Heavy Metal? Recognizing Complications of Metal on Metal Hip Arthroplasty

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Case Report

A 63-YEAR-OLD FEMALE with a history of osteoarthritis presents with exacerbation of right low back pain, deep groin pain, and decreased range of motion in her right hip. She underwent right total hip arthroplasty (THA) in 2008 with a metal-on-metal (MoM) prosthesis and left THA in 2011 with a metal-on-polyethylene prosthesis, as well as a previous L4/L5 laminectomy.

Magnetic resonance imaging (MRI) of the lumbar spine shows moderately severe spinal stenosis with bilateral foraminal stenosis at L4-L5 and a large, cystic lesion in the posterior lateral right hip abutting the greater trochanter.

What is the appropriate referral for this patient?

- A. Physical therapy for evaluation and treatment
- B. Interventional radiology for biopsy or aspiration of lesion
- C. Pain medicine for injection management
- D. Orthopedic surgery for possible revision of hip arthroplasty
- E. Positron emission tomography computed tomography (PET-CT) for further diagnostic information

Discussion

Total hip arthroplasty (THA) was introduced in the United States in 1960s. It is one of the most commonly performed surgical procedures in the United States. Between 1996 and 2006, hospital discharges for THA increased by one-third.¹ According to the Centers for Disease Control, there were 332,000 THAs performed in 2010 alone.² Initial complications of THA were frequent and led to several improvements in technique, design, and materials. In general, complications associated with hip arthroplasty include infection, mechanical loosening, dislocation, wear, and rarely component fracture.⁸ Risk factors for complications include implant size, position, and design as well as obesity, diabetes, connective tissue disease, and immunosuppressive medications. In the large United States Total Joint Replacement Registry, women were significantly more likely than men to require revision of THA.⁹

Initially, most bearing surfaces were smaller metal femoral heads that articulated against polyethylene. This bearing type, however, was associated with bone resorption, or os-

teolysis, and dislocation. MoM hip prostheses, consisting of a metal head and metal lined socket, had been used in some early hip designs but were largely abandoned due to failure of fixation and the superior overall performance of metal on polyethylene designs. However, some early MoM designs showed superior wear properties over polyethylene.⁴ By the mid to late 1990s, the problems with failure of fixation of implants had, for the most part, been solved when compared to the high rates of loosening seen in the 1980s. The “weak link” in survival of the hip replacement became the metal-on-polyethylene bearing. In the last 10–15 years, more wear-resistant polyethylene as well as ceramic and metal bearings were introduced.⁵ MoM offered the promise of greater stability with larger diameter femoral heads and also longevity with lower wear rates.⁶ By the mid-2000s, approximately one-third of all hip arthroplasties implanted in the United States were MoM, and worldwide, since 1996, more than 1,000,000 MoM bearing couples have been implanted.⁷

MoM THAs have their own, unique complications. Initially, hypersensitivity and the unknown chronic effects of cobalt and chromium particles being released systemically were the major concerns.^{6,10} In 2008, the first large case series of MoM THA-associated pseudotumors was published.¹¹ These large, solid or cystic growths can be painful or asymptomatic. Reported prevalence ranges from 0%–6.5%¹² up to 33%.¹³ The proposed mechanism of formation has been an adverse local tissue response,¹⁴ the result of intracellular toxicity from cobalt and chromium ions resulting in cell death.

Subsequently, the U.S. Food and Drug Administration, Health Canada, and the United Kingdom's Medicines and Healthcare Products Regulatory Agency issued medical device safety alerts regarding MoM hip arthroplasty.¹⁵ Risk stratification was proposed in a joint consensus statement from the American Association of Hip and Knee Surgeons, the American Academy of Orthopaedic Surgeons, and The Hip Society.¹⁶ Being female is associated with being in the highest risk category. Other risk factors include high activity level, larger diameter femoral heads, and recalled implant devices.

When suspecting a pseudotumor or other adverse event related to MoM THA, imaging should be considered. Both ultrasound and magnetic resonance imaging with metal artifact reduction (MRI MARS) have been evaluated. While

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ultrasound is better for detecting effusions and tendon pathology, MRI MARS is generally preferred due to its higher sensitivity for pseudotumors.¹⁷

Measuring serum metal ion levels, particularly cobalt and chromium, has been of interest in the diagnosis of MoM THA complications. Patient series have shown that abnormal metal ion levels are associated with the presence of pseudotumors, but not necessarily symptoms.¹⁸ However, elevated ion levels are not diagnostic of pseudotumors, nor sensitive enough to rule out the presence of a pseudotumor. Hence, at this time, ion levels are not recommended for routine screening.^{15,19}

Management options of pseudotumors from MoM THA are limited to a revision of arthroplasty with new bearing surfaces (typically ceramic on polyethylene) and resection of pseudotumor.²⁰ This procedure, however, has poorer outcomes compared to the primary hip arthroplasty and revisions performed for non-metal related pathology.^{21,22}

Although complications arising from MoM THA are not unique to women, awareness that female sex confers a higher risk of complication is important. Additionally, appropriate strategies for surveillance and follow-up must be pursued if complications are suspected. If a patient has an MoM implant, clinical history and examination should evaluate for pain, weakness, or loss of range of motion. If any concerns arise, imaging should be considered and the patient must be referred back to orthopedic surgery for formal evaluation.

Answer: The Correct Answer is D

This patient should be referred to orthopedic surgery for comprehensive evaluation and consideration of revision of her metal-on-metal hip arthroplasty. A referral to physical therapy or pain management might assist with this patient's symptoms but are inadequate strategies for management of pseudotumor. The clinical history and appearance of the lesion on MRI are consistent with pseudotumor, so biopsy and PET-CT are unnecessary for further diagnostic evaluation.

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