UNIVERSITI TEKNOLOGI MARA

MATHEMATICAL MODELLING OF ^{18}F-FDG CONCENTRATION IN THE KIDNEYS AND URINARY BLADDER

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ABSTRACT

Positron emission tomography/computed tomography (PET/CT) is a medical diagnostic imaging technique that allows identification of anatomical and quantitative assessment of physiological process in many types of cancers. Quantification of PET image enables to determine a direct relationship between the time-varying activity concentration in organs or tissues and the essential parameters that describe the biological processes at the cellular level. Hence, further improvement in the accuracy quantification of PET image as to ensure the amount of radiotracer activity to the targeted tissues or organs can be precisely measured. The aims of this study were to measure organs dose based on the region of interest (ROI) and to propose mathematical models for evaluating the concentration of ^{18}F-fluorodeoxyglucose (^{18}F-FDG) in the kidneys and urinary bladder using PET/CT images. Kidneys, abdominal aorta and urinary bladder of the nine healthy subjects were identified by manually drawing the ROIs from the dynamic PET images to measure organ's activity concentration of ^{18}F-FDG. The measurement of organ's activity based on ROI was used for estimating the amount of radiation dose received by the kidneys. The polynomial regression model and artificial neural network (ANN) were selected in this prospective dosimetric study. The results demonstrated that the estimation of organ's ^{18}F-FDG activity based on the drawn ROI had reduced its absorbed dose. The mean value of R^2 for the 15^{th} degree polynomial regression model is 0.85 with 0.015×10^9 of MSE while the R value of simulation for ANN is 0.85 with 0.012 of MSE. The development of mathematical models based on the polynomial regression model and ANN can be used to evaluate the distribution of ^{18}F-FDG concentration in the kidneys. The estimation of organ ^{18}F-FDG activity based on the drawn ROI and the two mathematical models used may increase the dosimetric evaluations of dynamic PET/CT imaging that might be useful in the clinical area specifically for patients presented with kidneys related diseases.

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