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**Multimodal imaging in awake : Combined microSPECT and  
MRI for real time imaging of dopamine transporter binding with  $^{125}\text{I}$   $\beta$ -  
CIT.**

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**Abstract:**

Methods were developed to combine high field MRI with SPECT to localize radiolabeled binding of  $^{125}\text{I}$   $\beta$ -CIT to the dopamine transporter in awake rats. With a custom made rat restrainer and RF electronics that is both MRI and SPECT compatible (Insight Neuroimaging System Worcester MA) rats were first imaged in a 4.7 T scanner using a RARE pulse sequence for high resolution brain anatomy (2562x30 slices). Immediately afterwards, animals received a tail vein injection of different concentrations of  $^{125}\text{I}$   $\beta$ -CIT (25, 50, 100  $\mu\text{Ci}$  in 250  $\mu\text{l}$  buffer 0.9% NaCl). Animals were then positioned in a microSPECT (MollyQ-50<sup>TM</sup>, NeuroPhysics Shirley MA.) and the brain scanned at 45 s intervals (75 slices).

MRI and SPECT images from multiple subjects were co-registered to a segmented 3D rat atlas for precise localization of ligand binding and quantification of binding potential. Peak binding in the dorsal striatum and prefrontal cortex occurred at 3-4 hrs after injection. Interestingly, the retina, an area high in dopamine transporter protein, showed intense activity binding and signal that doesn't appear under anesthesia, underscoring the need to do these studies in awake animals. To our knowledge this is the first example of *in vivo* autoradiography in awake animals combining micro SPECT with high field MRI to localize and quantify radiolabeled ligand binding in the brain.

This technology allows one to assess brain penetrance, pharmacokinetics, and dose occupancy of new CNS drugs.

Keyword: microSPECT ; MRI; Image registration ; awake animal