



OUTLINE : Approaches to Reducing Sedation & Anesthesia

Rationale

- Image Quality, Sedation/Duration Reduction
- PET-CT, PET-MR and Dedicated PET Scanners
- Discussion



RATIONALE : Reducing Sedation & Anesthesia

Effects of Anesthesia and Sedation on Pediatric Patients

- · Significant risks associated with anesthesia on the developing brain [1]
- · Visit durations significantly longer for anesthetized (4h) and sedated (3.5h) patients (vs 2.3h) [2]
- Require presence of Nurse & Anesthesia team
- Double the number of sedations/anesthesia for PET/MR
- Anesthetized patients incur the highest costs, followed by sedated patients

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[1] Mastro et al. *J of PeriAnesthesia* Nursing 2019 [2] Vanderby et al. *Radiology* 2010

OUTLINE : Approaches to Reducing Sedation & Anesthesia

- Rationale
- · Image Quality, Sedation/Duration Reduction
- SPECT, SPECT-CT and Dedicated SPECT Scanners
- PET-CT, TOF-PET, PET-MR and Dedicated PET Scanners
- Discussion

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METHODS : Approaches to Reducing Sedation & Anesthesia Bases for Approaches to Reducing Sedation/Anesthesia: Assess Image quality objectively by signal-to-noise ratio (SNR) for a clinical task (e.g., lesion detection, activity estimation) • Assume Poisson statistics, a doubling of counts (halve time) yields 41% ($\sqrt{2}$) improvement in SNR (and image quality) \bullet Conversly, if a physics or instrumentation approach yields an improvement of SNR of 41%, this gain could be used to halve the imaging time without changing image quality.





OUTLINE: Approaches to Reducing Sedation & Anesthesia Rationale Image Quality, Sedation/Duration Reduction PET-CT, PET-MR and Dedicated PET Scanners Discussion

OUTLINE: Approaches to Reducing Sedation & Anesthesia

Rationale

- Image Quality, Sedation/Duration Reduction
- Imaging Time Reduction by using iterative reconstruction and 3D geometry
- Discussion







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Rationale for Integrated PET-MR					
PET	MR				
High sensitivity	Exquisite high resolution, excellent soft tissue contrast				
Absolute quantitation	Non ionizing				
Good Time resolution	Excellent time resolution				
	 Poor sensitivity Absolute quantitation challenging				
Gordon Center for Medical Imaging	G. El Fakhri, Ph.D.				













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Nonhuman Primate Results























SCIENCE TRANSLATIONAL MEDICINE | FOCUS

IMAGING

Total-body imaging: Transforming the role of positron emission tomography

Simon R. Cherry.¹* Ramsey D. Badawi,¹ Joel S. Karp,² William W. Moses.³ Pat Price,⁴ Terry Jones³ The first total-body positron emission tomography (TB-PET) scanner represents a radical change for experimental medicine and diagnostic health care.

Cherry et al., Sci. Transl. Med. 9, eaaf6169 (2017) 15 March 2017



Conventional PET Scanner (2013)



EXPLORER Total Body PET Scanner (2013)





Total-Body PET: Maximizing sensitivity and simultaneously imaging the whole body



T. Jones



Total-Body PET: Maximizing Sensitivity

- 40x gain in effective sensitivity for total-body imaging!
- Can translate into 40x faster imaging time obviating the need for sedation
- 4-5x gain in sensitivity for single organ imaging



EXPLORER Image Gently

40-fold reduction in Imaging time

- Whole-body PET at ~0.15 mSv
 Annual natural background is ~2.4
 mSv
- Return flight (SFO-LHR) is ~0.11 mSv
- PET can be used with minimal risk new populations
- Very fast imaging obviates the need for sedation



EXPLORER



OUTLINE: Approaches to Reducing Sedation & Anesthesia

- Rationale
- Image Quality, Sedation/Duration Reduction
- TOF, PET/CT, PET/MR Dedicated PET Scanners
- Discussion





DISCUSSION : Physics Approaches to Reducing Sedation
Achievable Time reduction today:
- 70% in WB with iterative reconstruction
- 34% in liver with TOF-PET
- 70% in lungs with TOF-PET
Achievable Time reduction with PET/MR today: PET-MR reduces by half the number of sedarions and shortens the PET duration by 600% (still need to reduce MR duration)
Potential imaging time reduction with Total Body in the future:



