PET-CT in Staging Pediatric Rhabdomyosarcoma

Beth McCarville, MD
St. Jude Children’s Research Hospital
Memphis, TN
Do you interpret pediatric imaging studies?

- Yes
- No
Do you interpret PET-CTs?

- Yes
- No

Background

• Rhabdomyosarcoma
  – 3rd most common extra-cranial, malignant solid tumor in children
  – ~ 40% of all ST sarcomas
  – ~ 350 new cases/year

• Arises from primitive mesenchymal cells in all tissues except bone
International Classification of RMS

- Embryonal (57%): intermediate prognosis
  - Botryoid and spindle cell (6%): superior prognosis
- Alveolar (23%): Poorer prognosis
- Pleomorphic and other (14%): poorest prognosis
Clinical Features of RMS

- Non-metastatic disease ~ 86% survival
- 14% have metastatic disease at diagnosis
- Metastatic disease = poor outcome (~20% survival)
- Metastasizes to
  - Lung (36%)
  - Bone marrow (22%)
  - Local-regional lymph nodes (up to 20%)
  - Bone (7%)
Diagnostic Imaging of RMS

- Crucial to assigning risk-based therapy
- MRI or CT
  - Tumor origin/anatomic site
  - Size
  - Local invasion
  - Nodal spread
- Chest CT: Pulmonary metastases
- Tc$^{99m}$ bone scan: Bone metastases
- Potential role of PET-CT in RMS?
Diagnosis
Identifying an Unknown Primary

• Metastatic disease with unknown primary
  – 4% of rhabdomyosarcomas
  – 3-5% all cancers
• Diagnostic work-up
  – Guided by clinical suspicion and pathology of metastatic disease
  – Traditionally requires multiple imaging examinations
11 yo girl with anemia and adenopathy: Rule-out lymphoma

McCarville et al. AJR 2005:184:1293-1304
McCarrville et al. AJR 2005:184:1293-1304
MRI of the Primary Alveolar RMS

McCarville et al. AJR 2005:184:1293-1304

Staging
Pulmonary Metastases

- Nodules < 5 mm almost as likely as larger nodules to be malignant
- PET imaging has resolution of ~ 7 mm
- CT remains the reference standard

Fabien R. Clin Nucl Med 2011;36:672-677
McCarville MB. Radiol 2006;239(2):514-20
Osseous Disease

• Focal bone (7%) or diffuse marrow (22%)
• 14%-15% overall survival*
• Bone scan
  – Detects osteoblastic mets
  – Insensitive to osteolytic mets and marrow disease

*Oberlin O, J Clin Oncol 2008;26:2384-2389
5 yo Boy
Parapharyngeal Embryonal RMS

Bone Scan

Baseline PET-CT

Marrow Disease Confirmed by MRI and Biopsy

17 yo Boy
Skull Base Alveolar RMS

Bone Scan

PET-CT

Anterior
Posterior

Nodal Disease

- 20% at diagnosis
- Predicts local and distant recurrence*
- Requires local control
- Conventional imaging (CT or MRI)
  - Must include local-regional nodal basin
  - Subjective assessment of nodes

*LaQuaglia MP. Semin Surg Oncol 1993;9:510-519
3 yo Girl
Parameningeal RMS

STIR Coronal

PD Axial

Numerous Enlarged Nodes

Measured up to 1.6 cm

Biopsy Proven Benign

3 yo Boy
Alveolar RMS Lower Leg

STIR Sagittal

T1W C+ Sagittal

Other Metastatic Sites
17 yo boy
Skull Base Alveolar RMS
Peritoneal Metastasis

PET-CT

Diagnostic CT

17 yo Girl
Alveolar RMS

- Most common breast malignancy in children is metastatic disease
- RMS most common malignancy to metastasize to breast

17 yo Girl
Alveolar RMS

Overlooked on Diagnostic Abdomen CT
Pancreas Metastases in RMS

- Found at autopsy in 67%
- 3rd most common site after lung, lymph nodes
- Rarely reported in radiology literature
  - Abdomen not routinely imaged
  - Overlooked
- All cases of pancreas metastases associated with alveolar histology

Enzinger FM. Cancer 24:18-31
Conclusions

- Won’t replace chest CT for pulmonary dz
- May be more sensitive than bone scan to bone and bone marrow metastases
- May be more specific than conventional imaging for lymph-node involvement
- Detects unusual sites of disease not detected by conventional imaging
- Larger studies needed to validate use