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γ imager

Application Notes

DYNAMIC SPECT IMAGING OF TUMOR XENOGRAFTS IN NUDE MICE

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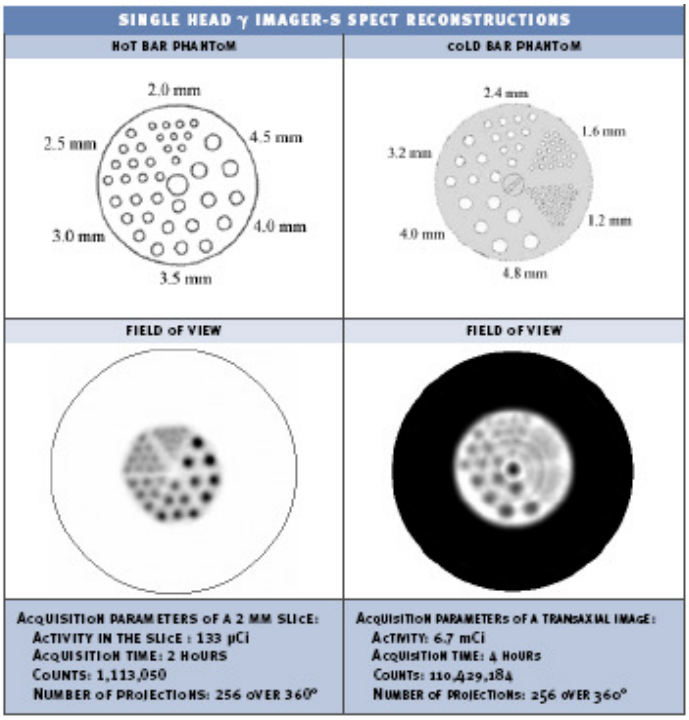
Goal:

Fast, high-resolution quantitative SPECT imaging is a powerful tool for the study of physiological processes. Optimal SPECT performance results from speed/resolution compromises and from the implementation of appropriate reconstruction algorithms suited to the low statistics of small animal imaging. The γ IMAGER-S (Biospace Lab, Paris) has been designed for SPECT imaging of rat and mouse models. It relies on the γ IMAGER (Biospace Lab, Paris), a scintigraphy camera with a unique continuous crystal and position sensitive photomultiplier detection head, leading to an intrinsic resolution of 2 mm and a 10 cm field of view. The γ IMAGER-S is a SPECT upgrade of the γ IMAGER, tested here in a single head version (a double head version is available). The γ IMAGER is mounted on a 2 position stand, set in the horizontal position and equipped with a rotating platform whose axis can be set at a distance from the parallel hole collimator ranging from 2 cm in the present case (mouse imaging) to 5 cm (rat imaging). The animal bed rotates at a speed of 1 turn/minute allowing dynamic tomographic reconstruction which is calculated by an OSEM (Ordered Subset Expectation Maximisation) algorithm and displayed in real time. We have tested the γ IMAGER-S in various configurations to assess contrast and resolution performance on both hot bar and cold bar phantoms, and have applied those configurations to a dynamic study of $^{99m}TcO_4^-$ uptake in nude mice bearing a xenogenic tumor.

Material and methods:

Both a cold bar and a hot bar phantom were used to measure contrast and resolution. The cold bar is a MicroDeLuxe phantom, while the hot bar is a home made phantom. In both cases, tomography was performed by rotating the phantom through 360° in 256 steps.
The following resulting image of the hot bar phantom is a 2 mm thick slice reconstructed after a 2 hour acquisition with a 1.3 mm diameter hole, 0.2 mm septa, 35 mm high parallel hole collimator. Note that the phantom diameter (2 inches) is only half the size of the spherical field of view and that air bubbles can make some bars disappear. The result of the cold bar phantom is illustrated by an axial image of the MicroDeLuxe cold bar phantom after 4 hours acquisition with the same parallel hole collimator. In the cold bar phantom the smallest detectable features are 2.4 mm diameter bars. In the hot bar phantom that involves a significantly lower amount of activity, the smallest detectable features are 2.5 mm diameter bars.

Further to this contrast/resolution validation, the capacity of the γ IMAGER-S to perform real-time, dynamic SPECT imaging was tested. A fast reconstruction algorithm was implemented to allow real-time reconstruction of a 2 mm slice and tested on a mouse tumor model, consisting of a subcutaneous xenograft of 10^7 PC12 cells grafted 3 weeks before the experiment in a nude mouse (30 g). The mouse was injected with 1.08 mCi $^{99m}TcO_4^-$ under isofurane (3%) anesthesia administrated through a nosecone.

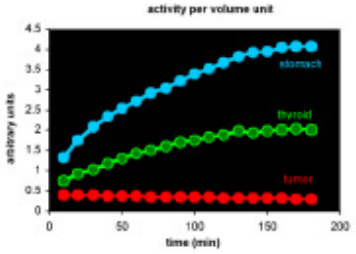


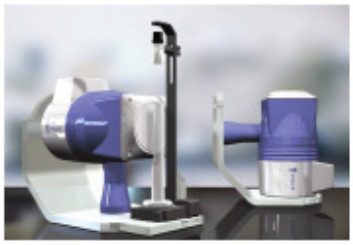
Results:

The following lateral projection of the animal is shown here with three reconstructed 2 mm thick transaxial slices (thyroid, tumor and stomach). N.B.: the scale of the slice displays has been adjusted for better visualization. Dynamic reconstructions were performed in 10 minute increments for the transaxial slices.
Automatic contouring, quantitation and kinetic tracing was performed with the γ IMAGER + software (Biospace Lab, Paris).

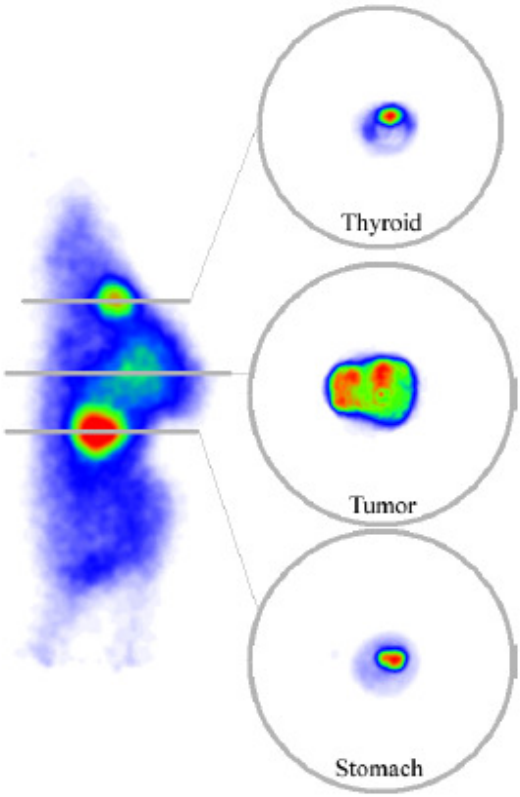
Conclusion:

The γ IMAGER-S is well suited for high-resolution SPECT studies of anesthetized rodents. Dynamic reconstructions can be performed with a minimum time increment of 1 minute. Besides, the ability to display transaxial slices in real-time allows fast assessment of the experiment. The γ IMAGER-S is ideal for easy imaging of the dynamic biodistribution of gamma-emitter labeled radiotracers.





γ IMAGER-S



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