FDG-PET: Techniques and pediatric variants

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- Drs. Gelfand and Sharp
- Dr. Lisa Lemen
- Techologists
Introduction

• Basics of PET / CT imaging in children
  – Preparation
  – Technique

• Normal variants common in children
Indications for FDG PET

- Lymphoproliferative disorders
- Sarcoma – Ewing, osteosarcoma, rhabdo
- Other malignancies
- Langerhans cell histiocytosis (LCH)
- Infection*
- Seizure**
Resources

Pediatric PET/CT Imaging: Tips and Techniques*
Susan McQuattie
Division of Nuclear Medicine, Department of Diagnostic Imaging, Hospital for Sick Children, Toronto, Ontario, Canada

PET and PET/CT in Pediatric Oncology
Hossein Jadvar, MD, PhD, MPH, MBA,* Leonard P. Connolly, MD,† Frederic H. Fahey, DSc,‡ and Barry L. Shulkin, MD, MBA§
Semin Nucl Med. 2007;37(5):316-31

Pediatric FDG PET/CT: Physiologic Uptake, Normal Variants, and Benign Conditions
Amer Shammas, MD • Ruth Lim, MD • Martin Charron, MD
Radiographics. 2009;29(5):1467-86

Weight-Based, Low-Dose Pediatric Whole-Body PET/CT Protocols
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PET preparation

- **Fasting**
  - *NPO 4 hours*
- Brown fat
- Distraction
- Sedation
PET preparation

- Fasting
- **Brown fat**
- Distraction
- Sedation
Brown fat

• Metabolically active fat
  – Sympathetic innervation
  – Thermoregulation

• More commonly FDG-avid in kids
  – 24% vs. 6% (Cohade et al)
  – 15% vs. 2% (Yeung et al)
  – 47% of cases (Gelfand et al)

Brown fat

- Same distribution in kids and adults
  - Neck
  - Supraclavicular
  - Costovertebral
  - Perinephric
  - Mediastinum
Brown fat

• Suppression
  – Avoid cold exposure
  – Warming
    • 30 – 60 min
    • Room, blankets
  – Pharmacology
    • Weight based fentanyl
PET preparation

- Fasting
- Brown fat
- **Distraction**
  - Uptake phase
  - Scan
- Sedation
PET preparation

• Fasting
• Brown fat
• Distraction
• **Sedation**
  – After uptake phase (30 – 45 min)
  – Minimal effect on cerebral uptake of FDG

PET / CT Technique*

• F-18 FDG
  – N.A. consensus guidelines
  – 0.1 – 0.14 mCi/kg (effective dose = 4.8 – 6.9 mSv**)
    • 0.1 mCi/kg for: < 20 kg, LCH

PET / CT Technique

- CT
  - Attenuation correction only
  - Low dose bone
    - Weight based
    - 80 – 100 kVp, 14 – 18 mAs
  - Standard localization
  - Diagnostic
PET / CT Technique

• CT
  – Attenuation correction only
  – Low dose bone
  – Standard localization
    • Weight based
    • 100 – 120 kVp, 16 – 29 mAs
  – Diagnostic
PET / CT Technique

- CT
  - Attenuation correction only
  - Low dose bone
  - Standard localization
  - Diagnostic
    - Weight based
Normal findings

• Waldeyer’s ring
• Thymus
• Muscle – speech, crying
• Marrow / GCSF
• Benign bone
Waldeyer’s ring

- Higher level of physiologic uptake in kids
- Peaks 6 – 8 y
- Symmetric
- Normal size tonsils and adenoids
Thymus - normal

- More thymus than adults
- FDG uptake
  - Low level
  - Uniform
  - Inverted V
Thymus – thymic rebound

- Stress
- Variable appearance
  - Bulk
  - Avidity
Thymus - abnormal

- Non-uniform uptake
- Abnormal contour
Muscle

- Tongue
  - Sucking during uptake phase
  - Infants and toddlers
- Speech
- Ocular
- Crying
Marrow / GCSF

- See more marrow uptake in kids than adults
- Low level (≤ liver)
- Uniform
- Known distribution

- Marrow stimulation
  - Anemia / chronic disease
  - Colony stimulating factors (GCSF)
Benign bone

- Ischiopubic synchondrosis

- Benign fibroosseus lesion
Conclusion

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  - Preparation
  - Technique
- Normal variants common in children
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