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SHORT COMMUNICATION

Yttrium-90 internal pair production imaging using first generation PET/CT provides high-resolution images for qualitative diagnostic purposes

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ABSTRACT. Yttrium-90 (^{90}Y) internal pair production can be imaged by positron emission tomography (PET)/CT and is superior to bremsstrahlung single-photon emission CT/CT for evaluating hepatic ^{90}Y microsphere biodistribution. We illustrate a case of ^{90}Y imaging using first generation PET/CT technology, producing high-quality images for qualitative diagnostic purposes.

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Yttrium-90 (^{90}Y) selective internal radiation therapy (SIRT) is an emerging treatment modality for inoperable liver tumours. ^{90}Y has internal pair production which can be imaged by positron emission tomography with integrated CT (PET/CT) [1–3]. ^{90}Y PET/CT is superior to bremsstrahlung single photon emission CT with integrated CT in evaluating hepatic ^{90}Y microsphere biodistribution, which correlates with post-SIRT response [2, 3].

We illustrate a case of ^{90}Y PET/CT acquired using a first generation PET/CT scanner (Biograph WO; Siemens, Erlangen, Germany), producing high-resolution images of ^{90}Y microsphere biodistribution (Figures 1–3). Our imaging protocol is detailed in Table 1. Total coincidences were 4.7 million over 40 min (1.2 GBq injected). No effort was made to reduce bremsstrahlung X-rays or background counts from the lutetium-based PET crystal. Background noise was visually minimised by adjusting the PET threshold. Images were analysed qualitatively for diagnostic purposes. Quantitation of ^{90}Y activity was not performed.

Imaging ^{90}Y microsphere biodistribution using first generation PET/CT technology is feasible. Its high-resolution images are useful for qualitative diagnostic purposes. Post-SIRT ^{90}Y PET/CT permits accurate prognostication and effective planning of adjuvant modalities (*e.g.* radiofrequency ablation) by targeting poorly implanted tumour regions.

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(a)

(b)

Figure 1. 56-year-old female with recurrent hepatocellular carcinoma (HCC) in the right lobe underwent yttrium-90 (^{90}Y) selective internal radiation therapy. She was previously treated by radiofrequency ablation and liver resection. HCC recurrence was in the caudate lobe and periablation cavity region. A total of 1.2 GBq of ^{90}Y resin microspheres was injected via the right hepatic artery. Pre-therapy triphasic CT liver (delayed phase) shows an ablation cavity (arrow) in segment VII/VIII—(a) transaxial; (b) coronal.

Table 1. Yttrium-90 (^{90}Y) imaging protocol using first generation positron emission tomography (PET)/CT

PET/CT scanner	Siemens Biograph LSO, Erlangen, Germany
General technique	Imaging performed 6 h post-^{90}Y injection; patient positioned supine with arms elevated; PET acquired in one bed position centred over the liver for 40 min
PET gantry information	Detector material: lutetium oxyorthosilicate; crystal dimension 6.45 × 6.45 × 25 mm; crystals per detector block 64; 144 detector blocks; 4 photomultiplier tubes per block; detector ring diameter 824 mm; 384 detectors per ring; 24 detector rings; total 9216 detectors
PET reconstruction parameters	PET matrix 128 × 128 × 47; attenuation weighted ordered subsets expectation maximisation iterative reconstruction; two iterations and eight subsets
CT parameters	Single-slice CT; 120 kVp; 90 mAs; field of view 50 cm; slice interval 3 mm

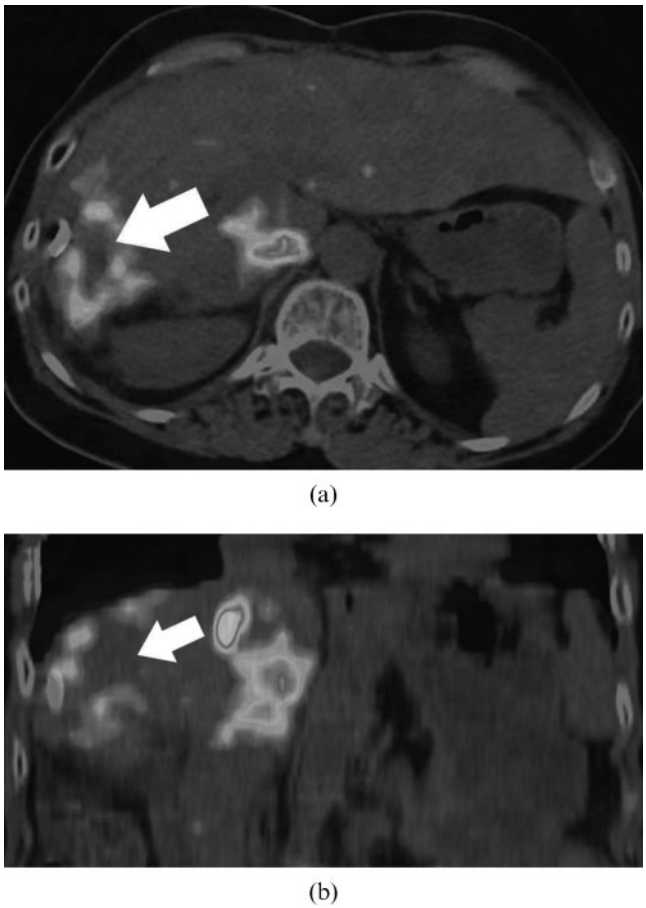

Figure 2. Yttrium-90 (^{90}Y) positron emission tomography/CT depicts hepatic ^{90}Y microsphere biodistribution in high resolution. Periablation cavity ^{90}Y activity (arrow) is well delineated and focal ^{90}Y activity in the caudate lobe is well defined—(a) transaxial; (b) coronal.

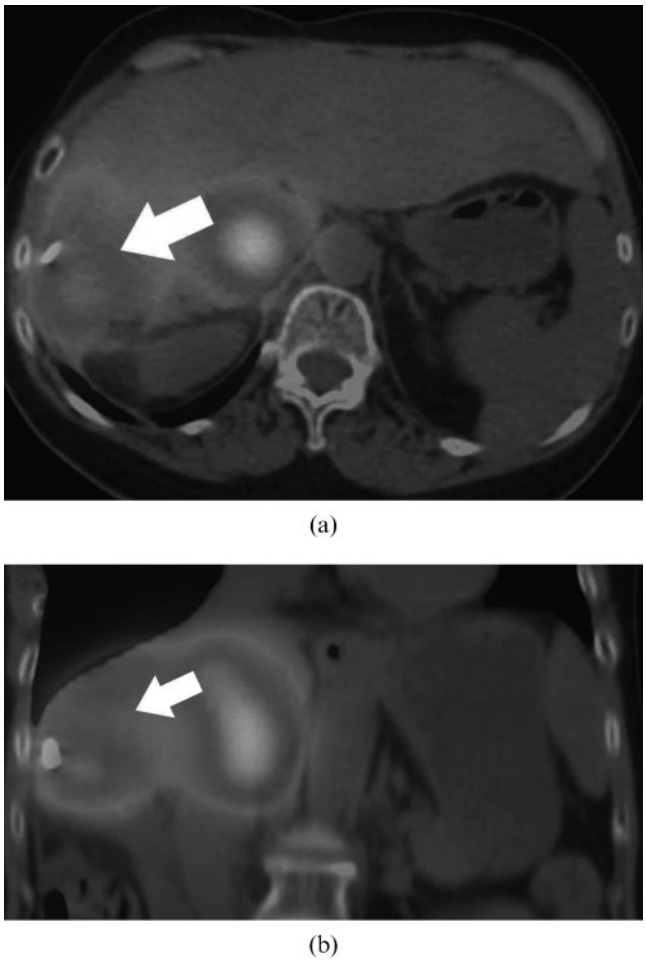

Figure 3. Bremsstrahlung single-photon emission CT (SPECT)/CT acquired on the same day depicts bremsstrahlung activity as diffuse foci, inferior to the spatial resolution of yttrium-90 positron emission tomography/CT. Periablation cavity bremsstrahlung activity (arrow) cannot be clearly delineated. Bremsstrahlung activity in the caudate lobe is seen on SPECT/CT as a conglomerate focus with diffuse margins—(a) transaxial; (b) coronal.

References

1. Lhommel R, van Elmbt L, Goffette P, Van den Eynde M, Jamar F, Pauwels S, et al. Feasibility of 90Y TOF PET-based dosimetry in liver metastasis therapy using SIR-spheres. Eur J Nucl Med Mol Imaging 2010;37:1654–62.
2. Lhommel R, Goffette P, Van den Eynde M, Jamar F, Pauwels S, Bilbao JI, et al. Yttrium-90 TOF PET scan demonstrates high-resolution biodistribution after liver SIRT. Eur J Nucl Med Mol Imaging 2009;36:1696.
3. Gates VL, Esmail AA, Marshall K, Spies S, Salem R. Internal pair production of 90Y permits hepatic localization of microspheres using routine PET: proof of concept. J Nucl Med 2011;52:72–6.