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CASE REPORT

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Peritoneal-dialysis-associated peritonitis due to *Staphylococcus sciuri*: a case report and literature review

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Abstract

Background Peritoneal-dialysis-associated peritonitis is a serious complication of peritoneal dialysis; prevention and treatment are crucial to reduce patient morbidity and mortality. *Staphylococcus sciuri* is an organism that, although present in several animal species, rarely causes disease in humans, particularly in patients undergoing peritoneal dialysis.

Case presentation A 54-year-old man with end-stage kidney disease on continuous ambulatory peritoneal dialysis was admitted to the emergency department with nausea, vomiting, slight abdominal distention, and cloudy peritoneal dialysis effluent. Relevant medical history included occupational exposure to different animal species. The white blood cell count in the peritoneal dialysis fluid sample was 11,200 cells/mm^3 with 90% polymorphonuclear cells. Peritoneal-dialysis-associated peritonitis was diagnosed. Empirical antibiotic treatment was started according to the International Society for Peritoneal Dialysis guidelines. *Staphylococcus sciuri* was identified in the peritoneal dialysis effluent culture by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. The treatment was modified on the basis of the sensitivity results. Medical cure was established on the basis of the negative result of the dialysate culture and absence of alterations in the cell count with differential after the end of treatment. The patient was instructed to be careful when administering peritoneal dialysis, especially in the care involved in being in contact with animals.

Conclusions This article highlights the importance of *Staphylococcus sciuri* as a significant pathogen due to its virulence and antibiotic resistance, especially in patients undergoing peritoneal dialysis. Prevention strategies as well as timely diagnosis and treatment compliance according to the International Society for Peritoneal Dialysis are essential for successful outcomes.

Keywords Peritoneal dialysis, Continuous ambulatory peritoneal dialysis, Peritonitis, *Staphylococcus sciuri*, Case report

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Background

Staphylococcus sciuri is a gram-positive, oxidase-positive, coagulase-negative organism with intrinsic antibiotic resistance mechanisms. This pathogen is widely present in several animal species, and although it is rare to cause disease in humans, it has become an emerging species with increasing recognition as an important cause of infection, especially in immunocompromised patients

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and those requiring the use of catheters. Therefore, patients undergoing dialysis are ideal targets for infection by *Staphylococcus sciuri* [1].

Peritoneal dialysis (PD)-associated peritonitis is a serious complication of PD, causing clinically important outcomes such as pain, peritoneal membrane alterations, hospitalization, catheter removal, or transfer to hemodialysis, resulting in increased treatment costs and increased health care utilization and even death [2].

Herein, we report a rare case of *Staphylococcus sciuri* as the causative agent of PD-associated peritonitis. To the best of our knowledge, there are only two cases reported in the literature.

Case presentation

A 54-year-old man with end-stage kidney disease due to diabetic nephropathy who has received continuous ambulatory peritoneal dialysis (CAPD) for 4 years was admitted to the emergency department of our hospital with the chief complaint of nausea and vomiting for 3 days and cloudy PD effluent. Relevant medical history included multiple previous PD-associated peritonitis caused by *Pseudomonas aeruginosa* during exchanges and occupational exposure to different animal species, including dogs and some farm animals such as sheep, horses, and cows.

At the time of admission, his vital signs were the following: blood pressure 130/85 mmHg, heart rate 76/min with regular rhythm, respiratory rate 18 breaths/min, and temperature 36.6 °C. On physical examination he was awake and alert and his abdomen revealed a slight abdominal distention, but was still compressible with no tenderness or pain. No scabs, erythema, or edema were found around the catheter exit site. Initial laboratory studies revealed a peripheral white blood cell count (WBC) of 5.01×10^3/uL (neutrophils, 50.1%; lymphocytes, 40.5%; eosinophils, 1.8%), hemoglobin of 10.4 g/dL, and a platelet count of 140.2×10^3/uL.

A cell count with differential and a culture of the dialysate were performed. The WBC count in the PD fluid sample was 11,200 cells/mm^3 with 90% polymorphonuclear (PMN) cells. PD-associated peritonitis was diagnosed. Empirical antibiotic treatment was started with intraperitoneal (IP) vancomycin 1.5 g every 5 days and ceftazidime 1 g daily while awaiting culture results. On the second day of hospitalization, *Staphylococcus sciuri* was identified in the culture of the PD effluent using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS). The patient showed clinical improvement, so the treatment was modified on the basis of the sensitivity results (Table 1), discontinuing ceftazidime and maintaining vancomycin for 2 weeks. On the third day, a new analysis of the dialysis effluent revealed WBC count of 6520 cells/mm^3 with 70% PMN cells, while on the seventh day it showed WBC count of 50 cells/mm^3 with 20% PMN cells.

Table 1 Antimicrobial susceptibility testing of *Staphylococcus sciuri*

Antibiotics	Interpretation	MIC (μg/mL)
Ceftazidime	S	≤ 8
Vancomycin	S	≤ 2
Oxacillin	R	≥ 4
Ciprofloxacin	S	≤ 1
Levofloxacin	S	≤ 2
Moxifloxacin	S	≤ 2
Erythromycin	R	≥ 8
Gentamycin	R	≥ 16
Clindamycin	R	≥ 4
Tetracycline	R	≥ 16
Cefazolin	S	≤ 8
Trimethoprim–sulfamethoxazole	S	≥ 320
Dicloxacillin	R	≥ 4
Nitrofurantoin	S	≥ 512
Rifampicin	S	≥ 32

MIC minimum inhibitory concentration

Once the treatment was completed, a new culture of the dialysate and cell count with differential were performed, which revealed negativization and absence of alterations, respectively, and medical cure was established. The patient was instructed to be careful when realizing PD administration, especially in the context of PD material handling to avoid contamination; he was encouraged to avoid any kind of mechanical stress in the exit wound and was also reminded that in case he acquired any kind of domestic pet he should avoid letting them inside the places where PD equipment is stored.

After discharge, he was scheduled for a follow-up visit at 2 weeks, in which a new dialysate culture was performed and showed no alterations. The patient and two family members were counseled by qualified personnel in accordance with the 2022 International Society for Peritoneal Dialysis (ISPD) Education Program. The patient remained uncomplicated at his first- and second-month follow-ups to assess the risk of refractory or recurrent peritonitis. Afterwards, he has continued with CAPD without incident to date.

Discussion and conclusions

Coagulase-negative staphylococci (CoNS) are among the most frequent constituents of the skin microbiota of humans and animals. These organisms are increasingly being recognized as causative agents of clinically

significant infections, with CoNS being considered the most frequent cause of nosocomial bloodstream infections and PD-associated peritonitis. Patients at particular risk for CoNS infection are those requiring the use of medical devices such as intravascular or peritoneal catheters, prosthetic heart valves, and orthopedic prostheses, as well as immunocompromised hosts [3]. CoNS comprise more than 40 species; however, only a few are clinically significant in humans, among which the most frequently implicated are *Staphylococcus epidermidis*, *S. haemolyticus* and *S. saprophyticus*, together accounting for approximately 80% of cases. Meanwhile *S. lugdunensis*, *S. hominis*, *S. capitis*, *S. warneri* and *S. Sciuri* are isolated infrequently [2].

Staphylococcus sciuri, a pathogen belonging to the group of CoNS is commonly found on skin and mucosal surfaces of various species across a broad range of animals, including marsupials, rodents, carnivores, monkeys, cetaceans, cattle, sheep, horses, and dogs. This information becomes relevant considering the patient in this case was exposed to some animals that had not been previously reported in similar cases. Interestingly, studies conducted in military barracks and hospitals have reported the presence of *Staphylococcus sciuri* in dust, so it has been proposed that this could be its means of dispersal. Despite all this, some reports indicate low rates of colonization by this etiologic agent in humans. However, when it does, it often acts as an opportunistic pathogen. Its clinical importance has grown, particularly due to its association with endocarditis, endophthalmitis, pelvic inflammatory disease, urinary tract infection, septic shock, surgical wound infection, and peritonitis, this last presentation commonly seen in patients undergoing PD [4]. Only two cases of *Staphylococcus sciuri* as a causative agent of PD-associated peritonitis have been reported in the literature, highlighting its rarity as an infection in humans [5, 6].

The patient on PD is at risk of contracting zoonotic diseases, which is of great importance, as pet ownership is increasing worldwide. The most common pet-associated organisms are *Pasteurella multocida* associated with cats, and less common organisms are *Campylobacter* spp. and *Neisseria* spp. In the study by Boudville et al. there was no significant increased risk of peritonitis with any type of pet, except for patients with both cats and dogs, who did have an increased risk of peritonitis compared with patients without pets. This should not limit PD patients from owning pets, but knowledge of it may be helpful for patients and their care team to direct training to minimize the risk of peritonitis, especially when having contact with a substantial number of animals [7].

Staphylococcus sciuri has a sophisticated arsenal of virulence factors and antibiotic resistance genes, acquired by mobile genetic elements, such as the staphylococcal cassette chromosome mec (SCCmec) that includes the *mecA* gene. *MecA* gene allows the encoding of penicillin-binding protein 2a (PBP2a); this is due to the synthesis of PBP2a that confers low affinity to beta-lactam antibiotics including methicillin, nafcillin, and oxacillin. In addition, biofilm formation ensures bacterial survival by rendering less accessibility via the host immune system and by impairing antibiotic activity. Together, all these factors increase their invasive properties. There is evidence suggesting the dissemination of SCCmec among staphylococci; thus, *Staphylococcus sciuri* is implicated in the worldwide spread of methicillin-resistant *Staphylococcus aureus*. Herein lies the importance of PD-associated peritonitis caused by *Staphylococcus sciuri*, since it implies a challenge in the treatment due to resistance to certain antibiotics (for example, [8]).

In our literature review, we found two cases of PD-associated peritonitis due to *Staphylococcus sciuri* (Table 2). After inclusion of the present case, out of the three patients, the predominant gender was male in 100% of the reports, while the mean age was 59.66 years. The most frequent comorbidity was diabetes, present in two (66.66%) of the reported cases. Two (66.66%) cases had history of previous PD-associated peritonitis caused by microorganisms different from *Staphylococcus sciuri*. The most frequent PD modality was CAPD, present in two (66.66%) of the patients. Notably, all (100%) patients reported exposure to animals. Initial empirical regimen in all (100%) of the patients had coverage for both gram-positive and gram-negative organisms. After analysis of the dialysis effluent and further identification of the causative agent, treatment adjustments were made in two (66.66%) of the patients, leaving only vancomycin administered IP for 2 weeks, while 33.33% was treated with cephalothin and piperacillin administered IP for 10 days with no treatment adjustments despite identification of the causing agent. Average follow-up time was 2 weeks, and overall clinical outcome reported was optimal in all (100%) of the cases reviewed.

Although the clinical course of peritonitis caused by *Staphylococcus sciuri* and other CoNS is usually similar—both respond well to treatment without complications and with a low mortality rate of 0.5%—it is important to note there is a notable difference between them. First, *Staphylococcus sciuri* PD-associated peritonitis is mostly caused by exposure to animals, whereas other CoNS infections are due to contact contamination. In clinical practice, distinguishing between peritonitis caused by *Staphylococcus sciuri* and other CoNS is crucial because

Table 2 Reported cases of PD-associated peritonitis due to *Staphylococcus sciuri*

Author, year	Age, sex	Cause of ESKD	Pets or animal exposure	Treatment	Outcome
Wallet et al. [5]	43 years, male	Type 1 DM	Contact with a dog	3 washings with dextrose 1.36, PIPC IP 1 g QID + CET IP 500 mg QID for 10 days	Day 4 of treatment showed cytology at 50 WBC; good response with catheter removal.
Meservey et al. [6]	82 years, male	Not specified	Exposure to different animal species (two dogs and one cat)	Empirical regimen: CTRX IV + VCM IV and IP Adjusted treatment: VCM IP for 14 days	A total of 2 days after admission, a repeat analysis of peritoneal fluid showed a tenfold decrease in cell count to 988 cells/μL and repeat peritoneal fluid cultures were negative. Cured.
Ibarra-Sifuentes et al. 2024 [Present case]	54 years, male	Type 2 diabetes	Occupational exposure to different animal species (dogs, sheep, horses, and cows)	Empirical regimen (1st day): VCM IP 1.5 g + CAZ IP 1 g Adjusted treatment (2nd day): VCM IP for 14 days	On the third day, a new analysis of the dialysis effluent revealed WBC count of 6520 cells/mm^3, and a new negative dialysate culture was obtained at the end of the treatment. Cured.

ESKD end-stage kidney disease, *DM* diabetes mellitus, *PIPC* piperacillin, *IP* intraperitoneal, *QID* four times a day, *CET* cefalotin, *WBC* white blood cells, *CTRX* ceftriaxone, *IV* intravenous, *VCM* vancomycin, *CAZ* ceftazidime

of their different characteristics and implications for treatment [4].

MALDI-TOF MS diagnostic method is a novel technique used for the identification of multiple microorganisms. Although it has not proven superior to conventional techniques, it has been demonstrated to identify the causative pathogen earlier, leading to an average time saved of 64 h. Establishing the diagnosis early is a key point, as it allows for the realization of treatment adjustments directed for the specific causative agent, which translates into shorter hospital stays and better clinical outcomes [2, 9]. Since our center had this resource, this diagnostic tool was used in our patient.

According to ISPD guidelines, the recommended treatment for peritonitis due to CoNS includes IP cephalosporin or vancomycin, according to susceptibility, for a period of 2 weeks. *Staphylococcus sciuri*, unlike many other CoNS, exhibits increased inherent resistance to antibiotics commonly used against CoNS infections, such as methicillin and other beta-lactams. This resistance profile necessitates a shift to agents such as vancomycin, daptomycin, or linezolid for effective treatment, unlike other CoNS, where they are reserved as second-line agents [2]. In our case, treatment was established according to ISPD guidelines, initiating empirical therapy via IP administration of vancomycin and ceftazidime. After identification of *Staphylococcus sciuri* and on the basis of the results of the sensitivity tests, treatment was continued with IP vancomycin alone for 14 days.

However, successful treatment depends on handling the root cause of infection by reviewing patient exchange techniques. A correct training program to avoid and reduce mistakes during PD administration is also encouraged. In addition, for patients with domestic pets, they should perform rigorous handwashing before and after PD exchanges, and they should prevent pets from entering areas where PD exchanges occur as well as the storage site for machines, tubing, and dialysis equipment [2]. These additional recommendations and precautions were made known to the patient in our case.

This article highlights the importance of CoNS, particularly *Staphylococcus sciuri*, as a significant pathogen, especially in patients undergoing PD. Despite its rarity in humans, *Staphylococcus sciuri* presents a real challenge due to its virulence and antibiotic resistance. Prevention strategies in patients with risk factors are essential, including proper catheter care and avoidance of potential sources of contamination. In addition, clinical suspicion, timely diagnosis, and adherence to treatment guidelines, as outlined by the ISPD, are crucial for successful outcomes.

Abbreviations

PD	Peritoneal dialysis
CAPD	Continuous ambulatory peritoneal dialysis
WBC	White blood cell count
PMN	Polymorphonuclear
IP	Intraperitoneal
MALDI-TOF MS	Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry
CoNS	Coagulase-negative staphylococci
SCCmec	Staphylococcal cassette chromosome mec
PBP2a	Penicillin-binding protein 2a
ISPD	International Society for Peritoneal Dialysis

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Declarations

Ethics approval and consent to participate
This work was approved by the Comité de Ética en Investigación of the Escuela de Medicina Unidad Norte, Universidad Autónoma de Coahuila, Piedras Negras, Coahuila, México.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and accompanying data.

Competing interests
The authors declare that they have no competing interests.

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