Pseudotumor formation following large-diameter metal-on-metal total hip arthroplasty—Report of two cases and literature review

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ABSTRACT

Pseudotumor formation following metal-on-metal total hip arthroplasty is an increasingly frequent complication in Taiwan. Orthopedic surgeons should be aware of this complication and follow up their patients regularly so that the disease can be detected early and properly managed. We report two cases of this complication. Case 1 exhibited cystic change with fluid accumulation, and in Case 2 a semisolid mass was found. In Case 1, a high inclination angle of the cup (at 65°) was noted. In Case 2, the cup was placed at a normal inclination angle, but it was too anteverted (31°). The histopathological studies revealed that the cystic pseudotumor had more diffuse lymphocyte infiltration and perivascular lymphocyte cuffing with eosinophil and plasma cells. The semisolid mass of Case 2 had less lymphocyte infiltration. Both cases had metal debris with foreign body granuloma. In patients with residual groin pain and a palpable mass after surgery, the possibility of pseudotumor formation should be considered. Various imaging techniques, such as ultrasound, computed tomography scan, and magnetic resonance imaging, can be used to confirm the presence of such lesions. Revision with nonmetal-on-metal articulation is suggested to relieve the symptoms.

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1. Introduction

Conventional metal-on-polyethylene (MOPE) total hip arthroplasty can result in the release of polyethylene particles, which induce osteolysis and bone destruction, leading to loosening of the prosthesis. Extensive bone resorption in the femur with pseudotumor formation after total hip arthroplasty (THA) was first described in 1976 by Harris et al. Between 1980 and 2000, several studies reported that the wearing effect of methylmethacrylate or polyethylene particles could induce bone destruction and peri-prosthetic pseudotumor formation following total hip replacement. Large diameter head (LDH) metal-on-metal (MOM) THA was later introduced because it causes less wear, has lower dislocation rates, and provides a better range of motion. However, the formation of a periprosthetic cyst or a locally destructive mass in patients with MOM hip articulation has been reported recently. We describe two cases presenting with a benign mass around a hip prosthesis but with different presentations. Case 1 exhibited cystic change with fluid accumulation, and in Case 2 a semisolid mass was found with both femoral nerve and lateral femoral cutaneous nerve compression after LDH MOM arthroplasty. Both patients underwent complete clinical, radiographic, and histological studies to document the cause and nature of the unusual complication.

2. Case reports

2.1. Case 1

A 44-year-old woman underwent an uneventful left un cemented THA with a large head MOM articulation (Durom, cup 54 mm, head 48 mm, Versys fiber metal tape stem; Zimmer, Warsaw, IN, USA) in February 2010. After surgery, she complained of a persistent burning sensation around the hip and trochanter area even while resting. The physical examination of the left hip showed that pain could be elicited by passive internal rotation and adduction; no obvious mass was palpable. Plain X-ray showed no visible osteolysis or loosening, but the cup was placed in a vertical position with an inclination angle of 65°. The axial lateral view showed that the cup anteversion was 17° (Fig. 1A and B). Results of a routine laboratory examination—including complete blood cell count, serum chemistry, erythrocyte sedimentation rate, and C-reactive protein—indicated the values were within normal ranges. Because
of persistent pain, iliopsoas tendinitis caused by impingement was suspected. A computed tomography (CT) scan showed a cystic mass (about 4.6 cm x 4 cm x 2 cm) in the pelvic floor (Fig. 2A and B). Because we suspected that there was an adverse reaction resulting from metal debris, a revision surgery was performed in August 2011. During the operation, we found extensive necrosis of the bursa with clear yellow fluid around the greater trochanter (Fig. 3A and B), but no significant osteolysis or obvious metallosis was noted. The cup was well fixed, and a little bone ongrowth of the cup was found. In addition, wear of the trunnion/head interface was also noticed (Fig. 4). The histopathology finding showed diffuse lymphocyte infiltration, perivascular lymphocyte cuf ting, eosinophil, and plasma cell infiltration, and metal debris measuring about 20 µm with foreign body granuloma was also noted (Fig. 6A–C). The burning sensation and discomfort around the hip subsided after surgery. Four months later, a CT scan showed no cystic mass in the pelvic floor.

2.2. Case 2

A 59-year-old woman underwent an uneventful left uncemented THA with a large head MOM articulation (Durom, cup 54 mm, head 48 mm, VerSys fiber metal tape stem; Zimmer) in July 2007 due to osteoarthritis with intolerable pain, and her pain was relieved immediately after surgery. She stated she had numbness on the anterior-lateral thigh and weakness in hip flexion since May 2010. We found a palpable mass in the inguinal area. Plain X-ray showed the cup inclination angle was 45°, and early osteolysis in zone 1 and zone 3 (DeLee and Charnley’s classification) was noted. The axial lateral view showed the cup anteverision was 31° (Fig. 7A and B). The mass in the inguinal area was soft and painless. Laboratory tests, including a complete blood cell count, serum chemistry, erythrocyte sedimentation rate, and C-reactive protein level, were normal. CT showed that there was a huge cystic mass (about 7 cm x 5 cm x 13 cm) in the left pelvic floor (Fig. 8A). Under the impression of infection, percutaneous ultrasonography-guided aspiration was performed in July 2010. The aspirated fluid was dark brown and sticky. The bacterial, tuberculosis, and fungal cultures all yielded negative results. After the percutaneous aspiration, the patient’s symptoms subsided temporarily. In July 2011, she had the same symptoms, so percutaneous aspiration was performed again and the cultures were still negative. She returned again in December 2011, and this time magnetic resonance imaging (MRI) revealed a semisolid mass in the pelvic floor and around the hip joint (Fig. 8B). After discussing the treatment options with the patient, we arranged a surgery for excision of the pelvic mass by an inguinal approach in January 2012. During the exploration, we found a mass compressing the lateral femoral cutaneous nerve, and it was connected to the hip joint. After mass excision, macroscopic examination of the specimen found massive soft tissue necrosis in the tumor and thickening of the capsule (Fig. 9A and B). The
Histopathological study showed less perivascular lymphocyte infiltration, but a lot of metal debris and foreign body granuloma were noted (Fig. 9C and D). The serum concentration of Co was 7.22 μg/L, Cr was 1.06 μg/L, and Ni was 0.19 μg/L (using inductively
couple plasma-mass spectrometry). We suggested that she undergo a complete revision to a conventional MOPE bearing couple, but she declined to undergo further surgery. Thirteen months after mass excision, she returned for follow-up in February 2013. She denied numbness or pain, and the Harris hip score was 93. However, the physical examination revealed a palpable mass in the inguinal area, and the MRI of the left hip showed recurrent mass formation in the same area.

3. Discussion

MOPE bearings produce particles, and the polyethylene debris may cause a foreign-body reaction. Macrophages and fibroblasts are the predominant cell types, but giant cells may also be present. The pathogenesis of MOPE-induced osteolysis involves the native immune response, and it is known that macrophages play a central causative role in the development of MOPE-induced osteolysis. Very few lymphocytes appear to be involved in its etiology.

Pseudotumor formation in patients who have received surgery with MOM bearing articulation has been investigated for more than 30 years. More recent studies showed that the histological findings of pseudotumors related to MOM arthroplasty and MOPE arthroplasty are different. There is evidence that metal particles may cause local cytotoxicity and elicit a delayed-type hypersensitivity-like reaction. The predominant histological findings were peri-vascular and diffuse lymphocytic infiltration, termed aseptic lymphocyte-dominated vasculitis-associated lesions (ALVAL). Some patients had metallosis, a response to excessive wear debris resulting from malposition of the acetabular or stem component. Adaptive immune response involving the T lymphocyte plays a major role in the pathogenesis of pseudotumor formation.

If the placement of the cup is such that its position and orientation are good, the generation of metal debris is reduced to a minimum, and the size of particles can be measured in nanometers. However, if the cup is not placed in the optimal position, such as in a position that is too vertical and anteverted, edge loading may cause excessive wear, and impingement may produce larger metal particles. Leslie et al suggested that an increase of the cup inclination angle from 45° to 60° results in an increase in wear rate, and Counsell et al reported one case with an extremely high inclination cup position that resulted in excessive wear and higher blood metal ion concentration, triggering the immunological response with ALVAL reaction. In Case 1, the cup was placed at an inclination angle of 65°, which could have resulted in excessive wearing. Case 2 had a more anteverted cup (31°). The safe zone of the inclination angle for the conventional cup may be 30°–50°. De Haan et al reported that there was a less safe zone in the monoblock metal cup implanting, especially when using a smaller acetabular component with the arc angle <170°. The shape of the Durom Cup is a flattened, truncated hemisphere that subtends an

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**Fig. 7.** (A) The cup inclination angle is 45°, and early osteolysis in zone 1 and zone 3 (DeLee and Charnley’s classification) is noted. (B) The axial lateral view shows the cup anteversion angle is 31°.

**Fig. 8.** (A) In July 2010, a huge cystic mass (7 × 5 × 13 cm) in the left pelvic wall is noted. (B) In December 2011, a well-defined, recurrent cystic lesion, measuring about 8.9 cm × 5.6 cm × 3.4 cm, is noted over the anterior aspect of the left hip with communication into the left hip joint.
arc coverage angle of 165°, which means that the safe zone for the Durom Cup inclination angle may be less and an increased inclination angle may cause excessive wear. In our two cases, the metal particles (>20 μm) are much larger than the typical particle size (about 40 nm), and this may have been caused by the abnormal edge loading and impingement.

There are several possible causes of postoperative groin pain after large head MOM arthroplasty, such as rubbing against the capsule, entrapment of synovial folds between the articulating surfaces, and impingement resulting in psoas tendinopathy. Differential diagnosis of the causes of the symptom should be done, as certain mechanical problems in the prosthesis could increase wearing, subsequently leading to pseudotumor formation. Imaging studies such as ultrasound and CT or MRI are useful for confirmation of the pseudotumor. Metal ion measurement is a surrogate for excessive wear. Kwon et al reported that the median serum cobalt and chromium levels in female patients with bilateral MOM-THA in the pseudotumor group were 9.0 μg/L and 12.0 μg/L, respectively. These metal ion levels were significantly greater than those of patients without pseudotumor. In our Case 2, the cobalt ion level was >7 μg/L, and thus excessive wear and pseudotumor formation were suspected.

In 2008, Clayton et al reported the first case of a pseudotumor with femoral nerve compression after hip resurfacing. Here, we report the first case (Case 2) of a similar condition, with progressive weakness of hip flexion after LDH MOM arthroplasty. In addition, Case 2 also presented with numbness at the left outer thigh, a symptom known as Meralgia paraesthetica, which results from the entrapment of the lateral femoral cutaneous nerve. The symptom was consistent with our surgical finding.

The cause of immune reaction to metal debris and formation of pseudotumor is not well understood. The adaptive immune response plays a major role in the pathogenesis of pseudotumor formation. In addition, the bearing surface is not the only source of metal debris wear and serum metal ions. In Case 1, we found evidence of corrosion in the trunnion, which could be another source of metal debris. Bolland et al performed a retrieval analysis on removed prostheses, and they found that the trunnion/head interface and passive corrosion of the stem were potential sources of metal wear. Garbuz et al compared MOM hip resurfacing with large-diameter head MOM-THA and reported that the junction between the femoral head and the neck was the major source of metal debris.

Previous studies on pseudotumor formation associated with early failure after LDH MOM arthroplasty have shown that for patients who present with unusual symptoms such as deep vein thrombosis, lower limb weakness or numbness, groin pain, or a palpable mass in the inguinal area, delayed hypersensitivity to metal debris or excessive wear-related foreign body reaction should be considered. Serum metal ion level could be a useful parameter for early detection of metallosis after MOM-THA prior to the clinical appearance of a palpable mass. Various imaging techniques such as ultrasound, CT, and MRI can offer more detailed perspectives to help
confirm problems at an early stage. However, based on our clinical experience, it is difficult to establish a definitive diagnosis without a surgical pathology report. Revision to a non-metal-on-metal articulation is suggested to relieve the symptoms.

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References