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Case Report

Citrobacter koseri Surgical Site Infection after Femoropopliteal Vein Bypass for Popliteal Artery Aneurysm Treated with a Graft Preserving Strategy

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Abstract

Background: A 69-year-old man underwent ligation and evacuation of a popliteal artery aneurysm with a femoral-to-popliteal vein bypass. He had a history of *Citrobacter koseri* prostatitis two months prior to the surgery. One month postoperatively, he presented with extremity swelling, redness, and fluid collections around the graft.
Methods: A graft preserving strategy was adopted. The patient underwent operative drainage, washing, and received long-term antibiotic therapy. Fluid culture grew *Citrobacter koseri*, previously not reported as cause of surgical site infection with infrainguinal graft involvement.
Results: The infection was treated successfully, and the patient is remains symptom free 18 months postoperatively.
Conclusions: This case highlights the importance of considering culturing the aneurysm content in the presence of infectious history.

Keywords: bypass; case report; citrobacter; infection; popliteal aneurysm

Surgical site infection with vascular graft involvement remains a serious complication of open revascularization [1]. Peripheral vascular graft infections are associated with high rates of amputation and mortality that reach 18% and 25%, respectively [2–4].

Common organisms implicated in vascular graft infections are gram-positive and gram-negative bacteria such as Staphylococcus and Pseudomonas [5,6]. The source of infection is either direct contamination during surgery, contamination from a contiguous infected site, or hematogenous seeding from a distant site [7].

Management strategies include long-term antibiotic therapy along with a surgical intervention (with graft excision or preservation), depending on presentation severity, anastomotic graft involvement and infecting organism [1,7–9]. We report a case of surgical site infection with graft involvement by *Citrobacter koseri* after a femoral-to-popliteal autologous vein bypass for popliteal artery aneurysmal disease. This case report is written in accordance with the CARE guidelines [10]. The patient's consent for publication was obtained.

Case Report

A 69-year-old male patient presented to the vascular clinic because of disabling claudication in both lower extremities. Duplex ultrasound showed a 2.3 cm thrombosed right popliteal artery aneurysm and a 3.2 cm left popliteal artery aneurysm with large intra-mural thrombus. The patient was known to have hypertension, coronary artery disease, and peripheral arterial disease with left iliac stenting 15 years prior to this visit. He also had transurethral resection of the prostate 10 years earlier for benign prostatic hyperplasia, and acute prostatitis two months prior to this visit. The patient had no urinary symptoms on presentation.

Computed tomography angiography confirmed the findings of a large popliteal artery aneurysm with an extensive thrombus and an occluded anterior tibial artery. To avoid the risk of acute popliteal thrombosis, the left popliteal aneurysm was addressed first. The left superficial femoral artery had multiple areas of atherosclerotic changes and narrowing at its origin. The proximal popliteal artery had diffuse ectatic changes. As such, the patient underwent left common femoral

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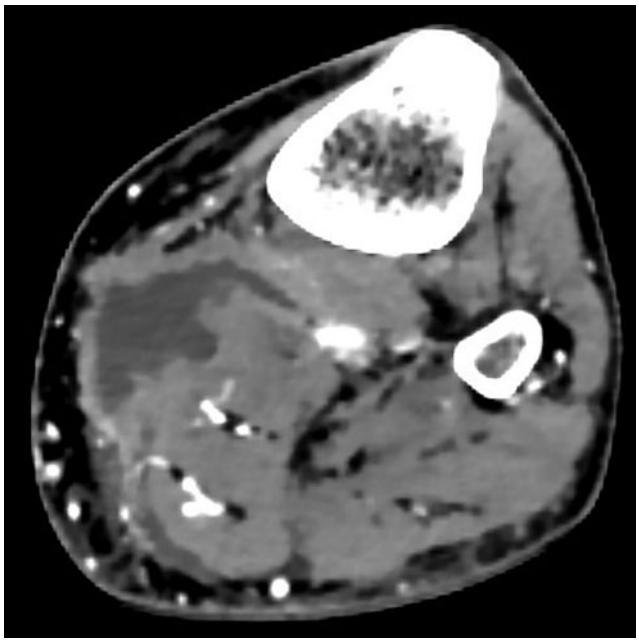

FIG. 1. Computed tomography angiography showing an abscess around the left medial calf.

to below the knee popliteal artery bypass using a left great saphenous vein. The aneurysm was double ligated proximal and distal to its origin and then opened and evacuated to avoid the possibility of continued future growth and any compression symptoms. The aneurysm was at the level of the knee joint, which necessitated a suprageniculate and an infrageniculate incision to achieve the proximal and distal ligation and construction of the distal anastomosis. The intraoperative aneurysmal content appeared to be the usual laminated thrombus along with liquid murky material. The graft was tunneled from the sub-sartorial plane in the thigh to the suprageniculate incision and then subcutaneously to the below the knee popliteal segment. The patient was discharged after two days with no complications. A week later he presented with redness on the staple line. The staples were removed, and he was discharged with an oral cephalosporin for one week for presumed cellulitis.

Thirty days post-operatively the patient presented to the clinic with pain, redness, and swelling around the suprageniculate incision site. Duplex ultrasound showed complex fluid collections measuring 5×10 cm in the suprageniculate and infrageniculate areas with the graft clearly within the fluid collections. Aspiration revealed a murky fluid and the collection containing thick material was not completely evacuated. The patient was started on clindamycin pending the fluid cultures which later grew *Citrobacter koseri*. A computed tomography angiogram was performed and revealed fluid collections in the suprageniculate and infrageniculate spaces with the graft in contact with the fluid collection (Fig. 1). The patient underwent surgical incision and drainage of the collections through the suprageniculate and infrageniculate incisions. Multiloculated fluid collections were evacuated with their gelatinous content. Debridement and copious washing of the infected spaces were done. Two 15F Blake drains were inserted into the suprageniculate and infrageniculate spaces. The patient was prescribed piperacillin-tazobactam pending culture sensitivities.

Knowing that the same organism (*Citrobacter koseri*) had been isolated previously from the urine at the time of prostatitis, the possibility of seeding from a distant source was considered. Positron emission tomography-computed tomography (PET-CT) was performed and showed increased tracer activity (fluorodeoxyglucose [FDG]) in the inguinal, suprageniculate, and infrageniculate areas but no FDG uptake in the prostate, contralateral popliteal aneurysm, or other non-surgical area.

Over the next few days, drainage from the drains became minimal and they were removed. The patient was maintained on oral antibiotic agents for six weeks. Follow-up duplex ultrasound showed resolution of the fluid around the patent bypass graft. A few months later the patient had a similar procedure for the right popliteal artery aneurysm without any post-operative infectious complication. Culture of the right popliteal aneurysm content did not reveal any organism. It is now more than a year after the first procedure and the patient and remains infection-free (Fig. 2).

Discussion

Citrobacter genus is a ubiquitous gram-negative bacilli with low infectivity rate in humans [11]. It includes 11 species, the most common of which are *Citrobacter freundii* and *Citrobacter koseri* [12]. When infection occurs, it is commonly in the urinary tract followed by the gastrointestinal and the respiratory tracts. It most commonly affects neonates, immunocompromised, and hospitalized patients [13,14]. Infections with *Citrobacter* impose a serious threat on patients, with mortality rates ranging between 6.8% and 33% [15].

Citrobacter has been rarely identified as a cause of vascular infection. Kwon et al. [14] and El Husseiny et al. [16] identified *Citrobacter freundii* as a cause of infection of a polytetrafluoroethylene aortic bypass graft. *Citrobacter koseri* has been identified as the causative organism of an aortic infection and a brachiocephalic aneurysm infection [13,17]. To the best of our knowledge, this is the first report of surgical site infection with infra-inguinal graft involvement caused by *Citrobacter koseri*. The degree of the graft involvement with this surgical site infection cannot be determined fully. It was clear that the graft was in contact with the infected fluid collection and contaminated by *Citrobacter koseri*. Most of the graft was tunneled in a subsartorial space and was covered by healthy vascularized tissue except for the perigeniculate area. To remove the graft from that infected

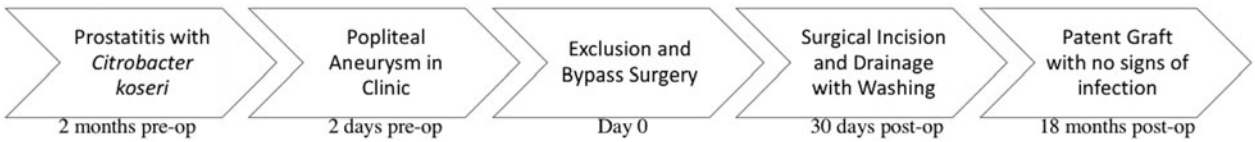

FIG. 2. Timeline of presentation, interventions, and outcomes.

field would have required the placement of an interposition vein graft from the mid or distal thigh level and tunneled laterally, constructing the distal anastomosis to the peroneal artery through a lateral approach because the anterior tibial artery was totally occluded. This would have been a major undertaking worth avoiding if possible. Another option would have been to incise and drain the collection and develop a gracilis muscle flap to cover the graft with viable muscle.

Although the graft was lying in the infected cavities, the decision was to adopt a graft preserving strategy because of the absence of systemic infection manifestations and the intra-operative assessment suggesting no involvement of the anastomoses that were covered by healthy tissue. Because the skin over the graft was well healed, we elected to try the least invasive approach first, which was incision, copious washing, and drainage while preserving the graft excision for a later stage if this approach failed to control the infection.

The patient received broad-spectrum antibiotic agents and continued a six-week course based on organism sensitivities. This strategy was successful as signs of infection disappeared and patency of the graft is still maintained with no evidence of recurrent soft tissue infections, prostatitis, or pseudoaneurysms.

Infected popliteal aneurysms have been reported rarely, with an estimated incidence of less than 2% [18]. It has been described traditionally as a complication of infective endocarditis [19]. Although commonly referred to as mycotic aneurysms, the most common isolated organisms are Staphylococcus and Streptococcus (20). Infection of a popliteal artery aneurysm after exclusion are also rare, with only three case reports in the literature [21]. All three cases occurred at least five years after the surgery [21,22].

Knowing that the patient had prostatitis due to *Citrobacter koseri* two months prior to presentation, seeding from the prostate could have been the cause of infection. The lack of active infection in the prostate or any other non-surgical site by PET-CT scan led us to postulate that the left popliteal aneurysm was seeded and infected by *Citrobacter koseri* at the time of the initial operation. This explains in retrospect the syrupy thrombus found inside the aneurysm. It can also be postulated that opening and evacuating the aneurysm contaminated the supragenicular and infragenicular incisions, leading to the infected fluid collections, which could have started as small post-operative hematomas.

In retrospect, the popliteal aneurysm content should have been cultured during the aneurysm exclusion operation. In addition, a pre-operative urine culture despite a normal urinalysis should have been obtained in this patient in view of the prior history of prostatitis. The possibility of bacterial seeding of a popliteal artery aneurysm should be entertained in the presence of a prior history of a systemic infection. As more popliteal aneurysms are being treated with endovascular stent grafts, such possibility should be kept in mind if post-operative infectious complications develop.

Conclusions

Citrobacter koseri is a rare but possible cause of femoropopliteal vein bypass surgical site infection after a popliteal artery aneurysm ligation procedure. Cultures of the aneurysm thrombus should be considered in the presence of atypical aneurysm content especially if prior infectious history exists. If bypass anastomoses are not involved, and the overlying tissue is healthy, surgical drainage and washing in addition to long-term antibiotic therapy, can treat the infection and preserve the graft.

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The authors declare that they have no conflict of interest.

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