Pseudotumor Caused by Titanium Particles From a Total Hip Prosthesis

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abstract

A 77-year-old woman underwent metal-on-polyethylene total hip arthroplasty for osteoarthritis of the right hip at another institution. During surgery, the greater trochanter was broken and internal fixation was performed with a trochanteric cable grip reattachment. Although postoperative recovery was uneventful, approximately 6 years later, the patient had severe right hip pain with apparent swelling, and she was referred to the authors’ institution. Plain radiographs showed evidence of severe osteolysis in the proximal femur and cable breakage; however, preoperative aspiration culture findings were negative for bacterial growth. Magnetic resonance imaging showed a well-circumscribed mass, presumed to be a pseudotumor. Serum cobalt and chromium levels were within normal limits, and the serum titanium level was high. During surgery, the mass was excised and removal of the cable system revealed a sharp deficit in the bare femoral stem. Gross surgical findings showed no obvious evidence of infection and no corrosion at the head-neck junction; therefore, all components were retained besides the cable system, which resulted in clinical recovery. All of the cultures from specimens were negative for bacterial growth, and histologic findings were compatible with a pseudotumor, such as histiocytes containing metal particles, abundant plasma cells, and CD8-positive cells. Quantitative analysis by inductively coupled plasma atomic emission spectrometry showed that the main source of metal debris in the pseudotumor was the femoral stem, which was made of titanium alloy, not the broken cable, which was made of cobalt-chromium alloy. The findings suggest that titanium particles can form symptomatic solid pseudotumors. [Orthopedics. 2016; 39(1):e162-e165.]

numerous reports have described pseudotumors as sterile masses in the soft tissue surrounding hip prostheses. Various sources of metal wear have been reported, such as the head-neck junction, metal-on-metal bearing, head-shell contact, neck-stem junction, and femoral stem, but the pathogenesis remains unclear.1-5 A recent report described a large pseudotumor after unsuccessful open reduction and internal fixation of a humeral fracture after trauma.6 This finding suggests that pseudotumors may form in all patients with metal devices.

This report describes a patient who had an adverse reaction to metal debris, with a large solid pseudotumor after trochanteric cable grip reattachment.7 Quantitative analysis of the metal in the specimens identified the main cause of the pseudotumor. This article describes the clinical course and pathophysiology, with a review of the related literature.

Case Report

In June 2006, a 77-year-old woman underwent metal-on-polyethylene total hip arthroplasty (THA) for osteoarthritis of the right hip joint at another institution.

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Its composition was a Trilogy acetabular cup (Zimmer, Warsaw, Indiana), a VerSys enhanced taper stem made of titanium alloy (Zimmer), and a 28-mm metal head made of cobalt-chromium alloy with an ultra-high-molecular-weight polyethylene insert (Zimmer). During surgery, the greater trochanter was broken; therefore, internal fixation was performed with a BMP trochanteric cable grip system made of cobalt-chromium alloy (Biomet, Warsaw, Indiana).

Postoperative recovery was uneventful; however, 2 years after the arthroplasty, the patient had a gradual increase in right hip pain. Repetitive plain radiographs showed progressive osteolysis around the cable system. In September 2012, radiographs showed cable breakage, and the patient had difficulty walking in addition to swelling of the right hip. Inflammatory biomarker levels were elevated, but an aspiration sample was negative for infection. Antibiotic treatment was discontinued, and the patient was referred to the authors’ institution in December 2012.

On initial consultation, the patient had marked swelling and redness of the right hip, but no fever or chills. Laboratory studies showed a C-reactive protein level of 2.6 mg/dL (<0.3 mg/dL) and a leukocyte count of 9200 cells/mm³ (normal range, 4000-9000 cells/mm³). Plain radiographs showed severe osteolysis in the proximal femur and breakage of the cable (Figure 1A). A small amount of blood was aspirated from the lesion, and it was negative for bacterial growth. Magnetic resonance imaging showed a well-circumscribed mass in the lateral aspect of the greater trochanter, presumed to be a pseudotumor (Figure 1B). Serum cobalt and chromium levels were within normal limits, and the serum titanium level was high, at 30 ng/mL (normal range, 0-1 ng/mL).

Intraoperative findings showed a large abnormal mass (Figure 2A) that was excised and submitted for analysis. The cable system was removed, and the patient had a sharp deficit in the bare femoral stem (Figure 2B). Gross surgical findings showed severe metallosis in the periprosthetic tissues, but no obvious signs of infection and no corrosion at the head-neck junction. Despite marked bone loss, the acetabular cup and the femoral components were solidly fixed, with no sign of dislocation; therefore, all components were retained besides the cable system.

All cultures from the specimens were negative for bacterial growth. Histologic study showed various findings compatible with a pseudotumor, such as histiocytes containing metal particles, abundant plasma cells, and lymphocytes (Figure 3A). Immunohistochemical staining showed CD8-positive cells (original magnification ×100) (B).

![Figure 1: Anteroposterior radiograph showing severe osteolysis and breakage of the cable, but no loosening of the metal-on-polyethylene total hip prosthesis (A). Coronal short-inversion-time inversion-recovery image showing a well-circumscribed, 5.0×5.2×8.2-cm inhomogeneous lesion extending from the lateral aspect of the greater trochanter to the subcutaneous fatty tissue (B).](image1)

![Figure 2: Intraoperative photograph showing an abnormal granulomatous mass (A) and a sharp deficit (arrow) in the bare femoral stem (B).](image2)

![Figure 3: Histologic images of specimens of the abnormal mass. Photomicrograph showing metal debris, histiocytes containing metal particles, abundant plasma cells, and lymphocytes (hematoxylin-eosin, original magnification ×200) (A). Immunohistochemical staining showing CD8-positive cells (original magnification ×100) (B).](image3)
The lymphocytes were mainly CD3-positive T cells, with a mixture of CD4-positive and CD8-positive cells (Figure 3B). The amounts of cobalt, chromium, and titanium from a small specimen of the pseudotumor were measured to calculate metal ratios by inductively coupled plasma atomic emission spectrometry with SPS5520 (Sumika Chemical Analysis Service, Osaka, Japan). The cobalt and chromium levels were both 2 μg (0.4%), whereas the titanium level was 250 μg (99.2%). At 2-year follow-up, laboratory data showed no abnormal findings, and the patient walked with a cane, with a slight Trendelenburg lurch.

**Discussion**

In patients who have an adverse reaction to metal debris, treatment is removal of the causative debris. This treatment differs from the treatment of septic failure; however, clinical distinction between adverse reaction to metal debris and septic failure is often difficult. The current patient was suspected to have infection, based on local appearance and laboratory values; however, preoperative culture and magnetic resonance imaging findings showed an adverse reaction to metal debris. The gross surgical findings also showed no evidence of septic failure, prompting retention of the entire pseudotumor. Postoperative analysis of the retrieval tissues and the patient’s clinical course also showed that this failure was caused by metal abrasion and not infection.

Bone destruction is significantly more frequent in THA with cobalt-chromium cable compared with stainless steel wire. Berton et al noted that cable breakage increases the risk of osteolysis and reported that 3 patients had a painful mass as a foreign body reaction. Accordingly, the authors speculated that the pseudotumor in the current patient was also associated with a cable system made of cobalt-chromium alloy. However, quantitative analysis of the metal from a segment of the pseudotumor showed that the ratio of titanium was greater than 99% and suggested a preoperative elevated level of serum titanium. This finding indicates that titanium played an important role in pseudotumor formation.

Gross surgical findings showed evidence of a sharp deficit in the bare femoral stem (Figure 2B). Onishi et al reported that an outer cup made of cobalt-chromium alloy has a tendency to shave down the stem neck made of titanium alloy easily, and in the current case, the deficit seemed to be caused by the same mechanism. Titanium wear particles can generate anywhere in the bare femoral stem and are believed to be abundant. Haynes et al suggested that titanium alloy particles show low toxicity, but induce high levels of inflammatory mediator release at a wide range of concentrations. Maloney et al reported that titanium particles were toxic at the highest concentration. McPherson et al reported a case of a massive pseudotumor in metal-on-polyethylene THA in the absence of metal other than titanium. Based on these reports and the pathophysiology in the current case, the authors concluded that this pseudotumor was closely related to continuously supplied abundant titanium wear particles. Histologic findings showed both abundant plasma cells and CD8-positive cells. The pathogenesis of pseudotumor formation is unknown, but it may involve both a chronic inflammatory response and a delayed hypersensitivity response to titanium particles. Although further research is needed to determine the role of subtle metal particles, quantitative analysis of titanium played a significant role in clarification of the pathophysiology of this pseudotumor.

**Conclusion**

The current patient, who had failed metal-on-polyethylene THA, represents a rare case of severe osteolysis, breakage of the cobalt-chromium alloy cable, and a large solid pseudotumor. Intraoperative findings and quantitative metal analysis clarified that the main source of metal in pseudotumor formation was the abraded titanium alloy femoral stem, not the broken cable. Although the pathogenesis is still unknown, the authors believe that abundant titanium particles can form symptomatic solid pseudotumors.

**References**


