Canadian Association of Radiologists Journal 67 (2016) 76–81

CANADIAN ASSOCIATION OF RADIOLOGISTS JOURNAL

www.carjonline.org

Musculoskeletal Radiology / Radiologies musculo-squelettique

The Management of the Symptomatic Patient With a Metal-on-Metal Hip Prosthesis

Kate Harrington, MB, BCh, BAO, MRCPI*, Emma Phelan, MB, BCh, NUI, MRCPI, William C. Torreggiani, MB, MRCPI, FRCR, FFRRCSI, Orla Doody, MB, MRCPI, FFRRCSI

Radiology Department, The Adelaide and Meath Hospital Dublin, Incorporating the National Children's Hospital, Dublin, Ireland

Abstract

Metal-on-metal (MoM) hip implants have gained popularity due to their greater stability and reduction in implant failure compare to metal-on-polyethylene prostheses. However, as well as carrying general risks of hip implantation, risks specifically associated with MoM implants have been well documented in recent years. Conditions such as pseudotumours or aseptic lymphocyte-dominated vasculitis-associated lesions are specific to MoM hip implants. In this review we discuss the typical patient presentation, the investigations that should be performed, the typical findings on various imaging modalities, and the treatment options of symptomatic patients with MoM hip arthroplasties.

Résumé

Les prothèses de hanche à couple de frottement métal-métal gagnent en popularité en raison de leur stabilité accrue et d'un nombre réduit d'échecs comparativement aux prothèses à couple de frottement métal-polyéthylène. Toutefois, en plus des risques généralement associés aux arthroplasties, les prothèses à couple de frottement métal-métal présentent des risques particuliers qui ont fait l'objet d'une vaste documentation au cours des dernières années. En effet, certaines affections, notamment les pseudotumeurs ou les lésions associées à des angéites aseptiques à prédominance lymphocytaire, sont étroitement associées aux prothèses de hanche à couple de frottement métal-métal. La présente étude aborde les signes et les symptômes des patients, les examens à réaliser, les constatations propres aux diverses modalités d'imagerie et les options thérapeutiques qui s'offrent aux patients symptomatiques ayant reçu une prothèse à couple de frottement métal-métal dans le cadre d'une arthroplastie de la hanche.

Key Words: Aseptic lymphocytic vasculitis-associated lesion; Metal-on-metal hip arthroplasty; Pseudotumour

Metal-on-metal (MoM) hip implants enjoyed a resurgence in use in the late 1990s and early 2000s due to concerns over metal-on-polyethylene wear-induced osteolysis, loosening, and failure, particularly in younger patients. The concurrent advances in technology and implant systems such as hip resurfacing systems and large-diameter femoral head components promised bone conservation, greater stability, and a reduction in implant failure in MoM prostheses. Two main types of MoM implants exist, namely the traditional MoM total hip replacement, which consists of a metal ball and stem (femoral component) and metal cup (acetabular component), and the MoM resurfacing hip system, which consists of most of the native femoral head with a metal cap articulating with a thin metal acetabular cup. As well as carrying general risks of hip implantation, a risk specifically associated with MoM implants in the form of a reactive periprosthetic soft tissue lesion has been documented in the literature in recent years. These periprosthetic lesions are known by a variety of terms, most commonly described as masses, cystic tumours, aseptic lymphocyte-dominated vasculitis-associated lesions (ALVAL) [1], pseudotumours [2], or adverse reactions to metal debris [3]. Although these terms are sometimes used interchangeably not all periprosthetic pseudotumours demonstrate an ALVAL type response. The term ALVAL was first used in 2005 and relates to the histological findings of the periprosthetic reactive masses of necrotic tissue and dense perivascular lymphocyte

* Address for correspondence: Kate Harrington, MB, BCh, BAO, MRCPI, Radiology Department, The Adelaide and Meath Hospital Dublin, Incorporating the National Children's Hospital, Dublin 24, Ireland.

E-mail address: harringtonkatea@gmail.com (K. Harrington).

0846-5371/$ - see front matter © 2016 Canadian Association of Radiologists. All rights reserved.
http://dx.doi.org/10.1016/j.carj.2015.10.006

infiltrates. The pathogenesis of such reaction remains unclear but a popular hypothesis is that metal ions are shed from the prosthesis and elicit a type IV hypersensitivity reaction [4]. Necrosis and macrophage infiltration, however, is a shared histological feature on all sampled periprosthetic masses, in keeping with a metal-induced cytotoxic effect [5]. In this article pseudotumour will be used to describe the abnormal periprosthetic masses.

In 2012 regulatory authorities in the United Kingdom, Canada, the United States, and Australia issued alerts and safety communications related to MoM implants and guidance on the management of such patients [6–9].

A discussion on the management of a symptomatic patient is presented with recommended investigations, optimization of imaging modalities, expected radiological findings, and further treatment options.

Presentation

The incidence of pseudotumour varies widely in recently reported studies from 25%-68% [10–13]. This is in contrast to a meta-analysis, which calculated the pooled incidence estimate of pseudotumours to be much lower at 0.6% [14]. However, this is likely due to the inclusion of early studies, with more recent studies quoting much higher incidences especially when using more sensitive imaging techniques such as metal artifact reduction sequences magnetic resonance imaging (MRI), imaging a high risk patient cohort and following patients over a longer time period. Notably a recent study by Bosker et al [15] demonstrated a significant increase in incidence of pseudotumours after prolonged follow-up. The meta-analysis also found that 3.9% required hip revisions. However, when the studied patient population is separated by gender it is apparent that females have a significantly greater incidence of pseudotumours and of requiring hip revision due to pseudotumours compared to men with incidences as high as 9.4% and 6.2%, respectively. Other risk factors identified for the development of pseudotumours include resurfacing systems with small femoral heads, total hip replacements with large diameter femoral heads, bilateral implants, type of implant used, and suboptimal alignment of the implant [16,17].

Symptoms are nonspecific and pain is the most common presentation. A palpable mass may be appreciated on examination. In severe cases there may be evidence of femoral neuropathy. The time to presentation may vary with patients presenting from a few months to a number of years after surgery [18].

Investigations

Serum Samples

Patients with MoM implants are at an increased risk of having increased serum levels of chromium and cobalt than their metal-on-polyethylene counterparts [19]. The significance of raised serum metal ion levels is still debatable and it is mostly used as a surrogate marker to detect wear in MoM prostheses as there have been proven associations with high levels or increasing levels of metal ions and implant failure [20]. There are, however, documented cases of failure due to pseudotumour without significantly raised serum metal ions. Many regulatory authorities now recommend monitoring of serum metal ion levels in all symptomatic patients with MoM with the Australian Government Therapeutic Goods also recommending monitoring of serum metal ion levels in asymptomatic patients [6–9]. Metal ion levels, however, should not be used in isolation when screening for MoM pseudotumours.

Skin patch testing is useful in type IV hypersensitivity reactions. Although the underlying pathogenesis of pseudotumours remains unclear, a type IV hypersensitivity reaction is a popular hypothesis. Studies have shown a greater frequency of metal allergies in patients with MoM implants, including those with failed implants, however, skin patch testing for metal allergy is not recommended at present for the workup of symptomatic or failed MoM implants [21].

Radiography

Radiography is the primary imaging modality for the follow-up of patients post THR. Findings such as periprosthetic loosening, medial calcar resorption, or femoral neck resorption can be seen in complicated cases (Figure 1). However, although these findings are not specific or sensitive for the presence of pseudotumours, in patients with a MoM prosthesis and radiographic abnormalities, pseudotumour should be considered. Furthermore, many patients with pseudotumours will have normal findings on plain radiograph [22].

MRI

MRI is the most useful investigation in the assessment of the postoperative MoM prosthesis of the surrounding soft tissues. While traditionally the presence of metal prostheses would preclude accurate evaluation of the adjacent soft tissues due to the presence of metal-induced susceptibility artifact, recent advances in the imaging of metal prostheses with the use of metal artifact reduction sequences now allows evaluation and diagnosis of periprosthetic soft tissue abnormalities. Parameters employed include increasing the receiver bandwidth or increasing the field of view with the vast majority of susceptibility reduction achieved by increasing the receiver bandwidth alone [23]. Fast spin echo sequences allows reduction of dephasing time and thus the amount of susceptibility artifact seen. A short echo time also reduces the time available for dephasing and is generally recommended, although there are reports into the usefulness of long echo time T2-weighted sequences that pick up blooming artifact from soft tissue metallic deposits [24]. Inversion recovery techniques are preferred to fat suppression. Finally, switching direction of phase- and frequency-encoding between acquisitions allows for greater visualization of the soft tissues due to differing susceptibility artifact in each direction.