Arthroplasty Today 1 (2015) 93–98

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Case report

Adverse reaction to metal debris in a patient with acetabular shell loosening 8 years after ceramic-on-metal total hip arthroplasty

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ARTICLE INFO

Article history:
Received 13 February 2015
Received in revised form
19 July 2015
Accepted 21 July 2015
Available online 21 October 2015

Keywords:
Adverse reaction to metal debris
Ceramic-on-metal
Metal-on-metal
Total hip arthroplasty

ABSTRACT

A 41-year-old woman presented 8 years after a left total hip arthroplasty. She complained of progressive groin pain for several months. Radiographs demonstrated a hard-on-hard bearing surface combination and radiolucent lines surrounding the acetabular shell. Laboratory analysis revealed a mild leukocytosis, a normal erythrocyte sedimentation rate, and a mildly elevated C-reactive protein. Serum cobalt and chromium levels were markedly elevated. Aspiration of the hip joint was negative for infection. Magnetic resonance imaging failed to demonstrate a pseudotumor. Revision total hip arthroplasty was performed, and a ceramic-on-metal bearing surface combination was explanted. Significant intraoperative findings included dark gray synovial fluid, metal transfer onto the ceramic femoral head, and a grossly loose acetabular shell pivoting about a single well-fixed screw. The explanted components otherwise appeared normal macroscopically. Histologic analysis of the capsular tissue demonstrated aseptic lymphocyte-dominated vasculitis-associated lesion and inclusion bodies consistent with third-body wear. Revision arthroplasty to a ceramic-on-polyethylene bearing surface combination was performed with a good clinical result and laboratory normalization at 9-month follow-up.

Introduction

As the number of young and active patients undergoing total hip arthroplasty (THA) increases [1], the search for the ideal bearing surface combination that has minimal wear and permits durable long-term results is ongoing. There are multiple alternatives for bearing surfaces, and each has unique characteristics that must be considered before utilization in the operative theater. Currently available acetabular liners include polyethylene, cobalt-chrome, and ceramic options. Femoral head options include cobalt-chrome, ceramicized metal, and ceramic designs. Although the metal-on-polyethylene (MoP) bearing surface combination—in which a cobalt-chrome femoral head articulates with a polyethylene acetabular liner—has a proven track record and excellent long-term results [2], hard-on-hard bearing surface combinations using pairings of the available metal and ceramic components have remained an attractive alternative because of in vitro studies reporting decreased volumetric wear [3].

Recently, the metal-on-metal (MoM) bearing surface combination has fallen out of favor because of complications associated with metal debris particles. The American Association of Hip and Knee Surgeons, the American Academy of Orthopaedic Surgeons, the Hip Society, and multiple other authors have published guidelines on monitoring and management of patients with MoM hips [4,5]. Although technology for ceramic componentry is evolving, early-generation ceramic-on-ceramic hips were fraught with complications that included squeaking and component fracture [6,7]. Therefore, the ceramic-on-metal (CoM) and metal-on-ceramic (MoC) bearing surface options were introduced with the theoretical advantage of minimizing the complications associated with ceramic-on-ceramic hips and MoM hips [8].

Initial enthusiasm for CoM and MoC hips originated from industry-sponsored hip simulator analyses [9-11] and a limited number of in vivo clinical trials with short-term follow-up [11-13].

One or more of the authors of this article have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.artd.2015.07.002.

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http://dx.doi.org/10.1016/j.artd.2015.07.002

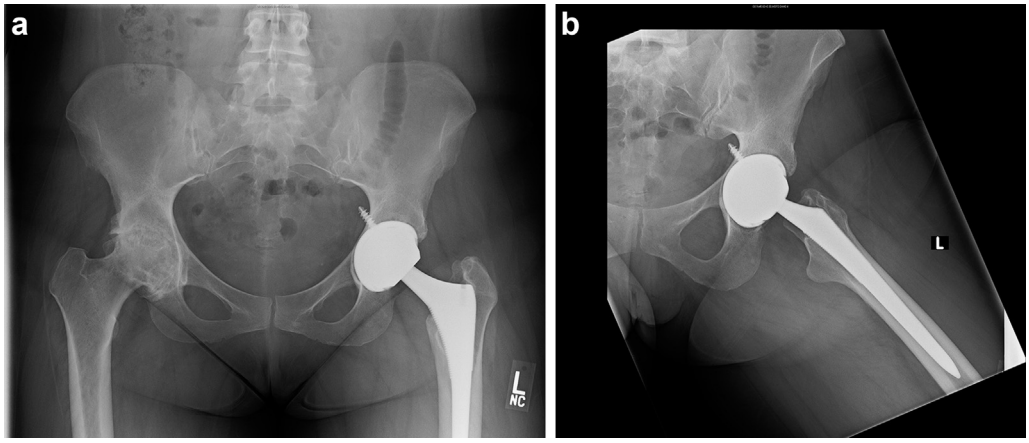

Figure 1. AP pelvis radiograph (a) and lateral view (b) of a 41-year-old woman with a hard-on-hard bearing surface combination demonstrating a complete radiolucent line surrounding the acetabular shell. The femoral stem appears to be well fixed.

Despite previous reports of CoM and MoC bearing surfaces possessing good functional outcomes at short-term follow up, elevations in cobalt and chromium levels were observed that often paralleled levels seen in patients with MoM hips [11-13]. The significance of elevated metal ion levels was underappreciated at the time, and it is estimated that the CoM bearing surface combination alone was used in >10,000 THAs [14]. As the body of evidence regarding adverse reactions to metal debris in MoM and MoP hips continues to evolve [8,15], reports of this situation in CoM and MoC hips are distinctively lacking in the literature. To our knowledge, only 2 case reports exist which describe metal debris—associated complications in patients with the MoC bearing surface combination [16,17], with no reports describing these same complications in patients having previously undergone CoM THA.

Therefore, we report the case of a patient who came to our clinic with a painful CoM THA and describe the clinical presentation, workup, and management of this scenario.

Case history

A 41-year-old woman with no significant medical history underwent uncemented left THA at an outside facility for degenerative osteoarthritis. Outside records were obtained and reported that she had undergone CoM THA as a participant in a multicenter clinical study. Implanted components included Pinnacle Gription titanium acetabular shell (52 mm), with a single titanium screw for additional fixation, cobalt-chrome acetabular liner (52 × 36 mm), Biolox (CeramTech, Plochingen, Germany) Delta ceramic femoral head (36 + 5 mm), and Summit Porocoat titanium femoral stem with high offset neck (size 12) (Johnson and Johnson-DePuy Orthopaedics, Inc., Warsaw, IN, USA).

After index THA, the patient was made weight bearing as tolerated and actively participated in formal physical therapy. Her postoperative course was unremarkable, and the patient quickly returned to her preoperative functional level with no pain or limitations. Approximately 8 years postoperatively, the patient presented to our clinic reporting several months of progressively worsening left groin pain which was causing her to miss days at work. She had not experienced any recent trauma and denied systemic symptoms such as fever or chills.

Physical examination revealed an antalgic gait and painful decreased left hip range of motion. She did not have a Trendelenburg sign. The surgical site was appropriately healed, and the overlying skin was benign. There was no palpable soft tissue mass over the greater trochanter. The patient's weight, height, and body mass index were 84 kg, 165 cm, and 31 kg/m^2, respectively.

Radiographs of the left hip demonstrated THA with a hard-on-hard bearing surface combination. There was no radiographic evidence of catastrophic hardware failure. There was a complete radiolucent line surrounding the acetabular shell which was

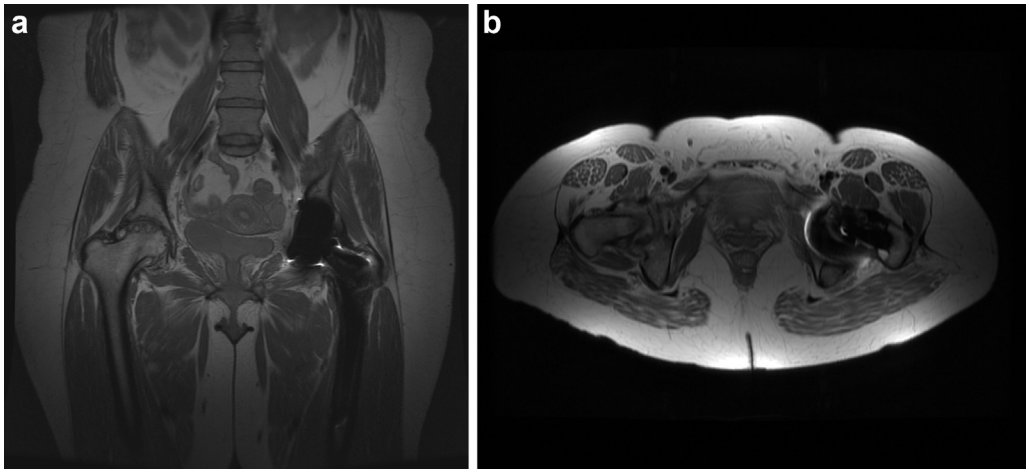

Figure 2. Coronal (a) and axial (b) MARS MRI demonstrating no evidence of pseudotumor or abductor insuffiency.