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Case Report

A rare first case of prosthetic knee joint infection by *Citrobacter koseri*

Yusuf Kagzi[1,*], **Mustafa Siraj Bohra**[2], **Alifiya Kagzi**[3], **Umer Rizwan**[4]

[1]*Dept. of Internal Medicine, M.G.M Medical College, Indore, Madhya Pradesh, India*
[2]*Dept. of Infectious Diseases, Corewell Health Dearborn and Wayne, MI, United States*
[3]*Dept. of Internal Medicine, Chirayu Medical College & Hospital, Bhopal, Madhya Pradesh, India*
[4]*Dept. of Internal Medicine, Camden Clark Medical Center, West Virginia University, West Virginia, United States*

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ABSTRACT

Citrobacter generally colonizes the gastrointestinal and urogenital tracts of humans, but musculoskeletal infection by Citrobacter in the elderly is extremely rare. To our knowledge, less than 15 cases of *C. koseri* causing musculoskeletal infection have been reported in the literature. In the last few years, there has been a considerable increase in the incidence of prosthetic knee joint infection in the United States, with a higher risk of infection in the first two years following surgery. Although gram-positive bacteria like Staphylococcus and Streptococci are more common cause of PJI, gram-negative bacteria can also be found in infected joints. We report the first case of PJI in the left knee due to *C. koseri* in an 82-year-old adult two years after bilateral knee arthroplasty. This case report intends to educate and raise awareness for *C. koseri* causing PJI as a long term post-op complication even in healthy individuals.
We searched articles on Pubmed and Medline for PJI and citrobacter infection. We report clinically and microbiologically confirmed *C. koseri* in a synovial fluid sample of the left knee joint. *C. koseri* should be considered as a possible pathogen for PJI in long term setting even in an otherwise healthy individual.

1. Learning Points

1. *Citrobacter koseri* has never been reported as a causal pathogen for PJI in the knee.
2. PJI is a serious complication and it is unusual for this to occur 3 years after surgery. *C. koseri* being a resistant bacterium necessitates prompt treatment with the appropriate antibiotics and removal of the hardware.
3. Despite being a commensal organism in humans, the source and risk factors that lead to *C. koseri* infection in an otherwise healthy adult remain unknown.

2. Case Presentation

An 82-year-old obese man with a past medical history of diabetes mellitus, hypertension, and osteoarthritis presented to an outpatient orthopaedic clinic with progressive worsening pain and swelling in the left knee for the one month.(Figure 1) During this time, he also complained of inability to bear weight on his left leg and difficulty while walking. He denied any fever, chills, redness, or edema. He had a past surgical history of bilateral knee arthroplasty three years prior for severe osteoarthritis and was on apixaban. He was not on any immunosuppressive medications. Radiographic imaging of the left knee was positive for effusion.(Figures 2 and 3) Serologic testing was ordered and the patient underwent knee joint aspiration for cell count and culture.

* *Corresponding author*.
E-mail address: dryufskagzi@gmail.com (Y. Kagzi).

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One week later, the patient presented to the emergency department with confusion, myalgia, left-sided weakness, and limited mobility of the left knee joint for 12 hours. Computed tomography and magnetic resonance imaging of the head were negative for cerebrovascular accidents. As he reported improved neurological symptoms within a few hours, a Transient ischemic attack was suspected. However, the patient's left knee was swollen, warm, tender to palpation or bear weight. On examination, the left knee was held at 30 degrees of flexion, with a limited range of motion, and the patient was unable to turn the opposite side or cross the legs. He denied habitual alcohol or tobacco use. Vitals on admission demonstrated a temperature of 97.8 fahrenheit, a heart rate of 68 beats per minute, a blood pressure of 169/69 mmHg, and an oxygen saturation of 99% in room air. Blood and synovial fluid results are shown in Table 1. Synovial fluid was sent for culture, and grew *Citrobacter koseri*, which was susceptible to cefazolin, gentamicin, and amoxicillin/clavulanate. Blood culture was sent and revealed no growth. The patient was started on ceftriaxone, and repeat arthrocentesis was performed for symptomatic relief. One week later, the patient was scheduled for a two-step revision surgery to remove the prosthesis.

Table 1: Laboratory results of blood and synovial fluid sample from the patient

Lab findings on admission	Values (unit)
Blood:	
White Blood Count (WBC)	10,300 /mm^3
Neutrophils	8,600/mL
Platelets	295,000/L
Erythrocyte Sedimentation Rate (ESR)	106 mm/hr
C-reactive protein	69.2 mg/L
Synovial Fluid:	
Color	Hazy-yellow
Red Blood Count	>15,000/mm^3
Total Nucleated Cells	>35,830/mm^3

Fig. 1: Swollen left knee joint

Fig. 2: Antero-posterior X-ray view of left knee joint

3. Discussion

Knee arthroplasty is the most common joint replacement surgery in the United States, and associated with a 2.3% incidence of knee PJI.[1–3] To our knowledge, *C. koseri* has not yet been reported in the literature to cause prosthetic knee joint septic arthritis.[4] The most common PJI causing organisms include aerobic gram-positive bacteria, followed by aerobic gram-negative bacteria, particularly pseudomonas and enterobacteriaceae. Citrobacter is a gram-negative bacillus in the Enterobacteriaceae family. It is known to cause paediatric central nervous system infections. However, in adults, the majority of cases are reported among immunocompromised or hospitalised post-surgical patients.[5] Till date, there has been no case reported in the literature by *C. koseri* responsible for prosthetic knee joint infection three years after the surgery.

Kaufman et al.[5] reported a case of early periprosthetic infection after 3 weeks of primary total hip arthroplasty that revealed *C. koseri* in the patient's deep tissues. In a study by Maynou et al.,[6] *C. koseri* was identified as the pathogenic organism that caused infected shoulder arthroplasty requiring resection arthroplasty. The source of infection remains unclear; however, the urinary tract, lower respiratory tract, and gastrointestinal tract are the most common sites colonised by Citrobacter species in humans.[7] Bacteremia due to this microorganism has been implicated in some cases of neonatal septicemia.[8] Various risk factors have been identified for PJI, including poorly controlled diabetes mellitus, tobacco use, malnutrition, and obesity, which are all modifiable.[9] In our case, the patient had a

Fig. 3: Lateral X-ray of left knee joint

long-standing history of diabetes and obesity but was on no immunosuppressive medications and was otherwise healthy. Though there is no single cause for increased susceptibility to infection in the postoperative period, various patient-related factors have been identified that can reduce the risk of PJI. A high HbA1c level has been significantly associated with increased infection susceptibility; hence, optimal glycemic control (less than 7.0) and the upper range of blood glucose levels should be maintained at less than 180 mg/dl in the postoperative period. Further, patients should be screened for other features of the metabolic syndrome, including BMI >30kg/m2, central obesity, hyperlipidemia, hyperglyceridaemia, and hypertension. Similarly, malnutrition also poses an increased risk, and investigations including total lymphocyte count <1500 cells/mm3, transferrin < 200 mg/dl, and serum albumin <3.5g/dl can identify patients at risk. Tobacco use, low vitamin D levels (20 ng/dl), and positive MRSA have been shown to increase the risk of infections during the perioperative and postoperative periods. Although aspirin use for 30 days after surgery is recommended, aggressive anticoagulation should be avoided except in high-risk patients with a history of thromboembolism or clotting disorders.[9]

Accurate diagnosis is necessary to rule out non-infectious joint failure. Blood tests and inflammatory markers can aid in the diagnosis; however, arthrocentesis remains the gold standard. Synovial fluid should be cultured ideally both aerobically and anaerobically. The significance of imaging remains unclear as it does not help identify the pathogen. During surgery, joint tissue and hardware specimens should be sent for cultures.

Source control with surgery and appropriate antibiotic therapy remain the mainstay of treatment. For acute infections, debridement and antibiotics with implant retention may be tried but in a majority of cases a resection arthroplasty of either one stage or two stage revisions is required. Intravenous antibiotic therapy is recommended for 6-12 weeks.[2] S. Mohanty et al. reported a high degree of resistance by Citrobacter species to cephalosporins, piperacillin and ciprofloxacin, and minimum resistance to carbapenems.[7] In our case, the synovial specimen was sensitive to cefazolin, therefore, the patient was transitioned to ceftriaxone for 2 weeks following which he was scheduled for hardware removal with spacer placement and was discharged on antibiotics with possible second revision surgery for new joint replacement in the future. Being a resistant organism, the majority of the cases need prompt removal of the infected hardware.

4. Conclusion

PJI can lead to functional impairment and financial burden to both patients as well as the healthcare system. In cases of PJI 2 years after total knee arthroplasty, atypical organisms like Citrobacter should be considered with high suspicion in patients with risk factors. Early recognition is important and an operative approach should be provided for the best outcomes. Orthopaedic surgeons and infectious disease physicians should be consulted for atypical organisms such as *Citrobacter koseri*, which can cause PJI years after surgery.

5. Consent

Consent has been taken by the patient to write regarding details of the case, use the images and publish the article.

6. Source of Funding

None.

7. Conflict of Interest

There are no conflicts of interest.

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Author biography

Yusuf Kagzi, MBBS Student https://orcid.org/0009-0000-9062-2484

Mustafa Siraj Bohra, Professor

Alifiya Kagzi, Medical Student

Umer Rizwan, Resident

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