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Normalization of chromium and cobalt values after femoral head replacement

Claudio Iacobellis[a,*], Antonio Berizzi[a], Assunta Pozzuoli[b], Carlo Biz[a]

[a] Orthopaedic Clinic, Department of Surgery, Oncology and Gastroenterology DiSCOG University of Padua, via Giustiniani 2, 35128 Padova, Italy
[b] Histology, Microbiology and Medical Biotechnology, University of Padua, via Giustiniani 2, 35128 Padova, Italy

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ABSTRACT

INTRODUCTION: Adverse reaction to metal debris (ARMD) can be caused by metal-on-metal total hip arthoplasty. We treated a case of ARMD in a 61-year-old patient by limited prosthetic revision, replacing the metal head with a polyethylene one.
PRESENTATION OF CASE: Two years after metal-on-metal total arthoplasty of the left hip, radiographic control showed osteolysis of the patient's greater trochanter. He underwent surgical curettage and the application of demineralized bone matrix. After a few months, blood Co and Cr increased, and at clinical evaluation, the patient had worsening paresthesias. He agreed to prosthetic revision after 14 months.
DISCUSSION: During surgery, the acetabular cup and femoral stem appeared correctly osteointegrated; therefore, the cup was maintained, while the prosthetic femoral head was removed and replaced with a 50 mm polyethylene head.
CONCLUSION: Blood Cr and urinary Cr and Co decreased and normalized 3 months after surgery, and the patient no longer suffered paresthesias. Blood Co normalized 7 months after revision. Radiographic follow-up showed no change after 30 months post-operatively. We believe this case report could be a starting point for a future randomized clinical trial to test the efficacy of the procedure used compared with complete implant revision.

1. Introduction

In recent years, metal-on-metal total hip arthroplasties (THAs) have been widely used because of their big femoral heads and thin profile acetabular cups with high stability and reduced wear. These implants have caused major problems due to a high incidence of adverse reactions to metal debris (ARMD) [1,2] and related pathologies (polyneuropathies, renal, cardiac, and thyroid alterations) [3–5] that lead to implant removal [6,7]. The aim of this report is to show how the treatment of an ARMD case with prosthetic revision limited to metallic head substitution allowed good clinical and toxicological results, resolving the complicated case.

2. Presentation of case

In January 2003, a 55-year-old bricklayer (height 170 cm, weight 86 kg, non-smoker) underwent an uncomplicated primary implant of a ceramic–ceramic total hip arthroplasty (Lima Corporate, Italy) at our institution for painful right hip coxarthrosis. At time of surgery, the patient was healthy. By Prick Test, he was found allergic to concrete, rubber, plastic, and latex; no allergies for food and drugs were found. The patient had a normal postoperative course with excellent results. After 11 years, the right hip was very mobile and without any pain, and radiographic follow-up was within normal limits (Fig. 1).

In October 2008, due to constant painful coxarthrosis of the left hip, the patient underwent uncomplicated total hip arthroplasty with primary anterior-lateral approach. Components included a PLS 158 mm femoral stem (Lima Corporate, Italy) and a large-diameter metal-on-metal bearing (56 mm metal cup and 50 mm head). The post-operative course was normal. The patient started bearing weight a few days after surgery, and the left hip presented almost complete mobility with 10° reduction in intra-rotation, maintained in later follow-up. One year after, both clinical and radiological evaluations were within normal limits.

In 2010, the patient was doing well, without complaints, fever, or hip pain. However, antero-posterior and lateral radiographs revealed a bone density reduction in the left greater trochanter and mild bone rarefaction of the acetabular cup on the medial side (Fig. 2). Laboratory analysis showed a CRP level of 15 mg/L (normal range 0–6 mg/L).

* Corresponding author. Tel.: +39 49 8213343; fax: +39 49 8213365.
E-mail addresses: claudio.iacobellis@unipd.it (C. Iacobellis), antonio.berizzi@unipd.it (A. Berizzi), assunta.pozzuoli@unipd.it (A. Pozzuoli), carlo.biz@unipd.it (C. Biz).

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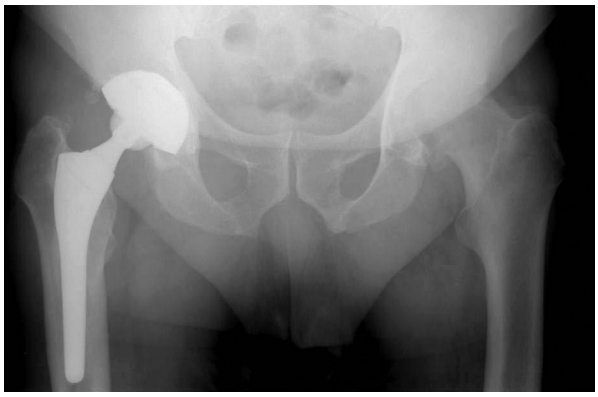
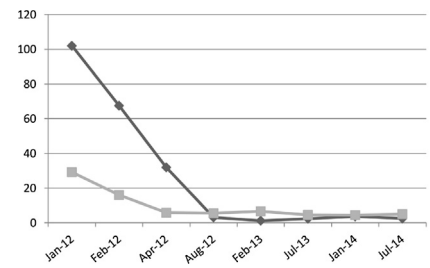


Fig. 1. Left hip pre-operative X-ray and primary implant of the ceramic–ceramic total hip arthroplasty on the right hip after 11 years follow-up.

Table 1
Blood cobalt (black) and blood chromium (gray) concentration during follow-up in μg/L.



	CoB μg/l	CrB μg/l
Jan-12	102.00	29.20
Feb-12	67.50	16.00
Apr-12	32.00	5.90
Aug-12	3.19	5.62
Feb-13	1.29	6.69
Jul-13	2.46	4.65
Jan-14	3.68	4.52
Jul-14	2.54	5.05

Therefore, in November 2010, 25 months after the initial procedure, the patient underwent prosthetic surgical revision. Intraoperatively, grayish caseous material was evident, once the greater trochanter was exposed. Creamy lead gray material spurted out from the hip articulation, occupying most part of trochanteric area (Fig. 3A). The stem appeared well fixed and stable. The remaining lytic area was filled with 11 cc of demineralized bone matrix (DBX by Synthes) and closed with the residual thin trochanteric wall (Fig. 3B). Histological sample examination confirmed metallosis, revealing amorphous fibrous material with marginal necrotic areas and inflammatory lymphocytic infiltrate, coupled with necrotic bone spicules and hemosiderin macrophages. Microbiological samples revealed no infection.

During 2 months follow-up, 20 cc of serum-hematic fluid were drawn weekly. At radiographic control (2 months after surgery), trochanteric lysis was no more visible and periarticular ossifications were evident (Fig. 4). There were no more articular effusions, but the patient complained of paresthesias in the whole left leg and foot. There was indication for surgical revision and prosthetic replacement. The patient refused it, preferring further clinical evaluation in 9 months time.

In September 2011, he developed swelling of his left thigh in the trochanteric region (from which 50 cc of grey fluid were drawn) and paresthesias (extending from his left leg to his foot). In February 2011, blood values of Cr and Co were 94.50 μg/L and 28.80 μg/L, respectively. The radiographic control resulted unvaried, and the patient refused a new operation.

In January 2012, 14 months after the previous surgery, because of the persistence of his left hip and lower limb symptoms, the patient agreed on single-stage arthroplasty revision. Blood values of Cr and Co were 102.00 μg/L and 29.20 μg/L, respectively, while their urinary values were 422.00 μg/L and 84.50 μg/L (Tables 1 and 2). There was no reflex deficit or muscular strength deficit. During surgical preparation, blood tests indicated a hemolysis compatible with autoimmune hemolytic anemia. Non-complement-fixing IgG class autoantibodies were found attached to red blood cells. The study of subclasses revealed the presence of IgG1 and IgG3 at a low titer of 1:1. Anesthesiologist colleagues planned a possible therapy with cortisone drugs and antihistaminergic drugs in case of blood transfusion, which proved unnecessary.

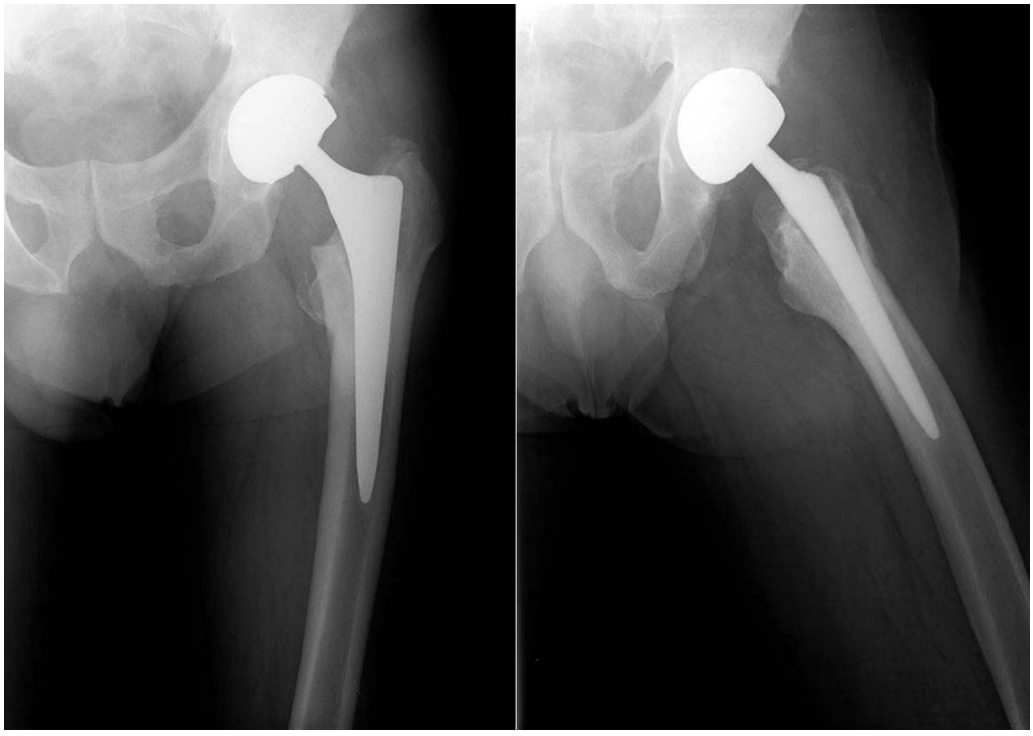


Fig. 2. Osteolysis of the greater trochanter at 2 year X-ray follow-up.

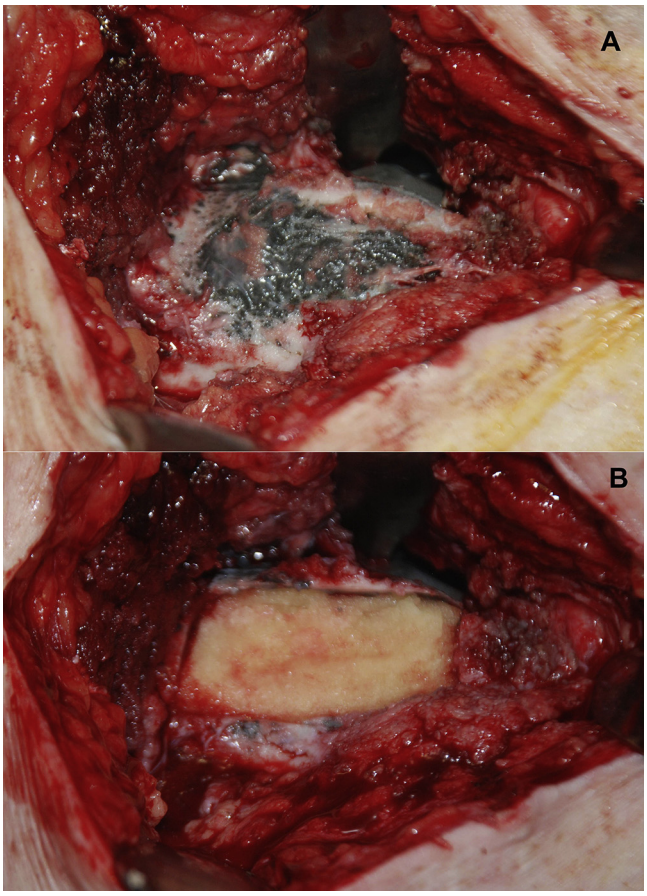


Fig. 3. (A) Creamy lead grey material spurted out from the hip articulation, occupying most part of trochanteric area. (B) The lytic area was filled with demineralized bone matrix (DBX).

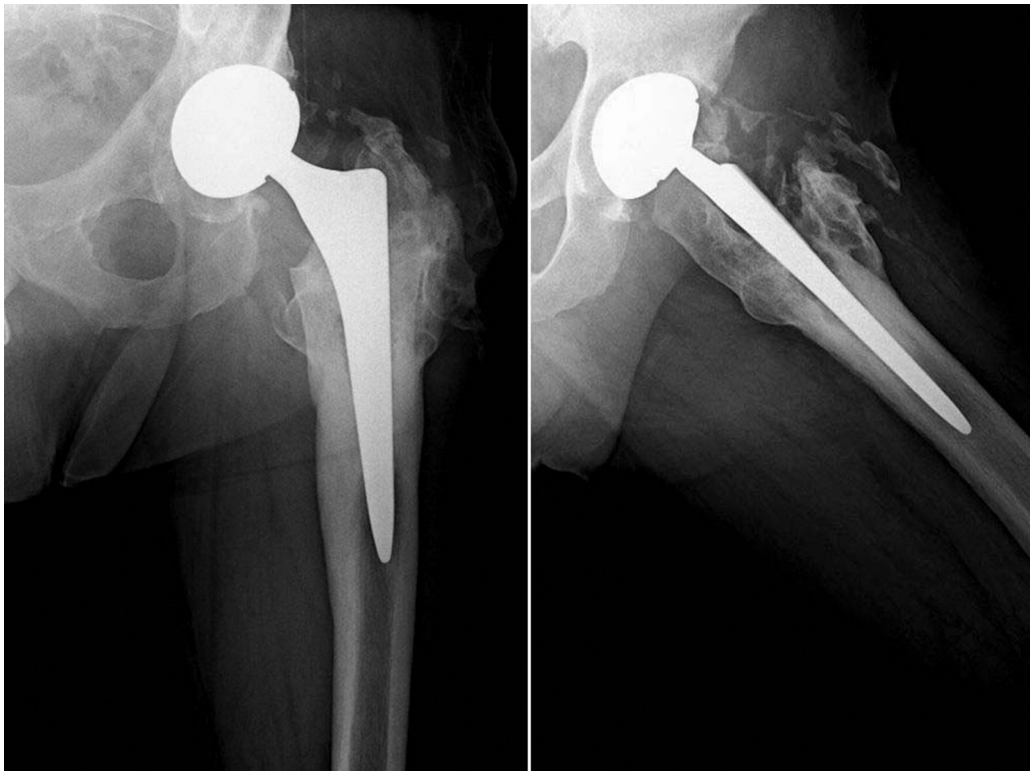
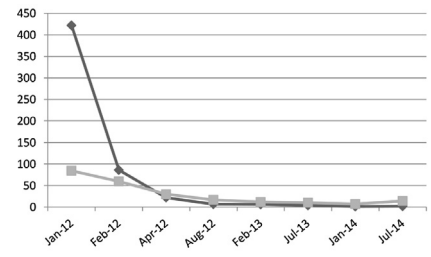


Fig. 4. 30 months X-ray follow-up.

Table 2
Urinary cobalt (black) and urinary chromium (gray) concentration during follow-up in μg/L.



	CoU μg/l	CrU μg/l
Jan-12	422.00	84.50
Feb-12	85.90	59.60
Apr-12	22.10	29.80
Aug-12	6.58	16.80
Feb-13	6.02	11.70
Jul-13	3.70	10.07
Jan-14	1.10	7.02
Jul-14	1.77	13.90

Revision of the original implant was carried out using the same surgical approach. Intraoperatively, extensive grey colored reactive tissue enveloping the prosthetic head and the neck of the femoral component and the acetabular cup edge was visible. A large paratrochanteric ossification was removed. All of the fibrotic tissue around the joint was extensively excised and sent for histology and microbiological analysis. The femoral head and neck surrounded by reactive tissue were then exposed. The prosthesis was dislocated and the metallic head removed. Metallic articular surfaces showed no damage. The acetabular cup and femoral stem were well fixed and optimally osteointegrated. The metallic head was replaced by a 50 mm polyethylene head (Lima Corporate, Italy). Microbiological samples taken intraoperatively were negative for infection; histological samples showed dense fibrous tissue with superficial areas of hyalinosis and foci of lymphocytic and macrophagic chronic inflammation (characterized by macrophages with pigmented cytoplasm and inclusions of extraneous material). Tests on samples obtained during surgery were performed by atomic absorption spectrophotometry in an industrial toxicology laboratory, independent of our institution. They revealed elevated values of cobalt (463.1 μg/L) and chromium (2938 μg/L) in subfascial tissue and similarly in articular fluid (cobalt 9380 μg/L and chromium 9300 μg/L).

After 40 days, the surgical wound was dry and the scar correctly formed. No effusions were present in follow-up. In April 2012, 3 months after surgery, blood chromium and urinary chromium and cobalt tended toward normal values (Tables 1 and 2). The patient was without paresthesias, which he had experienced before the previous operation. By August 2012, blood cobalt had dropped to normal values (Tables 1 and 2). Radiographic control did not show any variation from the post-operative one, as was the case after 30 months (Fig. 4).

3. Discussion

Tissue reaction to metal debris (ARMD) is often reported for patients with metal-on-metal THA. It may cause aseptic lymphocytic vasculitis-associated lesions (ALVALs). ALVAL is a precursor of lymphoid neogenesis that contributes to tissue necrosis and prosthetic failure [1,2].

ARMD damage is mainly to kidney, peripheral nervous system, heart, and thyroid function [3–5]. Some authors have reported a higher rate of metallosis in arthroplasties with small diameter femoral heads [8,9], while others [10] have not found significant differences in blood and urinary Co and Cr between two groups of patients, i.e., big vs. small femoral heads. Mokka et al. [11] showed a higher rate of ARMD in bigger diameter heads. Various authors [12–14] have suggested a higher rate of ARMD in incorrect acetabular cup placement, in anteversion, or related to greater inclination in the acetabular lateral opening angle. These studies highlight that increased friction in head-cup contact increases the risk of metallosis. Obesity is also considered a risk factor [8]. An effective monitoring procedure is blood and urinary Co and Cr dosing [15]. If metal concentration is high and clinical symptoms are significant, the only therapeutic choice is removal of the prosthesis, eliminating the origin of metallosis [6]. At present, the patient evaluated in this study is the only ARMD case among 130 metal–metal THAs treated in our clinic. He had allergic diathesis, mainly against concrete and latex. The acetabular cup had an inclination lower than 50°. The femoral head (50 mm) was a large diameter one, and the prosthetic cup and stem were correctly osteointegrated.

We considered only prosthetic head replacement legitimate and sufficient in order to avoid the aggressiveness of a total removal operation. The important decrease in Cr and Co values, along with a reduction of clinical symptoms (paresthesias), convinced us that our procedure, not reported previously in the literature, is an important alternative to total prosthesis removal.

4. Conclusion

Patients with metal–metal THAs, with high blood and urinary Co and Cr linked to clinical symptoms (like paresthesias), also without clear radiographic signs, should be considered for prosthetic revision. In this patient, good results were achieved with revision limited to the metallic head, avoiding major surgery for acetabular cup removal, while not precluding this procedure at a later stage if Cr and Co values should rise. We believe this case report could be a starting point for a future randomized clinical trial to test the efficacy of the procedure used compared with complete implant revision.

Conflict of interest

The authors declare that they have no conflict of interest related to the publication of this manuscript, and they have not received benefits or financial funds in support of this study.

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Author contributions

Prof. C. Iacobellis: study concept and design; writing the paper.
Dr. C. Biz: writing paper and data collection.
Dr. A. Berizzi and Dr A. Pozzuoli: data analysis and interpretation.

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