Failure of Total Hip Arthroplasty Secondary to Infection Caused by *Brucella abortus* and the Risk of Transmission to Operative Staff

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Abstract

Infection of total knee or hip arthroplasty by *Brucella* species is a rare complication. We describe the case of a failed hip replacement secondary to infection by *Brucella abortus*, as well as presentation, treatment course, and 2-year follow-up. In addition, we review the literature for features of periprosthetic *Brucella* species infections, and we describe the common exposures, clinical presentations, preoperative evaluation, and treatments used in the reported cases. Furthermore, we discuss the risk of transmission to operating room personnel and the appropriate preventative measures to avoid transmission.

Brucellosis is a zoonotic disease transmitted to humans through contact with animal hosts or animal products. Infection of total knee or hip arthroplasty by *Brucella* species is a rare complication with only 18 cases reported in the English literature.[1-12] We describe a case of an infected total hip replacement, its treatment, and 2-year follow-up and review the available literature. The patient provided written informed consent for print and electronic publication of this case report.

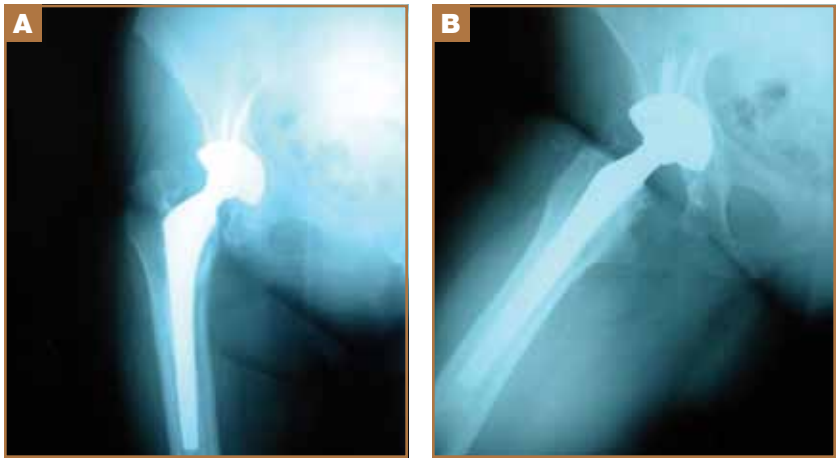
Case Report

A 67-year-old Spanish-speaking woman, a native of Mexico, presented with a painful right total hip arthroplasty (THA) 2 years after implantation in Chihuahua, Mexico. The patient reported 1 year of increasing thigh pain with recent onset of start-up pain, and also mild groin pain. The patient reported an uneventful postoperative course without wound drainage and denied any history of fevers, chills, or night sweats after the procedure. Preoperative notes and radiographs were unavailable for review. Radiographic evaluation showed a hybrid construct with a well-fixed–appearing, uncemented acetabular component but a failed cemented femoral stem (**Figures 1A, 1B**). Although we discussed revision surgery, the patient elected not to proceed with surgery or to undergo evaluation to rule out infection. Nine months later, she returned with worsening pain and requested revision surgery; radiographs showed progressive bone loss around the cement mantle (**Figures 2A, 2B**).

Hematologic evaluation showed an erythrocyte sedimentation rate (ESR) of 54 mm/h (normal, 0-27 mm/h) and C-reactive protein (CRP) level of 0.24 mg/L (normal, <0.8). An aspiration of the hip with fluoroscopic guidance produced a small sample (0.2 mL) of yellow synovial fluid. There was not enough fluid for cell count, but fluid culture was negative.

The patient was taken to the operating room for revision THA. Because of concern about progressive bone loss and elevated infectious indices, the administration of antibiotics

Figure 1. Initial (A) anteroposterior and (B) lateral radiographs showing a loose cemented femoral component.



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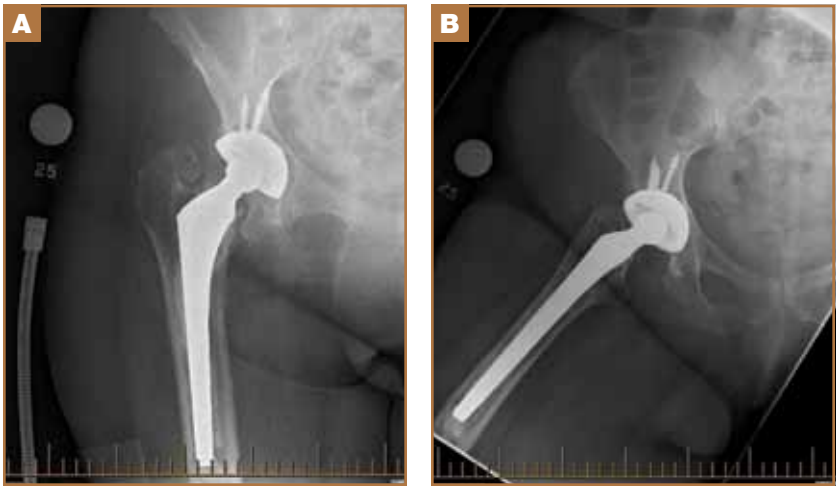

Figure 2. Repeat (A) anteroposterior and (B) lateral radiographs 10 months later, showing progressive bone loss of the femur and periacetabulum.

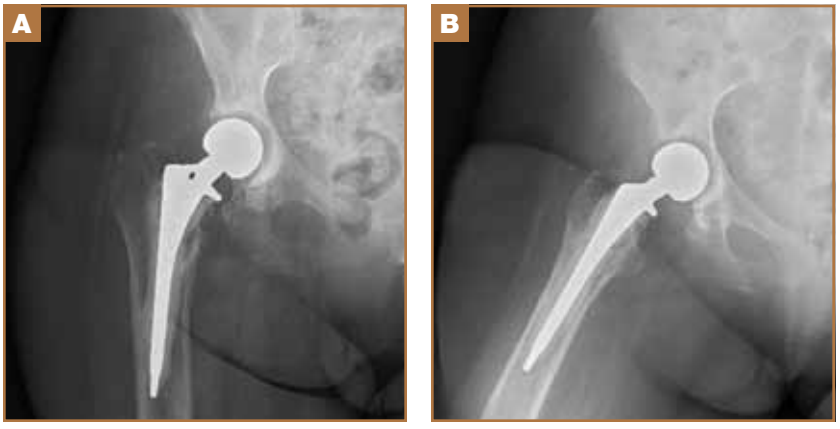

Figure 3. (A) Anteroposterior and (B) lateral radiographs of articulating, antibiotic-laden cement spacer.

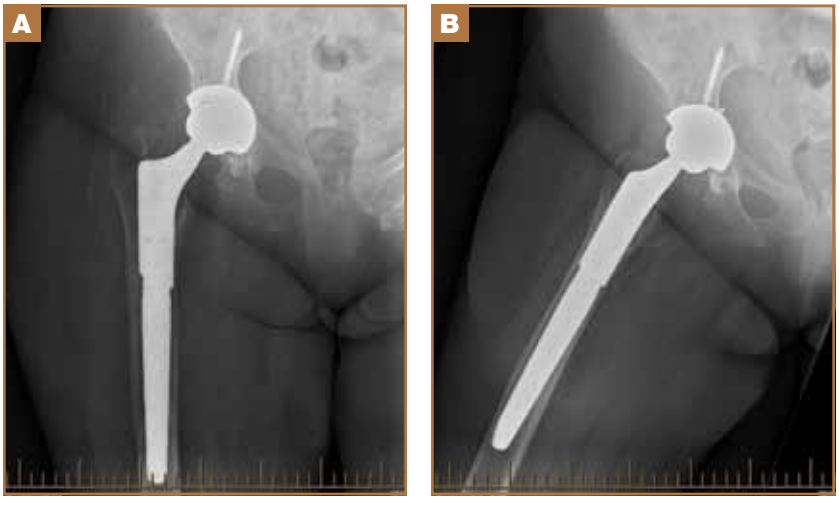

Figure 4. (A) Anteroposterior and (B) lateral radiographs 2 years after reimplantation.

was delayed until we obtained sufficient deep-tissue specimens. Before opening the capsule, we introduced a syringe into the joint and aspirated 10 mL of cloudy yellow synovial fluid that was sent for cell count. Additional findings at surgery included a grossly loose stem with a fragmented cement mantle surrounded by poor bone stock with anterior cortical bone loss and a loose acetabular component with pockets of cavitary bone loss. Frozen section showed up to 5 nucleated cells per high power field, and the cell count showed 1480 nucleated cells/μL (50% polymorphonuclear cells). The equivocal intraoperative findings (cell count and frozen section) and the loose femoral and acetabular components with significant bone loss were sufficiently concerning that we removed the components and placed a cement spacer rather than proceed with revision arthroplasty (**Figures 3A, 3B**). The surgeon, first assistant, and scrub technician wore body exhaust suits. We performed irrigation of the wound bed with pulse lavage.

Intraoperative cultures (synovial fluid, joint capsule synovium, and femur pseudocapsule) were positive after 8 days and growing *B abortus*. Infectious disease consultants prescribed rifampin 300 mg twice daily and doxycycline 100 mg twice daily for 5 months. Follow-up ESR and CRP returned to normal range. A preoperative aspiration of the hip was negative as well. The patient returned to the operating room at 6 months for re-implantation using uncemented components; synovial fluid and tissue cultures taken at this time were negative. Two years after re-implantation, the patient is doing well without evidence of infection (**Figures 4A, 4B**). Additional follow-up will be required to monitor for infection and implant survival. Additional history taken from the patient after the culture results revealed that her development of hip pain was preceded by a febrile illness consistent with brucellosis.

Because of the nature of the procedure (irrigation and débridement using pulse lavage), we were concerned about aerosolization of *Brucella* bacteria and possible transmission to all staff present during the procedure. After consulting with the New Mexico Department of Health (NMDOH) and the Centers for Disease Control and Prevention (CDC), all surgical, anesthesia, and

support personnel present in the operative suite and staff who cleaned the room after the procedure were treated prophylactically (rifampin 600 mg daily, doxycycline 100 mg twice daily for 3 weeks) to prevent development of brucellosis.[13] All 15 operating room personnel who were exposed elected to proceed with antibiotic prophylaxis. In addition to prophylactic antibiotics, serial serologic testing for anti-*Brucella* antibodies was conducted at baseline and 2, 4, 6, and 24 weeks postexposure to monitor for the development of *Brucella* infection. There were no conversions to positive antibody status. No personnel complained of symptoms that would indicate development of brucellosis. At the recommendation of NMDOH and CDC, all staff in the operating room during and immediately after the re-implantation procedure wore properly fitting N-95 disposable respiratory masks (3M, St. Paul, Minnesota) to guard against the potential risk of further exposure.

Discussion

Brucellosis is a zoonotic disease transmitted to humans through contact with animal hosts. Transmission can occur via breaks in the skin in direct contact, through the ingestion of unpasteurized dairy products or raw meat, or through ingestion of aerosolized bacteria. Transmission via aerosolization has been described during medical procedures.

Brucella is endemic in India, Middle Eastern and Mediterranean countries, Central Asia, and South America. *Brucella* species are gram-negative coccobacilli that are capable of surviving within phagocytic cells, making antibiotic treatment difficult. Brucellosis is a febrile illness that occurs after a 1- to 3-week incubation period and is often accompanied by headache, arthralgias, and hepatosplenomegaly. Osteoarticular infection is the most common complication, occurring in 10% to 85% of cases and usually involves the sacroiliac joint and the large joints of the lower extremity. Spondylitis, bursitis, tenosynovitis, endocarditis, colitis, meningitis, and osteomyelitis have also been described.[7,14-17]

As mentioned previously, 18 cases of infected THAs and total knee arthroplasties (TKAs) in 16 patients were identified in the English literature: 9 THAs and 9 TKAs.[1-12] With the exception of 1 case reported in Texas, all others were from the Middle East or the Mediterranean region. In these patients, symptom onset occurred from 2 months to 14 years from the time of the index surgery, and symptom duration ranged from 1 month to 2 years prior to presentation. The exposure was not reported in 2 cases, but the remaining patients either ingested unpasteurized dairy products or worked closely with livestock. Laboratory evaluation revealed elevated ESR or CRP in 8 cases. In 7 cases, no laboratory results were reported, although 1 had a draining sinus. In 1 case, the ESR was normal, but a bone scan was positive. Joint aspiration yielded *Brucella* species in 8 cases, was negative in 3, and not reported in 5 cases (one aspirate yielded *Acinetobacter baumanii*). Only 3 cases reported a time-to-culture positivity (1 "prolonged" and 2 took 7 days).

Eight cases presented with loose components, while 1 case was not reported, and the remaining were presumed to be well-fixed. In cases that were identified as loose, 5 underwent a 2-stage revision and 2 underwent a 1-stage revision (in one of the 1-stage revisions, the infection was identified only after the revision from intra-operative cultures). Of those with well-fixed components, 7 patients with 9 infected joints (including the case where no preoperative description of the components was reported) were treated with oral antibiotics only (range, 6 weeks to 26 months) and 1 with irrigation and débridement and oral antibiotics. Among those treated only with antibiotics, there were 2 failures (2 joints) leading to revision surgery. The other 5 cases were reportedly doing well between 8 months and 5 years after treatment. There were no reports of transmission to hospital or laboratory personnel in any of these cases nor were there reports of precautions to limit exposure for operating room staff or hospital personnel.

Failure of TKA or THA secondary to periprosthetic infection by *Brucella* species is rare, and this represents only the second reported case in the United States.[4] This case highlights several important principles. Maintaining a high level of suspicion for infection in cases of failed joint arthroplasty is important. In addition, as more international travel occurs and patients are seen from areas where *Brucella* is endemic, the possibility of this infectious etiology should be considered. Based on reported cases, patients will usually have elevated ESR or CRP; all (except 2 cases in which no exposure was reported) had known exposure to unpasteurized dairy products or livestock. Joint aspiration yielded *Brucella* species in 8 cases, was negative in 3, and not reported in 5 cases (1 aspirate yielded *Acinetobacter baumanii*). In this case, ESR and CRP were elevated, and infection was suspected but joint aspiration was negative. The initial aspiration was cultured for 5 days and previous data, as well as that presented here, suggest that prolonged culture may provide diagnostic value.[18] The patient had resided in an endemic area and had exposure to unpasteurized dairy products, but *Brucella* infection was not considered and, therefore, no precautions were taken.

Of the reported cases, only 1 met major criteria for periprosthetic joint infection (draining sinus) while 10 of the remaining 15 cases were positive for minor criteria of periprosthetic joint infection (elevated ESR or CRP, or positive culture from joint aspiration).[19] Unfortunately, the available case reports did not detail the extent to which preoperative periprosthetic joint infection could be established based on minor criteria for periprosthetic joint infection (elevated joint synovial white blood cell count or neutrophil percentage, intra-articular purulence, or elevated neutrophil count on periprosthetic tissue histologic analysis).[19]

Periprosthetic joint infection by *Brucella* species is so rare that specific recommendations for this infectious etiology based on 18 reported cases would be overreaching. However, *Brucella* should be considered when evaluating a potentially infected joint replacement where the possibility of exposure exists (eg, travel to or previous residence in endemic areas, close contact with livestock, or ingestion of unpasteurized dairy products in endemic regions), with the potential for transmission to operating room and hospital personnel also considered. If there is concern about *Brucella* involvement, tissue and fluid specimens should be labeled so that laboratory personnel can take

appropriate precautions. *Brucella* can be cultured using routine techniques on standard, nonselective media, but the culture time-to-growth may be prolonged. Culture plates should be held for 14 days before reporting no growth of *Brucella* if it is suspected; the New Mexico Department of Health Microbiology Laboratory holds routine cultures for 1 week after a report of no growth. Thus, a suspicion of *Brucella* should be communicated in order for culture time to be adjusted if the holding of culture plates after an initial report of no growth is not standard practice. If operative intervention is planned and brucellosis is known, personnel should be notified of the possibility of exposure and appropriate measures taken (ie, wearing N-95 respiratory masks during the procedure and considering other methods of irrigation less likely to aerosolize particulates). It is not known if preoperative antibiotic therapy can sufficiently lower the bacterial load to make aerosolization less likely. If brucellosis is suspected but not identified preoperatively, wearing N-95 respiratory masks should be considered during any open procedures.

Conclusion

In cases of *Brucella* infection and loose components, 1- or 2-stage revision with appropriate antibiotic therapy is indicated. (There is not enough data to recommend either 1- or 2-stage revision.) Several reports comment on the ability to treat periprosthetic joint infection in the setting of well-fixed components with antibiotic therapy alone. While this appears to have been successful in 7 of 9 infected joints reported in the literature, length of follow-up ranged from 8 months to 5 years, with no report of length of follow-up in some cases. Antibiotic therapy duration ranged from 6 weeks to 26 months, and the antibiotic treatment involved combination therapy with multiple agents reported but, most commonly, doxycycline, rifampin, and streptomycin. With 2 of 9 (22%) joints failing antibiotic therapy alone and those reported to be successful having relatively short-term follow-up, this treatment strategy should be approached with caution.

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