Introduction to PET/MRI Combined Scanner and Potential Pediatric Applications

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Learning Objectives
• Illustration of PET/MRI combined scanner configuration
• Advantages and disadvantages, capabilities and limitations of combined scanner
• Presentation of some early results
• Potential pediatric applications of combined PET/MRI scanning

Combined PET and MRI – Why?
Simultaneous acquisition of PET and MRI
– More precise co-registration and anatomic localization
– Potential for simultaneous quantitative dynamic PET and contrast-enhanced MRI
– MRI-based motion-correction techniques
– Identical physiologic state during both examinations
– Compared to separately-acquired MRI and PET, shorter acquisition time \(\rightarrow\) less sedation/GA

Potential Pediatric Applications of PET-MRI
• In what clinical scenarios is MRI a more effective modality than CT?
  • Brain tumors
  • Seizure disorders
  • Head and neck tumors
  • Body tumor imaging

Challenges in Development of PET-MRI Whole Body Imaging
• Integrated system and longitudinal field of view
• Is it better to have side-by-side MR and PET?
• Attenuation correction - body tissues not as homogeneous as brain, and therefore automated segmentation is more challenging
• Need for fast whole-body MRI sequences
• Minimize motion artifacts and bladder filling

Conclusions
• For pediatric conditions in which MRI is a more effective imaging modality than CT, combined PET/MRI holds great potential to reduce radiation dose and amount of sedation/anesthesia
• Currently available PET/MR systems have a small bore that can accommodate adult brain imaging. Body imaging of infants and small children has not yet been attempted, but is theoretically possible
• PET/MR imaging of infants and small children is now logistically difficult due to unavailability of off-campus sedation/anesthesia and the rarity of clinically-indicated PET scan in this age group
• Pediatric brain applications include tumor and seizure
• Pediatric body applications are also numerous and include: lymphoma, neuroblastoma, neurofibromatosis, multiple hereditary cartilage tumors
• Whole-Body MRI and Whole-Body 18F-FDG PET (separately acquired) are already being used in some of these patients