



Case report

Metal-on-metal total hip arthroplasty adverse local tissue reaction with intermittent unilateral vascular claudication

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ABSTRACT

Osteolysis and adverse local soft-tissue reactions are well-documented complications of metal-on-metal prosthetic implants. This case report describes a 68-year-old man who presented to the clinic 10 years after staged bilateral metal-on-metal total hip arthroplasty revisions with the primary complaint of groin pain, intermittent right leg pain, swelling, and muscle cramping while ambulating that resolved with rest. A complete workup was negative for deep venous thrombosis and infection. His symptoms were found to be secondary to an iliopsoas bursal mass externally compressing the femoral vasculature resulting in vascular claudication. He was treated with revision arthroplasty and drainage of the fluid within the iliopsoas bursal effusion with symptomatic resolution.

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Introduction

In 1953, George McKee was the first surgeon to document routine use of a metal-on-metal (MoM) hip implant. In the 1970s, the MoM design began to lose popularity because of higher revision rates and the local effects seen in revision surgery [1]. These local effects included joint effusions, osteolysis, and aseptic loosening which were thought to be secondary to metal ion debris from implant wear depositing into the surrounding tissues [1,2]. Historically, this was termed pseudotumor but is referred to as adverse local soft-tissue reaction (ALTR). ALTRs can also lead to persistent pain, femoral or sciatic nerve palsy, rash, and ureteral obstruction [3-6].

MoM total hip arthroplasty (THA) undergoes volumetric wear similar to MoM resurfacing but additionally has wear at the

trunnion head-neck junction and at the liner-shell junction. Hothi et al. [7] looked to understand the role of corrosion at the taper junction in MoM implants and concluded that corrosion of the head-stem taper junction occurred in nearly all cases (98%) of the THA group. When MoM THA was compared to failed MoM resurfacing, there was a statistically significant increase in the cobalt (Co)/chromium (Cr) ratio obtained with serology. Many studies have looked to correlate serum Co and Cr levels to predict who will develop symptoms and have attempted to determine when revision arthroplasty is necessary. Although no cutoff value has been identified, each study noted an increased serum ion level in symptomatic patients [2,8-10]. Despite the poor predictability of who will develop ALTRs, we know that these complications do occur.

Case history

History, presentation, and workup

A 68-year-old male patient presented to our clinic in 2016 seeking a second opinion for right leg pain and swelling with ambulation that resolved with rest. His history included a left THA

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revision in 2006 and a right THA revision in 2005 with conversion to a unique Encore sandwich (MoM) THA (Fig. 1). This revision was for aseptic loosening about his acetabular component secondary to particle debris from polyethylene wear. Several months before presentation, he began having right groin pain, swelling, and muscle cramping with ambulation. His initial workup at his local Veterans Affairs hospital was negative for deep venous thrombosis (DVT), but a computed tomography (CT) scan demonstrated a significant fluid collection in his right iliopsoas bursa with compression of the femoral vein (Fig. 2).

The fluid collection was aspirated on two separate occasions with noninfectious serology, but the fluid continued to reaccumulate, and symptoms remained despite aspirations and activity modification. He had no prior complications related to infection or wound healing with his prior hip surgeries. His past medical history, other surgical history, and family history are noncontributory to his current symptoms. Upon initial evaluation, there were no systemic symptoms, and on physical examination, it was noted that he had a well-healed right posterior-lateral hip incision without signs of infection. Right hip range of motion (ROM) was 110 degrees of forward flexion without contracture, 15 degrees of internal rotation with pain, 35 degrees of external rotation, 40 degrees of abduction, and 20 degrees of adduction. He had pain with active straight leg raise and was otherwise motor and sensory intact without a leg length discrepancy.

Imaging obtained during our initial evaluation was significant for bilateral cementless THA revisions with a “sandwich-type” MoM bearing surface. At that time, there was increased radiolucency superior to the acetabulum bilaterally at the sites of prior bone grafting, consistent with Paprosky IIa classification (Fig. 1) [11], with progressive osteolysis and intact superior rim and absent superior or medial migration of the acetabular component. CT scan demonstrated a large fluid collection in the right iliopsoas bursa with associated osteolysis around the acetabular component. Workup included a normal erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) and a noninfectious joint aspirate. However, further testing demonstrated elevated serum Co and Cr levels of 6.7 ppb and 5.9 ppb, respectively.

The patient's symptoms, examination, and presentation were consistent with a failed right THA, with radiographic signs of osteolysis, and soft-tissue reaction secondary to his MoM bearing surface. At that time, a revision hip replacement was discussed with the patient. However, we felt it was critical to review his case with our vascular surgery colleagues to address the femoral vein compression and intermittent claudication before revision arthroplasty.

Within one month, he was seen by the vascular surgery team who noted improved swelling with the use of compression

stockings and obtained venous insufficiency studies to evaluate his claudication symptoms. An interventional radiology venogram was obtained and showed no signs of venous thrombus but revealed greater than 90% occlusion of the right common femoral vein at the junction with the external iliac vein. This was congruent with the location and level of the fluid collection noted on interventional radiology venogram (Fig. 3).

Procedure

In November 2016, the patient underwent a revision THA through a standard posterior approach. At the time of the revision, a large effusion was drained when the capsulotomy was made, consistent with metal ion disease. His abductor musculature was found to be in good condition. The debridement included working through the anterior capsule and into the iliopsoas recess. His large fluid collection was decompressed and debrided, and cultures were sent to the laboratory. Subsequently, the acetabular component was found to be well fixed and in acceptable position. The decision was made to convert this to a highly crosslinked polyethylene insert. The revision sleeve of the metal femoral head was cold welded to the trunion and found to be in poor condition. Thus, the femoral stem needed to be removed through an extended trochanteric osteotomy. A modular tapered revision stem was used to bypass the distal aspect of the extended trochanteric osteotomy (Fig. 4). A new ceramic head was then impacted, and closure was completed in standard fashion with repair of the posterior capsule. He did very well and was discharged on postoperative day 3.

Postoperative course

At his 6-week postoperative visit, he had an antalgic gait with the assistance of crutches, and he noted pain over the posterior aspect of the right hip. His ROM at this visit was 120 degrees of flexion without contracture, 20 degrees of internal rotation, 35 degrees of external rotation, 30 degrees of abduction, and 20 degrees of adduction. Repeat radiographs at this time showed no interval change in the hip prosthesis placement.

At his 3-month follow-up appointment, the patient reported overall satisfaction with the results of his revision hip surgery and was now ambulating without any assistance. His ROM was consistent with his prior examination and radiographs noted a well-aligned right hip prosthesis with interval callus formation around the trochanteric osteotomy site (Fig. 5).

At 7 months, the patient called after being bitten by an insect in the woods with concerns for surgical site infection. CRP was 85.1 mg/L, ESR 28 mm/hr, and white blood cell count $11.6 \cdot 10^9/L$ at this time. Therefore, an aspiration was obtained, and both a Gram stain

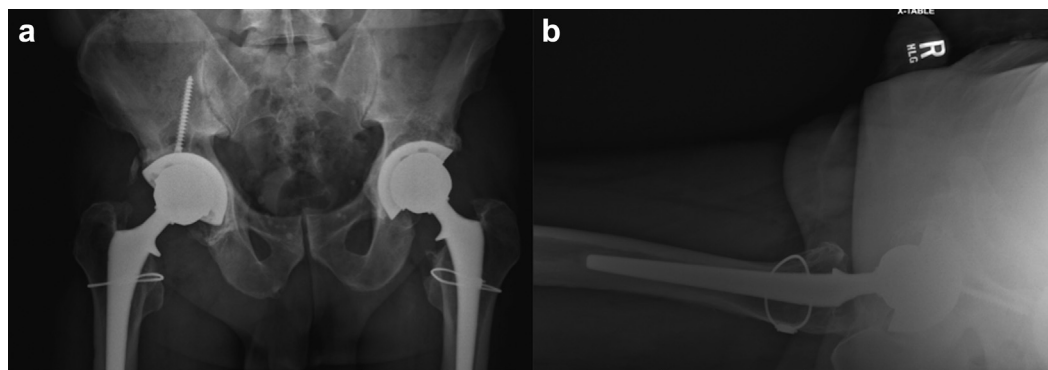


Figure 1. Preoperative (a) anteroposterior pelvis radiograph and (b) lateral right hip radiograph. Noted on the anteroposterior pelvis radiograph imaging is osteolysis of the right acetabulum with an intact superior rim without superior or medial migration of the acetabular component.

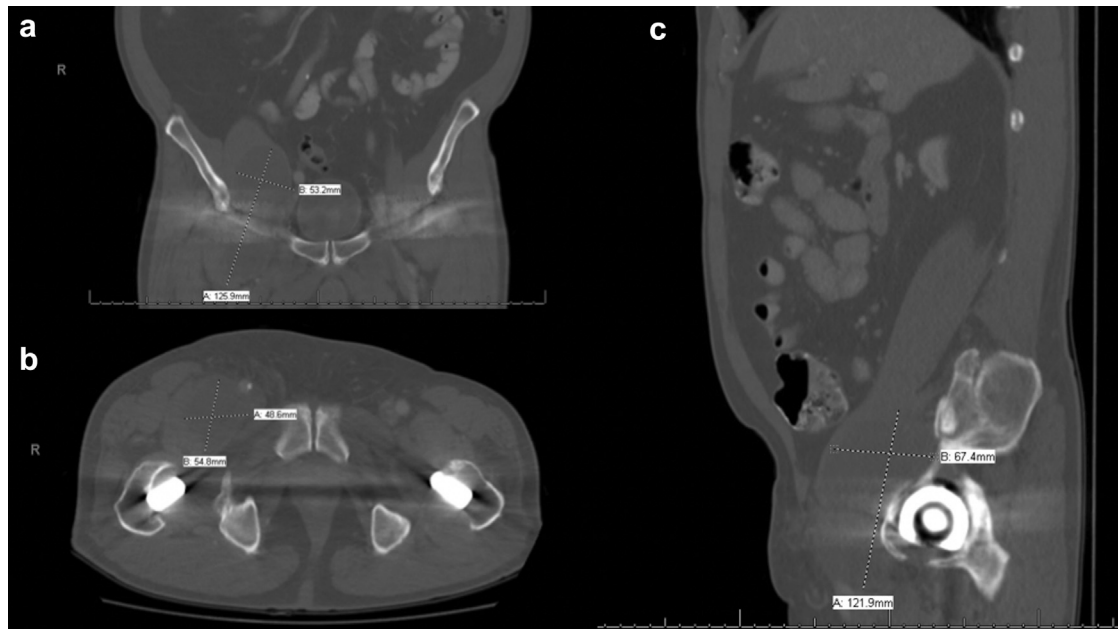


Figure 2. Preoperative CT images including (a) coronal CT with a 53.2 × 125.8-mm fluid collection, (b) axial CT with a 54.8 × 48.6-mm fluid collection, (c) sagittal CT with a 67.4 × 121.9-mm fluid.

and aerobic and anaerobic cultures were obtained. The results revealed a negative gram stain and no growth on the cultures. Repeat laboratory tests obtained in clinic the following day demonstrated a reduced CRP (34.2 mg/L) and increased ESR (51 mm/Hr). On examination, there was centrally draining serous fluid coming from the incision site, with peripheral erythema, and lack of palpable fluctuance. New radiographs revealed no interval change in alignment or interval healing of the trochanteric osteotomy. Musculoskeletal Infection Society (MSIS) criteria for prosthetic joint infection [12] at this time were not completely evaluated, but

the patient had a draining sinus tract (major criteria) and therefore met criteria for a prosthetic joint infection. Therefore, the decision was made to take the patient back to the operating room.

Revision

He underwent irrigation and debridement with femoral head and polyethylene exchange three days later. A cell count was not performed at this time, but intraoperative cultures were obtained. These were noted to have a negative gram stain and negative aerobic, fungal, and acid-fast bacilli cultures. However, the anaerobic culture grew *Propionibacterium* species. It is unclear whether or not this infection was present since the patient's prior surgery, but *Propionibacterium* species often manifest as an indolent infection, and therefore, it is reasonable to assume this infection could have been present since his prior surgery. After an uneventful hospital course, he was discharged with a central line and six weeks of intravenous antibiotics. At six weeks postdebridement, he reported feeling well and walking with minimal assistance. At four months, he was starting to return to normal activities; imaging noted no interval change and a well-fixed prosthesis. At 1 year after the irrigation and debridement, he was doing well, with CT demonstrating a resolving iliopsoas cyst. Heterotrophic ossification was seen on the iliopsoas muscle, which likely limited his flexion on examination. Repeat Co and Cr levels were 9.7 ppb and 5.6 ppb, respectively. It is hypothesized that the elevation in the metal ion levels are related to contralateral MoM hip prosthesis.

Fifteen months since the most recent surgery and two years from the revision surgery at our institution, the patient is doing well and has no symptoms of leg swelling or pain with ambulation. He has since returned to clinic due to interest of revision of his left MoM hip prosthesis secondary to pain and elevated metal ion levels.

Discussion

Modern MoM hip implants carry unique risks aside from the risks associated with all THAs. Historically termed pseudotumor,



Figure 3. Venogram demonstrating approximately 90% occlusion of right common femoral vein.

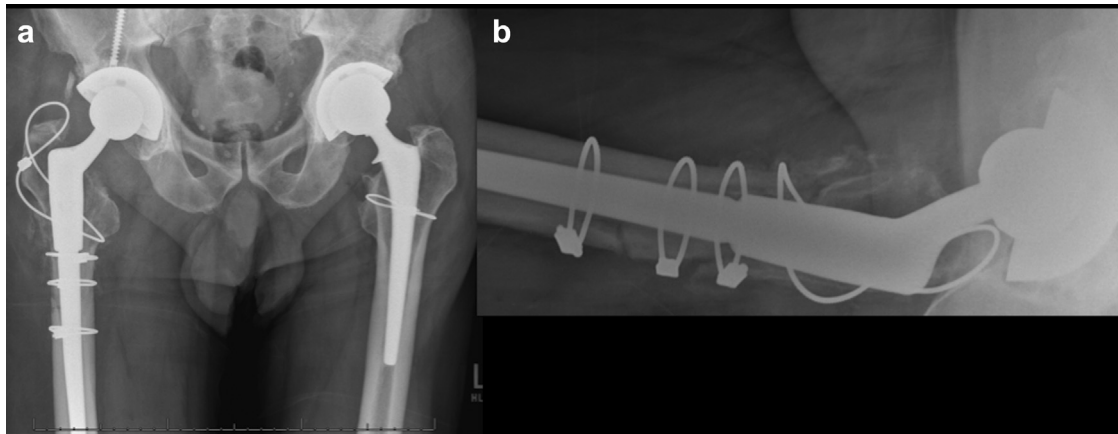


Figure 4. Three months postoperative (a) anteroposterior pelvis and (b) lateral right hip radiographs demonstrating revision right total hip arthroplasty with evidence of an extended trochanteric osteotomy with a modular tapered revision stem.

but now referred to as ALTR, results from metal ions being released locally and systemically [2]. The variability of individual response to these metal ions makes it difficult to predict which patient is more likely to require revision surgery after a MoM primary THA or resurfacing [2]. Metal ions carry their own adverse reactions including persistent pain, rash, and ureteral obstruction [3–6]. Systemic findings can include cognitive, auditory, and visual symptoms along with cardiac pathology, tremor, neuropathy, and depression [13]. Many studies have attempted to develop a critical serum metal ion (Co and Cr) to predict symptomatic ALTR or need for revision surgery. No conclusive serum ion cutoff level has been established despite noting increased levels in patients [8–10,14–17]. When used in combination with physical examination, laboratory evaluation, and radiographic findings, these levels can be another useful tool to understand symptoms and guide clinical decision-making.

In this case, our patient developed a symptomatic ALTR with right unilateral leg swelling with intermittent vascular claudication. According to our vascular surgery colleagues, his vascular claudication symptoms and cramping were secondary to femoral venous occlusion from adjacent soft-tissue swelling resulting in symptomatic intermittent venous insufficiency. Eight previous reports of MoM primary or resurfacing THAs have been reported to have ALTR with associated unilateral leg swelling [3,18–24]. However, to our knowledge, this is the only case reported with

intermittent vascular claudication as a primary complaint. While each previously reported case involved venous obstruction at the level of the pelvis secondary to ALTR external compression, four were found to have an associated DVT, and four had primary complaints of leg swelling or edema. One had progressive unilateral swelling which worsened with ambulation, but no claudication symptoms were reported [3,18–24]. ALTR formation occurs in 30%–60% of symptomatic and asymptomatic patients with MoM hip implants [15,16]. While not all are clinically significant or symptomatic, ALTR is a rare potential source of unilateral leg swelling in this unique demographic. When treating patients with unilateral leg swelling after THA, there are many causes of unilateral leg swelling that need to be ruled out. Grote et al. [20] recommended initial evaluation of unilateral leg swelling to include common sources, such as DVT, cardiac, renal, and vascular causes. They also recommended evaluation with ESR, CRP, serum metal ion levels along with initial radiographic evaluation of the implant position, osteolysis, and signs of loosening [21]. Advanced imaging should help affirm the diagnosis when suspicion is raised based off physical examination and negative initial workup [20].

Treatment of ALTR from MoM THA or MoM resurfacing is varied with aspiration, resection with or without revision of the implant, or implant revision alone [3,18–24]. Abdel-Hamid et al. and Grote et al. [3,20] both recommended involving the vascular surgery team

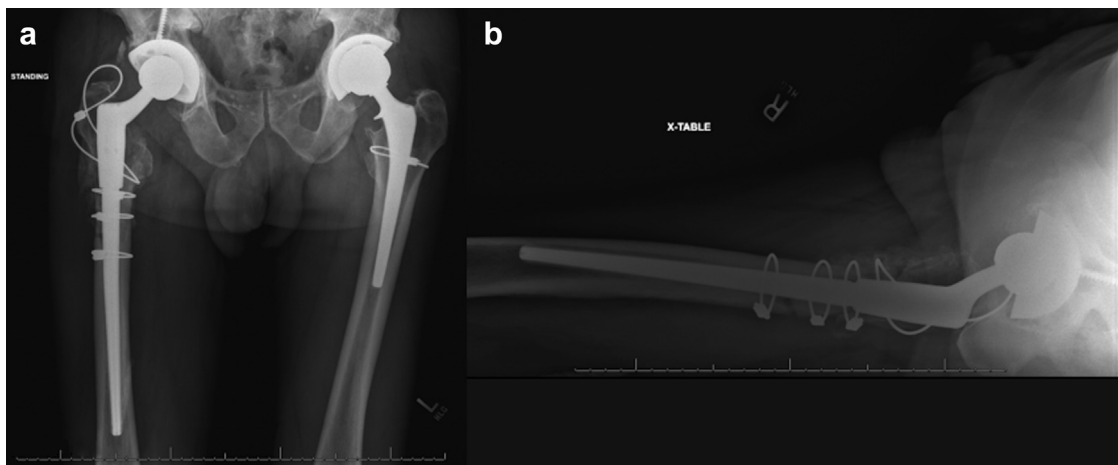


Figure 5. Three months postoperative (a) anteroposterior pelvis and (b) lateral right hip radiographs demonstrating a well-fixed modular tapered revision stem without significant change from previous postoperative imaging and interval healing of the extended trochanteric osteotomy.

in the treatment of these complicated patients with venous obstruction. Once recognized, management of these solid or cystic ALTRs should consist of implant revision and surgical excision with vascular surgery if available. Surgical samples should also be sent for culture and permeant pathology.

Summary

In patients with MoM THA, it is crucial to have a high index of suspicion for ALTR development and their possible sequelae. ALTR is a rare cause of unilateral leg swelling in patients with MoM implants. This case highlights the need for a thorough history and physical examination in addition to standard laboratory analysis and advanced imaging. To date, this patient's right hip is asymptomatic, and his preoperative claudication symptoms have resolved. He has scheduled a revision left THA for persistent pain on that side as well as elevated serum metal ion levels.

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