



CASE REPORT

Pseudomonas Aeruginosa Joint and Graft Infection Following Anterior Cruciate Ligament Reconstruction Surgery

Harin Bhavin Parikh¹, Aubrey Armento^{2*}, Tessa Mandler³ and Jay Albright⁴

¹University of Colorado School of Medicine, USA

²Department of Pediatrics, University of Colorado School of Medicine, USA

³Department of Pediatric Anesthesiology, University of Colorado School of Medicine, USA

⁴Department of Orthopedic Surgery, University of Colorado School of Medicine, USA

*Corresponding author: Aubrey Armento, Department of Pediatrics, University of Colorado School of Medicine, Children's Hospital Colorado, 13123 E 16th Ave, Aurora, CO 80045, USA, Tel: 404-514-1679, E-mail: Aubrey.armento@childrenscolorado.org



Abstract

Surgical site infection (SSI) is an uncommon postoperative complication of anterior cruciate ligament (ACL) reconstruction, with *Pseudomonas aeruginosa* (*P. aeruginosa*) even more rarely implicated as the infectious organism. Previous reports of *P. aeruginosa* SSIs outline hospital-associated etiologies such as inadequate sterilization of surgical instruments, but it is known that the organism can be found in public areas such as swimming pools and hot tubs. There is controversy over the optimal treatment for ACL graft infection regarding graft removal versus graft retention. We present a patient with a postoperative *P. aeruginosa* joint and graft infection following ACL reconstruction, likely secondary to environmental hot tub exposure. He was treated surgically with knee arthroscopic washout and ACL graft removal and a prolonged duration of antimicrobial therapy with an appropriate response to treatment.

Keywords

ACL reconstruction, *Pseudomonas* infection, Graft removal

Introduction

Surgical site infection (SSI) is generally a rare postoperative complication of anterior cruciate ligament (ACL) reconstruction that can be devastating if not urgently treated. The most common microbes cultured from SSIs are *Staphylococcus aureus* and Coagulase-negative *Staphylococcus epidermidis* [1]. More uncommonly cultured from SSIs is *Pseudomonas aeruginosa* (*P. aeruginosa*), an aerobic gram-negative bacterium [2]. *P. aeruginosa*

is commonly found in public areas such as swimming pools and hot tubs. Previous reports of *P. aeruginosa* SSIs outline hospital-associated etiologies such as inadequate sterilization of surgical instruments [3]. To our knowledge no environmental sources of *P. aeruginosa* infection following ACL reconstruction have been reported. In this case report, we describe a patient presenting with a postoperative *P. aeruginosa* infection following ACL reconstruction, likely secondary to environmental hot tub exposure.

Case Presentation

A 15-year-old male presented to our clinic with right knee pain sustained after a football injury. He was diagnosed with a right knee complete ACL tear and lateral meniscus injury based on magnetic resonance imaging (MRI) findings. He was taken to the operating room four weeks later for a right ACL reconstruction with quadriceps patellar autograft and a lateral meniscus repair. There were no immediate complications postoperatively. X-ray imaging one week after surgery demonstrated stable hardware placement and no fractures. The patient was compliant with his crutches and brace and was cleared to start formal physical therapy.

Eight weeks after surgery, the patient presented to clinic with a painful red bump over the incision site. He reported that he noticed the lesion shortly after surgery, but it had never been painful. Within a week, he

noted that the area became more red, swollen, and tender to the touch. He denied fever, chills, night sweats, or discharge from the site. Physical examination revealed a 1 cm × 1 cm fluctuant, erythematous mass over the tibial incision site with effusion in the joint. The mass was aspirated in clinic, revealing purulent fluid. The patient was prescribed oral clindamycin for treatment of the abscess.

A week later, the patient returned to clinic with persistent swelling and pain in the same area. Repeat aspiration of the abscess and joint fluid aspiration was performed, and the fluid was sent for culture. Two days later, the fluid culture demonstrated growth of *P. aeruginosa*. Laboratory studies obtained at that time revealed a white blood count (WBC) of $7.44 \times 10^3/\mu\text{L}$ with 86.6% segmented neutrophils, elevated C-reactive protein (CRP) of 2.9 mg/dL (ref range 0.0-0.9 mg/dL), and a normal erythrocyte sedimentation rate (ESR). Upon further questioning, the patient reported that he had been soaking in a hot tub at the local recreation center about two weeks after the initial surgery. The patient was taken two days later for right knee arthroscopic washout with an open tibial incision and drainage (I&D) procedure. Knee arthroscopy revealed significant synovitis and a grossly infected and damaged ACL graft. The graft was removed, along with all foreign material including the tibial and femoral buttons. Bacterial broth cultures of the graft and synovial fluid were sent and were positive for growth of *P. aeruginosa*. The patient was admitted to the hospital postoperatively, and the Infectious Disease was consulted for antibiotic management. He was initially treated with two days of intravenous (IV) cefepime, then transitioned to oral levofloxacin based on culture susceptibilities. The decision was made to treat as a chronic infection with bony involvement given the retained bone portion of the original ACL graft and prolonged soft tissue swelling around the tibial incision site, for a minimum of three months of expected duration of antibiotic therapy. He underwent a repeat washout of the joint two days after graft removal, which revealed no residual purulent fluid. At follow up one week later, the patient's CRP had normalized, and he had no reported pain or other symptoms. He went on to complete a three-month course of oral levofloxacin and has continued to make progress in physical therapy.

Discussion

It is known that *P. aeruginosa* thrives in moist environments and is commonly found in public areas such as swimming pools and hot tubs [2]. Given our patient's history of using a recreational hot tub two week after surgery, both the Orthopedics and Infectious Disease teams felt that this was most likely the etiology of the patient's SSI, although we cannot definitively rule out a hospital-associated etiology. Previous literature reports of *P. aeruginosa* infection following ACL reconstruction provide evidence of inadequate surgical instrument

sterilization as an infection source [3,4]. However, there were no reported breaches of sterilization reported within our institution during the time of the patient's infection. Standardized sterilization protocols that include complete tissue removal in cannulae and disposable shaver heads significantly reduce the chances of an institutional-related etiology of our patient's infection. Because our patient was the only reported *P. aeruginosa* SSI within our institution around the time frame of his care and he had a known hot tub exposure, we believe that the etiology of infection was due to an environmental source over a hospital-associated one.

The low incidence of SSI following ACL reconstruction makes it difficult to establish guidelines for a standardized treatment plan. A survey of sports medicine directors across the country revealed five different recommendations for SSI treatment following ACL reconstruction [5]. From a surgical standpoint, we chose to undergo I&D with graft removal. However, graft removal versus retainment following SSI remains a highly controversial topic within the field. The most common treatment strategy reported in the literature involves graft retention with I&D and culture-specific IV antibiotic therapy [6-10]. On the other hand, some authors advocate for graft removal regardless of joint appearance [11-14]. The synovitic appearance of the joint combined with the grossly infected appearance of the graft influenced our decision to remove the graft. In addition, concerns for the spread of infection and reinfection, along with a more unusual infecting organism as the cause, led us to select the more conservative treatment option.

The specific duration of antibiotic therapy in the setting of postoperative septic arthritis is determined by a myriad of factors including the infecting organism, resolution of symptoms, and normalizing WBC and inflammatory markers [5]. A typical duration of antibiotic therapy based on the literature appears to be between four to six weeks, both with or without ACL graft removal [5,10,12,13]. In consultation with the Infectious Disease team, we decided to treat the patient for a longer duration with a minimum of three months of antibiotics, as there was concern for bony involvement. Imaging such as MRI was not pursued to assess for bony involvement as it was felt that the joint had been adequately debrided and the majority of foreign material removed with rapid improvement in the patient's symptoms following the procedures. Additionally, a three-month course of antibiotics was felt to be sufficient for our patient with complete resolution of symptoms, normalized labs and progression through physical therapy.

To our knowledge, this is the first reported case of *P. aeruginosa* infection following ACL reconstruction attributed to a presumed environmental cause as opposed to hospital-associated. Even though infection after ACL reconstruction is rare, providers can take measures to prevent this type of infection for future

patients. Clinicians should remain cognizant that public pools, hot tubs, and other moist environments pose a *P. aeruginosa* infection risk to those who have recently undergone surgery. Moreover, we suggest that patients be informed of this risk (i.e. verbally or handouts) to avoid a potentially serious postoperative complication.

Conclusions

- 1) *P. aeruginosa* SSIs can be due to environmental or hospital-associated etiologies.
- 2) Without a complete history, the environmental etiology of our patient's SSI may have been missed.
- 3) Public pools, hot tubs, and other moist environments serve as reservoirs of microbes such as *P. aeruginosa*. Clinicians should be cognizant that patients who enter these areas postoperatively are at an increased risk of SSI.
- 4) There is no formal consensus on graft removal versus retainment following SSI. Even though SSIs are a rare occurrence following ACL reconstruction, the development of evidence-based guidelines could significantly improve patient outcomes. We believe that because of the arthroscopic findings, graft removal was the best treatment option for our patient.

References

1. Judd D, Bottoni C, Kim D, Burke M, Hooker S (2006) Infections following arthroscopic anterior cruciate ligament reconstruction. *Arthroscopy* 22: 375-384.
2. Kiska D (2003) *Pseudomonas*. *Manual of Clinical Microbiology* 8: 719-728.
3. Tosh PK, Disbot M, Duffy JM, Boom ML, Heseltine G, et al. (2011) Outbreak of *Pseudomonas aeruginosa* Surgical Site Infections after Arthroscopic Procedures. *Infect Contol Hosp Epidemiol* 32: 1179-1186.
4. Parada SA, Grasssbaugh JA, DeVine JG, Arrington ED, (2009) Instrumentation-Specific Infection After Anterior Cruciate Ligament Reconstruction. *Sports Health* 1: 481-485.
5. Matava M, Evans TA, Wright RW, Shively RA (1998) Septic arthritis of the knee following anterior cruciate ligament reconstruction: results of a survey of sports medicine fellowship directors. *Arthroscopy* 14: 717-725.
6. Pola E, Logroscino G, De Santis V, Canducci F, Delcogliano A, et al. (2003) Onset of Berger disease after *Staphylococcus aureus* infection: Septic arthritis after anterior cruciate ligament reconstruction. *Arthroscopy* 19: E29.
7. Schollin-Borg M, Michaëlsson K, Rahme H (2003) Presentation, outcome, and cause of septic arthritis after anterior cruciate ligament reconstruction. *Arthroscopy* 19: 941-947.
8. Viola R, Marzano N, Vianello R (2000) An unusual epidemic: staphylococcus negative infections involving anterior cruciate ligament reconstruction with salvage of the graft and function. *Arthroscopy* 16: 173-177.
9. Van Tongel A (2000) Septic arthritis after arthroscopic anterior cruciate ligament reconstruction. *Am J Sports Med* 35: 1059-1063.
10. Schuster P, Schulz M, Immendoerfer M, Mayer P, Schlumberger M, et al. (2015) Septic arthritis after arthroscopic anterior cruciate ligament reconstruction: evaluation of an arthroscopic graft-retaining treatment protocol. *Am J Sports Med* 43: 3005-3012.
11. Fong S, Tan JL (2004) Septic arthritis after arthroscopic anterior cruciate ligament reconstruction. *Ann Acad Med Singapore* 33: 228-234.
12. Williams R, Laurencin CT, Warren RF, Speciale AC, Brause BD, et al. (1997) Septic arthritis after arthroscopic anterior cruciate ligament reconstruction: Diagnosis and management. *Am J Sports Med* 25: 261-267.
13. Burks R, Friederichs MG, Fink B, Luker MG, West HS, et al. (2003) Treatment of postoperative anterior cruciate ligament infections with graft removal and early reimplantation. *Am J Sports Med* 31: 414-418.
14. Hantes M, Raoulis VA, Doxariotis N, Drakos A, Karachalios T, et al. (2017) Management of septic arthritis after arthroscopic anterior cruciate ligament reconstruction using a standard surgical protocol. *Knee* 24: 588-593.