SPECT-CT in Infection

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Aims

• The aims of this presentation are to:
  – Review the role of SPECT-CT in infection
  – Illustrate a range of clinical scenarios in which SPECT-CT can add value in patient management
Introduction

• Infection and inflammation can represent a major diagnostic challenge for clinicians

• Diagnosis and precise delineation of infectious foci is critical in certain scenarios

• Cross-sectional imaging provides high-quality anatomical detail but structural abnormalities underlying infectious processes can be non-specific
Functional Imaging of Infection

- Gallium$^{67}$ Citrate scintigraphy, Indium$^{111}$ and Technetium$^{99m}$ HMPAO-labelled white blood cell scanning and bone scintigraphy are widely used in the assessment of suspected infection

- The techniques suffer from poor spatial resolution and somewhat low specificity because of the absence or paucity of anatomical landmarks

- Combined anatomical and functional imaging with SPECT-CT facilitates more precise localization and accurate characterization of infectious foci
Value of SPECT-CT in infection

SPECT/CT Using $^{67}$Ga and $^{111}$In-Labeled Leukocyte Scintigraphy for Diagnosis of Infection

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Improved diagnosis/localization in 48% (n = 82)

Ga$^{67}$ SPECT-CT contributory in 36% of 47 patients:
- 48% with suspected osteomyelitis
- 23% with suspected soft-tissue infection
- 31% with fever of unknown origin

WBC SPECT-CT contributory in 63% of 35 patients:
- 67% with suspected vascular graft infection
- 55% with suspected osteomyelitis
Established uses of SPECT-CT

• Fever of unknown origin

• Suspected bone or soft tissue infection

• Suspected vascular graft infection

• Assessment of the diabetic foot

• Miscellaneous uses
Fever of unknown origin (FUO)

• Pyrexia > 38.3 ºC for > 3 weeks

• Final diagnosis is occult infection in a third of patients

• One third due to occult malignancy

• One third due to inflammatory disorders
Suspected Bone or Soft Tissue Infection

- SPECT-CT can be very useful to image bone and joint infections, by allowing accurate localization of labelled WBC accumulation.

- In some cases of bone infection with adjacent soft-tissue involvement, planar images are not able to distinguish soft tissue from bone infection and SPECT-CT is able to more precisely define the extent of infection.
Usefulness of Hybrid SPECT/CT in $^{99m}$Tc-HMPAO–Labeled Leukocyte Scintigraphy for Bone and Joint Infections

Luca Filippi and Orazio Schillaci

- 15 patients with suspected osteomyelitis and 13 patients with suspected orthopaedic prosthesis infection
- SPECT-CT correctly characterized and localized site of uptake in all patients with osteomyelitis, discriminating soft tissue from bone involvement and had a substantial impact on patient management in ~ 65% of patients
- Major benefit was diagnosis of osteomyelitis in patients with abnormal bones after trauma
Previous trauma, pain, skin broken ? infection
Sagittal SPECT
Sagittal fusion
Sagittal low-dose CT
Technetium labelled WBC study 4 hrs
Diagnosis: Bony non-union
Soft tissue infection
No evidence of osteomyelitis

Images courtesy of Dr Patrick Fielding, University of Wales Hospital, Cardiff
Images courtesy of Dr Gopinath Gnanasegaran, GSTT
$^{111}\text{In-WBC feet}$

Images courtesy of Dr Gopinath Gnanasegaran, GSTT
$^{111}$In-WBC 3 hours

24 hours

Images courtesy of Dr Gopinath Gnanasegaran, GSTT
31 year old male with paraplegia, ulcers in right groin and left buttock

? osteomyelitis in left ischium and pubic rami

$^{99m}$Tc-WBC 3 hours
Vascular Graft Infection

• Uncommon but severe complication

• Early and accurate diagnosis is critical

• Radio-labelled WBC scintigraphy with SPECT-CT or FDG PET-CT are the optimal techniques
Tc$^{99m}$ WBC SPECT-CT studies performed for evaluation of clinically suspected arterial graft infection retrospectively reviewed and compared with reference outcomes

Objective interpretation criteria evaluated using comparison with background liver and marrow activity

Liver best objective comparator for standardized interpretation
Assessment of the Diabetic Foot

- Common complication in diabetic patients

- Difficult differential diagnosis – rapidly progressive neuropathic joint versus osteomyelitis

- Osteomyelitis mainly due to direct spread from contaminated soft tissue
SPECT-CT changed interpretation of planar and SPECT images for 10 of 19 suspected sites (52.6%)

Excluded osteomyelitis in 6 cases, revealed bone infection in 1 case, and both bone and soft-tissue infection in 3 cases
• Exclusion of osteomyelitis and confirmation of soft tissue infection
Diagnosis of bone infection – confirmed at surgery
Miscellaneous uses

• Left ventricular implant device infection

• Infection in polycystic kidney disease
Device-related infection seen in 8 of 13 scans
SPECT-CT positive for infection in all 8 patients, whereas planar scans positive in 6 of 8
SPECT-CT provided relevant information on extent of infection and its exact location in all patients
Additional distant infectious foci demonstrated in 3 patients
SPECT-CT for suspected polycystic kidney infection

Images courtesy of Dr Shaunak Navalkissoor, Royal Free Hospital

$^{67}$Ga Citrate
Conclusions

• SPECT-CT can have a complementary role in the investigation of selected patients with suspected infection

• The technique allows more accurate localization, increases specificity and improves patient management
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Any Questions?