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GAWiseman, WL Dunn.

ORGAN SPECIFIC EFFECTIVE THICKNESS MEASUREMENTS FROM A COLLIMATED CO-57 TRANSMISSION SOURCE IMPROVES THE ATTENUATION CORRECTION ON WHOLE BODY GAMMA CAMERA IMAGING.

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Attentuation and scatter correction are two of the most important factors to consider in accurate gamma camera radiation dosimetry measurements. For attentuation correction many techniques assume uniform attentuation throughout the body or for a given pathlength and most use a standard attenuation coefficient. We compared the CT scan body (chest and abdomen) thickness with an effective thickness measured using a collimated Co-57 transmission sheet source for organ specific attenuation correction on patients enrolled in clinical therapy trials. CT thicknesses measured for the chest were done at the inferior most slice of the sternum and at the level of the carina of the trachea. The abdominal measurements were at the level of the umbilicus. The Co-57 effective thickness was performed using a whole body gamma camera scan and a collimated Co-57 sheet source lying on the lower head. The effective thickness was calculated from the counts per pixel without attentuation compared to the attenuated organ region of interest. The greatest differences were seen in the chest where the mean effective thickness was 56 % of the CT thickness (range 49-62%). The abdomen showed a mean effective thickness of 88% (range 78-109%) of the CT thickness. At the level of the kidney the effective thickness was 91% (range 85-109%) of the CT measured thickness. Conclusion: The measured the organ specific effective thickness with a Co-57 sheet source is generally lower than the CT body thickness. This is seen to have the greatest difference in the chest due to the lower tissue attentuation. The variability of attenuation in the body makes organ specific regional measurements of attenuation important in accurate gamma camera image radioisotope quantitation.

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HH El-Ali, S-E Strand, S Larsson, C Jonsson, J Palmer, M Ljungberg, J Nilsson .

A NEW PHANTOM BASED ON INK JET TECHINIQUE FOR IMAGING AND DOSIMETRY.

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Quality control of absorbed dose distribution in radionuclide therapy is an essential part in developing dose-planning programs. One method is direct measurements in realistic phantoms. Such a phantom should give the possibility of arbitrary activity distributions and also be possible to implement into dose planning systems and Monte Carlo calculations of images and absorbed doses. We are developing such a system based on a stack phantom (1).Briefly the phantom is based on discrete sampling of the radioactivity distribution in 3D objects by means of equidistant 2D planes obtained by processing CT-images. The automation of the CT-images is obtained by using the Mat lab imaging toolbox. These digital activity distribution maps can be printed out on paper sheets using an ink-jet printer, where the ink is mixed with radioactivity and stacked equidistantly into a 3D-structure with some arbitrary dense material in between. The first step has been to calibrate the ink jet printer and to verify the homogenous activity printing of the activity sheets. The goal of the printer calibration was to define the relationship between the digital activity distribution in the visual image (grey scale) and the activity distribution on the paper sheets (radioactivity). The relationship was logarithmical and a fourth grade polynomial could fit this relationship. Pinhole SPECT was used to investigate the distribution of the radioactivity inside the ink cartridge. The distribution of ( )-pertechnetate solution was found to be homogeneous in the ink solution. The next step will be to create an activity distribution in the phantom for further evaluation of the dosimetry. The phantom is a very flexible device and clearly much better than conventional phantoms which have fixed geometry and limitation. Arbitrary activity distributions resembling patient's 3D activity distribution will facilitate more proper evaluation of in vivo dosimetry in radionuclide therapy.

(1) S. A. Larsson, C. Jonsson, M. Pagani, L. Johansson, H. Jacobson: A novel phantom design for emission tomography enabling scatter- and attenuation "free" SPECT imaging, Eur J Nucl Med, (2000).27:131-139.

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SPATIAL DOSE DISTRIBUTION DETERMINATION IN SIMPLE PHANTOMS.

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With the recent advances in nuclear medicine and medical images as CT (Computerized Tomography) and SPECT (Single Photon Emission Computerized Tomography), new techniques for radiation dose estimation may be envisioned. One is the utilization of the CT anatomic information to built a patient-specific geometric phantom together with a functional SPECT data to obtain the spatial source distribution in the phantom. Several computational codes have been developed to perform dose estimation with the capability to handle digital data, such as those provided by nuclear images in diagnosis, allowing a detailed internal dose estimation giving not only average doses in regions of interest, but also, spatial dose distributions. The contribution of this work is to present some comparisons of dose estimates obtained using such a methodology with experimental values applied in simple geometric phantoms. Dose distribution measurements have been performed in two phantoms consisting of 2 cylinders. One has a diameter of 40 cm and height of 1 cm, the other has a diameter of 21.5 cm and a height of 18.7 cm. Both phantoms were filled with water containing Tc-99m uniformly distributed in the entire phantom volume. Dose measurements were made using thermoluminescent dosimeters TLDs (LiF-700) placed into the phantom and in its wall. Monte Carlo simulation of these experimental arrangement were performed using the MCNP-4B code for the spatial dose distribution calculation. In one of the phantoms, the spatial source distribution and the geometric information were obtained from a SPECT image of the phantom and transformed into an appropriated format to build the geometrical configuration and the source specification for the MCNP-4B code. Results obtained from the simulation were compared to experimental results showing a very good agreement, with maximum discrepancies of about 4.6 % in cases using SPECT images, and about 10% for calculations assuming uniform source distribution.

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