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Keyword Phrases: Dual Energy Quantitative CT

Abstract

TITLE: Dual-Energy Quantitative CT for Imaging and Quantifying Adipose Tissue in Rodents Using a MicroCT Unit

ABSTRACT BODY:

Objectives : Total- and partial-body fat measurements in rats and mice are the basis of many researches on obesity. The techniques used preferably should be non-invasive, and allow longitudinal, quantitative measures of subcutaneous and visceral fat, and/or total body fat in the chosen rodent model. The goal of the study was to evaluate the method dual-energy quantitative CT (DEQCT) as a candidate for such a fat-imaging technique.

Methods : We used a MicroCT system, SkyScan Model 1076, to implement a DEQCT routine for in vivo fat imaging and quantification in mice. DEQCT is based on imaging the subject at two x-ray beams of low and high energies the spectra of which are adequately separated to accentuate the difference in the ratio of photoelectric and Compton cross-sections between the adipose and the lean tissue. The two images then are treated with the DEQCT algorithm that generates separate images of the subject's fat and non-fat tissue. SkyScan 1076 was chosen because of its wide range of kVps (20 to 100). Live mice and tissue phantoms were imaged at 35 µm pixel size.

Results : Beam energies were 41 kVp (at 244 µA) using a 1-mm Al filter, and 100 kVp (at 100 µA) with the 0.25-mm Cu filter, yielding estimated median beam energies of 25- and 60-keV, respectively. The figure shows the low- and high-energy CT images of a slice in the mouse abdomen, together with the DEQCT images of fat and non-fat tissues, demonstrating the ability of DEQCT to distinguish fat and non-fat tissues with high signal-to-noise ratio. The bone pixels were artificially zeroed in the last two images. These images show that the spinal cord tissue belongs mostly to the non-fat tissue in its elemental composition. Quantitative studies with a phantom of mixed chicken fat and muscle reproduced the mass of fat in the phantom with 10% accuracy, a value that we expect to improve upon.

Conclusions : Fat imaging with DEQCT does not require image segmentation. Furthermore, because it separates the image signals from fat and non-fat tissue even when they are both

present in the same voxel the fat-image's gray scale represents the net fat density. This allows measuring the fat mass by calibrating the gray scale with a fat sample of known density. It also may be possible to separate different types of fat by their distinct densities besides their possible textural differences.

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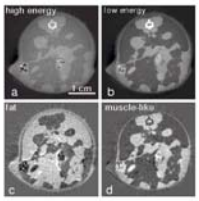
(No Table Selected)

Supporting Data



Mouse abdomen images: a) high energy, b) low-energy, c) fat, d) non-fat tissue.