Metal Sensitivity and Orthopaedic Implants

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What we know

• Arthroplasty failure
• Abnormal reaction to metal articulations in total hip arthroplasty
What we want to know

• The extent of the problem
• The nature of the problem
• Patient factors
• Poor surgery
• Poor implant design
• Implant manufacture
• Can information from total hip arthroplasty be extrapolated to knees?
Bearing surfaces

- Metal-on-plastic
- Metal-on-metal
Metal-on-metal

- Wear debris
  - Surface corrosion
  - Mechanical wear
- Cobalt, chromium and nickel ions
- Lower wear rates
- Low volume, small size but increased number
- Nanometre size particles
- Aseptic loosening and osteolysis
Metal-on-metal

• Prosthesis derived metal ions found within
  – Synovial fluid and periprosthetic tissues
  – Regional lymph nodes
  – Liver
  – Spleen
  – ? Extent of true dissemination
ALVAL

- Failed total hip arthroplasty
- Metasul Metal articulation – Willert et al.
- Histological findings of delayed-type hypersensitivity reaction
- Aseptic lymphocyte-dominated vasculitis associated lesion
- Osteolysis
Fig. 2 Low-power photomicrograph of a tissue section from a hip with a failed metal-on-metal total hip replacement

Fig. 3 Higher-magnification image of part of the same tissue section as shown in Figure 2

Metal sensitivity

- Metal ions form complexes with native proteins
- Metal-protein complexes – haptens
- Haptens include nickel, cobalt and chromium
- Unknown antigen presenting cell (APC)
Metal sensitivity

- Variety of immunostimulatory immunosuppressive mechanisms
- T-cell activation
- Secrete cytokines
  - IL-3 and GM-CSF
- Recruit and activate
  - Macrophages, monocytes, neutrophils
Investigation

- History
  - Pain

- Examination
  - Swollen
  - Erythematous
  - Eczema

- Investigation
  - Aseptic
Investigation

- Skin testing (patch or intradermal test)
  - Dermal type IV hypersensitivity
  - Langerhans antigen presenting cells
  - Dermatitis, urticaria and/or vasculitis
• Positive skin-patch testing to Ni, Co and Cr
  – Women
  – 5-10% native population
  – 15% with stable prostheses
  – 50% with loose prostheses
Investigation

• 15% patients do not have deep hypersensitivity reactions to prostheses
• No Langerhans cells in deep tissues
• Patch testing of short duration
Investigation

- In vitro testing

- Lymphocyte proliferation or transformation testing
  - More readily detects metal sensitivity than dermal patch testing

- Leucocyte migration inhibition testing
  - Haptens cause leucocytes to migrate more slowly

- Poor accuracy and no validation
Current management for failed metal articulation hips

- BOA/BHS proposal
- Report all revisions to MHRA
- Histology to a specialist centre
- All available imaging sent to working party
- BHS/BOA/MHRA/NJR – Chair Mr John Skinner)
• Should we be doing the same with the painful total knee replacement?