

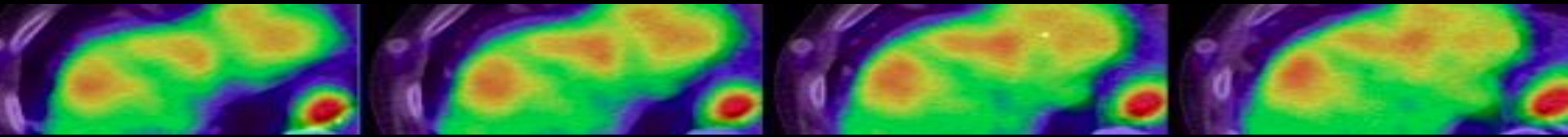
Glucose metabolism changes in patients with sepsis on FDG PET

Ghada Issa, MD PGY-3

Department of Diagnostic Radiology and Nuclear
Medicine

University of Maryland School of Medicine

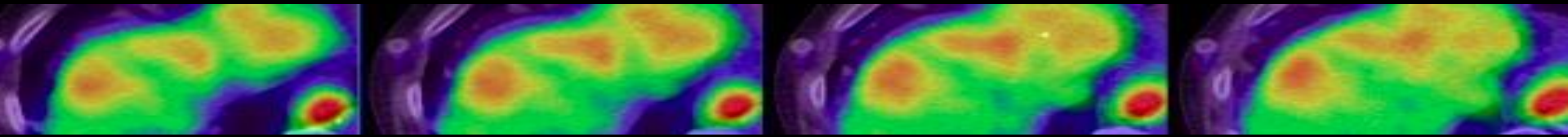
Baltimore MD



Background

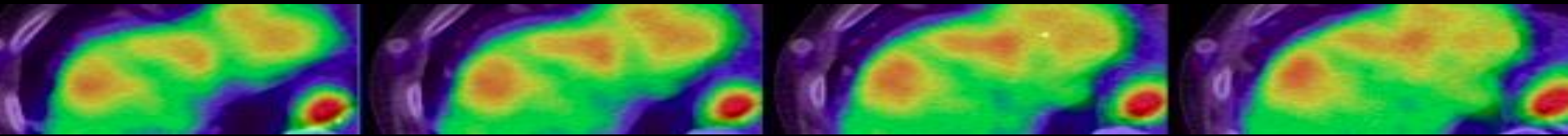
- Main features of sepsis are uncontrollable activation of pro and anti-inflammatory responses resulting in metabolic changes in vital organs
- Abnormal glucose metabolism is a known stress-related response
- Sepsis induced encephalopathy: decreased cerebral blood flow and cerebral glucose uptake (described in rat experiments)





Background

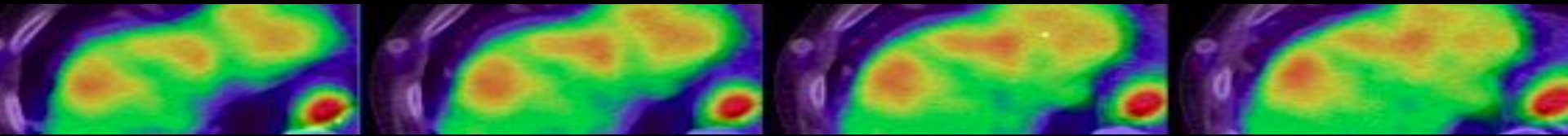
- FDG PET CT in infection:
 - Catheter or prosthesis related infection
 - Osteomyelitis
 - Early localization of site of infection in patients with sepsis or fever of unknown origin



Background

- FDG PET CT in infection:
 - Catheter or prosthesis related infection
 - Osteomyelitis
 - Early localization of site of infection in patients with sepsis or fever of unknown origin

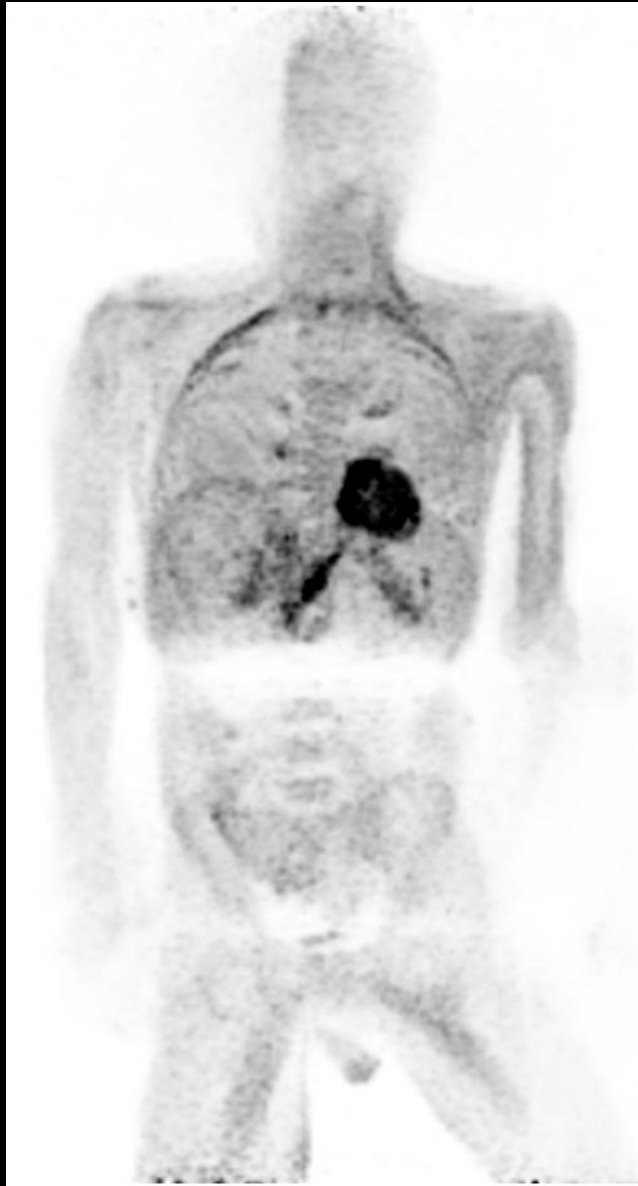




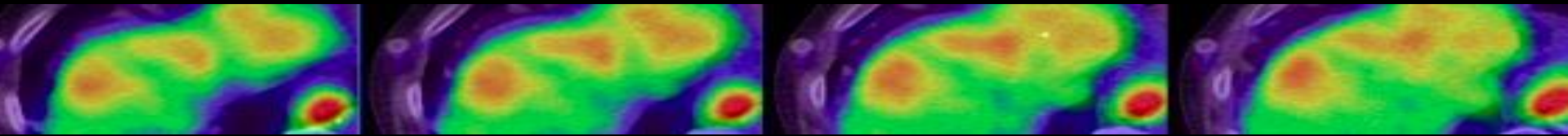
Hypothesis

- Patients with sepsis have decreased FDG uptake within major organs and relatively increased uptake within muscles and soft tissues compared to patients with infection without sepsis
- FDG distribution in patients with sepsis can correlate with severity and may predict prognosis









Materials and Methods

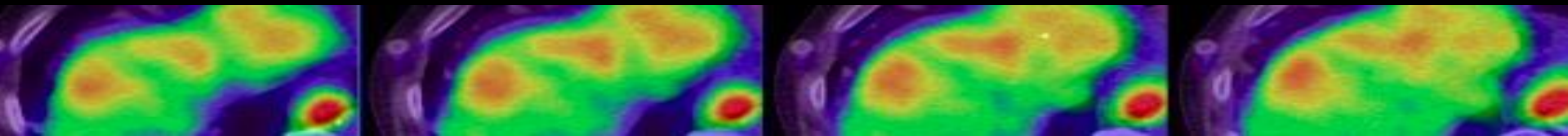
Retrospective review

Population

- Adult patients who underwent whole body PET CT for evaluation of infection/sepsis

Study period

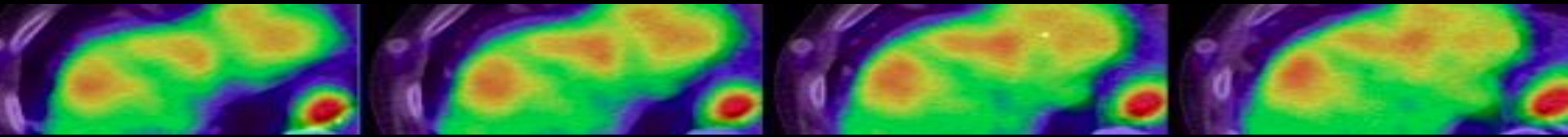
- Jan 2016 – Jan 2017



Materials and Methods

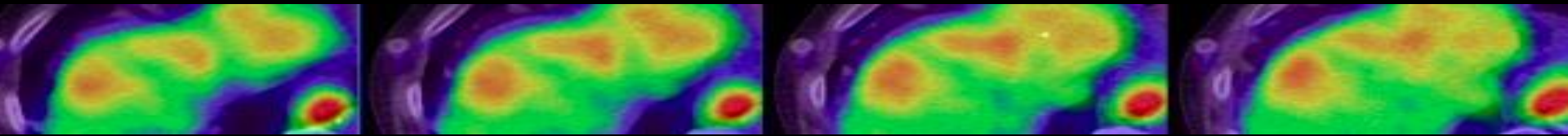
Data

- Demographics
- PET CT (Date, indication, SUV)
- Clinical data (VS, GCS, labs)



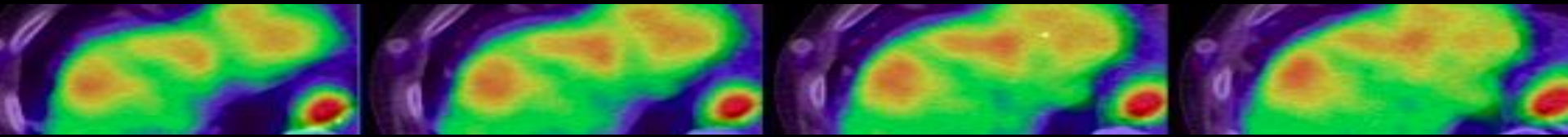
Materials and Methods

- PET CT review
 - All PET CT were reviewed by 2 radiology residents
 - Reviewers were blinded to clinical status



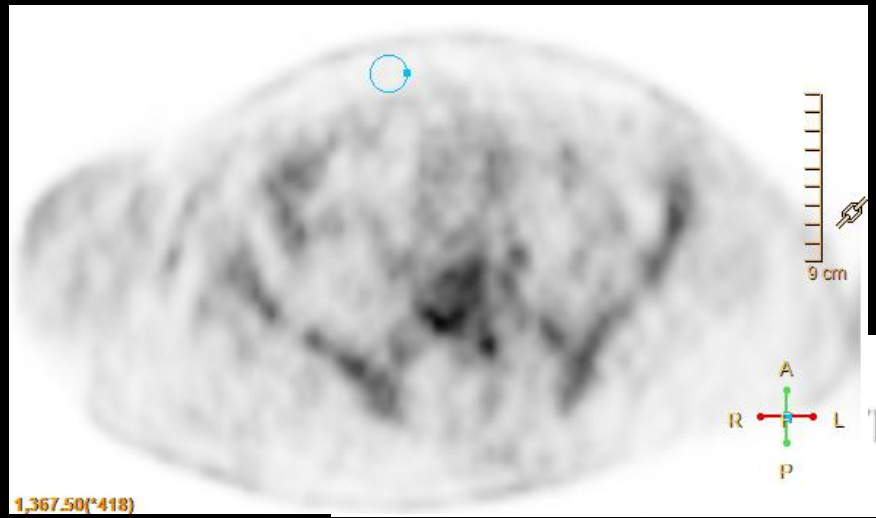
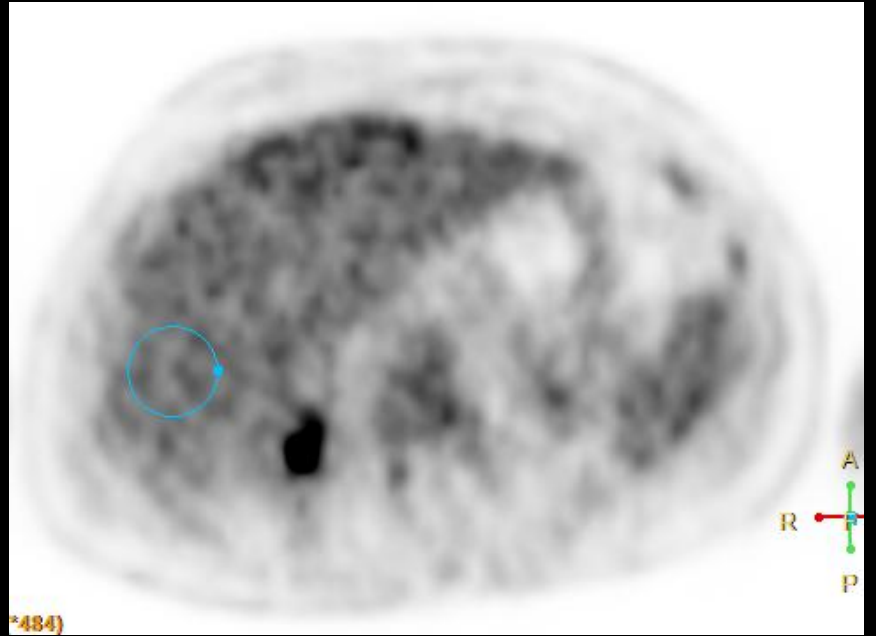
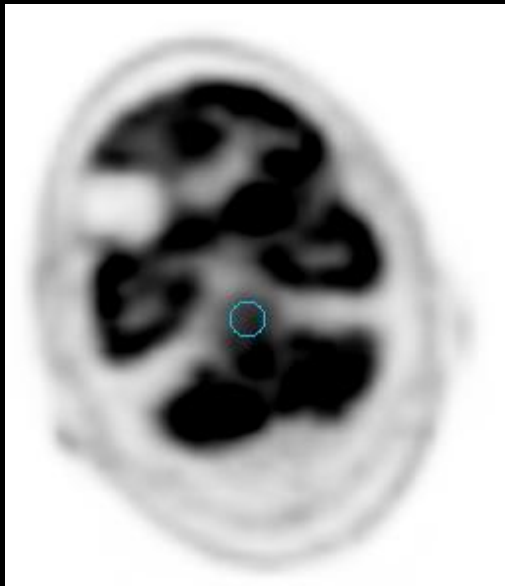
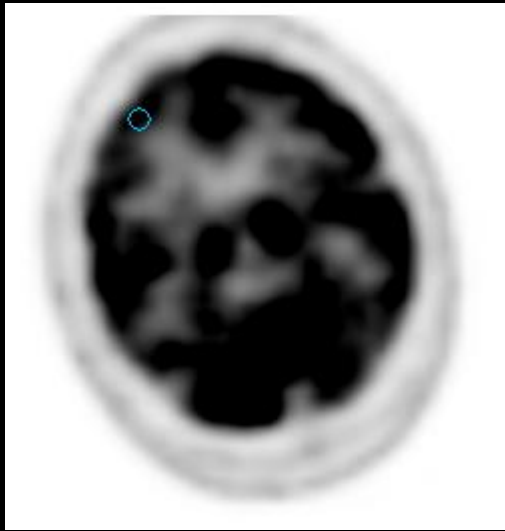
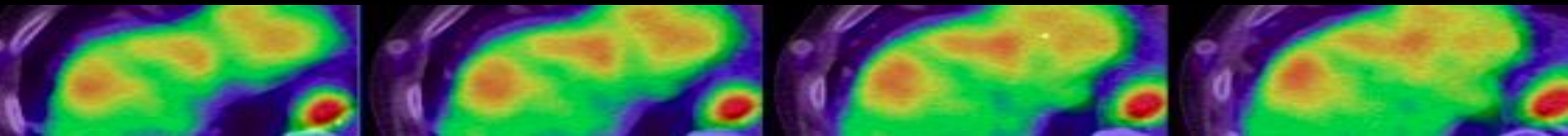
Materials and Methods

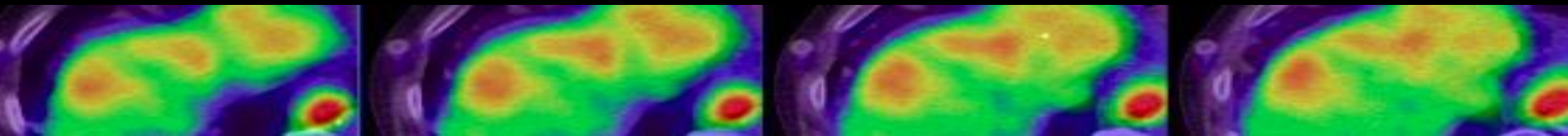
- PET CT review
 - ◆ SUV of the following major organs
 - Brain
 - Liver
 - Spleen
 - Adrenal gland
 - Bone Marrow
 - Subcutaneous fat
 - Muscles



Materials and Methods

- PET CT review
 - Special considerations
 - ❖ Brain: Bilateral frontal/parietal/temporal/occipital lobes, brain stem
 - ❖ Standardized SUV area (40 cm² for liver) for R and L hepatic lobes
 - ❖ Organs involved with focal infectious process were excluded

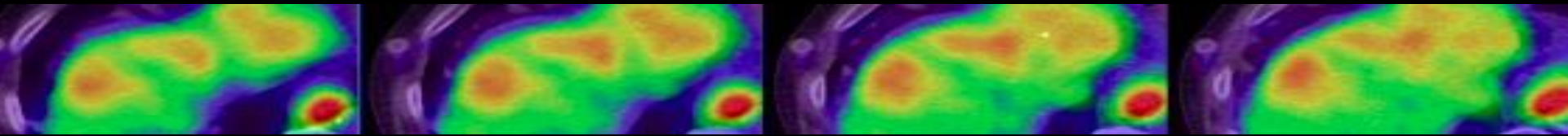




Materials and Methods

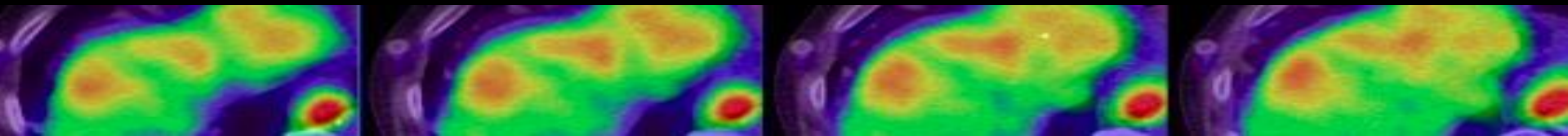
Sepsis groups

- Clinical data was reviewed by 2 ID physicians to determine sepsis diagnoses based on VS, GCS and lab values from the same day of PET CT
- Clinicians were blinded to PET CT results

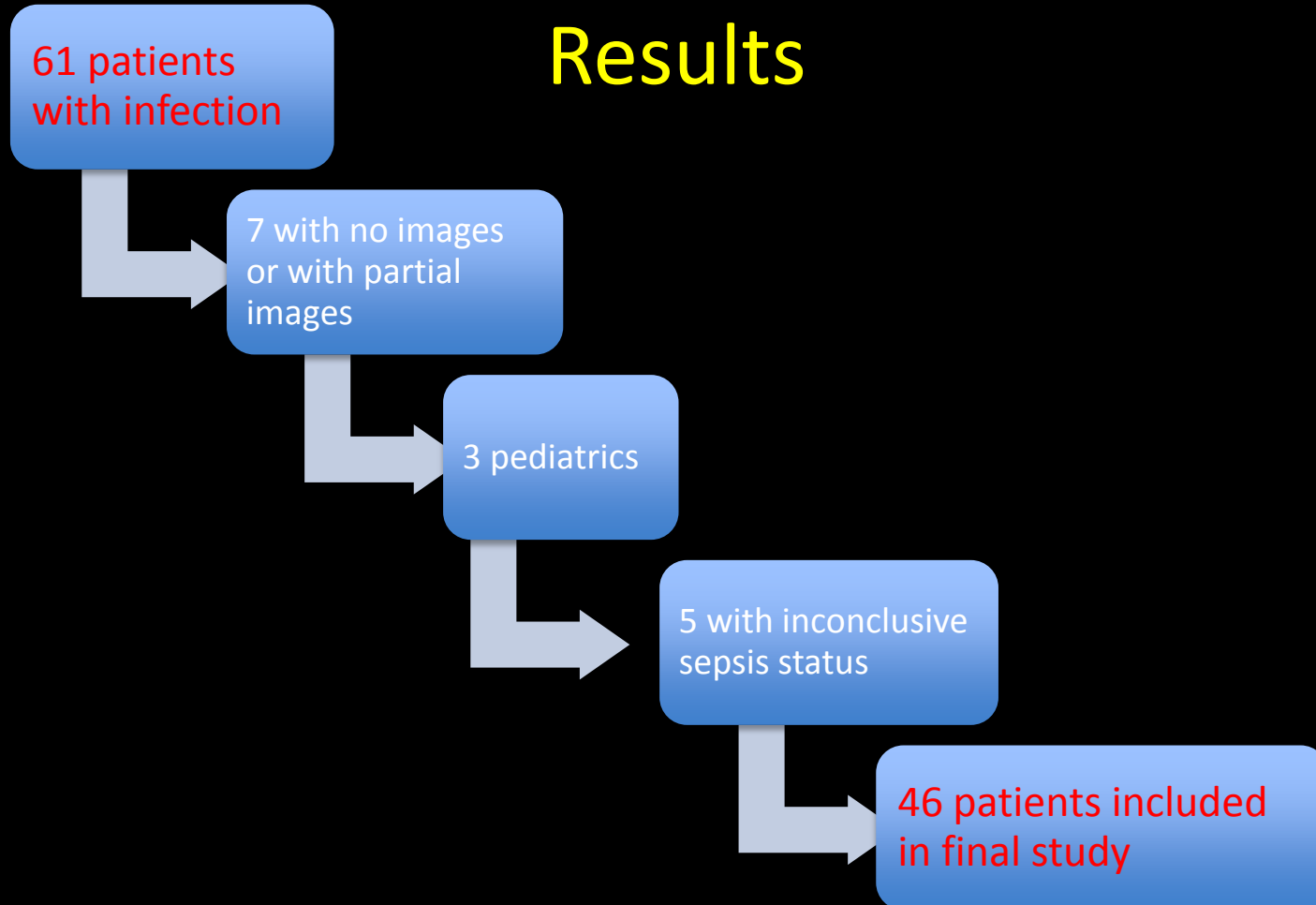


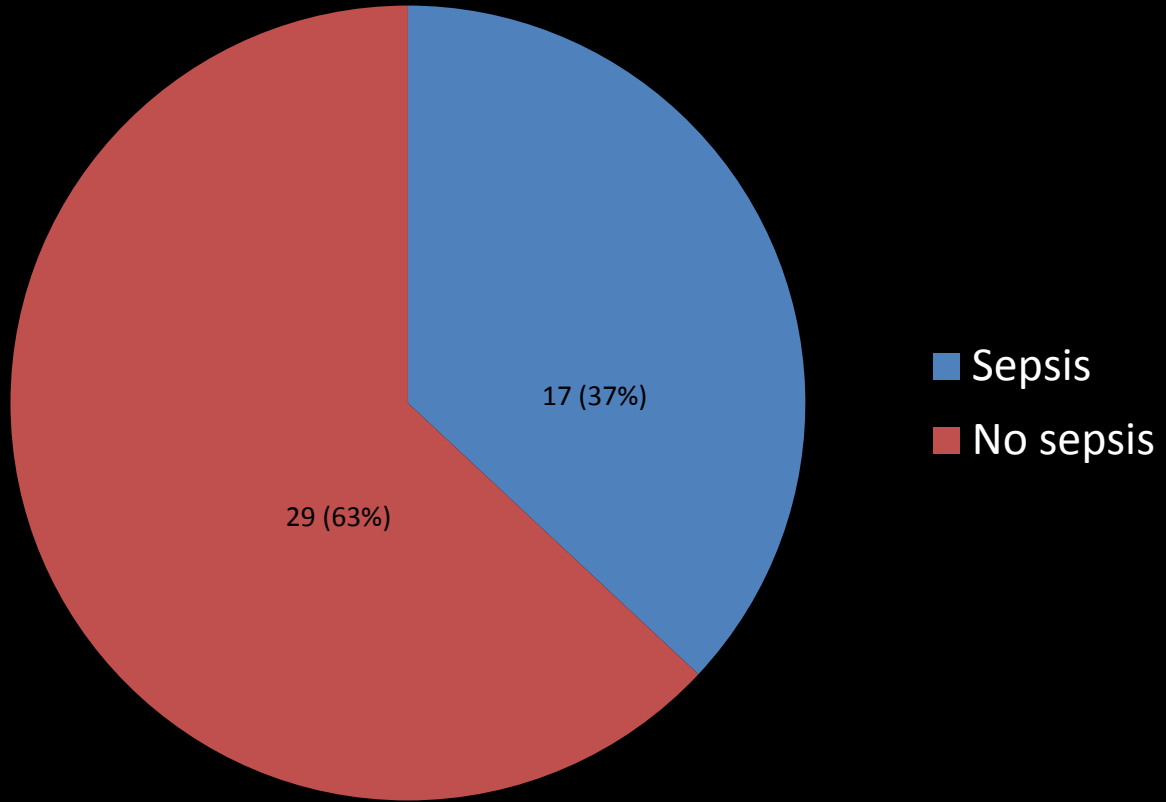
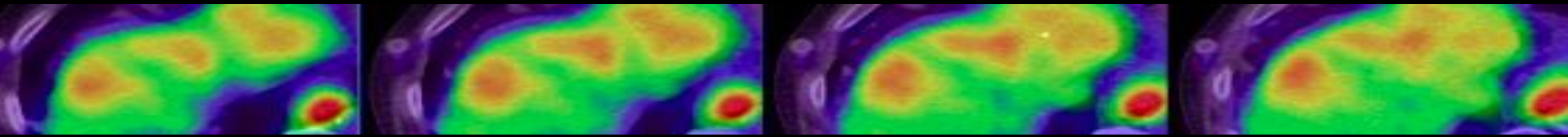
Materials and Methods

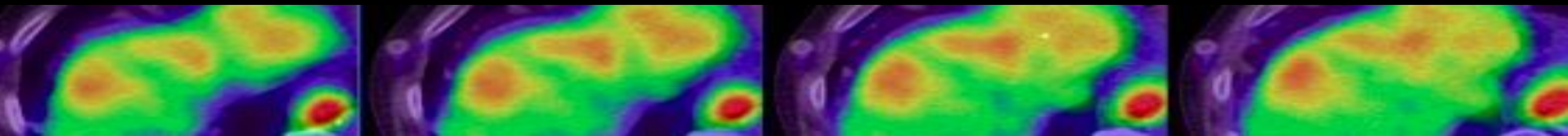
- Statistical analysis
 - Difference in major organ SUV values for the 2 groups was calculated with a simple t-test



Results



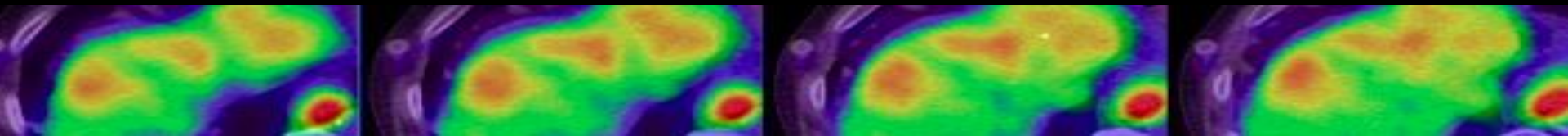




SUV values

Organ	Sepsis	No sepsis	P-value
Frontal lobe	4.3 (1.9)	7.5 (4.0)	0.0008
Parietal lobe	4.5 (1.9)	8.3 (4.1)	0.0001
Temporal lobe	3.9 (1.6)	6.5 (3.1)	0.0005
Occipital lobe	4.5 (2.2)	8.6 (4.6)	0.003
Cerebellum	4.3 (1.8)	6.8 (2.8)	0.0011
Brainstem	4 (1.7)	5.6 (2.1)	0.0093
Liver	3.1 (1.1)	3.1 (1.4)	0.97
Spleen	3.1 (1)	3 (1)	0.77
Adrenal	2.3 (1.4)	1.9 (0.5)	0.2
BM T12	4 (1.7)	2.9 (0.8)	0.02
BM iliac crest	3.2 (1.5)	2.3 (0.6)	0.03
Subcut fat	0.8 (0.4)	0.7 (0.4)	0.6
Muscle	1 (0.4)	1.1 (0.6)	0.6

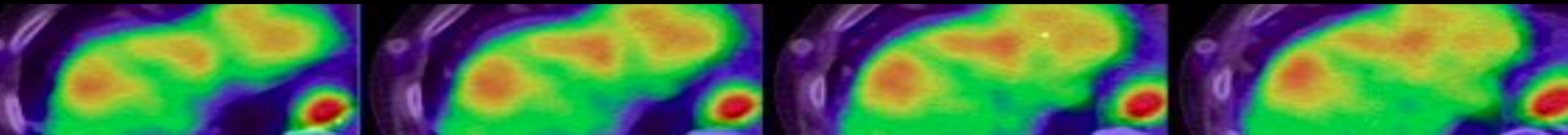
BM:bone marrow,
Subcut:subcutaneous



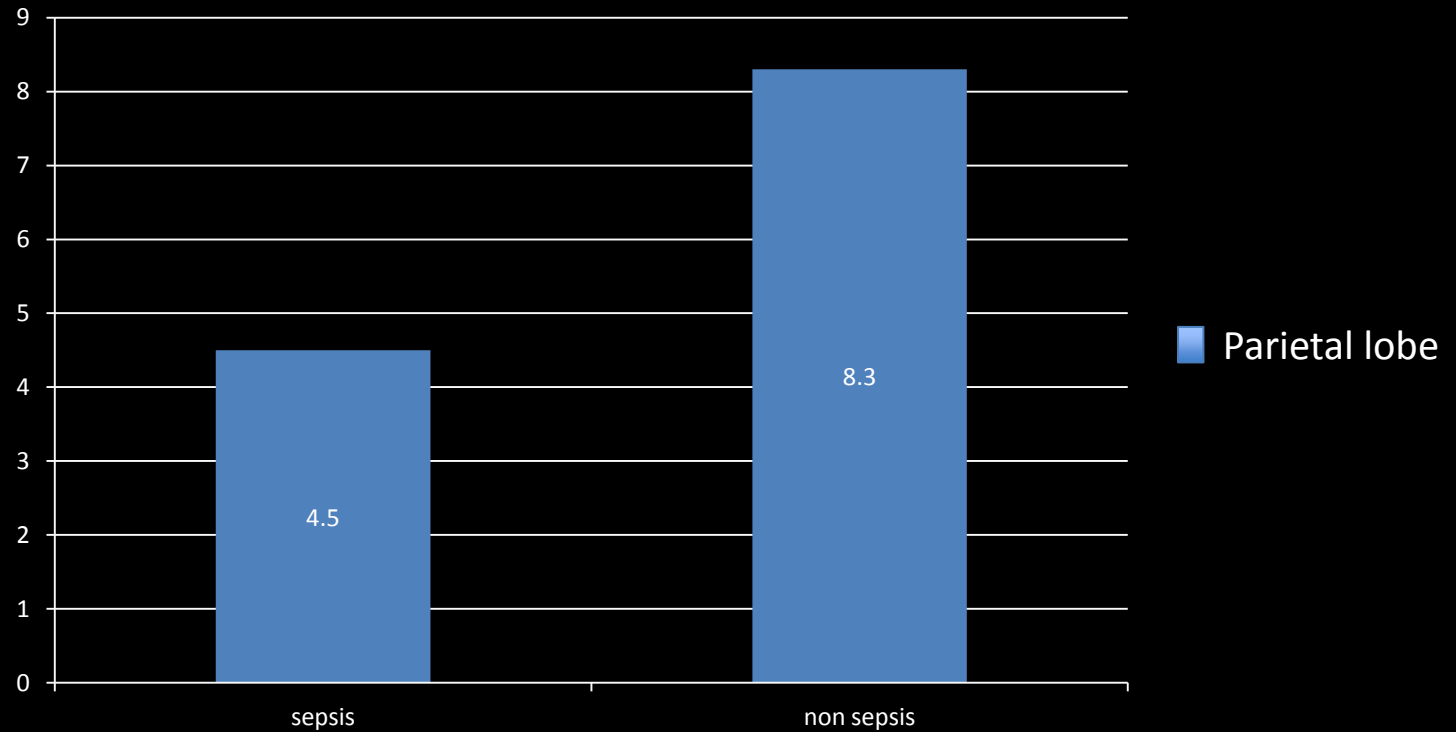
SUV values

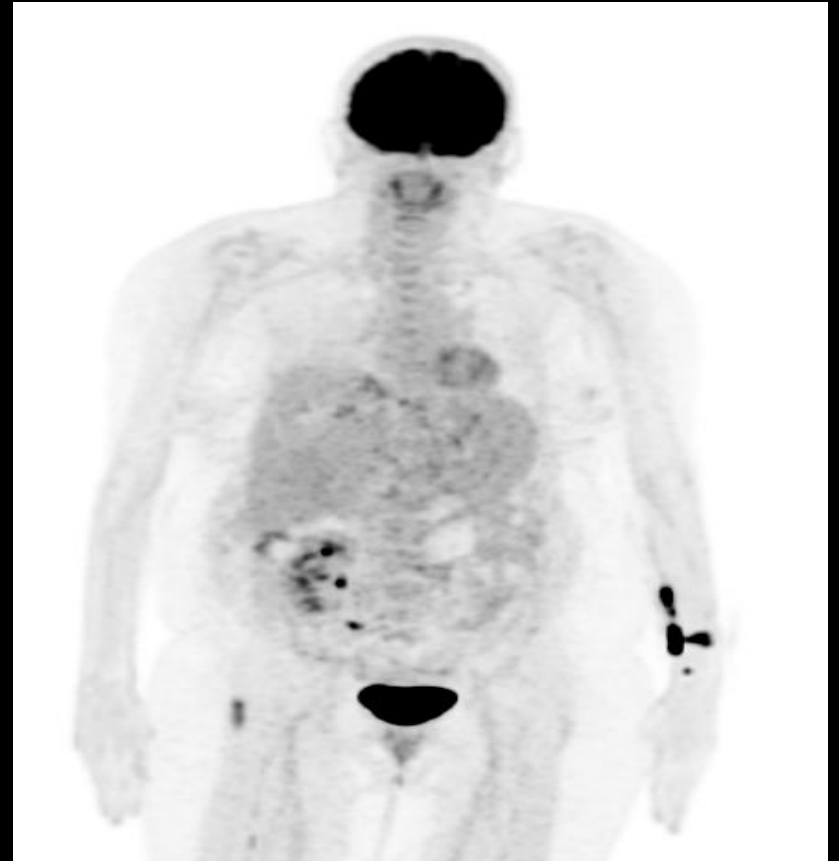
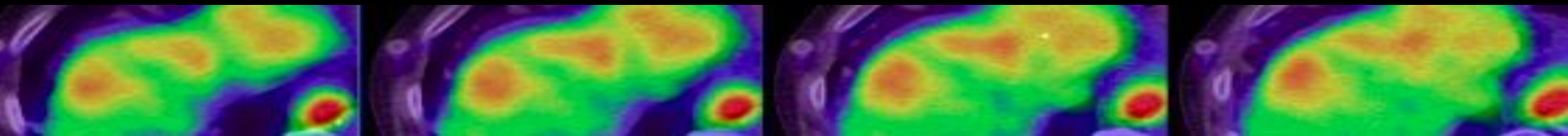
Organ	Sepsis	No sepsis	P-value
Frontal lobe	4.3 (1.9)	7.5 (4.0)	0.0008
Parietal lobe	4.5 (1.9)	8.3 (4.1)	0.0001
Temporal lobe	3.9 (1.6)	6.5 (3.1)	0.0005
Occipital lobe	4.5 (2.2)	8.6 (4.6)	0.003
Cerebellum	4.3 (1.8)	6.8 (2.8)	0.0011
Brainstem	4 (1.7)	5.6 (2.1)	0.0093
Liver	3.1 (1.1)	3.1 (1.4)	0.97
Spleen	3.1 (1)	3 (1)	0.77
Adrenal	2.3 (1.4)	1.9 (0.5)	0.2
BM T12	4 (1.7)	2.9 (0.8)	0.02
BM iliac crest	3.2 (1.5)	2.3 (0.6)	0.03
Subcut fat	0.8 (0.4)	0.7 (0.4)	0.6
Muscle	1 (0.4)	1.1 (0.6)	0.6

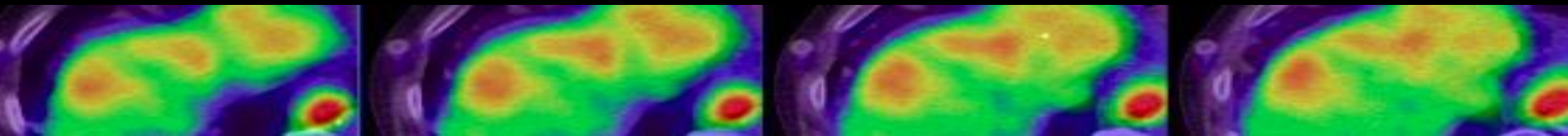
BM:bone marrow,
Subcut:subcutaneous



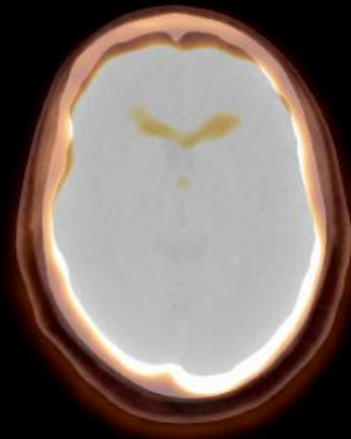
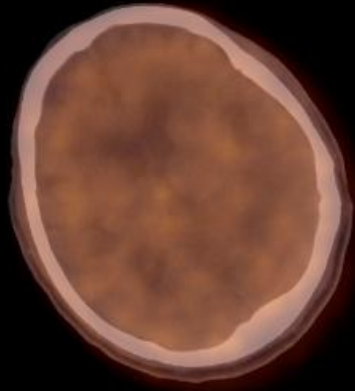
Results





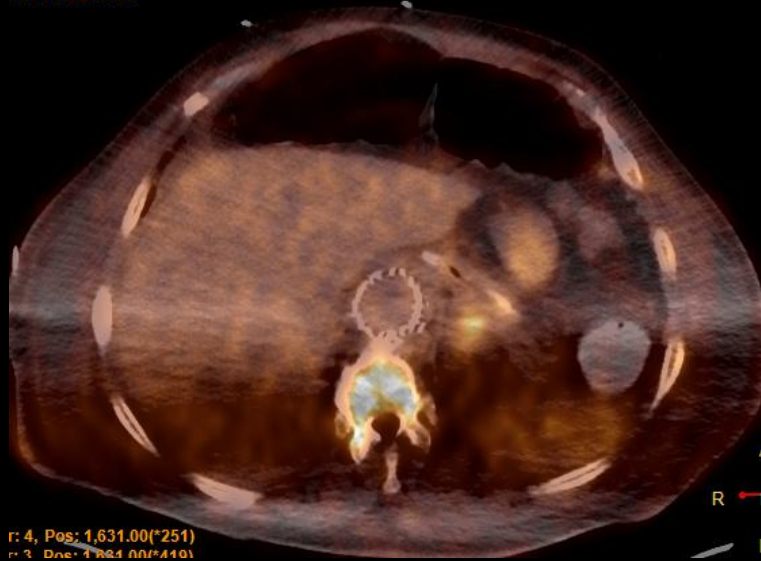


If 3
2016

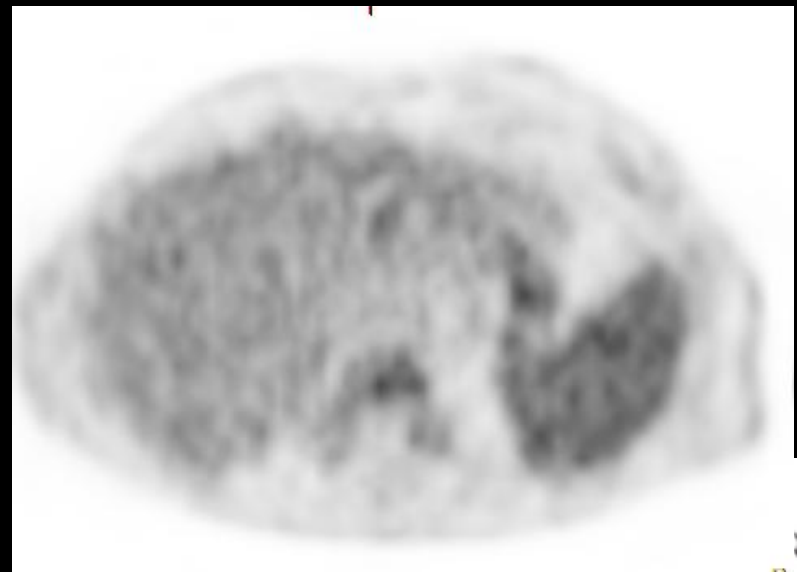
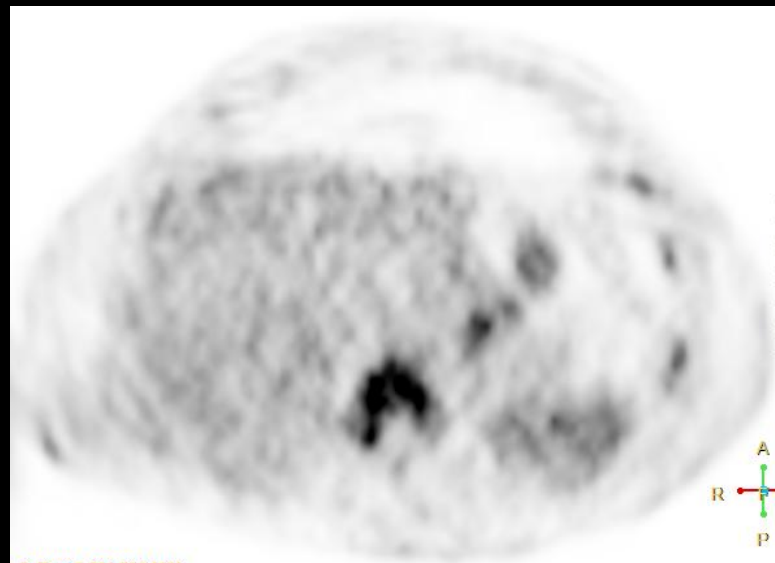


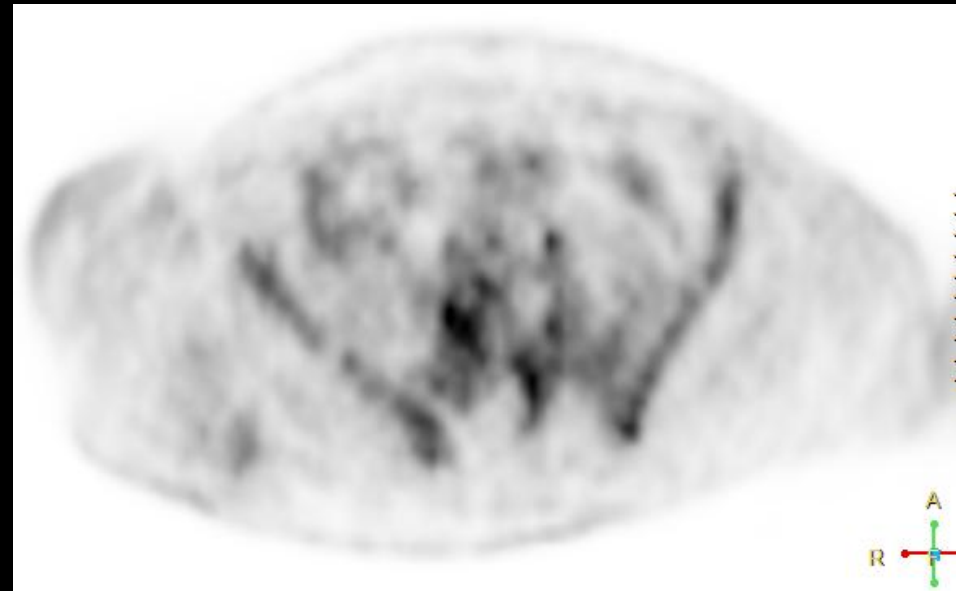
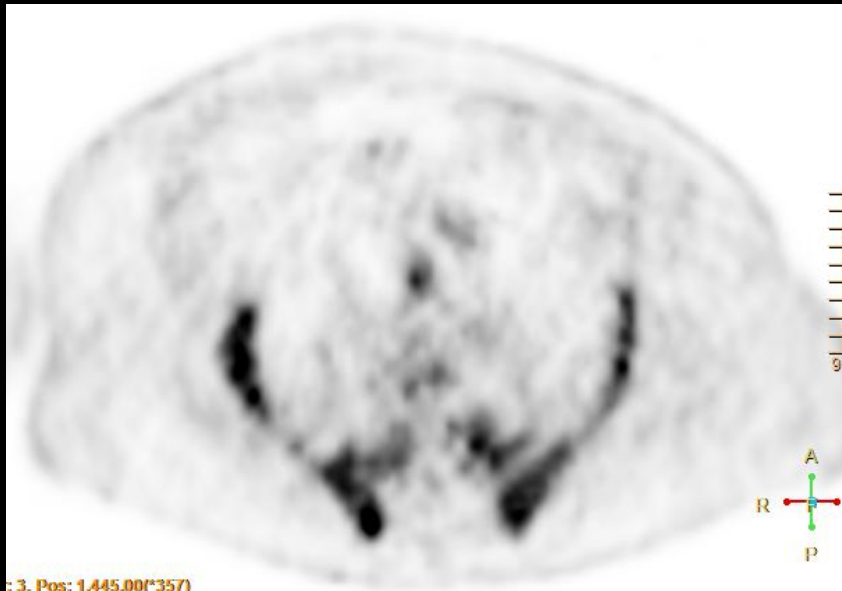
UNIVERSITY of MARYLAND
SCHOOL OF MEDICINE

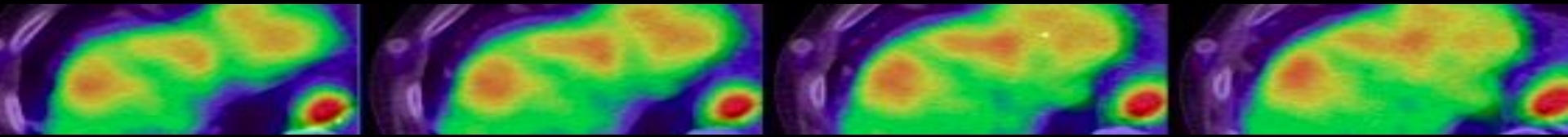
ate: 11-Mar-2016



r: 4, Pos: 1.631.00(*251)
r: 3, Dec: 1.004.00(*440)

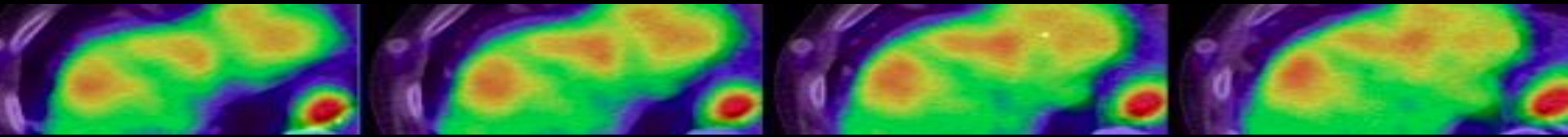






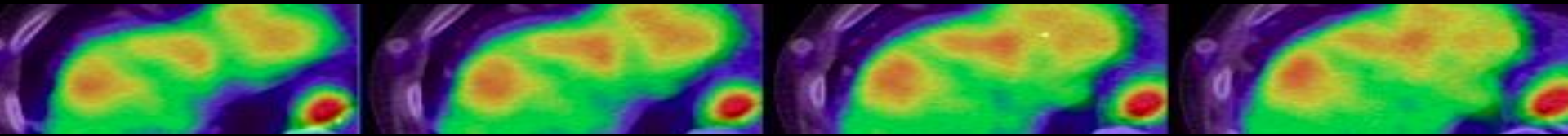
Discussion

- Patients with sepsis have significantly decreased SUV values in the brain and increased SUV values in bone marrow compared to patients with no sepsis
- Patient with sepsis may have qualitatively increased uptake in muscles and subcutaneous tissue – no statistically significant SUV value
- Sepsis encephalopathy can be quantified with FDG PET CT
- Increased bone marrow activity related to systemic inflammatory response



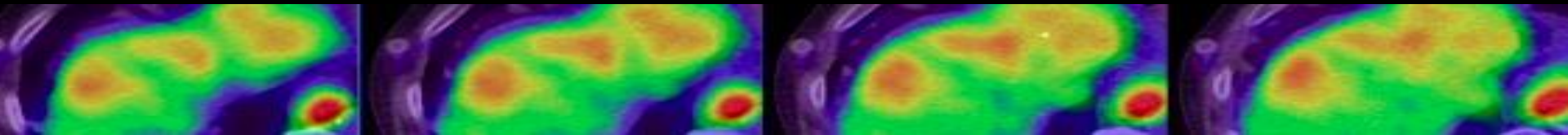
Discussion

- Further analysis:
 - Account for concomitant conditions, medications..
 - FDG distribution correlation with early sepsis versus severe sepsis
 - PET CT distribution pattern and outcome/prognosis of septic patients



Conclusion

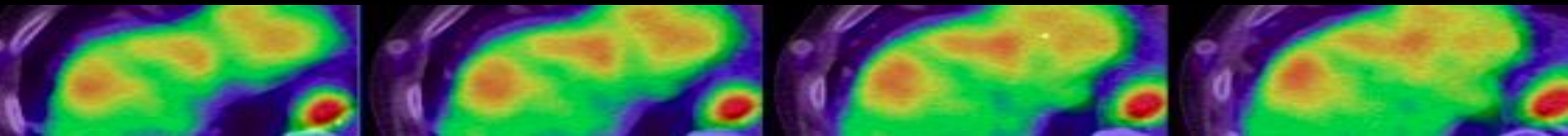
- There is altered glucose metabolism in sepsis
- FDG uptake as a useful tool to locate infection, assess severity and predict prognosis



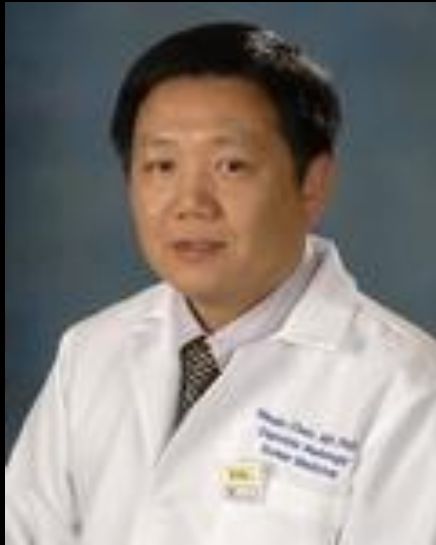
References

- *Hiroyuki et al* Blood glucose control in patients with severe sepsis and septic shock *World J Gastroenterol* 2009; 15(33)
- *Semmler et al* Sepsis causes neuroinflammation and concomitant decrease of cerebral metabolism *Journal of Neuroinflammation* 2008; 5(38)
- *Lheureux and Preiser* Year in review 2013: Critical Care – metabolism *Critical Care* 2014; 18(571)
- *Singer et al* The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) *JAMA* 2016; 315(8)
- *Charito et al* FDG PET of infection and inflammation *Radiographics* 2005; 25(5)





Thank you



Chee Lee Hwee, MD