



Case report

Haemodynamic instability during hip prosthesis removal due to metallosis: An acute chrome/cobalt intoxication? A case report

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ARTICLE INFO

Keywords:

Case report
 Chrome intoxication
 Cobalt intoxication
 Intraoperative hypotension
 Metallosis

ABSTRACT

Introduction: Metallosis is produced by friction between prosthesis pieces, release of metal particles that can enter systemic circulation provoking cobalt or chromium poisoning. No studies have been found in which the mobilization of metal particles causes haemodynamic instability.

Case presentation: We present the case of an 85 years old male with metallosis, programmed for washing and prosthesis extraction (Girdlestone procedure). During pseudotumor drainage and washing, patient presented sudden desaturation and hypotension refractory to volume and phenylephrine administration. Echocardiogram showed overall hypocontractility. Situation was controlled with high inspired oxygen fraction and noradrenaline perfusion. In postoperative period *E. coli* grew in pseudotumor samples and metal particles could be seen in soft parts as the testicles. Plasma metal concentration showed high levels of chromium, but no chelator treatment was needed.

Discussion: Intraoperative hypotension raises several differential diagnoses. Echocardiography was useful to rule out hypovolaemia, pulmonary embolism and cardiac ischaemia. The results of analytical tests are often delayed, especially cultures and plasma metal levels; therefore, if metal poisoning is suspected, supportive treatment should be performed. Chelation and plasmapheresis should be used once the diagnosis is certain and are therefore not useful in the acute phase.

Conclusion: Intraoperative hemodynamic instability during hip prosthesis explant may be due to bleeding, release of inflammatory or infectious detritus, acute pulmonary thromboembolism, etc. However, the sudden increase of cobalt or chromium ions should be considered as a feasible option in patients with metallosis, despite not presenting previous clinical manifestations of intoxication.

1. Introduction

Metallosis is a rare arthroplasty complication, produced by friction between bearing surfaces or chemical interactions between the prosthesis pieces. Metal particles dissolve in body fluids forming metal ions that can remain locally in the joint or enter systemic circulation. Consequently, metal blood concentration rises and produces a wide variety of clinical manifestations depending on the prosthesis' specific components. The symptoms of cobalt toxicity, which is the most prevalent element, are mainly neurological and cardiovascular. It produces changes in vision and hearing, fatigue, weight and strength loss and, most serious, cardiomyopathy that can lead to heart transplantation [1]. Chromium poisoning, although rarer, is mainly characterized by digestive bleeding, liver failure, disseminated intravascular coagulation and renal failure

[2].

Metallosis treatment is based on the prosthesis removal, profuse washing and new arthroplasty [3,4]. Metal intoxication needs fluid replacement therapy, chelators such as dimercaptopropanesulfonate and *N*-acetylcysteine, and adjuvants including ascorbic acid [2,5]. In some severe cases, hemodialysis, as supportive renal function therapy and not as excretory therapy, or plasmapheresis can be useful [2]. The other clinical manifestation should be treated supportively, for example, cardiomyopathy could be treated with beta-blockers, ACE inhibitors and diuretics [6].

We present a case of hypotension during washing of metallosis that could have been related to metal particles entering systemic circulation. We couldn't find any articles referring to acute chrome intoxication associating hypotension and hypoxemia. This work has been reported in

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<https://doi.org/10.1016/j.ijscr.2022.107033>

Received 17 February 2022; Received in revised form 2 April 2022; Accepted 2 April 2022

Available online 6 April 2022

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line with the SCARE 2020 criteria [7].

2. Case presentation

We present a case of an 85 years old male patient with atrial fibrillation and recent basal ganglia stroke, anticoagulated with edoxaban and non-obstructive apical myocardial hypertrophy, who had been diagnosed of metallosis in left total hip arthroplasty. Due to the pandemic, surgery was postponed until the patient consulted in the emergency department of our Central Hospital because of impossibility to walk, increased pain, and oedema and erythema in the left thigh and hip. On MRI, a periprotetic collection was observed on the left hip, suggestive of pseudotumour due to metallosis with radiological emperorship with respect to previous studies.

His first hip surgery was performed in 2007 with a ceramic prosthesis. Five years later the prothesis broke and was replaced by a cobalt/chrome metallic one. Girdlestone procedure was scheduled due to patient's medical history.

On admission, blood tests showed microcytic anemia, leukocytosis with neutrophilia, elevation of acute phase reactants such as ferritin, C-reactive protein, procalcitonin, and coagulopathy. Venous doppler ultrasound ruled out the presence of deep vein thrombosis. Despite the presence of febricula and leukocytosis, no antibiotic therapy was initiated due to negative urine and blood cultures. Blood cobalt concentration was normal ($0,5 \mu\text{g l}^{-1}$), while chrome concentration was high ($22 \mu\text{g l}^{-1}$).

Patient was assessed by the anaesthesiologist and inform consents were signed. Edoxaban was replaced with enoxaparin and phytomenadione was administered to correct coagulopathy.

Anaesthesia induction was performed by an experienced anaesthesiologist with fentanyl, etomidate and rocuronium and patient was maintained with sevoflurane and fentanyl boluses. Antibiotic prophylaxis was performed with cefazolin. At the opening of the subcutaneous cellular tissue and fascia, 600 ml of greenish-gray liquid were drained from the pseudotumour and samples were collected (Fig. 1). Severe mobilization of the stem and cotyl, abundant ceramic remains and

significant erosion of the metal head were observed. The prosthesis was extracted without difficulty and the cavity was washed with 5 l of physiological solution.

During washing the patient presented sudden hypotension, refractory to volume and phenylephrine administration, and moderate desaturation (90%) which was corrected by raising the inspired oxygen fraction. Noradrenaline perfusion was initiated, the patient was placed in a supine position and transthoracic echocardiogram showed both atrial dilation, normal right cavities with slightly dilated left ventricle and overall hypocontractility. In the analysis, a decrease of 2 g dl^{-1} of haemoglobin was observed and blood transfusion was started. Once surgery was finished, patient was extubated and transferred to Intensive Care Unit (ICU).

During the first postoperative days the patient needed low-dose noradrenaline and furosemide due to oliguria in spite of good blood volume. Oedema extended from the hip to the testicles and metal particles could be seen in the X-ray (Fig. 2). The echocardiogram was repeated 48 h after surgery, with normalization of biventricular function. New plasma metal concentration showed $24,9 \mu\text{g l}^{-1}$ of chrome and $0,5 \mu\text{g l}^{-1}$ of cobalt. *Escherichia coli* grew in the culture of intraoperative samples and patient was treated with intravenous meropenem for two weeks and then oral ciprofloxacin. The patient was discharged from the ICU 72 h after surgery, with recovery of renal function and correction of infectious parameters.

3. Discussion

The estimated incidence of metallosis is 5% [8]. While cobalt forms divalent ions, chrome usually is identified in blood as a trivalent. Nevertheless, rapid ion plasma reduction could form hexavalent chromium that is more toxic [9]. Metal normal blood concentration is less than $0,6 \mu\text{g l}^{-1}$ for cobalt and less than $2 \mu\text{g l}^{-1}$ for chrome. It is known that the maximum ion values are seen in the first year after surgery and, in our case, more than five years have passed [9]. Despite our patient showed high chromium concentration, no clinical manifestations of chrome intoxication were present [2]. This is consistent with the

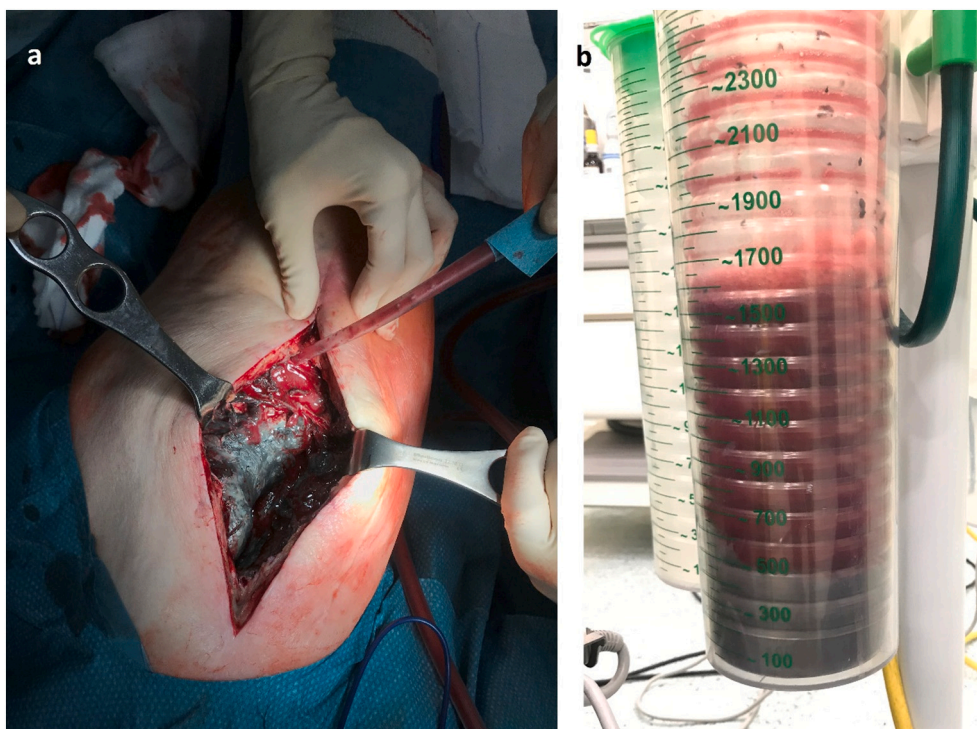


Fig. 1. a. Hip pseudotumor. b. Aspiration liquid.



Fig. 2. Postoperative hip X-ray.

findings of Ho J et al. who studied the association of systemic toxicity with normal serum cobalt and chromium concentrations in patients with metal-on-metal (MOM) hip prostheses [10]. They found no direct correlation between the occurrence of symptoms and plasma concentration of these metals, as in our case.

The continuous liberation of metal debris into systemic circulation leads to production of cytokines and chronic inflammation. Locally, these produces a containment response of the noxa, forming a pseudotumour. However, systemically, the entrance of metal particles activates the immune system, which could cause an autoimmune/auto-inflammatory syndrome induced by adjuvants (ASIA) [11]. Vaz R et al. reported a case of a 51 years-old woman who presented neurological and constitutional symptoms that reversed with the extraction of a MOM hip prosthesis [8]. Yet, cobalt and chromium are not considered as inducing agents of this syndrome, as Vaz R does.

Then again, Ameratunga et al. in a more recent publication, refutes the diagnostic criteria of ASIA emphasizing that the major criterion does not specify which are the external factors that could originate it. It further argues that there is no mandatory time limit for exposure and appearance of symptoms and that a large number of individuals (all those who have received vaccines or had an infection) would be included in this group and yet have no symptoms of ASIA [12]. In our case, our patient presented a chronic inflammatory syndrome that we correlated to metallosis because no other inflammatory cause was found. However, after the prosthetic extraction, we discovered a chronic infection contained in the pseudotumour, which could have explained the analytical data.

In regard to intraoperative management, regional anaesthesia was not considered as an option due to recent hemorrhagic stroke and coagulopathy, although the latest had been corrected with vitamin K administration. We could not find any study that recommends a specific type of anaesthesia in metallosis. Having an awaked patient could have been helpful to assess the neurological state. But in our case, patient had a cardiovascular history and surgeons transmitted the possibility of a long procedure.

The hemodynamic event produced during washing was mainly associated with the mobilization of inflammatory debris during extraction, because pulmonary thromboembolism or hypovolemia were already discarded with intraoperative echocardiogram. However, once the increased oedema of soft parts, such as the testicles, was observed and postoperative radiographs showed traces of scrotal metal, we considered acute metal poisoning as a possible cause and sampled serum metal concentration. On the other hand, the appearance of *E. coli* in the

intraoperative cults raised the possibility of acute bacteraemia causing hypotension [13,14]. However, if that was the case, we expect at least moderate response to volume or vasoactive drugs. Sadly, we did not collect blood samples during the acute phase, but we found a slight elevation of serum chromium value in the laboratory tests performed a week after explantation and could assume that the intraoperative values would have been higher [15]. However, as said before, plasma metal concentration not always correlate with clinical manifestations [16].

We didn't find any study referring to intraoperative metal intoxication provoked by washing and extracting metallosis, but it is important to take in to account the possibility of systemic entrance of cobalt/chrome during mobilization of a corroded prosthesis. There is not a specific treatment of this situation, but to hemodynamic and respiratory support such as: securing the airway, high inspired oxygen fractions, fluid therapy and vasoactive drugs. Once the acute situation is under control, chelators can be used [2,17]. Kidney replacement therapies are not useful in the removal of serum chromium; however, they are essential for the treatment of kidney failure [2].

4. Conclusion

Intraoperative hemodynamic instability during hip prosthesis explant may be due to bleeding, release of inflammatory or infectious detritus into the bloodstream, acute pulmonary thromboembolism, myocardial infarction, etc. However, the sudden increase of cobalt or chromium ions should be considered as a feasible option in those patients with previous diagnosis of metallosis and who present high concentration of plasma metals, despite not presenting previous clinical manifestations of intoxication.

Provenance and peer reviewed

Not commissioned, externally peer-reviewed.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

None.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Authors contribution

Paula Agostina Vullo: conceptualization, methodology, investigation, writing – original draft **Daniel Olivera Moreno:** conceptualization, investigation, writing – review and editing **Diana Crego Vita:** visualization, writing – review and editing.

Research registration

None.

Guarantor

Paula Agostina Vullo.

Declaration of competing interest

None.

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