Imaging samarium-153 on a small animal SPECT/CT system with pinhole collimators: A feasibility study

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ABSTRACT

Introduction: Pre-clinical nuclear medicine research forms a valuable step in developing novel radiopharmaceuticals for diagnosis and therapy. Recently, dedicated animal imaging systems that feature single photon emission computed tomography (SPECT) technology have been developed. This study aims to demonstrate the feasibility of a small animal SPECT/CT system (Albira Si™, Bruker, USA) for ^{153}Sm imaging in preclinical studies. **Materials and Methods:** The Albira Si™ SPECT/CT features a continuous CsI(Na) crystal detector with two pinhole collimators that can detect 30-400 keV gamma rays. To calibrate the system, a vial of 14.8 MBq/mL ^{153}Sm solution was imaged using 120-mm field-of-view (FOV), energy window of 103 keV ± 20%, and dual-energy scatter correction. The images were reconstructed using the OSEM algorithm and analyzed using PMOD software. The integral uniformity and sensitivity were assessed by drawing a cylindrical VOI at the centre of the image. As a pilot study, one liver tumor-bearing Sprague-Dawley rat injected with ~15 MBq ^{153}Sm microspheres was imaged at 24 h and 48 h post-injection to evaluate the biodistribution. **Results:** Phantom studies revealed that integral uniformity of the image is 20% with an 8% coefficient of variation. The sensitivity for a pinhole collimator configuration is 21.7 cps/MBq. The SPECT/CT images of the liver tumor-bearing rat treated with 153Sm microspheres showed localized hotspots in the injected sites with no leakage to nearby normal tissues for both time points. The biodistribution study showed that 69% of the detected activity were localized in the tumour site. **Conclusion:** This feasibility study showed that the Albira Si™ micro-SPECT/CT system can be used to detect and quantify 153Sm activity in phantoms and small animals. Characterization of the image quality and quantification accuracy will be conducted. The machine will be used for preclinical evaluation of 153Sm for theranostic applications.