BMJ

BMJ 2011;342:d3009 doi: 10.1136/bmj.d3009

FEATURE

Commentary: Metal on metal hips

John Skinner *consultant orthopaedic surgeonchair*[1 2], Peter Kay *consultant orthopaedic surgeonpresident*[3 4]

[1]Royal National Orthopaedic Hospital, Stanmore, UK; [2]Joint Expert Advisory Group on Metal Bearing Hips of the British Orthopaedic Association, British Hip Society, and National Joint Register to the Medicine and Healthcare Products Regulatory Authority, UK; [3]Wrightington Hospital, Wigan, UK; [4]British Orthopaedic Association, UK

Total hip replacement is one of the most successful operations of the 20th century and is currently performed in 70 000 patients a year in the UK,[1] 250 000 a year in the United States, and one million worldwide. In an attempt to improve wear resistance and to allow bone conservation through hip resurfacing, metal on metal bearings were re-introduced in the 1990s.[2]. These are made of cobalt chromium alloys, and in some series metal hip resurfacing has shown excellent results in the younger and most active patient groups.[3] Several other designs were introduced, and hip resurfacing became popular with patients through the internet as a younger person's solution to arthritis that allowed high activity levels. It was used in 10% of hip arthroplasties in the UK between 2006 and 2009 and in 50% of all hip replacements in patients younger than 50 years.[1]

Problems with hip resurfacing that were initially reported included raised blood cobalt and chromium ions,[4] loosening of components,[5] hip fracture,[6] and soft tissue reactions around the hip.[7] In an attempt to overcome the fracture problem and to extend the use of large diameter metal on metal bearings to those not suitable for hip resurfacing, metal resurfacing type bearings were introduced on total hip replacement stems.[8] These large diameter metal on metal total hip replacements had a lower theoretical rate of dislocation. In fact, metal on metal bearings were used in up to 35% of all total hip replacements in the United States in 2009.[9]

The commonest symptoms of adverse reactions to metal debris are pain, swellings around the hip, and loss of function with reduced exercise tolerance and onset of limp. Soft tissue swellings, fluid collections or "bursas" may be noticed in the groin, buttock, or laterally. Pain and symptoms in patients with metal on metal hips should be investigated and referred to an orthopaedic surgeon. Normal causes of pain should be excluded as for any hip replacement (infection, component loosening, lysis/wear, pain referred from another source). Full clinical assessment should be accompanied by investigations including radiographs, full blood count, erythrocyte sedimentation rate, and C-reactive protein. Cross sectional magnetic resonance imaging using metal artefact reduction sequences or ultrasound should also be performed to look for fluid collections (common) or solid masses (rare) around the implants. Hip aspiration and injection may be helpful.

Blood should be taken for cobalt and chromium ion measurements; again this is best done as part of an orthopaedic assessment. In asymptomatic patients with well functioning metal on metal implants, levels of these ions are low, typically around 2 parts per billion (μg/L or ng/mL).[4] In the UK the Medicines and Healthcare Products Regulatory Agency (MHRA) has suggested that patients with levels of cobalt or chromium ions above 7 parts per billion should be further investigated and ion measurements repeated as part of closer follow-up.[10] But measurements may also need to be repeated in asymptomatic patients with levels between 3 and 7 parts per billion, particularly in those with large diameter metal on metal total hip replacements, perhaps at 6-12 months.[11] There is evidence that levels are higher in the first 6-12 months after insertion of a metal on metal bearing as it beds in (run-in wear) and then they fall, in some patients.[12]

As yet, the level of cobalt or chromium at which revision surgery is advised has not been clearly defined.[13] Blood metal ion levels are therefore an adjunct in assessing metal on metal hip function at present. Clinicians are used to assessing the value of a laboratory test and are familiar with uncertainty and the use of several pieces of evidence to finalise a clinical decision.

It is agreed that revision surgery should be performed in patients with substantial pain, worsening pain, limp, or poor function. Similarly, it should be considered in those with rising blood metal ions, increasing fluid collections or masses, or very large fluid collections around the hip.[13]

The risk to patients of failing metal on metal implants is a progressive inflammatory response leading to tissue necrosis around the hip. All joint replacements using conventional bearings of metal on polyethylene, ceramic on polyethylene, or ceramic on ceramic will wear and may fail, with debris generating different adverse responses. These include metallosis, osteolysis, loosening and dislocation.[14] The difference with metal on metal bearings seems to be the potential to develop necrosis and cell death in tissues around the hip. They can occur

john.skinner@ucl.ac.uk

with all metal on metal bearings in both hip resurfacing and total hip replacements. They are more likely in women, with small component sizes (in hip resurfacing), with particular implants, with raised blood metal ions, and in components that have come to lie in suboptimal positions. If a painful metal on metal hip is revised before substantial soft tissue damage then the outcome is likely to be excellent.[15] If substantial tissue damage occurs then revision surgery is associated with poorer function and higher rates of complication including limp and dislocation.[16]

In 2010 one of the available implants was withdrawn worldwide (the ASR hip resurfacing and the ASR XL THR, Depuy, Warsaw, Indiana, USA) because of higher than expected rates of failure.[17] The company has agreed to fund all investigations and revision surgery. It has been the focus of much media interest and patients are understandably concerned.

Not all patients know whether they have a metal on metal bearing; all patients with a hip resurfacing do and a minority of patients with total hip replacements do. This information is recorded at the hospital where the operation was performed and also centrally in the UK on the National Joint Register, which is accessible through the hospital.

In the absence of pain with a metal on metal bearing, no investigations are needed other than an annual assessment and the prompt reporting of new symptoms. The MHRA guidelines included four situations in which to test blood for metal ions: pain or symptoms associated with metal on metal bearings; radiological features associated with adverse outcomes including component position or small component size; concerns of the patient or surgeon about the bearing; and concerns about a cohort of patients with higher than expected rates of failure.

The MHRA has suggested follow-up for five years for all metal on metal implants and for the life of the prosthesis in patients with the withdrawn ASR /ASR XL devices. Patients who have painful metal on metal implants should be reviewed by their orthopaedic surgical team as above. The decision on whether to revise the hip remains a clinical one between the patient and the surgeon, guided by the above investigations. The British Orthopaedic Association recommends a second opinion if there is uncertainty. The revision surgery may be difficult and complex in the presence of substantial soft tissue damage and should probably be performed by revision hip specialists with experience in this area.

Currently the advice of the British Orthopaedic Association and British Hip Society to surgeons is that large diameter metal on metal total hip replacements should not be performed until more is known about their mode of failure (13% revision rate by 5 years on the UK National Joint Register), except in exceptional circumstances.

Hip resurfacing with components that have proven track records still seems to be an effective and safe treatment in the truly active under-55 age group, with favourable hip anatomy with component survival rates of 97-98% at 10 years in men and only slightly less in carefully selected women.[3]However, adverse metal reactions can still be seen in this group.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; PK has previously acted as consultant for Johnson and Johnson in the development of a cemented cross-linked polyethylene acetabular component, for which no royalties are received, nor are any ongoing payments linked to its use; no other relationships or activities that could appear to have influenced the submitted work.

Provenance and peer-review: Commissioned, not externally peer reviewed.

1 National Joint Registry for England and Wales. 7th Annual Report. 2010.
2 McMinn D, Daniel J. History and modern concepts in surface replacement. *Proc Inst Mech Eng [H]* 2006;220:239-51.
3 Carrothers AD, Gilbert RE, Jaiswal A, Richardson JB. Birmingham hip resurfacing: the prevalence of failure. *J Bone Joint Surg Br* 2010;92:1344-50.
4 Hart AJ, Sabah S, Henckel J, Lewis A, Cobb J, Sampson B, et al. The painful metal-on-metal hip resurfacing. *J Bone Joint Surg Br* 2009;91-B:738-44.
5 Morlock MM, Bishop N, Zustin J, Hahn M, Ruther W, Amling M. Modes of implant failure after hip resurfacing: morphological and wear analysis of 267 retrieval specimens. *J Bone Joint Surg Am* 2008;90(suppl 3):89-95.
6 Shimmin AJ, Back D. Femoral neck fractures following Birmingham hip resurfacing: a national review of 50 cases. *J Bone Joint Surg Br* 2005;87:463-4.
7 Pandit H, Glyn-Jones S, McLardy-Smith P, Gundle R, Whitwell D, Gibbons CL, et al. Pseudotumours associated with metal-on-metal hip resurfacings. *J Bone Joint Surg Br* 2008;90:847-51.
8 Berton C, Girard J, Krantz N, Migaud H. The Durom Large Diameter Head acetabular component: early results with a large-diameter metal-on-metal bearing. *J Bone Joint Surg Br* 2010;92:202-8.
9 Bozic KJ, Kurtz S, Lau E, Ong K, Chiu V, Vail TP, et al. The epidemiology of bearing surface usage in total hip arthroplasty in the United States. *J Bone Joint Surg Am* 2009;91:1614-20.
10 Medicines and Healthcare Products Regulatory Agency. Medical Device Alert MDA/2010/033: all metal-on-metal (MOM) hip replacements. 2010.
11 Bolland BJRF, Culliford DJ, Langton DJ, Millington JPS, Arden, NK, Latham JM High failure rates with a large-diameter hybrid metal-on-metal total hip replacement. Clinical, radiological and retrieval analysis. *J Bone Joint Surg [Br]* 2011;93-B:608-15.
12 Brodner W, Bitzan, P, Meizinger V Kaider A, Gottsauner-Wolf F, Kotz R. Serum cobalt levels after metal-on-metal total hip arthroplasty. *J Bone Joint Surg [Am]* 2003;85-A:2168-73.
13 Haddad FS, Thakrar RR, Hart AJ, Skinner JA, Nargol AV, Nolan JF, et al. Metal-on-metal bearings: the evidence so far. *J Bone Joint Surg Br* ;93:572-9.
14 Clohisy JC, Calvert G, Tull F, Mcdonald D, Maloney WJ. Reasons for revision hip surgery: a retrospective review. *Clin Orthop* 2004;429:66-9.
15 Sandiford NA, Muirhead-Allwood SK, Skinner JA. Revision of failed hip resurfacing to total hip arthroplasty rapidly relieves pain and improves function in the early post operative period. *J Orthop Surg Res* 2010;5:88.
16 Grammatopolous G, Pandit H, Kwon YM, Gundle R, McLardy-Smith P, Beard DJ, et al. Hip resurfacings revised for inflammatory pseudotumour have a poor outcome. *J Bone Joint Surg Br* 2009;91:1019-24.
17 Medicines and Healthcare Products Regulatory Agency. Medical Device Alert: MDA/2010/069, DePuy ASR hip replacement implants. 2010.

Cite this as: *BMJ* 2011;342:d3009