Disclosures

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Outline

• Neonatal & Infant Spine US
  – Indications
  – Technique
  – Anatomy
  – Pathology

• US evaluation of Spinal Rod Lengthening
Neonatal & Infant Spinal US
Indications

• Cutaneous findings associated with occult spinal dysraphism
  – Dimples, hairy patch, hemangioma, subcutaneous mass
• Congenital anomalies (e.g., sacral agenesis, ARM)
• Suspected: Cord Tethering or compression, diastematomyelia, hydrosyringomyelia,
• Detection of Blood
  – Injury (spinal tap or birth injury)
  – Intracranial hemorrhage
• Postoperative assessment for cord re-tethering.
Indications

- Cutaneous lumbosacral findings associated with occult spinal dysraphism
  - Sacral dimple
    - Simple - < 5mm, < 25 mm to anus
      - Single and no associated findings
    - Atypical - > 5 mm, > 25 mm above anus
      - Multiple dimples or associated findings

Screening NOT recommended

Screening recommended
Technique

- Infant in prone position
- Recent feeding or a pacifier dipped in glucose solution
- Rolled blanket bolster
  - Spacing of the spinous processes
  - Accentuate lumbar lordosis
- High-frequency linear array transducer (7-12 MHz)
  - Exception: Craniocervical junction small footprint sector probe
- Longitudinal, axial, still & cine images
Technique

C-Spine

T-Spine

L-Spine
Technique

Dorsal
Technique

Dorsal

US Transducer
Technique

Dorsal
Technique

Dorsal

US Transducer
Technique

Dorsal

US Transducer
Technique

Dorsal
Anatomy

- Cord
Anatomy

• Cord
  – Dorsal & ventral surfaces = hyperechoic
Anatomy

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  – Central echogenic complex
    • +/- small amount of fluid
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- **Cord** = hypoechoic
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- **Conus**
  - Determination of spinal level
  - Newborn at or above L2/L3 disc
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**Borderline low conus medullaris on infant lumbar sonography: what is the clinical outcome and the role of neuroimaging follow-up?**

Thakur NH¹, Lowe LH.
Determination of Vertebral Level

Methods:
1. Define lumbosacral junction
2. Count up from S5
   – Ossification centers
     • Sacral - squared
     • Coccygeal - rounded
3. Count down from last rib
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S5  C1
Determination of Vertebral Level

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In term infant conus at or above L2/L3
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- Nerve roots = echogenic
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• Nerve roots = echogenic

• Filum terminale
  – Center hypo / margins hyperechoic
  – Mobile with CSF pulsations
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Normal Motion
Normal Motion – M-mode
Normal Variants

- Terminal ventricle
  - Incidental, transient mild dilatation of caudal central canal
  - 2-4 mm diameter, ≤ 2 cm length

2 weeks of age
Normal Variants

- Terminal ventricle
  - Incidental, transient mild dilatation of caudal central canal
  - 2-4 mm diameter, ≤ 2 cm length
Normal Variants

- Terminal ventricle
- Filar cyst
  - Simple cyst within or on filum terminale
Pathology
Tethered Cord

• Fixation of the spinal cord in caudal location
  -> Progressive stretching with growth
• Neurologic symptoms may not be present in newborn
• May be associated with many other conditions:
  – Thick filum terminale, intradural/filar lipoma, dorsal dermal sinus, lipomyelocele, lipomyelomeningocele, diastematomyelia
Tethered Cord – US Findings

- Low conus (nl L2/L3)
- Abnormal conus configuration
- Thick filum (>2mm)
- Dorsal position of conus/filum
- Decreased or absent movement of conus / filum
- Caudal tissue mass
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Spinal dysraphism

- *dys* = bad, *raphe* = seam
- Nonspecific term for congenital abnormalities in the development of: vertebrae, spinal cord or nerve roots.
- Overt (open neural tube defect)
  - Myelocele & Myelomeningocele
  - Not typically imaged postnatally with US prior to repair
- Occult (closed / skin covered lesion)
  - Not discovered with AFP screening
  - May have findings on physical exam
Occult spinal dysraphism

- Spinal lipoma
- Meningocele
- Myelocystocele
- Dorsal dermal sinus
- Diastematomyelia
- Split notochord syndrome
Occult spinal dysraphism

- Spinal lipoma
  - Fibrolipoma of the filum terminale
  - Intradural lipoma
  - Lipomyelocele/Lipomyelomeningocele
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Detection of hemorrhage

5 day old
Detection of hemorrhage

5 day old

4 days later
After lumbar puncture
Detection of hemorrhage

Pre LP

Post LP
US evaluation of Spinal Rod Lengthening
Early Onset Scoliosis

• Progressive spinal deformity developing <5-10yrs
• Goal:
  – Correct & stop progression of deformity
  – Allowing spinal growth
• Treatment: Growing (distractible) rods
  – Traditionally needed repeated surgeries/anesthesia
  – Magnetically Controlled Growth Rod (MCGR)
Magnetically Controlled Growth Rod

Magnetically Controlled Growth Rod

Magnetically Controlled Growth Rod

Magnetically Controlled Growth Rod

Neck  Housing

Motor

Magnetically Controlled Growth Rod

Magnetically Controlled Growth Rod

Neck Housing

Magnetically Controlled Growth Rod

Neck  Housing

Magnetically Controlled Growth Rod

Neck  Housing

Magnetic wand used to localize motor
Magnetic wand used to localize motor
Problem: Increased radiation in young girls

• Magnetically Controlled Growth Rods
  – Frequent distractions
    • Monthly distractions of 2mm (mimics physiologic growth)
  – Require frequent radiographs post distraction
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Cancer mortality among women frequently exposed to radiographic examinations for spinal disorders.
Ronckers CM¹, Land CE, Miller JS, Stovall M, Lonstein JE, Doody MM.

Multiple diagnostic X-rays for spine deformities and risk of breast cancer.
Ronckers CM¹, Doody MM, Lonstein JE, Stovall M, Land CE.
Solution: US to monitor lengthening

- High inter & intra rater reliability
- Differences in measurements b/n radiographs and ultrasound ~ 0.3mm


The use of ultrasound in comparison to radiography in magnetically controlled growth rod lengthening measurement: a prospective study.

Yoon WW¹, Chang AC, Tyler P, Butt S, Raniga S, Noordeen H.
Echogenic Spinal Rod

Subcutaneous Tissues

Posterior Acoustic Shadowing
Housing

Expanded

Neck
Measurement – Base of neck to top of housing
Pre-lengthening

Post-lengthening
Summary

• Neonatal & Infant Spine US
  – Indications
    • Sacral dimple – simple vs atypical
  – Normal Anatomy
  – Pathology

• US evaluation of spinal rod lengthening
  – Measured from top of housing to base of neck
References


