Pediatric Hip Pain: Septic Arthritis, Transient Synovitis, and Osteomyelitis

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Core Radiology Clerkship, BIDMC
November 16, 2009
Agenda

- Patient Presentation
- Anatomy Review
- Differential Diagnosis of Hip Pain/Limp
- Septic Arthritis vs. Transient Synovitis
- Osteomyelitis
- Diagnose our Patient
HPI: MB is a 20 month old previously healthy female with 1 day history of sudden pain in her L hip. Refuses to walk. No recent falls or trauma.

Further history: Non-contributory

Vitals: T 37.3, HR 120, BP 105/59, RR 24

Focused Exam: L leg was extended and internally rotated. L hip tender to palpation. No warmth, tenderness, or erythema of lower extremity, lower back, or SI joint. Knee and ankle can be manipulated through FROM. Resists manipulation of hip. Will not bear weight on L. An insect bite was apparent on left calf.

Remainder of exam: Benign
Hip Anatomy


Fx of femoral neck can disrupt perfusion through branches of circumflex femoral arteries, leading to avascular necrosis (AVN)
Exhaustive Differential Diagnosis of Hip Pain/Limp in Children

- **Infectious**
  - Septic Arthritis- Hip/SI Joint
  - Osteomyelitis- femoral head, pelvis
  - Diskitis
  - Lyme Arthritis
  - Psoas abscess
  - Cellulitis
  - Soft tissue abscess
  - Pyomyositis
  - Appendicitis
  - Pelvic inflammatory disease
  - Pelvic abscess
  - Bursitis

- **Neoplastic**
  - Osteoid Osteoma
  - Osteogenic Sarcoma
  - Ewing Sarcoma
  - Leukemia
  - Spinal Cord Tumors
  - Lymphoma

- **Inflammatory**
  - Toxic/Transient Synovitis
  - Juvenile Rheumatoid Arthritis
  - Spondyloarthropathy
  - Kawasaki Disease
  - Dermatomyositis
  - Polyarteritis nodosa
  - Henoch Schonlein Purpura
  - Systemic Lupus Erythematosus

- **Trauma**
  - Sprains, Strains, Contusions
  - Fracture (fx)- Toddler’s, stress, other

- **Mechanical/Orthopedic**
  - Slipped Capital Femoral Epiphysis (SCFE)
  - Legg-Calve-Perthes (LCPD)
  - Developmental Dysplasia of Hip
  - Patellofemoral pain syndrome
  - Myositis ossificans
More Practical, Narrowed Differential Diagnosis

- Septic Arthritis - can’t miss due to rapid joint destruction and morbidity
- Toxic Synovitis - most common diagnosis in children with limp*
- Osteomyelitis - high morbidity if missed
- Trauma
- Acquired - Legg-Calve-Perthes Disease (LCPD), Slipped Capital Femoral Epiphysis (SCFE)
- Cancer

Septic Arthritis (SA) of the Hip

- Infancy, 3-6 year olds
- Staph, Group B Strep, Gonococcal
- Spread
  - Direct Inoculation
  - Local Spread
  - Hematogenous Spread - 72%*
- Mechanism - Bacteria in synovial membrane → acute inflammatory response → cartilage destruction → synovial effusions → necrosis
- Complications - necrosis/joint destruction, growth arrest, sepsis
- Tx - antibiotics, arthrocentesis

Transient Synovitis (TS)

- Inflammation of joint space
- Pain and limited ROM in hip
- No clear precipitant
  - allergic
  - posttraumatic
  - Post-infectious (classically follows URI)*
- Benign clinical course that resolves with conservative tx (NSAIDs)

Transient Synovitis and Septic Arthritis – Different Entities, Similar Presentation

- atraumatic, acutely irritable hip
- progressive signs of fever
- limp or refusal to bear weight
- limited ROM
- abnormal labs
Because of the morbidity of SA and the relatively benign course of TS, it is very important to be able to distinguish between these two entities. What is the role of imaging in this process?
Role of Imaging – Plain Radiographs

- By ACR Appropriateness criteria, plain films of the area of interest are the #1 study in all limping/hip pain children!*

- Advantages
  - Rapid overview
  - Rule out certain conditions e.g. fx
  - Rule in certain conditions e.g. SCFE
  - Fast, cheap, readily available
  - Automatic control from contralateral hip

Let’s view some examples of diagnoses that can be made on plain film alone.
Toddler’s Fracture on frontal radiograph of R lower extremity–oblique, nondisplaced fx of tibial diaphysis

Legg-Calve-Perthes Disease on frontal radiograph of pelvis - AVN of L femoral head
Avulsion Fracture on Plain Film

Frontal radiograph of pelvis showing avulsion fx of R ischial tuberosity in 14 yo F athlete
“Frog leg”/lateral radiograph of pelvis showing R SCFE with “ice cream falling off cone” appearance
In review, plain films are the initial study of choice in all children with hip pain or limp. What are the imaging recommendations for patients with suspected SA?
Imaging of Suspected Septic Arthritis - ACR Appropriateness Criteria and Score*

- **Plain Films – 9**
  - Early Changes- effusion, soft tissue swelling
  - Late Changes- cortical destruction, periosteal reaction

- **Ultrasound of Hip – 8**
  - Detect effusion
  - Guide aspiration (provides definitive diagnosis)

- **Tc-99m bone scan of lower extremity – 7**
  - Good for nonfocal physical exams
  - 54% of patients with no diagnosis after clinical, laboratory, and radiographic evaluation had abnormal bone scans+

- **MRI of area of interest – 7**
  - Detect effusion, synovial inflammation
  - Nonspecific changes

Let’s look at our patient’s initial imaging...
Our Patient’s Plain Films

Frontal Radiographs of Pelvis and Left Lower Extremity

All films read as normal

Lateral Radiographs of Pelvis and Left Lower Extremity

Frog leg position (femur abducted, externally rotated) provides lateral view of femoral heads

All Images- PACS, CHB
Our Patient’s Ultrasound

- Two Primary Roles
  - Detect joint effusion
  - Guide aspiration of effusion which provides only definitive diagnosis of SA
- Because TS is most common cause of limp, some algorithms use U/S before plain films in evaluation of these children*

Sagittal Ultrasound of MB’s hips

- Normal joint space-anechoic, concave
- Joint Effusion-increased size, convex shape

* Fischer, 1999
What’s the problem with Ultrasound?

- Both SA and TS present with joint effusion, so ultrasound can’t make this all-important distinction

- Options for distinguishing SA from TS
  - 1. Clinical Criteria
  - 2. Arthrocentesis
Option 1- Kocher Criteria* for Differentiating SA and TS

1. Fever
2. Non-weight bearing
3. ESR>40 mm/hr
4. WBC>12,000/mm³

Prospective Confirmation

Only 59% chance of SA if all 4 criteria met+

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<th>Criteria</th>
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<tr>
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Our Patient and the Kocher Criteria

How would our patient score on the Kocher Criteria?

- Afebrile
- Non weight bearing
- ESR 86 mm/hr
- WBC 12,500/mm$^3$

She meets 3 of the Kocher criteria, so her chance of SA is 93%

If her chance were lower, we could stop here

93% chance of SA requires us to proceed with arthrocentesis
Option 2 – Arthrocentesis

- Aspiration provides definitive diagnosis and fluid can be sent for culture and sensitivity
- But aspiration is invasive, so we don’t want to do it in setting of low clinical suspicion for SA
- MB’s Kocher criteria gave us a high suspicion for SA, so we decided that aspiration was appropriate
MB’s parents did not consent to arthrocentesis (they felt her clinical status had improved). So we can’t definitively say what she had, but let’s look at some other patients with SA.
Septic Arthritis – Companion Patient #1
7 yo M presenting with R hip pain

Sagittal Ultrasound of Hip

Joint space widening

T2 Fat Sat Axial MRI

Hyperintense fluid within joint space consistent with effusion

XR AP Pelvis, Companion Patient

Effusion → bulging fat pads
Gluteal and Iliopsoas

Femoral heads with normal bone marrow signal

Manaster BJ. Chronic Hip Pain: Radiographic Evaluation Radiographics 2000;20:S3-S25
In this patient, septic arthritis was confirmed by aspiration, but transient synovitis could have had identical imaging.
Septic Arthritis – Companion Patient #2

11 yo M p/w 3 day history of refusal to bear weight, fevers, chills

- Plain films at outside hospital read as normal
- The now familiar ultrasound…

Sagittal Ultrasound of Hips

Joint space shows effusion

Layering and echogenicity consistent with debris
Septic Arthritis – Companion Patient #2
11 yo M Continued

Diminished tracer uptake/photopenia in R capital femoral epiphysis indicating lack of perfusion

What’s the story?

Tc-99m Bone Scan of Anterior Pelvis

ANTERIOR

PACS, CHB
Septic Arthritis – Companion Patient #2

11 yo M Continued

MR Axial T2 Fluid Sensitive
Hyperintense collections showing joint effusion and surrounding edema

MR Coronal T1 Post-Contrast
Lack of enhancement of R capital femoral epiphysis compared to L suggests avascular necrosis
Septic Arthritis – Companion Patient #2

What Happened?

Septic Arthritis → Joint Effusion → Tamponade of Vascular Supply to Femoral Head → Avascular Necrosis of Femoral Head
Imaging of Septic Arthritis - Conclusion

- Imaging can distinguish between SA and TS, but generally only late in the disease process when there is already bone involvement/AVN.
Day 2
- Spiked fever
- Now partially weight bearing
- Repeat U/S showed resolution of effusion
- Resolving U/S and partial weight bearing reduce suspicion for SA
- Spiking fevers and hip pain increase suspicion for osteomyelitis
Osteomyelitis

- Proximal femur is most common site in children
- Pelvic osteomyelitis may also occur (notably children will allow careful examination of hip)

Menu of Imaging

- Plain Film - more sensitive in later stages, shows bone destruction (if >30%) and effusion*
- Bone Scan - can detect multifocal disease in children with suspected osteomyelitis
- MRI - useful if plain films negative, detect bone marrow edema and effusion

Osteomyelitis – Companion Patient #3
11 yo F fever, L hip pain, MSSA bacteremia

Sagittal Ultrasound of L Hip

Tc-99m Bone Scan

Increased tracer uptake in L ischium and acetabulum

Note LACK of effusion
Osteomyelitis – Companion Patient #3
11 yo F fever, L hip pain, MSSA bacteremia

MR Axial T2/Fluid Sensitive Sequences - Inferior on Left and Superior on Right

Hyperintensity on Fluid Sensitive Sequence showing Marrow Edema and Abscess
Osteomyelitis – Companion Patient #3
11 yo F fever, L hip pain, MSSA bacteremia

MR Coronal T1 Pre-Contrast (Left) and Post-Contrast (Right)

Enhancement of L ischium with contrast suggests increased perfusion to infected bone
Our Patient – MR Images

T1 Coronal MRI of Pelvis

No difference in signal intensity or appearance between R and L femurs

T2 Coronal MRI of Pelvis

Normal bone marrow intensity bilaterally without surrounding fluid

Normal bone marrow intensity bilaterally without surrounding fluid

No Evidence of Osteomyelitis
Our Patient – A Review

- 20 month old female with pain in L hip and refusal to walk
- Plain Films- Normal
- U/S- Significant effusion in L hip
- No aspiration per parent’s request
- 2 days later- resolving effusion and spiking fevers
- MR- No evidence of osteomyelitis
Our Patient’s Diagnosis- Transient Synovitis

- Pain and limited ROM in hip
- No clear precipitant
- Role of Imaging in TS
  - Plain Films- exclude bony abnormalities, may be normal or show effusion
  - U/S- shows effusion and may guide arthrocentesis
  - MRI- may show joint effusion and synovial inflammation, exclude osteomyelitis
- Imaging results not specific for TS
- TS is a clinical diagnosis that requires ruling out SA by aspiration if suspicion high
Review/Conclusions

- DDx of hip pain/limp in children is very broad
- ACR Appropriateness Criteria
  - Everyone should get plain films
  - U/S, MRI, Tc-99m Bone Scan all have a role
  - Little role for CT- limited to trauma, pre-op planning
- Viewed radiographic appearance of Toddler’s fx, LCPD, avulsion fx, SCFE
- Viewed characteristics of SA, TS, and osteomyelitis on various imaging modalities
- TS vs. SA is a hard and all-important decision
  - Imaging not very helpful until late in disease process
  - Kocher Criteria can help
  - Arthrocentesis provides definitive diagnosis
Acknowledgements

Thank you!

- Adam Jeffers, MD
- Sarah Bixby, MD
- Diana Rodriguez, MD
- Iva Petkovska, MD
- Gillian Lieberman, MD
- Maria Levantakis
References