SPECT-CT and PET-CT in infection imaging

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What is this new technology?

- PET-CT
  - New tracers
- PET-MR
- SPECT-CT
  - New tracers?
- Digital SFOV cameras
- Probes
SPECT-CT or PET-CT?
What can we do with each machine

- SPECT-CT
- Tc-99m MDP
- Ga-67
- In-111 labelled WBCs
- Tc-99m HMPAO WBCs
- Tc-99m antibodies

- PET-CT
- F-18 FDG
- F-18 WBCs
SPECT-CT

- Roach et al 2006 NMC
- Looked at 50 scans including bone and Ga-67 SPECT-CT
- 16% of patients had minor change
  11% major change c/w SPECT alone
- Almost all to do with localisation and improved specificity
- Specificity itself improved by 26%
SPECT/CT for suspected bone infection on GS. A 56-y-old woman presented with fever, low back pain, and infected scar 1 mo after spinal surgery and was referred for GS for suspected vertebral osteomyelitis. (A) Planar posterior whole-body GS image (left) shows prominent abnormal uptake in left lower back, corresponding in part to regions of increased irregular uptake seen on planar posterior whole-body $^{99m}$Tc-MDP image (right) along operated vertebrae. (B) Transaxial GS SPECT/CT image (left) localizes abnormal uptake on GS (center) to paravertebral soft-tissue abscess seen on corresponding CT image (right), thus defining soft-tissue infection without osteomyelitis. There was no evidence of vertebral osteomyelitis on follow-up CT 4 wk later.
WBC SPECT-CT showing an infected iliac graft Bar Shalom et al. JNM 2006 48% more accurate than planar WBC imaging
Specific results for infection

- Inquie et al J Comp Assist Tom 2007
- 16 patients (11 In-111 WBC and 6 Ga--67)
- SPECT/CT images yielded "added value" for anatomical localization in 65%, diagnostic confidence in 71%, and altered interpretations in 47% of cases
Ga-67 in infected Tx

Nowosinska CNM in press 2013
Patient with Ga-67 SPECT-CT

Patient with infected renal transplant SPECT-CT confirms uptake in peri-nephric fat
In-111 WBC in iliac A mycotic aneurysm
Infected in petrous bone
Infected cholangitis
SPECT-CT
PET-CT in infection

- Improved sensitivity
- Localisation on CT
- Not specific but can be in particular clinical situation
- Quantitative so can follow treatment
  - F-18 FDG
  - Ga-68 citrate
  - F-18 WBCs
Blockmans et al Clin Infect Dis
Leuvenan department
58 patients with FUO studies, final diagnosis in 38
40% of scans unhelpful in diagnosis
Results similar to those from Ga-67 in 40 patients studied with both scans only helpful in 42% for each tracer
PET and FUO

- Bleeker-Rovers et al. EJNMMI 2004
- Nijmegen group
- 35 patients with FUO imaged
- Diagnosis confirmed in 19
- 37% of scans clinically useful
- 65% of the positive scans clinically useful
- PPV 87%, NPV 95%
PET vs In-111 WBC

- Kjaer et al EJNMMI 2004
- Copenhagen group
- 19 patients had In-111 WBC and F-18 FDG
- FDG counted as useful if found infection or malignancy (WBC infection)
Image from Blockmans et al

Showing F-18 FDG uptake in spinal TB
Cryptococcus in patient with HD treated with Chemo
Giant cell arteritis
Peritonitis
Spinal TB and Pott’s #
Improving specificity

- Problem of trying to improve the specificity in infection imaging
- How can the sensitivity of PET and the specificity of labelled WBCs be combined
- The answer F-18 WBCs???
F-18 FDG labelled WBCs

- Dumarey et al JNM 2006
- Labelled leukocytes in vitro with F-18 FDG
- WBCs incubated with 740MBq F-18 FDG
- After 20 minutes and washing of cells about 100-200MBq available for injection
- In 21 patients sensitivity 91% specificity 83% of a lesion by lesion basis
- Able to find difficult infections such as endocarditis
F-18 WBCs normal distribution
F-18 FDG WBCs in endocarditis
Ga-68 citrate PET

- Nanni et al Bologna JNM Dec 2010
- 31 patients with bone and joint infection imaged 60 mins post 167MBq Ga-68 citrate
- Authors found 4 false-positive scans, 23 true-positive scans, 13 true-negative scans, and no false-negative scans, resulting in a sensitivity of 100%, a specificity of 76%, a positive predictive value of 85%, a negative predictive value of 100%, and an overall accuracy of 90%
Normal distribution of Ga-68 citrate
Ga-68 citrate in complex OM

Before surgical curettage

After surgical curettage and local antibiotic delivery
Conclusions

- SPECT-CT increasingly established in infection imaging
- PET-CT emerging role in PUO and TB
- Some role in bone and joint
- F-18 FDG WBCs may have a future
- Ga-68 citrate/antimicrobial peptides/antibiotics