 Evaluation of Painful Hip after Arthroplasty

Dr. (Prof.) Anil Arora

MS (Ortho)  DNB (Ortho)  Dip SIROT (USA)  
FAPOA (Korea), FIGOF (Germany), FJOA (Japan)  
Commonwealth Fellow Joint Replacement  
(Royal National Orthopaedic Hospital, London, UK)  
Senior Knee and Hip Replacement Surgeon  
Associate Director  
Department of Orthopaedics and Joint Replacement  
Max Superspeciality Hospital, Patparganj, Delhi (India)  
E-mail : anilarora@delhiorthojournal.com
<table>
<thead>
<tr>
<th>Intrinsic</th>
<th>Extrinsic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aseptic loosening</td>
<td>P.V.D.</td>
</tr>
<tr>
<td>Infection</td>
<td>Lumbar spine disease</td>
</tr>
<tr>
<td>Wear debris synovitis</td>
<td>CRPS</td>
</tr>
<tr>
<td>Osteolysis</td>
<td>Nerve injuries</td>
</tr>
<tr>
<td>Occult instability</td>
<td>Malignant tumor</td>
</tr>
<tr>
<td>Iliopsoas tendinitis</td>
<td>Hernia</td>
</tr>
<tr>
<td>Impingement</td>
<td>Stress fractures</td>
</tr>
<tr>
<td>Modulus mismatch</td>
<td>Metabolic disease</td>
</tr>
<tr>
<td>GT nonunion</td>
<td></td>
</tr>
</tbody>
</table>
Early causes
<1yr

- Failure of fixation
- Infection
- Instability
- Other sources
- Mechanical dysfunction
  Psoas tendon impingement
  soft tissue irritation
- **Metal-on-metal hypersensitivity**

Late causes
>1Yr

- Loosening
- Wear reactions
- **Mechanical dysfunction**
  Subluxation associated with
  wear of the articular couple.
- Late hematogenous infection
- Other sources
Never pain-free after the operation

- Improper Indication for surgery
- Initial implant stability was never achieved
- Infection
A pain-free interval after the operation

- Loosening
- Late-onset infection
- Lysis (Osteolysis)
Site of pain

**Trochanteric region**
- Bursitis
- Osteolysis
- Fracture
- Irritation secondary to underlying sutures or wires

**Buttock or groin**
- Acetabular loosening or osteolysis
- Iliopsoas impingement or tendinitis secondary to acetabular retroversion;  
  *Vascular or neurogenic claudication*
  *Inguinal, femoral, obturator hernia*
  *Gynecological or genitourinary causes*
  *Nerve root involvement*

**Thigh pain**
- Loose femoral implant
- A mismatch in the modulus of elasticity between femur and the stiff femoral stem
Nature of pain

**Pain felt at rest or during the night**
- Underlying infection
- Malignancies

**Start-up pain..subsides after the first few steps**
- Early loosening and micromotion of either component
- Iliopsoas tendinitis
- Secondary to modulus mismatch?

**Activity-related pain that is relieved only by rest**
- Loosening
- Subtle or Impending fracture
- Vascular or neurogenic claudication.
Physical Examination

Detailed Hip Examination

**Gait** - Antalgic gait

Limb-length discrepancy

Spine, SI, contralateral hip, and both knees

Progressive shortening may indicate progressive subsidence of either component
Subluxating Hip

- Pain in a particular position in which hip subluxates.
- Can confirm under fluoroscopy.
- Possible in late cases due to articulation wear resulting in instability
Plain Radiographs

- A plain AP radiograph of the pelvis,
- AP and lateral radiographs of the hip
- AP and lateral of thigh

Compare serial radiographs

Radiological findings in patients with indolent infection can be unremarkable or show minimal changes, and a normal appearing radiograph does not exclude infection.
Features of well fixed implant

**Major signs**

- An absence of reactive lines
- Endosteal “spot welds” around the porous coated part of the prosthesis.

**Minor signs**

- Calcar atrophy,
- Absence of bead-shedding
- Absence of a pedestal, indicating a stable distal part of the stem.
Features of well fixed implant

**Major signs**
- An absence of reactive lines
- Endosteal “spot welds” around the porous coated part of the prosthesis.

**Minor signs**
- Calcar atrophy,
- Absence of bead-shedding
- Absence of a pedestal, indicating a stable distal part of the stem.
Radiographic features
Loosening

- Peri-implant lucency > 2mm
- Described using Gruen Zones
- Stress views / Interval change in position
Cortical thickening

• Associated with loosening

• Can be asymptomatic
Pedestal formation
Loose uncemented femoral component

Lucency around the tip of the uncemented prosthesis indicating loosening (aseptic)
Bead shedding
Loose stem
Differentiation between **Septic** and **Aseptic** Loosening on plain radiographs is difficult

- Endosteal scalloping,
- Generalized osteolysis
- Osteopenia
- Periosteal new bone formation

Indicative of **infection**, especially if they are rapidly progressive.
Acetabular component loosening

X-Ray features:

- **Radiolucency** greater than 2 mm all around +/- progressive
- **Medial migration** of cup
- Change in inclination of cup
Acetabular component loosening

**X-Ray features:**

- **Radiolucency** greater than 2 mm all around +/- progressive

- **Medial migration** of cup

- Change in inclination of cup
Wear and Osteolysis

Preop

Postop

Eccentric wear
GT fracture
Laboratory Tests

**IL-6**  Peak - first 6 to 12 hours
baseline- 3 Days

**CRP**  Early peak 2-3 days after surgery,
normal first 3 wks after operation.

**ESR**  Peak 5-7 days operation,
pre-operative levels in 3 months.

A combination of CRP and IL-6 has recently been shown to provide excellent sensitivity in the assessment of infection after THR.

Perioperative Testing for Joint Infection in Patients Undergoing Revision Total Hip Arthroplasty

By Mark F. Schinsky, MD, Craig J. Della Valle, MD, Scott M. Sporer, MD, and Wayne G. Paprosky, MD

Investigation performed at Midwest Orthopaedics at Rush, Rush University Medical Center, and Central DuPage Hospital, Chicago, Illinois

Methods: Two hundred and thirty-five consecutive total hip arthroplasties in 220 patients were evaluated by one of two surgeons using a consistent algorithm to identify infection and were treated with reoperation. Receiver-operating-characteristic curve analysis was used to determine the optimal cut-point values for the white blood-cell count and the percentage of polymorphonuclear cells of intraoperatively aspirated hip synovial fluid. Sensitivity, specificity, negative predictive value, positive predictive value, and accuracy were determined. Patients were considered to have an infection if two of three criteria were met; the three criteria were a positive intraoperative culture, gross purulence at the time of reoperation, and positive histopathological findings.

Results: Thirty-four arthroplasties were excluded because of the presence of a draining sinus, incomplete data, or a preoperative diagnosis of inflammatory arthritis, leaving 201 total hip arthroplasties available for evaluation. Fifty-five hips were judged to be infected. No hip in a patient with a preoperative erythrocyte sedimentation rate of <30 mm/hr and a C-reactive protein level of <10 mg/dL was determined to be infected. Receiver-operating-characteristic curve analysis of the synovial fluid illustrated optimal cut-points to be >4200 white blood cells/mL for the white blood-cell count and >80% polymorphonuclear cells for the differential count. However, when combined with an elevated erythrocyte sedimentation rate and C-reactive protein level, the optimal cut-point for the synovial fluid cell count was >3000 white blood cells/mL, which yielded the highest combined sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of the tests studied.

Discussion: A synovial fluid cell count of >3000 white blood cells/mL was the most predictive perioperative testing modality in our study for determining the presence of periprosthetic infection when combined with an elevated preoperative erythrocyte sedimentation rate and C-reactive protein level in patients undergoing revision total hip arthroplasty.
<table>
<thead>
<tr>
<th>Test*</th>
<th>Infected (N = 55)</th>
<th>Noninfected (N = 146)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythrocyte sedimentation rate (mm/hr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>55.4</td>
<td>26.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Range</td>
<td>5 to 124</td>
<td>1 to 103</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>24.5</td>
<td>17.0</td>
<td></td>
</tr>
<tr>
<td>C-reactive protein (mg/dL)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>52.4</td>
<td>7.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Range</td>
<td>0.5 to 393</td>
<td>0.1 to 157</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>86.1</td>
<td>21.2</td>
<td></td>
</tr>
<tr>
<td>Synovial fluid WBC/mL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>61,336.0</td>
<td>1721.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Range</td>
<td>470 to 407,000</td>
<td>0 to 53,200</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>84,268.0</td>
<td>4722.9</td>
<td></td>
</tr>
<tr>
<td>Percent PMN in synovial fluid (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>86.1</td>
<td>51.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Range</td>
<td>5 to 100</td>
<td>0 to 98</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>20.3</td>
<td>29.3</td>
<td></td>
</tr>
<tr>
<td>Years from primary surgery to revision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test††‡</td>
<td>Sensitivity</td>
<td>Specificity</td>
<td>Positive Predictive Value</td>
</tr>
<tr>
<td>--------</td>
<td>------------------</td>
<td>------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Elevated erythrocyte sedimentation rate &gt;30 mm/hr</td>
<td>97% (93% to 100%)</td>
<td>39% (31% to 47%)</td>
<td>42% (34% to 50%)</td>
</tr>
<tr>
<td>Elevated C-reactive protein &gt;10 mg/dL</td>
<td>94% (87% to 100%)</td>
<td>71% (64% to 79%)</td>
<td>59% (49% to 69%)</td>
</tr>
<tr>
<td>Synovial fluid WBC count &gt;4200 WBC/mL</td>
<td>84% (74% to 94%)</td>
<td>93% (88% to 98%)</td>
<td>81% (71% to 91%)</td>
</tr>
<tr>
<td>Synovial fluid WBC differential &gt;80% PMN†</td>
<td>84% (74% to 93%)</td>
<td>82% (76% to 89%)</td>
<td>65% (54% to 76%)</td>
</tr>
<tr>
<td>Positive frozen section</td>
<td>73% (63% to 86%)</td>
<td>94% (83% to 94%)</td>
<td>82% (60% to 84%)</td>
</tr>
<tr>
<td>Positive culture</td>
<td>87% (79% to 95%)</td>
<td>92% (89% to 95%)</td>
<td>80% (71% to 89%)</td>
</tr>
</tbody>
</table>
Computerized Tomography

- Potential loosening of components before changes are visible on x-rays.
- Identify the inflammatory lesion in patients with iliopsosas impingement
- Osteolytic zones less than 1 cm
Osteolysis on CT
Nuclear Imaging

Tc 99 S MDP scan
Tc 99 WBC lab scan
Gallium Scan
Indium111 Scan
Nonspecific immunoglobulin-G (IgG).

Uncemented implants tend to cause false-positive results for up to 2 years.
Bone scan showing diffuse uptake

- May suggest infection
- Also seen in aseptic loosening
The characteristic findings with an infected THR are **increased uptake in all three phases** of the scan.

The **lack of increased uptake in the first two phases** is an **important negative finding** that would militate against the diagnosis of infection.

Indium leukocyte scan: Sensitivity 95%,
Negative predictive value 100% for infection.
Radionuclide imaging of the painful hip arthroplasty

POSITRON-EMISSION TOMOGRAPHY VERSUS TRIPLE-PHASE BONE SCANNING

From University Hospital Aachen, Aachen, Germany

Two major complications of hip replacement are loosening and infection. Reliable differentiation between these pathological processes is difficult since both may be accompanied by similar symptoms. Our aim was to assess the diagnostic ability of triple-phase bone scanning (TPBS) and positron-emission tomography (PET) to detect and differentiate these complications in patients with a hip arthroplasty. Both TPBS and PET were performed in 63 patients (92 prostheses). The radiotracer for PET imaging was $^{18}$F-fluorodeoxyglucose (FDG). Image interpretation was performed according to qualitative and quantitative criteria although the final diagnosis was based upon either surgical findings or clinical follow-up.

The sensitivity, specificity and accuracy of PET was 0.94, 0.95 and 0.95 respectively, compared with 0.68, 0.76 and 0.74 for TPBS. We found that an image interpretation based exclusively upon quantitative criteria was inappropriate because of its low selectivity. The histological examination indicated that increased periprosthetic uptake of FDG in patients with aseptic loosening was caused by wear-induced polyethylene particles and the subsequent growth of aggressive granulomatous tissue.
FDG PET images show diffusely increased grade 3 FDG uptake (arrowheads) around the head and shaft of the left total hip replacement.
USG

Effusion
USG
Iliopsoas tendinitis
USG
Pseudotumor
Magnetic Resonance Imaging

- Soft tissue Evaluation
- Metallosis
- Pseudotumor

Artefacts generated by ferrous components is a problem with the technique
Metal hypersensitivity

**ALVAL** (Aseptic Lymphocytic Vasculitis Associated Lesions), and Metal hypersensitivity.

Pandit et al. reported soft-tissue masses (Pseudotumors) around hip resurfacing components in sixteen female patients.

Pain (twelve patients)

Palpable lump (three)

Neurological symptoms (two)

Sense of instability and subluxation (two)

Spontaneous hip dislocation (one).

**USG/MRI**  Solid or a cystic mass arising from the hip joint
Normal looking radiograph

MRI
Aspiration

- **Should not be performed routinely**
- High false-positive rate

Aspiration has proved to be more sensitive and specific when there is radiographic or clinical evidence of infection.

A cell count of >3000 PMNs per cc in association with elevated ESR and CRP is highly suggestive of infection.
THANKS
We reviewed the plain radiographs, bone scans and hip aspiration results of 54 patients with painful hip arthroplasties which had been explored surgically, to compare the results of the investigations with the operative findings.

For acetabular loosening, the sensitivity and specificity of bone scanning were 87% and 95%, with an accuracy of 90%: for serial plain radiography sensitivity was 95%, specificity 100% and accuracy 97%. For femoral component loosening, bone scan sensitivity was 85%, specificity 100% and accuracy 89%: the sensitivity of plain radiography was 100%, with specificity 92% and accuracy 98%.

Technetium bone scanning did not provide additional information with regard to loosening and is not necessary in the routine investigation of a painful hip arthroplasty. Serial plain radiography is the most effective method of detecting loosening, and bone scanning is useful only when radiography is inconclusive with regard to loosening or infection.

Received 10 August 1992; Accepted 23 October 1992
Plain Radiographs
Infection

- Sinus tract formation
- Bone destruction
- Lytic lesions
- Progressive interfacial widening
- Periosteal reaction
- Smooth endosteal scalloping

- Extensive bone destruction
- Extensive/aggressive periosteal reaction
- Air in the soft tissue and/or joint
- Wide or irregular lucent zone

Agressive infectious agents

Most suspicious radiological signs of infection
• Bacterial identification by Polymerase Chain Reaction analysis has been reported to have better specificity and sensitivity than standard culture methods.