Osteonecrosis of the knee
Treatment with ESWT

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Osteonecrosis (ON) of the knee

- SPONK- Spontaneous ON of the knee
- Secondary ON of the knee
- Postarthroscopic ON of the knee
SPONK

- Single condyle in older patients (>55yrs)
- M: F - 1:3
- Sudden onset
- Singular lesion in epiphysis
- No associated factors or disease
- Pathology - fibrotic bone, healing fracture
Secondary ON of the knee

- Younger than 45 yrs
- M>F in alcohol induced
- F>M in SLE
- Gradual onset
- Bilateral, multiple condyles (femur and tibia)
- Multiple lesions in epiphysis, metaphysis and diaphysis
- Other joints involved- hip, shoulder, ankle
- Associated factors and diseases+
- Pathology- necrotic bone
SECONDARY ON OF KNEE
AVN OF HEAD OF FEMUR
Postarthroscopic ON of knee

- Infrequent but destructive complication
- 70 cases reported so far
- Epiphysis of a single condyle
- 24 weeks (4-92 weeks)
- Necrotic bone after laser assisted chondroplasty
- Fibrotic bone and healing # after mechanical debridement and meniscectomy
**Modified Ficat & Arlet classification of ON of knee**

<table>
<thead>
<tr>
<th></th>
<th>Joint space</th>
<th>Condyle contour</th>
<th>Trabecular pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Normal</td>
<td>Normal</td>
<td>Mottled areas of osteoporosis</td>
</tr>
<tr>
<td>II</td>
<td>Normal</td>
<td>Normal</td>
<td>Wedge sclerosis</td>
</tr>
<tr>
<td>III</td>
<td>Normal or slightly decreased</td>
<td>Subchondral collapse</td>
<td>Sequestrum apperence</td>
</tr>
<tr>
<td>IV</td>
<td>Decreased</td>
<td>collapse</td>
<td>Extensive destruction</td>
</tr>
</tbody>
</table>
SECONDARY ON OF KNEE

CASE 1

- Young surgeon complained of pain in knee with some episodic effusion with occ feeling of giving way
- No history of trauma, alcohol or medical problem
- Xrays normal from time to time
- Not relieved of symptoms with routine Rx
- MRI detected bilateral ON of knee
- Ficat and Arlet grade I
Knee pain in young patient with normal X rays
MRI before ESWT

LYSHOLM
SCORE 33
8 years follow up post ESWT

LYSHOLM SCORE 94
ESWT- HISTORY

• 1966- Dornier factory in Germany
  - high velocity projectiles produced electric shock like feeling without electricity
Effect of ESWT on biological tissues studied by Dept of Defense
• Wife of an engg → kidney stones
• Animal studies-ESWT striking pelvis-osteogenic response
ESWT-ACCEPTANCE

- Europe-Germany, Austria, Italy
- USA-FDA approval-Oct 2000
- International Society for Musculoskeletal Shockwave Therapy
- Member Nations: 54 countries
- www.ismst.com
Lithotripsy in Orthopaedics: A new concept-ESWT

- The technology involves a device which produces an intense wave of pressure variable to 6000 PSI
- Sonic beam
- Non invasive
BASIC PHYSICS

Shockwaves are characterized by

1. High positive pressure
2. Rise time < 10 ns
   → (Direct Shockwave effect)
3. Tensile wave → Cavitations
   (Indirect shockwave effect)
FDA APPROVAL – OSSATRON
Action of Shockwaves on Tissues

- Physical phase: Extra cellular cavitations, ionized molecules, membrane permeability altered
- Physical-Chemical phase: Diffuse radicals, interactions with biomolecules
- Chemical phase: intracellular reactions, molecular changes
- Biological phase: Cell and cell organelles
ESWT : How Does It Work

• Shockwaves stimulate or reactivate healing process in tendons, surrounding tissue and bones:
  – Micro disruption of avascular or minimally vascular tissues to encourage revascularization
  – Release of local growth factors
  – Recruitment of appropriate stem cells conducive to more normal tissue healing
ESWT → HEALING PROCESS

• Shockwaves →
  – Avascular planes of tissue
  – Traumatic injury to scar tissues with haemorrhage
  – Increase of blood circulation and metabolism
  – Positive effect on osteoblastic cells
  – Neovascularization in the treated area
  – Suppress COX-2 and PG E2-reduction of inflammatory mediators
ESWT $\Rightarrow$ HEALING
PROCESS-2

• Release of neuropeptides-
  – Substance P
  – eNOS (endothelial nitric oxide synthetase)
  – VEGF (vessel endothelial growth factor)
  – PCNA (proliferating cell antinuclear antigen)
  – Signal-regulated kinase (ERK)
  – p38-kinase
PAIN CONTROL

• ESWT is used for alleviation of musculoskeletal pain in high performance athletes
• Effect similar to transcutaneous neuromuscular stimulation
• Altered / increased cell membrane permeability → analgesia
• Nociceptors loose their ability for generation potential necessary to elicit pain signal response (gate control theory)
Effect of shockwave on bones

- Multidirectional building of new trabaculae
- Enhanced endoperiosteal and periosteal osteoneogenesis
- Increased osteoneogenesis
- No changes in serum values
ESWT in bone vascular diseases

- Rationale is to treat precociously all bone vascular disturbances and altered bone turnover in order to avoid possible and irreversible worsening.
- ESWT is a powerful non-pharmacological tool to normalise local heightened bone metabolism.
- Therapeutic intervention before positive radiographs are obtained.
Radiology-patho-clinical correlation.

- Bone marrow edema strongly correlate with necrotic volume.
- A large necrotic volume of > 30% is an indicator for predicting future worsening of pain.
- Higher grades of articular cartilage defects are associated with higher prevalence and greater depth and cross sectional area of subchondral bone marrow edema.
Secondary ON knee case 2

- 27 years young male came with second opinion with proved ON of medial femoral condyle, a large lesion. Ficat and Arlet grade III
- Pain, instability and limp with pain in right knee.
- ESWT given to right knee with excellent recovery. Lysholm score 8→80.
- Developed Rt hip pain after 3 years with AVN
Osteochondritis Dissecans of medial femoral condyle
12 years follow up post ESWT
Final outcome
Case 3

- Middle aged house wife having vague knee pain and swelling in both knee with giving way and occ locking episodes.
- Point tenderness at medial femoral condyles and no evident instability.
- Ficat and Arlet grade III
- Not responding to routine Rx
Pre ESWT
MRI of both knee
ESWT to both knee
6 months f/u
X rays at 3 years post ESWT
4 YRS FOLLOW UP
FINAL OUTCOME

Lysholm score
24 ➔ 94
CASE 4

- Young housewife with left knee pain and swelling with point tenderness over medial epicondyle
- No instability or medial joint line tenderness.
- Ficat and Arlet grade I
- Lysholm score 54
- Not relieved by routine Rx
Clinical picture
X rays 8 months back
Recent Xrays
MRI pics of left knee
Conclusion

• Osteonecrosis is not uncommon cause of pain the knee.
• Better understanding of the condition with gradation like AVN of hip can allow us to plan the treatment and prognosticate.
• ESWT is a safe, noninvasive and effective modality and has proven value of preventive and therapeutic intervention.
thank you