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# Clinical applications of SPECT/CT in non-oncological diseases

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After the introduction of PET/CT hybrid cameras, registration of image data from different modalities has gained considerable interest in the last years. In particular, also imaging devices integrating a CT scanner with a dual-headed SPECT camera have been developed. Furthermore, considerable progress has been made also in the field of software-based image registration since data compatibility between different modalities has been much improved. However, evidence on the anatomical accuracy of software-based registration between SPECT and CT is still scarce; most authors report the anatomical inaccuracy of that technique to be in the order of 1 cm. With SPECT/CT hybrid imaging, the accuracy of image fusion is expected to be much better: first own data show that the anatomical mismatch between skeletal SPECT and CT is well below pixel width, averaging 1 mm (1).

In SPECT/CT datasets, CT may be used for attenuation correction of the SPECT images. Applying this technique to skeletal scintigrams, the deeper bony structures of the body will gain in counts compared to the more superficially located parts of the skeleton. Whole-slice ratios of the uptake of polyphosphonates in the vertebral bodies, for example, will increase by 30 % when SPECT images are attenuation-corrected. Using a hybrid camera combining a low-dose CT with a SPECT system, Fricke and coworkers validated CT-based attenuation correction of mayocardial perfusion images in comparison to PET with N-13-ammonia and reported that this technique leads to a more accurate representation of myocardial perfusion (2). However, misalignments between SPECT and CT will lead to considerable artefacts when attenuation correction is used. Therefore, for the clinical application of that technology, an exact data match is mandatory, and it should be employed cautiously. This applies in particular to myocardial scintigraphy where this technology would be expected to have the greatest diagnostic impact since the signal from the inferior myocardial wall is often obscured by attenuation artefacts.

The high anatomical accuracy of image registration by SPECT/CT offers the potential to exactly relate SPECT abnormalities to an anatomical region. Data published on the obvious clinical advantage of that feature in non-oncological diseases are still scarce (for a review, see 3). However, several authors have studied the diagnostic impact of SPECT/CT hybrid imaging for evaluating infection either with leukocyte antibodies (see 3) or with Ga-67 or In-111-labeled leukocytes (4) and could convincingly show that SPECT/CT can make an incremental contribution to planar imaging and SPECT in roughly one half of the patients studied. The advantage offered by this technology has also been demonstrated in the diagnosis of splenosis (see 3). Conflicting data have been reported with regard of the value of this technique to localize parathyroid adenomas (5). In theory, SPECT/CT bone imaging would be an interesting option also for the diagnostic workup of orthopedic disorders; however, only very preliminary evidence exists in this field. From experience in oncology, it seems plausible that in particular bone imaging will benefit from the integration of diagnostically sufficient spiral-CT scanners into the hybrid systems; SPECT/ spiral-CT scanners have, however, been commercially available only since Summer 2005 so that publications using this new technology are practically absent at the time of this writing.

In summary, it is to be expected that SPECT/CT hybrid imaging will prove its superiority over SPECT alone also for many non-oncological indications in the years to come. Clearly, more evidence is needed to carefully evaluate its advantages, also in view of the higher costs of the hybrid devices compared to stand-alone SPECT systems. Further research work should also address the interesting question of how high the quality of the CT scanner integrated into the SPECT/CT hybrid systems should be to obtain the best clinical results in terms of diagnostic accuracy and cost efficiency.

**References**

1. Nömayr A, Römer W, Strobel D, et al. Anatomical accuracy of hybrid SPECT/ spiral-CT in the lower spine. Nuclear Medicine Communications (in press).

2. Fricke E, Fricke H, Weise R, et al. Attenuation correction of mayocardial SPECT perfusion images with low-dose CT: Evaluation of the method by comparison with perfusion PET. J Nucl Med 2005; 46: 736-744.
3. Schillaci O. Hybrid SPECT/CT: a new era for SPECT imaging? Eur J Nucl Med Mol Imaging 2005; 32: 521-524.
4. Bar-Shalom R, Yefremov N, Guralnik L, et al. SPECT/CT using $^{67}$Ga and $^{111}$In-labeled leukocyte scintigraphy for diagnosis of infection. J Nucl Med 2006; 47: 587-594.
5. Gayed IW, Kim EE, Broussard WF, et al. The value of 99mTc-Sestamibi SPECT/CT over conventional SPECT in the evaluation pf parathyroid adenomas or hyperplasia. J Nucl Med 2005; 46: 248-252.