سامية محمد مصطفى

شبكة المعلومات الجامعية

بسم اللّه الرحمن الرحيم

شبكة المعلومات الجامعية

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التوثيق الالكتروني والميكروفيلم

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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سامية محمد مصطفى

بعض الوثائق الأصلية تالفة

PHYSICAL FACTORS AFFECTING QUANTITATIVE SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

Thesis

Submitted in partial fulfillment
For
The Ph.D. Degree of Science
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By

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To

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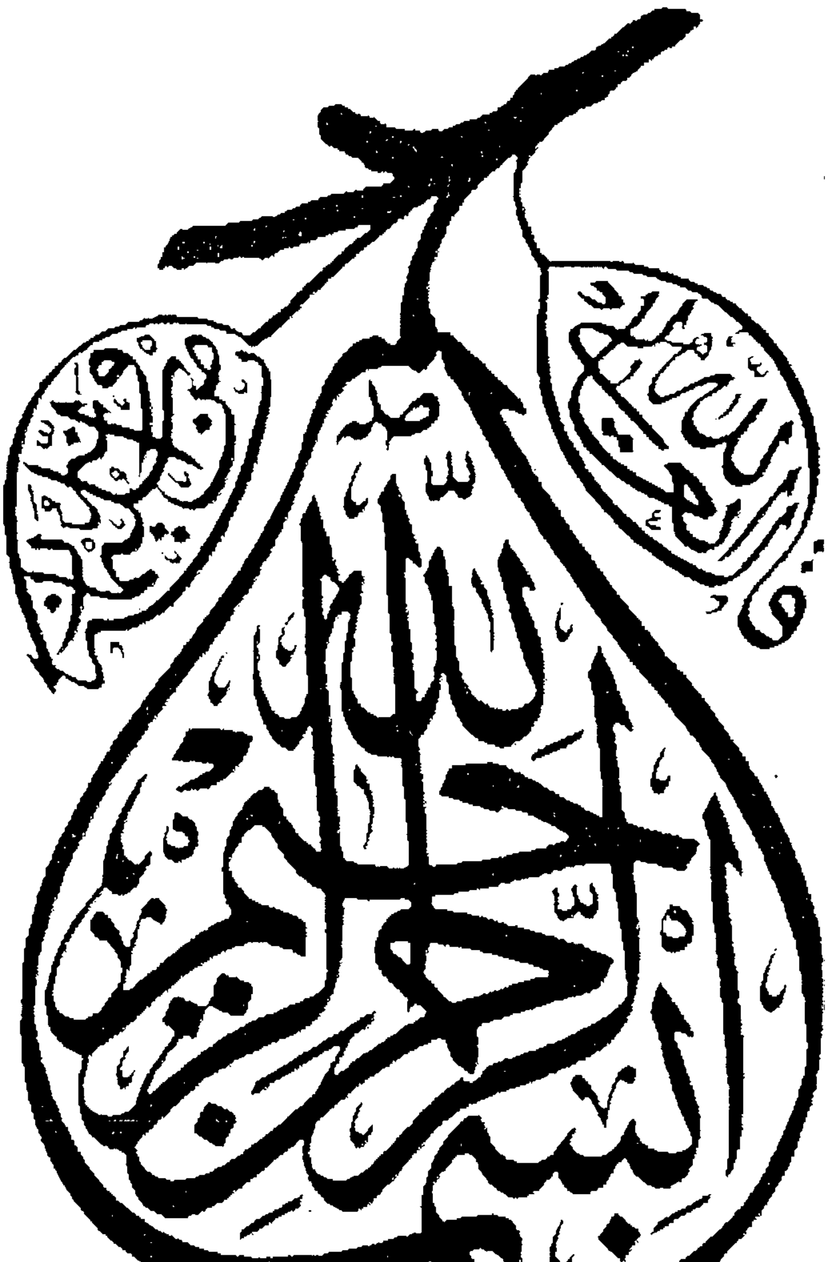

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Approval Sheet

Title

PHYSICAL FACTORS AFFECTING QUANTITATIVE SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

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To my family, my wife
& my love Ahmad & Fadwa

CONTENTS

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Ramadan Ali Hassan Ali

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ABSTRACT

Single Photon Emission Computed Tomography (SPECT) is a technique for studying the biodistribution radioactive tracers introduced into the body, and provides high-contrast three-dimensional images. SPECT imaging has a number of potential advantages over conventional nuclear medicine planar imaging. However, special attention is needed, and a SPECT system will not produce adequate results unless corrections & very great care is taken in both acquisition and reconstruction of the image.

Degradation of single photon computed tomography images due to attenuation of photons; and Compton scattering can cause artifacts in clinical images and deteriorate the quantification. This necessitates the implementation of correction techniques in order to obtain accurate quantitative SPECT images.

On the other hand for acquisition parameters non circular orbit, 180° acquisition with 64 matrix size is considered standard for cardiac SPECT imaging. Although theoretically, a 360° acquisition orbit with 128 matrix size is preferred because of more complete Fourier spectral information on projection data and better resolution.

ECG-gated myocardial perfusion SPECT has allowed the simultaneous assessment of myocardial perfusion and function, particularly for the left ventricular myocardium. This progress has allowed the assessment of both global and regional left ventricular function. As with any technique, it is important to understand the accuracy of the approach, the variables that determine this accuracy, and the causes of errors.

The main purpose of this investigation was the evaluation and implementation of a homogeneous attenuation correction (Chang method), with the window subtraction scattering correction of SPECT images by using the Jaszczak cardiac phantom.

Homogeneity, contrast and FWHM assessed quantitatively with the differential effect of acquisition orbits (180° versus 360°), circular and non circular orbit and the matrix size (64 versus 128).

To evaluate factors affecting heart quantification by gated single photon emission computed tomography (GSPECT), movable cardiac phantom (MCP) was constructed in the nuclear medicine unit, National Cancer Institute, Cairo.

All SPECT imaging with a dual-head gamma camera (E-CAM) was performed on normal Jaszczak cardiac phantoms filled with a ^{99m}Tc solution, using different acquisition orbits and matrix. The cardiac phantom was inserted inside the chest phantom and imaging without and with the founding of attenuation and scattering media (water). The homogeneity of count distribution, contrast, and FWHM (characterizing the spatial resolution of the imaging system) in the three short axis slices of the cardiac phantom was analyzed.

Then for the best selected acquisition parameters (Uniformity, Contrast, and FWHM) five cardiac images were acquired; first without background or liver activity of ^{99m}Tc, second with low background without liver activity, third with a high background without liver activity, fourth with low liver activity without background, then the last one with high liver activity without background.

The selected acquisition parameters again were used for studying the validation of MCP for GSPECT by imaging 12 different volumes (for ESV started with 22.5 ml ended with 63.4 ml, and for EDV started with 56.3 ml ended with 96.9 ml) with increase of 3.75 ml.

Linear regression analysis was performed to assess the correlation between the real versus measured volumes & ejection fraction for all the 12 different volumes.

Then the correlation between real EF and the GSPECT-quantified EF for the acquisition frame/cycle (8 versus 16), and time per projection (40 versus 20 sec) assessed.

Relative quantification was performed on the SPECT studies. The results obtained from the SPECT phantom studies indicated that the attenuation & scattering correction did improve the quantitative accuracy of the images.

When the cardiac phantom was placed in the attenuation and scattering media, homogeneity, contrast and spatial resolution were degraded, and all were improved with the applying attenuation and scattering correction. 180° orbital motion, non circular orbital type and 128