

Systemic allergic dermatitis caused by cobalt and cobalt toxicity from a metal on a metal hip replacement

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Case Report

An 84-year-old woman with a complex orthopaedic history was referred for patch testing with a severe, generalized pruritic eczematous rash. She had undergone a metal-on-metal (MoM) right total hip replacement (Smith and Nephew R3 acetabular system, R3 acetabular liner Co–Cr, femoral head Co/Cr, and standard stem with titanium) for a fractured femur neck in May 2009. The components of her prosthetic hip included a cobalt–chromium metal head articulating against a cobalt–chromium acetabular insert. Prosthesis misalignment was diagnosed on the basis of poor hip abductor strength, a large prosthetic head (40 mm), and a cup inclination angle of 64° (ideally 40–50° to optimize wear rates). She subsequently underwent further surgery involving a right abductor muscle repair, which was

complicated by a complex polymicrobial prosthetic hip infection (February 2010). The rash started as a localized urticarial dermatitis around her right hip operative scar, 5 months after muscle repair surgery in July 2010. It became generalized and persisted despite treatment with topical and oral corticosteroids, antihistamines, a mentholated emollient, and ultraviolet B light (three times weekly for 5 weeks).

Skin biopsy of the rash revealed urticarial features with no overt histological evidence of a drug eruption. Patch testing was performed in August 2011 while the patient was still receiving prednisolone 10 mg daily, and she had a positive reaction to cobalt (+ reaction). Serum cobalt and chromium levels were elevated, at 967 nmol/l (normal: <20 nmol/l) and 442 nmol/l (normal: <100 nmol/l), respectively. There was no evidence of infection on the basis of the patient's serum inflammatory marker levels, which were normal (C-reactive protein level, erythrocyte sedimentation rate and white blood cell count were 5 mg/l, 30 mm/hr, and 7.3×10^9 /l respectively).

The patient was diagnosed with systemic allergic dermatitis (SAD) caused by cobalt. She also developed some cognitive impairment, with short-term memory

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loss, and concerns were raised that this was related to cobalt toxicity. She underwent hip revision surgery, involving the removal of the cobalt–chromium hip prosthesis and the insertion of a titanium-on-polyethylene hip prosthesis. At 3 months post-operation, her dermatitis started to resolve. Her serum cobalt levels had decreased to 232 nmol/l at that stage. She has not suffered from skin symptoms since, but the whole saga, including multiple operations and episodes of hospitalization, has caused a marked reduction in her functional capacity.

Discussion

An MoM total hip prosthesis comprises a femoral head component that articulates in an acetabular cup. Both components are made from a metal alloy containing cobalt and chromium. Although MoM hip implants have a lower physical wear rate than other implants, there have been concerns about the possible health consequences of systemic metal toxicity, arising from the metal ions generated by the articulating hip surfaces. Cardiac, cutaneous and neurological symptoms have been described in case reports of MoM hip implant patients (1). To date, little is known about the metabolism and elimination of metal ions (2). In this patient, it is likely that prosthetic misalignment resulted in uneven wear and the accelerated release of cobalt and chromium ions, as reflected in her serology.

It can be difficult to differentiate between metal allergy and infection in a patient with a symptomatic MoM hip arthroplasty (3). The diagnosis of cobalt allergy was eventually made in the context of a prior hip prosthetic infection. However, there was no evidence of persisting infection clinically and biochemically.

Systemic exposure to cobalt through ingestion, orthodontics or metal joint prostheses has been reported to cause SAD (4). The pathogenesis of SAD is poorly understood. It is postulated that *de novo* sensitization occurs following MoM prosthetic joint implantation, initiating a localized inflammatory reaction (5). The metal ions released have a propensity to form larger metal–protein complexes, resulting in a delayed type IV hypersensitivity response that is thought to be responsible for aseptic loosening, osteolysis, and cutaneous reactions (6). The haematogenous transport of the metal–protein complex to the skin and T cell activation via dermal Langerhan cells could explain the generalized dermatitis.

Schalock et al. recommend patch testing two groups of patients in this context:

- (1) Post-metallic implant patients who present with arthralgia, implant loosening, or cutaneous dermatitis.
- (2) Preoperative patients with known metal hypersensitivity.

The authors suggested using a non-allergenic alloy or coating the allergenic metal with polytetrafluoroethylene in those with positive metal test results (7). In all MoM implant patients, cobalt and chromium levels are recommended to detect increasing serum levels at regular intervals (8).

This case highlights the cutaneous and systemic complications of a misaligned MoM prosthetic hip implant. The patient experienced not only systemic allergic dermatitis, but also symptoms of cobalt toxicity, leading to a marked deterioration in her functional capacity.

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