CASE REPORTS

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Pseudotumor as adverse local tissue reaction due to implant corrosion

Pseudotumor kao lokalno neželjeno dejstvo usled korozije implanta

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Abstract

Introduction. The term adverse local tissue reactions (ALTRs) is used to describe pathologic tissue conditions appearing after total joint replacement, and it includes osteolysis, bone necrosis, muscle necrosis, cystic lesions, excessive fluid collections, soft tissue masses, pseudotumors, metal sensitivity, metallosis, and chronic inflammatory lesions. ALTRs are rarely described in the literature after the breakage of the ceramic components of the hip prosthesis. **Case report.** We present a case of a patient with massive fluid collections filled with metallic and tissue detritus, along with signs of systemic cobalt (Co) and chromium (Cr) intoxication. Symptoms developed after revision of the acetabular component with the application of a metal-on-polyethylene coupling. Previously, several revisions were made due to breakage of the ceramic components of the endoprosthesis and instability of the hip. After removal of pseudotumor masses and revision of all components of the endoprosthesis with implantation of a coupling between the ceramic head and the polyethylene insert, there was a significant drop in the serum values of Co and Cr. **Conclusion.** Trunnion damage should be assessed during revision procedures, and if present, both prosthetic components should be replaced to prevent disastrous effects of metallic corrosion, ALTRs, and systemic metallic ions intoxication. Measurement of serum levels of Co and Cr in patients after joint replacement could identify patients at risk for the development of ALTRs and metallosis.

Key words:
arthroplasty, replacement, hip; chromium; cobalt; long term adverse effects; prostheses and implants; tissues.

Apstrakt

Uvod. Termin neželjene lokalne reakcije tkiva (NLRT) odnosi se na patološke promene tkiva koje se javljaju nakon totalne zamene zgloba i uključuje osteolizu, nekrozu kosti, nekrozu mišića, cistične promene, prekomerno nakupljanje tečnosti oko zglobova, pojavu mekotkivnih pseudotumora, reakciju preosetljivosti na metal, metaloze tkiva i hronične inflamacijske lezije. U literaturi su retko opisivane NLRT nastale nakon pucanja keramičkih komponenti endoproteze kuka. **Prikaz bolesnika.** Prikazujemo slučaj bolesnika sa masivnim tečnim kolekcijama ispunjenim metalnim i tkivnim detritusom i znacima sistemske intoksikacije jonima kobalta (*cobalt* – Co) i hroma (*chromium* – Cr). Simptomi su se razvili nakon revizije acetabularne komponente uz primenu metal-na polietilen oslanjajućeg para. Prethodno je učinjeno više revizija zbog pucanja keramičkih komponenti endoproteze i nestabilnosti kuka. Nakon uklanjanja pseudotumorskih masa i revizije svih komponenti endoproteze sa implantacijom oslanjajućeg para između keramičke glave i polietilenskog inserta, došlo je do značajnog pada nivoa Co i Cr u serumu. **Zaključak.** Tokom revizionih procedura treba proceniti oštećenje truniona (*trunnion*) i ukoliko ono postoji, potrebno je zameniti obe protetske komponente, kako bi se sprečili efekti korozije metala, NLRT i sistemska intoksikacija jonima metala. Merenjem nivoa Co i Cr u serumu kod bolesnika posle totalne artroplastike, mogu se prepoznati oni bolesnici koji imaju rizik od nastanka NLRT.

Ključne reči:
artroplastika kuka; hrom; kobalt; neželjeni efekti, dugoročni; proteze i implantati; tkiva.

Introduction

The term adverse local tissue reactions (ALTRs) has been used more often to describe pathologic tissue conditions appearing after total joint replacement, and it includes osteolysis, bone necrosis, muscle necrosis, cystic lesions, excessive fluid collections, soft tissue masses, pseudotumors, metal sensitivity in the form of aseptic

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lymphocyte-dominated vasculitis-associated lesions, metallosis, and chronic inflammatory lesions [1]. Recently, ALTRs have been noticed around metal-on-metal (MoM) articulations more often [2]. Damage to the femoral stem neck and head–neck junction (trunnion) of cobalt (Co) and chromium (Cr) components of the implants leads to an increase in the serum levels of metallic ions and local tissue reactions [3].

We present a patient in whom breakage of the ceramic components led to damage of the stem neck and consequent local tissue reaction which deteriorated after partial revision of the bearing surfaces. The patient developed a systemic manifestation of Co and Cr poisoning.

Case report

A 57-year-old man has been admitted to the hospital because of pain and pelvic mass. Initially, total hip replacement was performed at the age of 50 due to avascular necrosis of the hip and consequent degenerative hip disease. Initial total hip replacement was performed in 2005 with ceramic-on-ceramic (CoC) coupling (Zimmer Trilogy AB acetabular component, Fiber Metal Midcoat stem, Biolox forte alumina, ceramic head 28 mm) (Figure 1).

Fig. 1 – Postoperative X-ray showing unremarkable implant position.

In 2007, two years after index surgery, atraumatic breakage of the ceramic acetabular insert occurred. The revision was performed by replacing the ceramic components solely (Zimmer Trilogy AB acetabular component, Fiber Metal Midcoat stem, Biolox forte alumina, ceramic head 28 mm) (Figure 2). No significant debris was encountered at that time.

Fig. 2 – X-ray after first revision surgery showing replaced ceramic insert and modular head with retained initial acetabular and femoral components.

In 2010, three years after the first revision surgery, another breakage occurred, this time of both ceramic components (Figure 3).

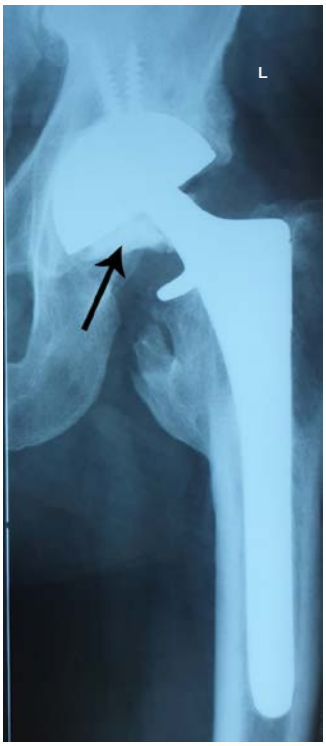

Fig. 3 – X-ray depicts breakage of prosthetic ceramic head and insert (arrow).

Another revision was done by the same surgeon using the previous incision through a posterolateral approach. The acetabular component was revised with a constrained liner, with metal-on-polyethylene (MoP) coupling with titanium aluminum vanadium (TiAlV) alloy consisting of CoCr head and polyethylene liner with stainless steel ring [Zimmer Trilogy acetabular component, ultra-high molecular weight polyethylene (UHMWPE), CoCr ceramic head 28 mm]. No damage to the femoral stem and neck was notified and mentioned in the report (Figure 4).

Fig. 4 – X-ray after revision hip arthroplasty with acetabular replacement and constrained polyethylene liner insertion.

In 2011, the patient started to complain about pain and discomfort in the inguinal and gluteal region with ataxic episodes and hearing and seeing impairment, and a constant feeling of fatigue. The symptoms were evolving rapidly and the patient was admitted to our hospital for a large pelvic and abdominal mass. These symptoms were accompanied by elevated blood Co and Cr levels – 133.9 μg/L and 40.3 μg/L, respectively. Multidetector computed tomography (MDCT) showed large intra-abdominal masses and collections (Figure 5).

In December 2012, he was prepared for surgery, and multiple lobulated tissue formations filled with dark fluid were removed from the inferior pelvic wall and retroabdominal musculature, which was infiltrated by metallic debris and dark greyish fluid (Figure 6).

A subsequent pathohistological examination confirmed metallosis. The laboratory markers of inflammation were slightly elevated – C-reactive protein 7.7 mg/L [reference value (RR) up to 5 mg/L], erythrocyte sedimentation rate 2 mm/h (RR up to 10 mm/h), fibrinogen 3.5 g/L (RR 2–4 g/L). Metallic head and stem neck trunnion were reduced in size, and polyethylene showed signs of gross wear (Figure 7).

Fig. 5 – Large pseudotumor mass (279 × 94 × 59.3 mm) depicted on multidetector computer tomography (arrows).

Fig. 6 – Part of the excised intrapelvic mass.

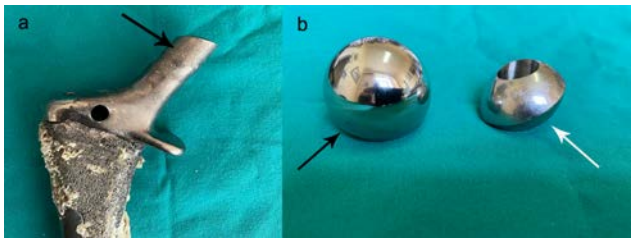

Fig. 7 – a) Extracted femoral stem showing the altered shape of the head–neck junction (arrow); b) Extracted modular metal head (28 mm diameter) with severe damage and size reduction (white arrow); regular modular metal head (32 mm diameter) for comparison (black arrow).

Prosthetic components were removed, and the joint was thoroughly debrided. There were no signs of infection, and tissue cultures remained sterile.

In July 2013, seven months after the removal of pseudotumor masses and explantation of endoprosthesis, another revision was performed, and a modular revision stem was implanted with a ceramic head and polyethylene liner coupling (Zimmer Modular Revision stem, Zimmer Trilogy acetabular component, and UHMWPE liner, ceramic head 32 mm) which consists of a stem and shell made of Ti/Va/Al alloy with a polyethylene acetabular insert and ceramic modular head (Figure 8).

Fig. 8 – X-ray image after final revision with residual metal particles in the periarticular tissue resembling heterotopic ossification.

The patient recovered to unassisted walking. His hearing and sight loss did not recover. At the last follow–up in 2021, his hip was pain-free and functional, and serum Co and Cr levels were within normal values (1.5 μg/L and 4.2 μg/L, respectively).

Discussion

The patient described in this case report had a large ALTR in the lower abdominal region and around the involved hip in the form of metallosis and the development of a pseudotumorous mass. Initial damage of the stem neck after ceramic components breakage was not recognized during the first and second revisions. Revision to a metallic modular head-on acetabular poly-constrained component led to progressive severe destruction of stem neck and head junction and an increase of metallic debris. The consequent formation of semi-liquid masses around the hip had progressed to the pelvic cavity and lower abdomen.

Ceramic articulations are less tolerant to malposition of the components, which most often results in increased posterior edge loading when acetabular cups are positioned in excessive abduction. The fact that several hip dislocations were reported in the presented case in the interval between revisions for implant fracture points to the existence of this problem. Fracture of the ceramic component produces particles that act as a third body after revision and can produce wear to the revised components [3].

The most attributable cause of this condition is fretting corrosion in the head–neck junction and acetabular ring impinging on the stem neck, which was probably already damaged by fractured ceramic particles from previous surgeries. Metallic particles had led to irritation and fluid accumulation in the bursa and granuloma formation around foreign body material. The severity of the damage to the head and neck components and the appearance of the retrieved components could suggest that fretting could not be the sole cause of the damage. Differences in electrical potential may cause galvanic corrosion when two different metals are in contact in an electrolyte solution [4].

Trunnion corrosion is identified as a possible cause of fulminant pseudotumors [5]. The increase in MoM implant usage in the early 2000s led to the recognition of more frequent metal-associated ALTRs and the need for early revision [6]. Further research on this problem has led to new diagnostic tools such as metal ion level tests and metal hypersensitivity tests [7, 8]. Subsequently, metal-associated tissue destruction was also found in implants with MoP-bearing material [9].

ALTRs are registered in about 10% of patients with MoM hip implants and a lower but unknown number of patients with mostly used MoP hip implants [10].

The Co and Cr ions levels in serum could be elevated after hip replacement, although routine serum level determinations are usually not performed. The cut-off for metal ion levels for risks of clinical complications is 7 μg/L [11]. The increase of Co and Cr ions in serum could lead to systemic body manifestations, which could be very variable, ranging from skin rash and nausea to progressive cardiac insufficiency, renal failure, hearing impairment, and loss of vision [12].

Measuring serum levels of metal ions has a diagnostic value not only for systemic exposure to metallic ions but also for the wear of the metallic parts of implants, which indicates the possibility of adverse reactions around the affected implant. Elevated ion levels could suggest trunnion damage and wear as a source of metallosis and likely cause of pseudotumor formation.

In most cases, pseudotumor formations after CoC implant couplings could be attributed to stem neck damage and corrosion or metallic debris from the stem coating [3, 13]. Measuring serum levels of Co and Cr is useful in such situations and could indicate mechanical damage to the components that are difficult to confirm by other diagnostic tools.

Due to a usual absence of pain in the affected hip, differential diagnosis of the ALTRs could be difficult and should consider soft tissue problems such as psoas tendonitis and bursitis, referred pain from spinal disorders, and inguinal or abdominal hernias. Multidetector computer tomography scan could be helpful in the evaluation of the component position; magnetic resonance imaging could be helpful in the evaluation of pelvic and abdominal masses and fluid collections. Bone scintigraphy can indicate infection or loosening.

Conclusion

Trunnion damage assessment during revision procedures should be mandatory. The surgeons are urged to consider trunnion lesions during revisions, especially after the breakage of ceramic components. If trunnion damage exists, it is necessary to replace both prosthetic components, even if they are well fixed, in order to prevent disastrous effects of metallic corrosion, ALTRs, and systemic intoxication by the metallic ions.

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