Dose Reduction Strategies in Pediatric Nuclear Medicine: An Update
S. Ted Treves, MD

What activities should be considered towards dose reduction in Pediatric Nuclear Medicine?

A. Education
B. Appropriateness of Indications
C. Optimization of acquisition and display protocols
D. Application of Advanced Image Processing
E. All of the above

Answer: E

RATIONALE
The answers A, B, C, and D are correct as they all can contribute in different ways to radiation dose reduction in pediatric nuclear medicine patients

REFERENCES

FDG PET/CT of Infection: Potential Pitfall or Key Diagnostic Tool in Children with Malignancies
Marguerite T. Parisi, MD, MSEd

Which of the following statements is TRUE regarding the role of Fluorine-18 FDG PET or PET/CT in pediatric infection and inflammatory imaging?

A. The mechanism of action of F-18 FDG-PET in imaging of infection is different from that of F-18 FDG PET in imaging of malignancy.
B. F-18 FDG PET or PET/CT can reliably distinguish infectious from non-infectious inflammation or malignancy.
C. F-18 FDG PET/CT should replace the Tc-99m bone scan as the first line imaging procedure for diagnosing acute uncomplicated osteomyelitis.
D. F-18 FDG PET or PET/CT is becoming increasingly important in the evaluation of children with fever of unknown origin.

Answer: D
References:

FDG/PET in Therapeutic Response Monitoring of Lymphoma: Outcomes Predictors
M. Beth McCarville, MD

After chemotherapy treatment for Hodgkin lymphoma all of the following can cause a false positive on FDG PET-CT except which one?

A. Histoplasmosis
B. Non-viable tumor
C. Xanthomatous pseudotumor
D. Rebound thymic hyperplasia
E. Granulocyte colony stimulating factor

Answer: B
Non-viable tumor is not FDG avid. According to the International Harmonization Criteria residual masses showing unequivocal FDG avidity should be considered to represent viable residual tumor. The significance of minimal residual FDG avidity in children with Hodgkin lymphoma is currently under investigation.

References:

Rationale:
Answer a. Histoplasmosis can cause FDG avid mediastinal and hilar adenopathy and can mimic lymphoma.

**Answer c.** Xanthomatous pseudotumor is a histio-cyte rich pseudotumor that results from a florid response to chemotherapy-induced tumor necrosis. It has been reported in patients following treatment for lymphoma and breast cancer. It can be FDG avid and can mimic residual tumor.


**Answer d.** Rebound thymic hyperplasia occurs in 10-25% of patients receiving chemotherapy, usually within two years after initiation of therapy. On imaging the thymus is diffusely enlarged, has smooth contours and a homogenous appearance on pre and post-contrast-enhanced CT and MRI. On PET-CT the hyperplastic thymus can be FDG avid.


**Answer e.** In patients being treated for cancer, granulocyte colony stimulating factor (GCSF) can have a variable effect depending on the degree of chemotherapy induced myelosuppression. Patients receiving intensive high-dose chemotherapy will have greater myelosuppression than those receiving conventional chemotherapy. The effect of GCSF will be more evident in patients whose bone marrow is less suppressed compared to those with greater underlying suppression. GCSF can cause diffuse, generally bilaterally symmetric, increased FDG marrow avidity and homogenous splenic avidity. To avoid the effect of GCSF on PET imaging the ideal time to perform PET-CT is 2 to 4 weeks after it’s administration.


2) Effect of colony-stimulating factor and conventional or high-dose chemotherapy on FDG uptake in bone marrow. Kazama1 T, Swanston N, Podoloff D, Macapinlac H. *European Journal of Nuclear Medicine and Molecular Imaging* Vol. 32, No. 12, December 2005
Neuroblastoma: Respective Roles of MIBG and FDG PET/CT in Therapeutic Response Monitoring
Susan E. Sharp, MD

Which of the following statements regarding 123I-MIBG is true?

A. Less specific for neuroblastoma than FDG PET/CT
B. Gives higher effective radiation dose than FDG PET/CT
C. Preferred over 131I-MIBG for imaging
D. Acts as a glucose analog
E. None of the above

Answer: C

Rationale:
MIBG has a specificity of almost 100% for neuroblastoma. FDG is less specific, showing uptake in sites of infection/inflammation, as well as most tumors. 123I-MIBG gives a lower effective radiation dose than FDG PET/CT. 123I-MIBG is preferred over 131I-MIBG for imaging for several reasons; it lacks a beta particle, has an ideal photon energy for gamma camera imaging, and has a shorter half life. MIBG is related to norepinephrine and utilizes the type I catecholoamine reuptake system for uptake into cells. FDG is a glucose analog.

References:

FDG PET/CT in Diagnosis and Follow-up of LCH and Wilm's Tumors: Comparison with Conventional Imaging
Michael J. Gelfand, MD

When choosing between FDG PET/CT and conventional bone imaging (bone scintigraphy and bone radiographs) for imaging of lesions of Langerhans cell histiocytosis (LCH), which of the following are true?

A. The effective dose from FDG PET/CT is lower than the effective dose from conventional bone imaging.
B. With successful treatment of LCH lesions, bone scintigraphy abnormalities resolve more rapidly than FDG abnormalities.
C. With successful treatment of LCH lesions, bone radiographic abnormalities resolve more rapidly than FDG abnormalities.
D. Disappearance of FDG uptake is believed to track resolution of the abnormal proliferative process within the lesion.
E. Disappearance of FDG uptake occurs when bone healing is complete.
REFERENCES:

RATIONALE:
Option A is false. The effective dose from FDG PET/CT using typical pediatric imaging parameters and administered activities is higher than the effective dose from conventional bone imaging [3]. Options B, C and E are false. Uptake on FDG PET within the lesion resolves with appropriate treatment of the LCH abnormal proliferative process. Bone radiographic and bone scintigraphic abnormalities resolve months later when bone healing in complete [1,2]

Pediatric Bone Tumors and Soft Tissue Sarcomas: Therapeutic Response Monitoring and Outcomes
Helen R. Nadel, MD, FRCPC

Regarding PET/CT evaluation of pediatric sarcoma:
A. Post treatment SUV max of less than 2.5 is indicative of good prognosis in all sarcoma patients
B. SUV 2/SUV 1 less than or equal to 0.5 may be indicative of good response in Ewing Sarcoma tumor patients
C. 18-F FDG is specific for response assessment in treated sarcoma patients
D. Bone scintigraphy is better for lytic metastatic disease than 18F-FDG PET/CT.
E. All bone and soft tissue sarcoma subtypes show similar avidity on 18-F-FDG PET/CT studies

Answer: B

References:

Hybrid Imaging of Pediatric Brain Tumors, Neurofibromatosis and Non-Lymphomatous Head and Neck Tumors
Lisa J. States, MD

The patient shown is a teenager with NF1 and increasing back pain and lower extremity neuro-deficit. You are shown an image from an abdominal MRI and a corresponding image from a PET/CT. The SUVmax of the lesion marked by the arrow is 8.0. Which one of the following is the MOST likely etiology of the abnormality.

A. Neuroblastoma
B. Malignant peripheral nerve sheath tumor
C. Osteomyelitis
D. Benign plexiform neurofibroma

Answer: B

Rationale:
- The MRI demonstrates a large retroperitoneal tumor extending into the neural foramen with compression of the spinal cord. The axial PET/CT shows increased 18FDG uptake throughout most of the lesion.
- The coronal CT shows other foci of mild increased uptake including both arms and thighs.
- Other small plexiform neurofibromas seen on the MRI have no 18FDG uptake.
- A. Although a retroperitoneal mass in a teenager may have this appearance, NBL is not associated with NF1 and is considered less likely.
- B. Extension through the neural foramen confirms a neural origin.
- C. The imaging characteristics are not consistent with abscess or phlegmon.
- D. The high SUV favors a malignant over a benign process, however biopsy is necessary.
Multi-Modality Whole Body Imaging: Data to Date and Future Perspectives
Helke E. Daldrup-Link, MD

PET/MR Design Challenges Include:

A. PET detector must not use magnetic materials
B. PET detector must not emit in MR frequency
C. Eddy currents must be avoided
D. Photon scatter due to MR materials must be minimized
E. All of the above

Answer is E.

Rationale:
There are many challenges associated with the design of PET/MR scanners. With regard to the PET detector, these include the design of detectors free of magnetic materials, MRI-compatible PET shielding materials and detectors that do not emit in the radiofrequencies usually utilized for MRI. On the MRI side, these include avoiding or eliminating eddy currents, which could heat the PET-detector or cause noise in the PET detector, as well as photon scatter due to MRI materials.

References: