal RNA in the NCBI GenBank database. The antimicrobial susceptibility results revealed resistance to aminopenicillins and susceptibility to all other tested antimicrobials. To our knowledge, this is the first report of catheter-related vegetation with echocardiographic confirmation and the successful eradication of *A. hermannii* infection in a patient undergoing hemodialysis with imipenem/cilastatin.

Correspondence to:
Preslava M. Hristova, preslavahristova@outlook.com

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Introduction

Atlantibacter hermannii, previously known as *Escherichia hermannii*, is a Gram-negative, non-spore-forming, motile bacteria found in a diverse range of habitats, including host-associated, aquatic, and terrestrial sites. The microorganism was reclassified as a species of a new genus *Atlantibacter* within the *Enterobacterales* family in 2016 after identifying biochemical and genomic differences from *Escherichia coli* [1].

A. hermannii was initially considered non-pathogenic bacteria. According to the recent literature, it has been reported as a human pathogen in cases of bloodstream infections (BSIs), urinary tract infections, purulent conjunctivitis, osteomyelitis, and cephalohematoma [2–5]. Several reports testify that the most frequently infected patients are immunosuppressed, especially those undergoing hemodialysis [6, 7].

Case Presentation

A 34-year-old Caucasian man with an end-stage renal disease complained of chills, fever, and general fatigue at the end of a regular hemodialysis session conducted at the Department of Hemodialysis of Dr. Georgi Stranski University Hospital, Pleven, Bulgaria, in August 2022. The medical record revealed that the patient had a congenital anomaly of the upper urinary tract (bilateral megaureters) and due to the renal failure he was undergoing hemodialysis since February 2019. A tunneled catheter in the right internal jugular vein was inserted because other vascular accesses were exhausted. Also, the patient had bilateral nephrostomy tubes that were being changed every 4 months.

Physical examination demonstrated that the patient was febrile (39.2°C) with a normal pulse rate (80/min) and arterial pressure (140/80 mm/Hg). The laboratory tests were as follows: white blood cells 7.2×10^9/L with 89% neutrophils, C-reactive protein 145 mg/L, hemoglobin 89.0 g/L, erythrocytes 2.7×10^{12}/L, hematocrit 0.28 L/L, platelets 184×10^9/L, and creatinine clearance <5 mL/min. The echocardiographic examination showed a normal dimension of the heart cavities, without any valvular lesions. In addition, vegetation located on the dialysis catheter in the right atrium was visualized (shown in Fig. 1).

Empirical therapy was immediately initiated with intravenous (IV) gentamicin (1 mg/kg following each dialysis). After the isolation and confirmation of the infection agent, the treatment was continued with IV imipenem/cilastatin 500 mg once daily for 2 weeks. The tunneled catheter was replaced with a new one over the guidewire after 72 h without a fever. A fibrin sheath (a vegetation) was formed over the tip of the catheter (shown in Fig. 2). Levofloxacin per os 500 mg once daily and fluconazole per os 150 mg once every second day were prescribed for at-home treatment. The patient continued with the routine hemodialysis sessions in the Department of Hemodialysis, and no further signs of infection or any deterioration of his condition was detected.

The blood cultures were performed using BD BACTEC™ Plus Aerobic/F (Becton, Dickinson, and Company, Sparks, MD 21152), and BD BACTEC™ Plus Anaerobic/F bottles incubated in BACTEC 9120 Blood Culture System (Becton, Dickinson, and Company, Sparks, MD 21152). A total of 4 paired blood samples were obtained prior to initiation of antibiotic therapy: 2 from the catheter and 2 from a peripheral vein. Three aerobic and all 4 anaerobic blood culture bottles turn positive in the first 24 h of incubation. Lactose-fermenting, indole-positive colonies with yellow pigment grew on the culture media. Gram-negative rods were visualized, and *A. hermannii* was identified by the Vitek 2 Compact system (bioMerieux, France). The following biochemical tests for the pathogen were positive: motility,

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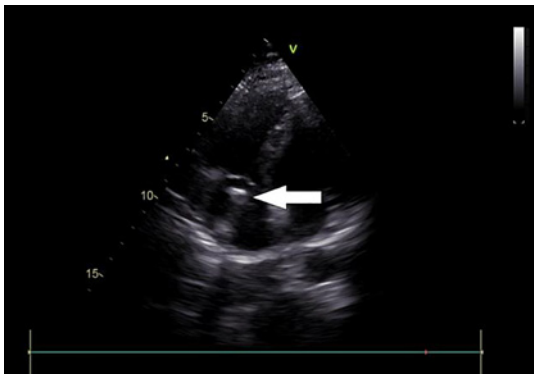

Fig. 1. Transthoracic echocardiography (apical 4-chambers view) showing vegetation (arrow) with dimensions 14/18 mm below the leaflets of the tricuspid valve connected to the catheter in the right atrium.

fermentation of D-glucose, lactose, L-rhamnose, D-maltose, D-cellobiose, D-trehalose, D-mannitol, presence of ß-galactosidase, and ornithine decarboxylase.

Semiquantitative (roll-plate) culture of a segment from the replaced catheter tip was performed. More than 15 CFU grew on the culture media. The urine sample from nephrostomy was negative for *A. hermannii* and the presence of other microbial agents was not detected.

Verification of the automated identification with Vitek 2 Compact was performed using 16S sequencing. The PCR was conducted with a primer set suitable for amplification of the 16S region in the *A. hermannii* genome, as described previously [8]. The PCR product was purified using the Exo-CIP™ Rapid PCR-Cleanup kit (New England Biolabs, USA) before it was sequenced. Nucleotide sequencing of both strands of the PCR amplicon was performed using an ABI 3,500xl Genetic Analyzer (Applied Biosystems, USA). The 16S sequence product was used to query the NCBI bacterial database using BLASTn (http://blast.ncbi.nlm.nih.gov) and revealed 99.75% identity to that of *A. hermannii* strain CIP 103176 16S ribosomal RNA in the NCBI GenBank database.

The antimicrobial susceptibility test was performed by using ATS-N222 card on a Vitek 2 compact (bioMerieux, France), and minimum inhibitory concentrations were reported by the system automatically. The results were interpretate according to the recommendations of the European Committee on Antimicrobial Susceptibility Testing (EUCAST Breakpoint Tables for Interpretation of MICs and Zone Diameters, version 12.0, 2022, http://www.eucast.org/clinical_breakpoints/). *A. hermannii* was susceptible to piperacillin/tazobactam, ceftazidime, cefepime, imipenem, meropenem, amikacin, gentamicin, tobramycin, ciprofloxacin, trimethoprim/sulfamethoxazole, and colistin and resistant to piperacillin (antimicrobial susceptibility testing of the isolated *A. hermannii* is shown in Table 1). The CARE Checklist has been completed by the authors for this case report, attached as supplementary material (for all online suppl. material, see https://doi.org/10.1159/000533581).

Discussion

Catheter-related BSIs are serious complications among patients undergoing hemodialysis. The data from Ioannou's metanalysis [2] revealed that 4 (57.1%) out of 9 patients with bacteremia caused by *A. hermannii* had a central venous catheter (CVC). According to the latest guidelines of the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) [9], the definition of catheter-related BSI includes the presence of clinical manifestations (chills, general fatigue, hypotension, and an increase in body temperature) during the next dialysis session and at least one positive blood culture. The blood

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Fig. 2. A fibrin sheath (a vegetation) over the tip of the catheter.

Table 1. Antimicrobial susceptibility testing of *A. hermannii* isolated from a patient with an end-stage renal failure

Antimicrobial agent	Susceptibility	MIC, μg/mL
Piperacillin	R	8
Piperacillin/tazobactam	S	≤4
Ceftazidime	S	≤1
Cefepime	S	≤1
Imipenem	S	≤0.25
Meropenem	S	≤0.25
Amikacin	S	≤2
Gentamicin	S	≤1
Tobramycin	S	≤1
Ciprofloxacin	S	≤0.25
Trimethoprim/sulfamethoxazole	S	≤20
Colistin	S	≤0.5

culture should be taken from dialysis circuit or vein (peripheral source), and the semi-quantitative (>15 CFU) or quantitative (>10^2 CFU) cultures from the catheter segment (e.g., hub or tip) must be positive for the same pathogen isolated from blood samples of the peripheral source.

A Japanese study [10] investigated a strain of *A. hermannii* isolated from a patient with persistent apical periodontitis lesion and found that the pathogenicity of this microorganism was associated with the production of biofilm-like structures. Rank et al. [11] also reported a suspected biofilm formation on a tunneled catheter in a patient undergoing hemodialysis. In the current study, the echocardiographic examination confirmed vegetation on the dialysis catheter, suggesting the production of a biofilm from the bacteria.

The CVC must be immediately removed in patients that are clinically and hemodynamically unstable; with persistent fever or/and bacteremia 48–72 h after application of systemic antibiotics; that have metastatic complications (such as endocarditis, suppurative thrombophlebitis) or/and infections due to *Staphylococcus aureus*, *Pseudomonas aeruginosa*, mycobacteria, or fungi; and those that have an infection on the tunnel-site [9, 12]. Replacement of the patient's catheter over the guidewire was done due to existing catheter-

related sepsis, caused by the potentially problematic, opportunistic agent *A. hermannii* and lack of evidence for infection on the exit bore or the subcutaneous tunnel of the CVC.

The antimicrobial susceptibility results revealed resistance only to aminopenicillins and susceptibility to all other tested antimicrobials. Similar findings were reported also in other studies [3, 5, 6, 11]. In 50% of the BSIs caused by *A. hermannii*, aminoglycosides were used to treat the patients. Following the recommendations to avoid and minimize the nephrotoxic effects of aminoglycosides and to preserve the residual renal function of the patient [13, 14], we decided to replace the IV administration of gentamicin with imipenem/cilastatin.

Conclusions

To our knowledge, this is the first report of catheter-related vegetation with echocardiographic confirmation and the successful eradication of *A. hermannii* infection in a patient undergoing hemodialysis with the combination of imipenem/cilastatin.

Statement of Ethics

The study was approved by the Local Ethics Board of Medical University – Pleven. Data processing was anonymized and complied with local data protection legislation (No. 5/2022) and with the European Directive on the Privacy of Data (95/46/EC). Written informed consent was obtained from the patient for publication of this case report and any accompanying images in accordance with the Declaration of Helsinki.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

P.H. and B.B. contributed to the study conception and design. Material preparation and data collection and analysis were performed by P.H., A.A., and B.B. The first draft of the manuscript was written by P.H. and B.B., and all authors commented on previous versions of the manuscript. The final review was done by P.H., A.A., and B.B. All authors also read and approved the final manuscript.

Data Availability Statement

All data generated during this study are included in this published article. Further inquiries can be directed to the corresponding author.

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