Avascular Necrosis

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AVN

• Outline
• Predisposing factors
• Aetiology & Pathology
• AVN Hip
  – Diagnosis, imaging & management
• SONK
  – Diagnosis, imaging & management
Avascular necrosis

• Bone death due to lack of blood
• Common sites affected
  – Hip
  – Wrist (scaphoid & lunate)
  – Knee (SONK)
  – Talus
  – May be widespread
    • Caisson’s, Gaucher’s, Sickle cell etc
Aetiology of AVN

- Primary
  - Idiopathic
  - \( \frac{1}{3} \) cases (hip)
  - Young adult M
  - 35-45 yrs
  - Frequently bilateral
  - 20% of femoral heads (THR)
    - ?due to overload

- Secondary
  - Identifiable cause
  - Fracture
  - Steroids
  - DXT
  - Alcohol
  - Sickle cell (worldwide)
  - Caisson’s
  - Gaucher’s
  - Hyperlipidaemia
  - Smoking
  - DDH
  - etc
Pathology

Ficat Stage

0

- Steroids
- Alcohol
- DXT
- Sickle cell
- Caisson's
- Hyperlipidaemia
- Smoking

Vascular Obstruction

Hypoxia

Bone Marrow cell oedema

Recorvery?

Ischaemic Threshold

Anoxia

Bone necrosis

Repair?

Repair Threshold

Microfractures

Repair?

Segmental collapse

Replacement?

Secondary OA

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Pathology contd

• Various methods of causing vascular obstruction
  – Abnormal Hb & vascular occlusion (Sickle)
  – N gas bubble precipitation (Caisson’s)
  – Post-irradiation vasculitis
  – Fatty infiltration (steroids & alcohol)

• Fate of femoral head related to site & size of infarct
  – Large in WB areas worst prognosis
  – Limited capacity for repair
Diagnosis

• History
  – Predisposing factors
  – Pain of insidious onset
    • Out of proportion to x-ray changes
    • Frequently worse at night
    • Unremitting
    • Non-mechanical
    • Worse with activity

• High index of suspicion
Diagnosis

• Examination
  – Irritable joint
  – Tender joint line
  – ↓ROM
  – Effusion

• Investigation
  – Plain x-rays
    • 2 views needed
    • X-ray changes late
  – MRI Ix of choice
    • Hi sens & spec
    • Allows imaging of other side
    • Can pick up early stages
  – Bone scan less reliable
38 y/o fireman, post dislocation Left hip. X-rays 4 months apart
Features of MRI in AVN

• T1 Peripheral band of low signal outlining central marrow area
  – Represents reactive interface

• T2 high signal at inner border of peripheral band
  – Double-line sign
  – Pathognomonic of AVN
## Classification - Hip

- **Ficat 1985**
  - Based on x-ray findings

<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical features</th>
<th>Radiography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early 0</td>
<td>Preclinical</td>
<td>-</td>
</tr>
<tr>
<td>I</td>
<td>Preradiographic</td>
<td>+</td>
</tr>
<tr>
<td>II</td>
<td>Pre-flattening</td>
<td>+</td>
</tr>
<tr>
<td>Transition</td>
<td></td>
<td>Crescent or flattening</td>
</tr>
<tr>
<td>Late III</td>
<td>Collapse</td>
<td>++</td>
</tr>
<tr>
<td>IV</td>
<td>OA</td>
<td>+++</td>
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</tbody>
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Showed that prognosis poor after femoral head collapse

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Classification

• Modifications
  – Ohzono (1999)
    • Looked at site & size of area of infarct
  – Steinberg (1995)
    • MRI based classification
    • 7 stages (0-VI)
    • V & VI relate to extent of acetabular involvement
    • Subgraded I-V in terms of % femoral head involved
      – Size is important!
Management of AVN

• Stage disease
• Early stages (0-II)
  – Risk factors (no evidence)
  – Off-load
    • Modify activity
    • Cushioned shoes
    • Stick/crutches
    • Rest
  – Consider core decompression
Core decompression

• Drill/trephine through cortex into femoral head to ↓ intravascular pressure
  – Gives good pain relief
  – Pre-collapse (0-II) gives better outcome
  – Can allow hip to be saved
  – Similar to fasciotomy for compartment syndrome
  – Can be done with large or small drills
  – Role for vascularised (fibular) graft
Post-collapse treatment

• Intertrochanteric osteotomy
  – Combination of rotation & varus/valgus
  – Aim to remove avascular segment from WB area
  – Various success rates reported
  – Don’t spoil pitch for later THR

• Arthroplasty
  – Cemented vs uncemented
  – ?role for resurfacing or bipolar replacement
AVN of Femoral Head - Summary

- Outcome determined by:
  - Extent
  - Site
  - Aetiology

- Early diagnosis important
  - Outcome poor once collapse occurred
  - Offload joint
  - Core decompression can preserve hip

- Arthroplasty as salvage
AVN of the Knee

- **SONK**
  - Spontaneous osteonecrosis of the knee
  - Subchondral weight bearing area
  - 1st recognised by Ahlback (1968)
  - ? Responsible for 1-2% of knee OA
  - M:F 1:3
  - MFC 98% (then MTP)
  - Aetiology unknown
    - Exclude other causes
Presentation of SONK

- Usually F, age >60
- Spontaneous onset medial knee pain
- Night pain & activity related
- Acute phase lasts approx 8 weeks
- Mobility & weight-bearing preserved
- Can be mistaken for meniscal injury
  - Unnecessary arthroscopy
- Plain films normal initially
Radiology

Varies with stage

Aglieetti classification  
(after Ahlbeck & Koshino)

1. Plain films normal
2. Flattening of condyle
3. Lucent area surrounding area of sclerosis
4. Sclerosis around lucency
5. Degenerate change
Radiology – tibial SONK
MRI for SONK

- Ix of choice in early stages
- Changes may predate plain film changes
- Allows sizing & cartilage assessment
- Discrete low signal area on T1 in subchondral bone
- Surrounding oedema on T2
- Large areas progress (>5cm² or >50%)
- Shows additional foci of osteonecrosis

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SONK - pathology

- Central necrotic area
- Surrounding sclerosis
- Large crater due to collapse
- Progression to OA determined by size of lesion
  - healing vs collapse Lotke 1982
Management of SONK

- Stage disease
- MRI
  - Establish diagnosis
  - Size & location of lesion
- Early stage small lesion (<50% condyle width)
  - Activity modification
  - Crutches
  - ?Core decompression
    - Many do well with no surgery

Forst et al 1998

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Surgery for SONK

• Grades 3-5
• HTO
  – Reasonable for young active pts
  – Offload area of AVN  
    Soucacos 1997, Koshino 1982
• UKA
  – 89% good/excellent 34 knees 5.5 yrs
  – Similar results to UKA for OA 3.8 yrs
    Marmor 1993
    Langdown 2005
• TKR
  – All show slightly worse outcome when compared to TKR for OA
SONK - Summary

• Predominantly MFC, F, >60 yrs, unifocal
• MRI
• Small (<50%) may heal
  – Activity modification
• Large (>50%) may progress
  – Collapse & subsequent medial OA
  – ?Role for core decompression in early stages
  – HTO vs UKA for established OA