Seminars in Arthroplasty ▮ (2016) ▮▮▮–▮▮▮

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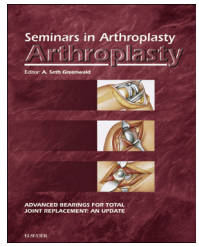

Metal–metal hip replacement: Indications for intervention

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ARTICLE INFO

Keywords:
metal-on-metal
adverse local tissue reaction
bearing surface
revision total hip arthroplasty

ABSTRACT

Metal-on-metal bearing surfaces were frequently used because of their potential for increased stability and lower wear rates. However, data reported by multiple nation-wide registries over the past 5 years, has demonstrated an increase in failure rates compared to metal-on-polyethylene bearings. In addition, adverse local tissue reactions associated with pseudotumors and destruction of the soft tissue around the joint have led to revision of these implants. Currently, there is no definitive algorithm to manage these patients and no single test should be used to determine treatment. This review discusses an evidence-based approach in managing this patient population.

1. Introduction

Metal-on-metal implants (MoM) were initially described by Wiles over 70 years ago, and were popularized in the 1960s with the advent of the McKee–Farrar prosthesis [1]. The development of polyethylene lead to a decreased interest in metal-on-metal bearings. However, in the 1990s, with concerns regarding polyethylene wear limiting the longevity of total hip arthroplasty, there was a renewed interest in metal-on-metal bearings. The use of metal-on-metal bearings gained traction because of two favorable attributes; potentially advantageous wear properties, and larger femoral heads that afford increased stability [2]. It has been estimated that since 1996, greater than one million metal-on-metal implants have been implanted worldwide, with over 38,000 implanted in the United States alone during the year 2006 [3].

However, increased revision rates of up to three fold in comparison to conventional metal-on-polyethylene as reported by several nation-wide registries, prompted the rapid decline in the use of metal-on-metal bearings [4,5]. These failure rates have since been attributed to the release of metal ions in the periprosthetic joint space, leading to sterile effusions, osteolysis, pseudotumor formation, and in some cases, destruction of the surrounding soft tissues [3]. This disease process is now more commonly referred to as adverse local tissue reaction or ALTR [3].

Routine surveillance and clinical evaluation of patients with a history of a metal-on-metal prosthesis remains paramount in diagnosing and treating these lesions. Apart from history and physical exam, other modalities such as advanced imaging and laboratory evaluation can help to guide management. Despite several studies documenting risk factors such as femoral head size, cup position, and cutoff values for serum ion levels, no definitive algorithm has been universally adopted to guide treatment. Given the potential catastrophic complications associated with ALTR, it is incumbent upon the treating surgeon to maintain a high level of suspicion when caring for this patient population.

2. ALTR

In the early 2000s, Willert et al. [6] described an immunologic reaction to the release of metal particles from associated

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http://dx.doi.org/10.1053/j.sart.2016.06.024
1045-4527/

corrosive wear between the femoral head and acetabular liner; a delayed type hypersensitivity reaction termed aseptic lymphocyte dominant vasculitis associated lesion (ALVAL). An ALTR can present in a number of different ways. Patients may develop a perivascular lymphocytic infiltration (ALVAL), a pseudotumor, or osteolysis. Individuals that develop an ALTR may have all or any of these three tissue responses.

Histologic evaluation of the periprosthetic tissues in patients with ALVAL, demonstrate perivascular and intramural lymphocytic infiltration of the postcapillary venules, distinctive of a cell mediated delayed type IV hypersensitivity reaction [6]. This response is characterized by antigen activation of Helper T Cells (CD4+). Activation of these cells triggers release of a number of cytokines including interferon-gamma (IFN-gamma), tumor-necrosis factor-alpha (TNF-alpha) as well interleukins 1 and 2, which, in combination with antigen presenting cells, provide chemotaxis for macrophage and further T cell recruitment. Macrophage activation triggers further T cell mobilization, effectively creating a positive-feedback loop, which could be associated with pseudotumor formation and even extensive damage to the muscles surrounding the joint.

A pseudotumor is defined as a sterile solid and/or fluid inflammatory mass that can develop in the soft tissues surrounding a metal-on-metal prosthesis [7,8]. These lesions have been associated with numerous complications, such as pain, swelling, thromboembolic events, infection, and soft tissue destruction resulting in revision surgery [9,10]. In addition, patients with an ALTR may also develop osteolytic lesions in response to metal debris. The majority of case reports and prospective studies have focused on symptomatic patients [11,12]. However, a recent study discovered pseudotumor formation in 6.5% of asymptomatic patients with a well functioning prosthesis during routine follow-up [13]. This raises the question of which patients warrant further evaluation of these lesions, and how to risk stratify them.

3. History and physical

Initial evaluation of patients with metal-on-metal total hip arthroplasty begins with a thorough history and physical examination. More broadly, these patients can be classified as symptomatic or asymptomatic. Below, we discuss the evaluation of the patient with a painful metal-on-metal prosthesis.

3.1. *History*

The differential diagnosis for a painful total hip arthroplasty is quite extensive; however, it can be subdivided into intrinsic and extrinsic etiologies as listed in the Table. Common causes of intrinsic issues include infection, mechanical loosening, implant failure, periprosthetic fracture, and osteolysis [14,15]. Diagnoses extrinsic to the joint include lumbar spine pathology, malignancy, trochanteric bursitis, iliopsoas tendonitis, vascular claudication, complex regional pain syndrome, metabolic disease (stress fracture), or referred pain [16,17]. A thorough history and physical exam serves as the cornerstone in the evaluation of a painful total hip arthroplasty.

A detailed history provides valuable information that can considerably narrow the differential diagnosis. When did the pain begin? The chronology of symptoms, date of onset, and pain characteristics all provide insight to the root cause. Was there ever a pain-free interval following surgery? Has there ever been drainage from the wound? Pain persisting from the date of surgery, especially in the setting of delayed wound healing, suggests the possibility that the pain is secondary to infection [18]. Patients with metal-on-metal issues usually do not develop pain until several years following component implantation.

History of skin changes or familial history of metal hypersentivity? It is unclear if metal hypersensitivity contributes to osteolysis and prosthesis failure, or if the patient develops the hypersensitivity following an immune response to the wear debris [19]. The treating surgeon should document a history of metal hypersensitivity and its possible sequelae, including neurologic changes, renal function impairment, thyroid dysfunction, presence of urticaria, or reactive dermatitis [20].

3.2. *Physical examination*

The physical exam should be focused on inspection of previous incision(s), the joint, surrounding soft tissues, gait, range of motion, neurovascular status, and examination of adjacent joints and spine to rule out sources of referred pain [18]. The surgical scar should be scrutinized for evidence of infection and the skin should be examined for evidence of reactive urticaria or dermatitis. Palpation should be performed to illicit tenderness characteristic of trochanteritic bursitis, or generalized soft tissue swelling. Iliopsoas tenderness also needs to be ruled out. Range of motion should be assessed and a thorough evaluation of the patient's

Table – The Differential Diagnosis of the Painful Total Hip Arthroplasty

Intrinsic Causes	Extrinsic Causes
Infection	Lumbar spine pathology
	Malignancy
Aseptic loosening	Peripheral vascular disease
Osteolysis	Complex regional pain syndrome
Periprosthetic fracture	Hernia, femoral or inguinal
Implant malrotation/malpositioning	Referred pain
Inflammatory bursitis/tendonitis (trochanteric/iliopsoas)	Metabolic disease (stress fracture)