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Case report

Renal failure after placement of an articulating, antibiotic impregnated polymethylmethacrlyate hip spacer

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ABSTRACT

A 58-year-old male presented with native joint septic arthritis of the hip and osteomyelitis. After treatment with an articulating antibiotic spacer, he developed acute renal failure requiring dialysis. He continued to have elevated serum tobramycin levels exclusively from the antibiotic spacer elution as no intravenous tobramycin was used. Subsequent explantation was required to correct his renal failure. Although renal failure after antibiotic impregnated cement placement is rare, the risk of this potential complication should be considered preoperatively and in the postoperative management of these patients.

Introduction

Acute septic arthritis in native joints is a rare condition affecting 2-12/100,000 per year up to 30-70/100,000 in high-risk groups [1-9]. It occurs more commonly in children, the elderly and males [5] with inpatient hospital mortality ranging from 2%-10% [1,2,7,10]. The incidence is rising with advanced age, orthopaedic procedures, skin infections, intraarticular corticosteroid injections, and diabetes as potential risk factors [8,11]. The most frequent organism isolated is *Staphylococcus* in 35%-56% of cases [1,2,10,12]. *Streptococcus* is the second most common organism isolated, followed by gram negatives accounting for 20% of cases [1,3,6,13,14]. As virulence factors produced by bacteria, such as toxins and enzymes, can directly contribute to eroding the affected joint [15], prompt diagnosis and management is essential to prevent permanent damage.

Diagnosis of acute septic arthritis is based on clinical symptoms: acute onset joint pain, erythema, swelling, decreased range of motion, and possibly the inability to ambulate. Elevated inflammatory markers with serum white blood cells (WBCs) >11,000/μL, erythrocyte sedimentation rate (ESR) >20 mm/h, and aspirated WBCs in the joint fluid (cell count) >50,000/μL have sensitivities of 75%, 75%, and 50% and specificities of 55%, 11%, and 88%, respectively. However, the combined sensitivity of WBCs, ESR, and cell count is 100% when all 3 tests are positive [16]. Although some patients present with sweats, rigors, and a history of fever, none are required for diagnosis, as fever is present in only 50.9% of patients [17] with sweats and rigors as low as 15% and 6%, respectively [4]. Although elevated WBCs and ESR combined with patient symptoms can indicate a high likelihood of acute septic arthritis, the diagnosis is confirmed when bacteria are isolated from the synovial fluid [18]. Direct inoculation from traumatic or iatrogenic causes or hematologic spread of bacteria can cause acute septic arthritis. Concomitant bacteremia is common with 50%-70% of patients having positive blood cultures [12], likely indicating hematogenous seeding. Immunosuppressed patients or hospitalized patients can acquire bacteria via intravascular devices, catheters, or recent orthopaedic procedures [11]. Acute septic arthritis is most commonly treated by surgical debridement and oral or intravenous antibiotics; with concurrent osteomyelitis, bony resection may be required.

During surgical management of acute septic arthritis with concomitant osteomyelitis, antibiotic impregnated cement (AIC) may be used both as a spacer and to control long-term joint

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infections [19]. Studies show that AIC leads to local concentrations above the minimum inhibitory concentration for most pathogens, whereas systemic concentrations remain relatively below levels associated with nephrotoxicity [20,21], thus conferring an advantage over intravenous antibiotic administration. Systemic intravenous antibiotic administration can cause significant renal dysfunction, with 12.9%-14% of patients of aminoglycoside-treated and 8%-18% of vancomycin-treated patients experiencing a decline in renal function postadministration [22,23]. Vancomycin and aminoglycosides have a synergistic effect on the risk of renal toxicity when used in combination [24]. Even the addition of a vancomycin to cefazolin for routine perioperative prophylaxis in primary joint arthroplasty was associated with a significantly higher incidence of acute kidney injury (13%) compared to the 8% incidence when cefazolin is administered alone [25]. Although renal toxicity associated with AIC is rare, it can occur. Previous studies have reported incidence rates of acute kidney injury after AIC placement ranging from 4.8%-20% [26,27].

This case report presents an isolated case of acute kidney injury after placement of tobramycin impregnated cement to treat acute septic arthritis with osteomyelitis. Symptoms and laboratory evidence of renal damage resolved after explantation of the AIC, indicating direct kidney injury mediated by AIC.

Informed consent for the authorization of medical case study and publication was obtained from the patient.

Case history

A 58-year-old male with a history of metastatic melanoma stage IV status post recent parietal craniotomy with no further evidence of disease presented to the emergency department with worsening left leg pain for 2 days, inability to bear weight, and fevers. After his neurosurgical procedure, he was placed on high-dose corticosteroids and was discharged on a dexamethasone taper. Initial radiographs showed no fracture or lytic lesion (Fig. 1). Duplex ultrasound for venous thrombosis was negative. The patient was febrile to 38.9°C and urinalysis showed evidence of a urinary tract infection; urine culture and blood cultures grew gram-negative rods. During physical therapy, he was unable to ambulate because of left hip pain. Computed tomography imaging revealed a moderate left hip effusion (Fig. 2). Infectious disease was consulted and recommended piperacillin-tazobactam 3.375 g IV q8hr and orthopaedic consultation for possible septic arthritis. Interventional radiology (IR) performed a fluoroscopically guided aspiration of the left hip, yielding 20 mL of purulent material which grew pansensitive *Escherichia coli*. Magnetic resonance imaging of the pelvis showed bilateral hip effusions with femoral head avascular necrosis (AVN; Fig. 3). His left hip was significantly tender to range of motion, whereas his right hip was relatively asymptomatic. He underwent an open irrigation and debridement (I&D) of the left hip through an anterolateral Heuter approach with closure over a drain. He continued piperacillin-tazobactam and started ceftriaxone. He convalesced on the floor, but remained febrile despite appropriate organism-specific antibiotic therapy. On postoperative day 3, he had worsening right hip symptoms. Given his effusion on magnetic resonance imaging, his right hip was aspirated (26,500 cells/μL, 94% neutrophils, positive for *E. coli*) then underwent I&D via Heuter approach with closure over a drain. *E. coli* cultured from his urine, blood, and bilateral hips was sensitive to levofloxacin and his antibiotic therapy was narrowed to this single drug, 750 mg PO qday × 6 weeks. On the day of discharge, new blood and urine cultures showed no growth, ESR was 96 mm/h and C-reactive protein was 235.89 mg/L.

The patient returned to the emergency department 3 days after discharge with worsening bilateral hip pain, painful range of motion, and limp. Serum WBC count was 14,500 cells/μL; C-reactive protein improved to 195.79 mg/L and ESR was similar at 103 mm/h. Orthopaedics was consulted for concerns of recurrence of bilateral hip joint sepsis. The patient was placed on broad spectrum vancomycin and piperacillin-tazobactam for a possible second organism. IR aspiration obtained 80 mL of purulent fluid from the left hip (107,000 cells/μL, 100% neutrophils) and 10 cc of purulent fluid from the right hip (72,000 cells/μL, 98% neutrophils). The patient returned to the operating room. Upon entering the left hip, a massive recurrent purulent fluid collection was found. After resection of the femoral head, the anterior aspect of the femoral head was cut in the coronal plane and showed evidence of AVN without frank collapse. There was a small area of fragmentation of articular cartilage anteriorly that communicated with the avascular lesion. The left hip was reconstructed with an articulating, antibiotic impregnated polymethylmethacrylate spacer (PROSTALAC). One pack of Cobalt HV polymethylmethacrylate cement with 0.5 g gentamicin (Biomet Orthopedics, Warsaw, IN) with a mixture of 3.0 g vancomycin and 3.6 g tobramycin was used for the acetabulum. A second pack of Cobalt HV polymethylmethacrylate cement with 0.5 g gentamicin (Biomet Orthopedics, Warsaw, IN) with a mixture of 3.0 g vancomycin and 3.6 g tobramycin was used for the femoral component. Antibiotic dosages were chosen based on previous studies that indicated no morbidity associated with these dosages [28-32]. The patient was reprepped and draped for the right hip I&D, where 70 cc of purulent material was found. Repeat irrigation

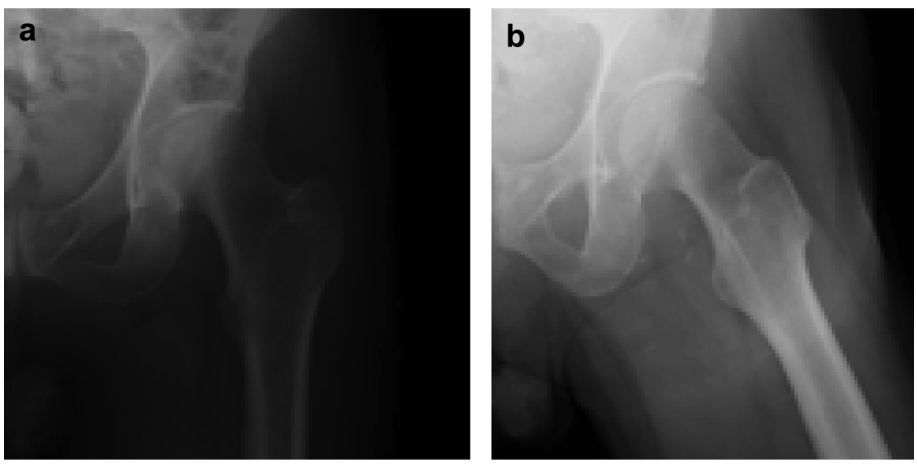

Figure 1. Initial anteroposterior (AP) radiograph of left hip (a) and lateral radiograph (b) showing no fracture or major bony lesion.

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