

## Multidrug-Resistant *Pseudomonas aeruginosa* Infection of Central Venous Catheter in a Patient with KDIGO V Chronic Kidney Disease Receiving Hemodialysis Treatment: A Case Report and Literature Review

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### Abstract

**Background:** *Pseudomonas aeruginosa* is a Gram-negative opportunistic bacterium with wide distribution around the world capable of both aerobic and anaerobic growth that may become Multidrug Resistant (MDR). It is typically associated with nosocomial infections in patients with serious underlying conditions and most notably in immunocompromised individuals, though; it is not a common infectious agent in central venous catheters (CVC) of patients receiving hemodialysis treatment, however, infection of CVC is a well-known complication in patients with end stage chronic kidney disease.

**Case Study:** The current article is a retrospective study that presents a case of a 63-year-old male patient with KDIGO V chronic kidney disease that presented multidrug resistant *Pseudomonas aeruginosa* infection of CVC; exposing evaluation of transmission and treatment and making mention of American, Spanish and Mexican guidelines regarded to vascular acces management for prevention of bacteremia an infection.

**Result:** Patient is currently asymptomatic, with remission of the infection and after catheter removal receiving his usual hemodialysis therapy with a functional Cimino-Brescia fistula.

**Conclusion:** MDR microorganisms such as *Pseudomonas aeruginosa* are a public health problem secondary to antibiotic resistance, it is necessary to implement the strict care of vascular acces following the recommendations of national and international guidelines to reduce the morbidity and mortality generated by infection of CVC.

**Keywords:** Bacteria; Central venous catheter; Chronic kidney disease; KDIGO; Gram negative; Hemodialysis; Infection

### Introduction

*Pseudomonas aeruginosa* is a gram-negative opportunistic bacterium with wide distribution around the world capable of both aerobic and anaerobic growth that makes it capable of becoming Multidrug Resistant (MDR) [1-8]. It is typically associated with nosocomial infections in patients with serious underlying conditions and most notably in immunocompromised individuals, though it is not a common infectious agent in central venous catheters (CVC) of patients in hemodialysis treatment [2]. There are several articles and epidemiological registers that list as most common microorganisms associated to catheter infections *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus* spp, *Enterococcus* spp, *Corynebacterium* spp, and micotic organisms as *Candida* spp [4-22].

Infections related to CVC are a serious public health problem due to their high morbidity and mortality, and most importantly because they are potentially preventable with proper protocols and aseptic techniques as well as management strategies for care and use of the catheters [4,22].

Bacteremia and infection of CVC is a well-known complication due to the type of catheter, time of use, associated co-morbidity, and general care of the line as well as asepsia and methods of cleaning and management of the CVC [18,22]. Guidelines from Mexico, Spain and US have similar strategies for the management of central and peripheral vascular acces, but the strict application of these guidelines is far away from the daily clinical practice. Likewise, patients with Chronic Kidney Disease (CKD) have a notable state of immunosuppression with a certain higher risk of CVC infection than other patients who require CVC for other reasons [4]. Changes of temperature, pH, and catheter lack of cautions such as wetting, unusual cleaning added to the normal

state of immunosuppression in patients with CKD, predisposes to the dissemination of bacteria with consequent bacteremia and infection [2-18].

The current article is a retrospective study that presents a clinical case of a 63-year-old male patient with KDIGO V chronic kidney disease that presented multidrug-resistant *Pseudomonas aeruginosa* infection of CVC; exposing risk factors, diagnosis, clinical evolution and treatment as well as the clinical outcomes. We also comparatively evaluated the central and peripheral vascular acces guidelines from México, Spain and the US, emphasizing on which of the recommendations were followed and which of them should have been taken into consideration not only for prevention of bacteremia and infection in our patient, but also for the early treatment and improvement of the clinical status of the patient and diminish of complications.

### Case Report

A 63-year-old male patient from Puebla, México with end stage chronic kidney disease diagnosed four years ago secondary to diabetic nephropathy receiving treatment with hemodialysis three times a

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week, central venous “Mahurkar” catheter was placed in May of 2015 in the internal right jugular with no checkups or replacement, he is also diagnosed with long-term hypertension treated with nifedipine and candesartan, diabetes mellitus type 2 diagnosed 15 years ago without treatment and chronic anemia. He came to the hemodialysis department unit for usual treatment clinically and hemodynamically stable, vital signs within normal range and no fever. 20 minutes after the beginning of the procedure he presented chills, fever ranged 38°C to 38.9°C (102.2°F), generalized tremor, cold sensation, headache, asthenia, dyspnea, decrease in partial oxygen saturation PaO<sub>2</sub> and tachycardia; 10 mg metazolone was applied in bolus and 2 blood samples were collected for culture study, one from each lumen of the catheter as well as one peripheral blood culture. Patient was discharged after hemodialysis treatment locking catheter with 100 mg amikacin; ambulatory empirical treatment was indicated with 500 mg oral dicloxacillin every twelve hours until culture results came out. Clinical history high lightened patient presented one year ago bacteremia data treated with ceftriaxone 10 doses during hemodialysis treatment, no blood cultures were taken or reported at that time. Blood cultures reported *Pseudomonas aeruginosa*. Our patient presented again to his hemodialysis treatment presenting bacteremia, fever and tremor despite empirical treatment, because of which, after finishing treatment and because fever persisted catheter was removed, and culture of the catheter was performed reporting as well *Pseudomonas aeruginosa*. An antibiogram for 23 antibiotics was made demonstrating resistance for 21 antibiotics and low sensibility for carbapenem and amikacin; thence, he was diagnosed with multidrug resistant *Pseudomonas aeruginosa* infection. He was hospitalized for intravenous treatment starting combination with carbapenem-amikacin for two weeks.

A temporal left jugular catheter was placed for hemodialysis, patient received 3 renal replacement therapies without bacteremia data and new blood cultures were performed after one and a half week intravenous treatment, reporting *Pseudomonas aeruginosa* and *Staphylococcus epidermidis* infection, this last one with high sensitivity for usual antibiotics, although multiresistance for *Pseudomonas aeruginosa* persisted, in consequence, an alternative therapy was establish with intravenous carbapenem and gentamicin, extending IV antibiotic therapy for 21 days during treatment patient presented bacteremia in two more ocations. Two weeks after new blood cultures from catheter and peripheral vein were performed reporting negativity for such pathogen. Patient evolved favorably and then was discharged after 2 negative blood cultures and no fever or bacteremia data. Left jugular catheter remained functional; it was decided then to perform aseptic measures with clorhexidine in every further hemodialysis and antibiotic lock with 100 mg amikacin. However, as a request from the patient and his relatives a radiocephalic cimino-brescia fistula was surgically performed in left arm and two months after ripening it, left CVC was retired. His fistula is functional and then patient remains asymptomatic.

## Discussion

The pathogenesis of catheter-related infection is multifactorial and complex. It's well known that the pathway primarily involved in infection related to long-term hemodialysis catheters is endoluminal colonization [23]. As mentioned before, *Pseudomonas aeruginosa* is not a common bacterium related to catheter infection in patients receiving hemodialysis treatment. Where by the daily procedure of hemodialysis treatment requires a great manipulation of the connection lines, which facilitates the colonization with the epithelial microbiota of the patient or of the sanitary personnel that manipulates it [8,24]. Microorganisms

can also be accessed endoluminally within the CVC after the infusion of a contaminated liquid or after hematogenous spread from a distant point of infection [24].

The suspicion and diagnosis of catheter-related infection is based on the presence of clinical, local and systemic symptoms of infection [2-6]. Frequent clinical findings, such as fever, have a high sensitivity but very low specificity, while inflammation or the presence of purulent exudates around the point of insertion show greater specificity, although little sensitivity [6]. In several cases diagnosis of infection related to CVC involves the therapeutic decision of the withdrawal of this. Thereby critically ill patients or with limited vascular access, can be compromised. Therefore, conservative diagnostic techniques have been developed, such as quantitative blood cultures extracted through the CVC and venipuncture, and the study of the differential time between the conventional blood culture bottles extracted simultaneously through the CVC and venipuncture [14].

Our patient had high blood pressure, diabetes mellitus and end stage chronic kidney disease receiving treatment with hemodialysis, these underlying conditions added to the immunosuppression state in patients with chronic diseases, predisposed to the presented infection [23]. *Pseudomonas aeruginosa* is a gram-negative opportunistic bacterium capable of both aerobic and anaerobic growth that may become multidrug resistant (MDR) and has a high probability to produce biofilm [3,24]. It has remained as first etiologic agent of multiple infections associated with health care and that it's common to become MDR. *Pseudomonas aeruginosa* produces different of resistance mechanisms to antibiotics, such as broad-spectrum β-lactamases, metallo-β-lactamases (MBL), and alteration of penicillin-binding proteins (PBP), mutation of porins, enzymatic modification of plasmids, and DNA mutation [8,24]. Carbapenems (Imipenem and Meropenem) are broad-spectrum antibiotics used for the treatment of nosocomial infections caused by *Pseudomonas aeruginosa* [16]. The specific resistance to carbapenems is attributed to the lack of permeability in porin (OprD). As mentioned before resistance to antibiotics has been associated to biofilm formation [3,24]. Our patient presented multiresistance for 21 antibiotics including gentamicin and meropenem but second IV therapy used based in carbapenem-gentamicin was the antibiotic therapy combination that ceased the infection in the patient. It's notable that in spite gentamicin resistance, the outcomes were favorable [25]. Mexican guidelines recommend arteriovenous fistula as the favorite access for hemodialysis [4,5], our patient had functional blood vessels although he had a right jugular Mahurkar catheter as first option. Right internal jugular vein is the preferred vessel for CVC recommended as well in Spanish and American guidelines [1-18]. It's important to mention that at the end it was performed a Cimino-brescia fistula in our patient. Worldwide guidelines recommend performing aseptic techniques for preparing the catheter after connection to hemodialysis machine [1,4], Mexican clinical practice guide suggest the use of chlorhexidine before and after manipulating central lines or iodic solutions in second term [4,5]. As it was made, guide reports that in suspicion of infection or persistence of fever blood cultures must be taken simultaneously from peripheral vein and catheter and removal of this last one is mandatory [1-18]. Spanish guidelines also mention that hands are the main transmission mechanism therefore hand washing is the most effective preventive measure for bacteremia [1]. American and Spanish guidelines point that regardless of the bacteremia and identification of the same the attention should be directed to preventive measures [1-18].

Prevention medicine in patients with several comorbidities and chronic kidney disease receiving treatment with hemodialysis as the patient of the presented case is vital for reducing the already increased mortality risk and quality of life.

## Conclusion

Multidrug resistant microorganisms such as *Pseudomonas aeruginosa* are a public health problem secondary to antibiotic resistance, not only it is necessary to implement the strict care of vascular accesses following the recommendations of national and international guidelines in order to reduce the morbidity and mortality generated by infection of CVC but also education of the patient, reduction of comorbidities and usual asepsia of the catheter before manipulation is imperative for preventing bacteremia and catheter infections.

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