سامية محمد مصطفى

شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

سامية محمد مصطفى

شبكة المعلومات الجامعية

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التوثيق الالكتروني والميكروفيلم

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سامية محمد مصطفى

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التوثيق الإلكتروني والميكروفيلم

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بالرسالة صفحات لم ترد بالأصل

FACTORS AFFECTING SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT) WITH A SPECIAL PROCEDURE APPLIED TO HUMAN BRAIN

Thesis

Submitted in partial fulfillment
For
The Master Degree of Science
(Medical Biophysics)

By

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To

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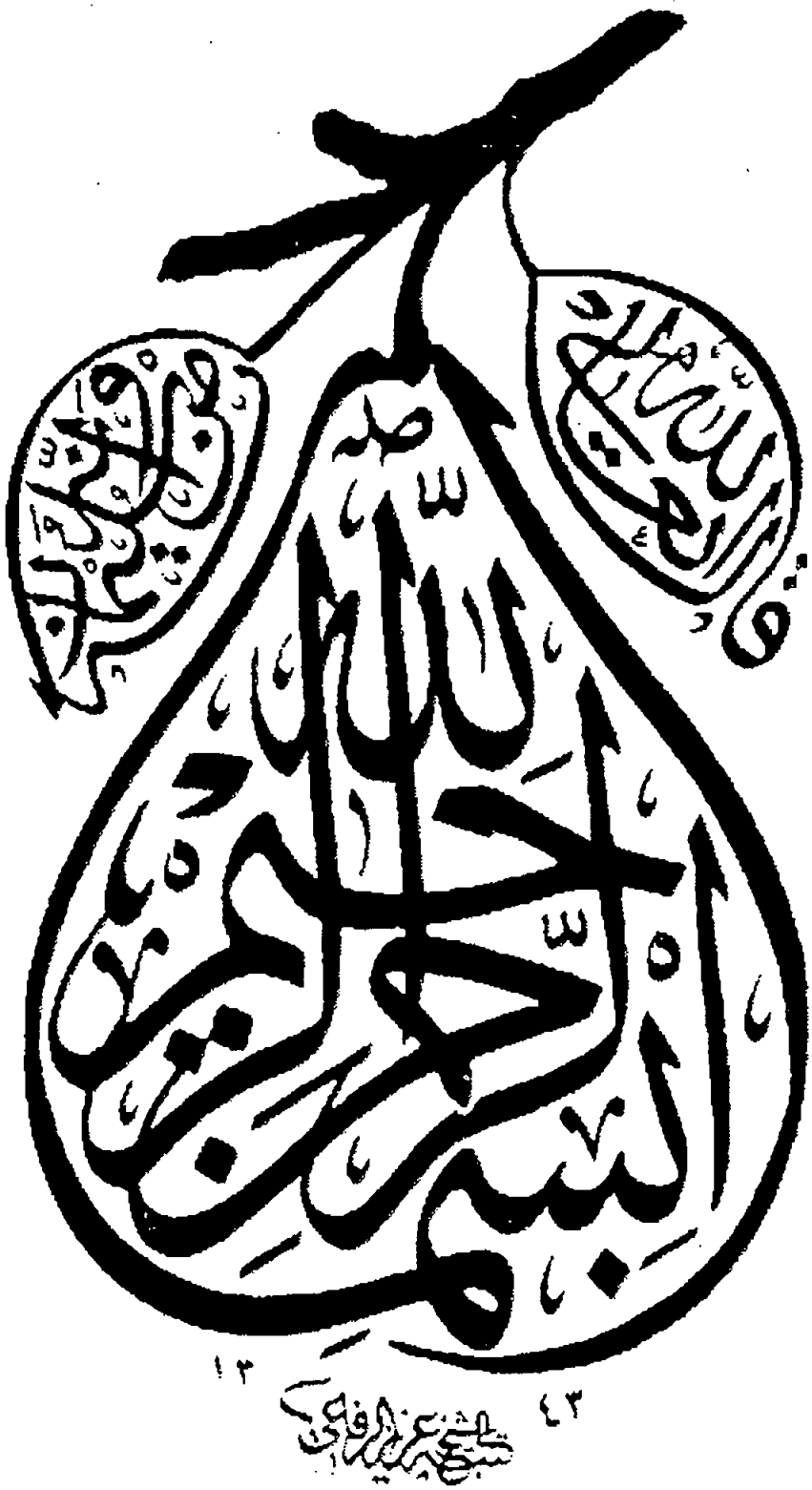
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Title

FACTORS AFFECTING SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT) WITH A SPECIAL PROCEDURE APPLIED TO HUMAN BRAIN

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To my family and my wife

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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 very great care is taken in both acquisition and reconstruction of the image.

There are whole ranges of acquisition and reconstruction parameters, the change of which will affect the quality of the final image.

The present study investigates the various parameters effecting SPECT images and the experimental results demonstrate that;

Although uniformity is important in planar images, it is essential to tomographic images. Any borderline nonuniformity in a planar image is magnified many times in the SPECT image and could lead to significant errors in the reconstructed tomographic sections (ring - entire or partial - of high /lower counts in the transaxial images).

So, daily uniformity checks and evaluation are essential to ensure that the SPECT system is working properly during the period between one calibration and the next. It's recommended to obtained high-count uniformity calibration images weekly (monthly for a stable system), and after servicing.

One of the most important quality control procedures for Tomography is the center of rotation (COR) calibration; the principal behind this calibration is that the center of the camera image must exactly match the center of the computer image when the images' data are reconstructed.

The COR used in the reconstruction process could be correct to avoid data misalignment and subsequent artifact production.

Also, the sampling requirements of SPECT need to be carefully determined in order to minimize noise, and star effects. The increase in the number of views (NOV) leads to better definition of the SPECT images. In our study 60 NOV gave the best image quality, rather than 20 or 30 views. In clinical applications, approximately 60 views are adequate for most clinical studies. We have to consider the whole time of acquisition to be suitable to patient stability.

The longer the acquisition time per view (TPV), the more events are obtained but at the expense of possible artifacts from patient movement .So, we could go down to 30 or 20 sec TPV without much loss of image quality. We have to consider the whole time of acquisition to be suitable to patient stability, whenever we plan the acquisition parameters.

About the type of collimator we found that, ultra high-resolution collimator, rather than high-resolution collimator, is recommended in order to provide good spatial resolution particularly when imaging smaller structures of brain. Although the changing to higher resolution collimator leads to a decrease in the number of counts, this decrease could be compromised by other parameters such as increasing the number of views or time per views.

On the other hand patient motion occurring during data acquisition in SPECT could cause serious reconstruction artifacts. A cine display is recommended to identify movement artifacts.

The data obtained obliged us to fix patients during acquisition. We can use some restraining devices such as head holders especially with patient suffering from instability.

In the case of matrix size, the results obtained show that there is a great difference between images obtained with a 64x64 image matrix and that using a 128x128 matrix.

That difference concentrated around the image resolution. Matrix 128x128 give the best resolution than matrix 64x64. Smaller pixel size 128 x 128 could display more image details than 64 x 64.

In the case of energy window width, we noticed that; the resolution improved and total count decreased when decreasing the energy window width. This improvement in resolution due to scatter reduction in case of 15% energy window compared with the standard 20% symmetric energy window around the 140 keV photopeak of Tc-99m.

Analysis of results obtained from different types of filters, revealed that the Butterworth filter (cut off 0.57 cyc/cm with order 6) give the best resolution, and the Parzen filter showed the worst resolution and lowest maximum count in the image. Referring to resolution of the images we can arrange the filter quality as Butterworth, Hamming, Hanning, Gen-Ham., and Parzen.

Tomographic reconstruction software leaves the choice of filter to the user. Unfortunately, there is no golden rule regarding optimum choice of filter, and even if filters are given the same name on different systems there is no guarantee that they will produce the same results. As a general rule, images should not be smoothed too much, since brain images exhibit fine structures and hence high frequency components. The filter choice is largely dependent on statistical noise (the number of counts collected). This is influenced by the collimator used, the radiopharmaceutical dose administrated, the rate of the blood flow, the imaging time post injection, etc.

For visual interpretation the user is advised to test each possible filter in turn, and select the most suitable. This can easily be done by carrying out tests on an image for which the interpretation is already known.

Photon attenuation is the dominant factor affecting SPECT images. Without attenuation correction applied the count of the transverse image was decreased with the depth due to