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Disclosures

- There will be myriad discussions of procedures and devices which are non-FDA approved for the procedure/patient/technique.

- Financial:
  - DMSB board of Woodmont Pharmaceuticals, Inc
  - Will not be discussed here
Objectives

- Discuss IR techniques in the MSK system
- Demonstrate selected cases
- Discuss current/future developments
Categories

- Arthrography
- Joint Injections
- Biopsy
- Drainages
- Bone cysts
- Thermal ablation
- Foreign body removal
- New/future therapy

- 15-25 cases per week
Arthrography

- Indications
  - Labral tears
  - Rotator cuff tears
  - Intra-articular foreign bodies
  - TFCC tears
  - OCD
  - Hip impingement

Pediatr Radiol. 2015 Mar;45(3):308-16
Most common sites
- Shoulder (anterior or posterior approach)
- Hip
- Wrist (Dorsal approach)

Arthrography

- **Technique**
  - 22 g or smaller needle
  - Ultrasound guidance for puncture
  - Fluoroscopy to inject contrast
  - Iodinated contrast followed by dilute gadolinium (2.5-5 ml gadolinium/500 ml NS) *
  - Exercise joint
  - Obtain xray images
  - MR (or CT)
Rotator Cuff Tear
IA Foreign Bodies
IA Foreign Bodies
Wrist TFCC Tear
Joint Injections

Indications

- JIA: Acute inflammation vs chronic changes
- Snapping hip
- Overuse syndromes
- Pain without known reason

Pediatr Radiol. 2015 Jul;45(8):1212-7
Pediatr Radiol. 2012 Dec;42(12):1481-9
Joints Our Experience

- Ankle
  - Tibio-talar
  - Subtalar
  - Tendon sheaths

- Foot
  - Tarsals
  - MTP’s
  - IP’s
  - Tendon sheaths

- Wrists: all 3 compartments

- Hands
  - MCP’s
  - IP’s

- Elbows

- Shoulders
  - Glenohumeral
  - Acromioclavicular

- TMJ’s

- Bursa/tendon sheaths

- SI’s

- Knees

- Hips

- Spine facets
Joint Injections

- **Outcomes**
  - Difficult to predict
  - Re-treat as needed (every 3-6 months)
  - May be diagnostic

- **Complications (<3% total)**
  - Soft tissue atrophy
  - Infection
  - Skin hypopigmentation
  - Local effects
Joint Injections: Technique

- Approaches (Need to be skilled and innovative)
  - Longitudinal
  - Transverse
  - Oblique

- Small gauge needles
  - 22 g for larger joints
  - As small as 30 g for hands/feet

- No contrast injections

- No fluoroscopy (shoulders?)
Joint Injections: Technique

- Sites
  - Prescribed by rheumatology/ortho
  - MR scanning
  - Ultrasound evaluation

- Doses: Based on established tables
Joint Injections: Technique

Table 2: Juvenile idiopathic arthritis (JIA) corticosteroid dose protocol.

<table>
<thead>
<tr>
<th>Location</th>
<th>Adults</th>
<th>12 y/o (75%)</th>
<th>8 y/o (53%)</th>
<th>4 y/o (39%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee, hip, shoulder</td>
<td>mg</td>
<td>TH (ml)</td>
<td>TA (ml)</td>
<td>mg</td>
</tr>
<tr>
<td>20–40</td>
<td>1–2</td>
<td>0.5–1</td>
<td>15–30</td>
<td>10.6–21.2</td>
</tr>
<tr>
<td>Tibiotarlar</td>
<td>16–30</td>
<td>0.8–1.5</td>
<td>12–22.5</td>
<td>8.5–16</td>
</tr>
<tr>
<td>Elbow</td>
<td>8–20</td>
<td>0.4–1.0</td>
<td>6–15</td>
<td>4.2–10.6</td>
</tr>
<tr>
<td>Radialcarpal</td>
<td>8–20</td>
<td>0.4–1.0</td>
<td>6–15</td>
<td>4.2–10.6</td>
</tr>
<tr>
<td>Subtalar</td>
<td>8–16</td>
<td>0.4–0.8</td>
<td>6–12</td>
<td>4.2–8.5</td>
</tr>
<tr>
<td>Cuboid-cuneiform</td>
<td>8–14</td>
<td>0.4–0.7</td>
<td>6–10.5</td>
<td>4.2–7.4</td>
</tr>
<tr>
<td>Talonavicular</td>
<td>8–12</td>
<td>0.4–0.6</td>
<td>6–9</td>
<td>4.2–6.4</td>
</tr>
<tr>
<td>Navicular-cuneiform</td>
<td>8–12</td>
<td>0.4–0.6</td>
<td>6–9</td>
<td>4.2–6.4</td>
</tr>
<tr>
<td>Mid-cuneiform</td>
<td>8</td>
<td>0.4</td>
<td>6</td>
<td>4.2</td>
</tr>
<tr>
<td>Intermetacarpal</td>
<td>8</td>
<td>0.4</td>
<td>6</td>
<td>4.2</td>
</tr>
<tr>
<td>MCP/MTP</td>
<td>6–8</td>
<td>0.3–0.4</td>
<td>0.15–0.2</td>
<td>4.5–6</td>
</tr>
<tr>
<td>PIP</td>
<td>4–6</td>
<td>0.2–0.3</td>
<td>0.1–0.15</td>
<td>3–4.5</td>
</tr>
<tr>
<td>DIP</td>
<td>2</td>
<td>0.1</td>
<td>0.05</td>
<td>1.5</td>
</tr>
</tbody>
</table>

BSA = body surface area, TH = triamcinolone hexacetonide, TA = triamcinolone acetonide, MCP = metacarpophalangeal, MTP = metatarsophalangeal, PIP = proximal interphalangeal, DIP = distal interphalangeal, y/o = years old.
Joint Injections: Fingers
Joint Injections: TMJ
Joint Injections: Ankle

right subtalar joint
Evaluate and Inject
Biopsy

- **Indications**
  - **Infection**
    - Acute
    - CRMO
    - Pathogen diagnosis
  - **Tumor (bone or soft tissue)**
    - Primary
    - Recurrence
  - **LCH/ABC/other**
Biopsy

- Guidance
  - US when possible
  - Fluoroscopy
  - CT
  - MR
Biopsy

- Guidance
  - US when possible
  - Fluoroscopy
  - CT
  - MR
Biopsy: Equipment

- **Needles**
  - Have multitude on hand
  - Bone specific needles
  - Drill
  - Soft tissue needles
  - Scrape biopsy
  - Coaxial
Biopsy: ? Metastatic Disease
Biopsy: ? Metastatic Disease
Biopsy: LCH
Drainages

- **Indications**
  - Septic joints
  - Soft tissue abscesses (MRSA)
  - Post operative collections
    - Definitive
    - Pre-sclerotherapy
Drainages: Technique

- Ultrasound (again!)
- Standard drainage techniques
- For joint effusions: Labs important
Drainages
Drainages
Hip Effusions

- Kocher criteria (1 pt each)
  - Non-weight bearing
  - ESR > 40
  - Fever > 38.2 Deg C
  - WBC > 12,000
- ? Reproducibility
- ? Osteomyelitis

<table>
<thead>
<tr>
<th>Score</th>
<th>% septic arthritis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>3</td>
<td>93%</td>
</tr>
<tr>
<td>4</td>
<td>99%</td>
</tr>
</tbody>
</table>

J Bone Joint Surg Am. 1999 Dec;81(12):1662-70
Clin Orthop Relat Res. 2014 May;472(5):1645-51
Hip Effusions

- Surgical criteria
  - WBC: > 80K
  - Positive cultures
Other Effusions
Aneurysmal Bone Cysts

- Benign/Rare
- 80% in < 20 yo

Path
- High levels of MMP, TRAP, VGEF
- Giant cells and osteoclasts
- Chromosomal translocations (16q22 and 17p13)
- MMP destroys extracellular matrix
- Osteoclasts destroy bone
- VEGF promotes vascular in-growth
Aneurysmal Bone Cysts

- High recurrence rate with surgery
- Physeal injury often
- Sclerotherapy
  - Multiple agents tried: Variable response
  - Doxycycline
    - Inhibits MMP
    - Anti-angiogenic
    - Induces osteoclast apoptosis
Aneurysmal Bone Cysts: Doxycycline

- Foamed with albumin and air (25/25/50)
- Multiple needle punctures (15-25 g)

Clin Orthop Relat Res. 2013;471:2675-2683
Exp Cell Res 2011;371:1454-1464
Aneurysmal Bone Cysts: Doxycycline
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Aneurysmal Bone Cysts: Doxycycline
Thermal Bone Lesion Ablation

- Indications
  - Osteoid Osteoma
  - Bone tumors
    - Primary
    - Painful metastases

Radiology. 1992 Apr;183(1):29-3
Semin Musculoskelet Radiol. 2006 Jun;10(2):137-44
Thermal Bone Lesion Ablation

- Techniques
  - RF Ablation
  - Microwave
  - Laser
  - Cryoablation

Radiology. 1992 Apr;183(1):29-3
Semin Musculoskelet Radiol. 2006 Jun;10(2):137-44
Osteoid Osteomas: What are they?

Pathology

- Sclerotic bone
- Internal nidus (up to 1.5-2 cm)
  - Osteoid
  - Osteoblasts
  - Fibrovascular stroma
  - Nerve endings

Packed mesh of thin, contorted osteoid and woven bone trabeculae cellular tissue, active osteoblastic rim, osteoclasts, dilated capillaries, and neurofibers.
Thermal Bone Lesion Ablation

- Techniques
  - RF Ablation
  - Microwave
  - Laser
  - Cryoablation

Radiology. 1992 Apr;183(1):29-3
Semin Musculoskelet Radiol. 2006 Jun;10(2):137-44
Biopsy issues

Langerhans Cell Histiocytosis
Osteogenic sarcoma metastases
Ewing’s Sarcoma Recurrence
Chondroblastoma
Foreign Body Removal

- **Foreign Bodies**
  - Splinters
  - Needles
  - BB’s/Pellets
  - Self inflicted harm
  - Whatever else you can think of

AJR Am J Roentgenol. 1990 Dec;155(6):1277-81
Foreign Body Removal

- Guidance
  - US
  - Fluoroscopy (metallic if best way)

AJR Am J Roentgenol. 1990 Dec;155(6):1277-81
Foreign Body Removal
Foreign Body Removal
New/Future Developments

- Embolization for hemarthrosis (Hemophilia)
- Gene therapy
  - Muscular dystrophy
  - Spinal Muscle Atrophy
    - Spinraza
    - Gene therapy
  - Batten’s disease
Hemarthrosis

- Embolization for hemarthrosis (Hemophilia)
- Reduces frequency of re-bleeds

Haemophilia. 2015 May;21(3):e226-8
Hemarthrosis
Hemarthrosis
Spinraza/SMA

- SMA
  - Autosomal recessive
  - Effects motor neurons
  - SMN1 gene defect
Spinraza/SMA

- **Spinraza**
  - Functionally converts SMN2 to SMN1
  - Halts progression
  - 60% see improvement
  - $$$$$$$$$$$$$$$$$$$$$$$
  - Intrathecal administration
    - 4 loading doses
    - Q 4 months for life

*Lancet. 2016 Dec 17;388(10063):3017-3026*
Spinraza/SMA
Muscular Dystrophy

- Genetic Defect: Multiple types
- Progressive muscle wasting
- Early death in DMD
- Dystrophin deficiency
- Follistatin
  - Myostatin pathway antagonist
  - Improves strength
  - Delivered by AAV

Muscular Dystrophy
Conclusions

- MSK IR is an important part of pediatric radiology practice
- Ultrasound is key in many (most) of the procedures
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