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Kinetic modeling and graphical analysis of ^{18}F-Fluoromethylcholine (FCho), ^{18}F-Fluoroethyltyrosine (FET) and ^{18}F-Fluorodeoxyglucose (FDG) PET for the discrimination between high-grade glioma and radiation necrosis in rats

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Background: Discrimination between glioblastoma (GB) and radiation necrosis (RN) post-irradiation remains challenging but has a large impact on further treatment and prognosis. In this study, uptake of 18F-fluorodeoxyglucose (18F-FDG), 18F-fluoroethyltyrosine (18F-FET) and 18F-fluoromethylcholine (18F-FCho) positron emission tomography (PET) tracers were investigated in a F98 GB and RN rat model applying kinetic modeling (KM) and graphical analysis (GA), with the aim to clarify our previous results.

Methods: Dynamic 18F-FDG (GB n=6 and RN n=5), 18F-FET (GB n=5 and RN n=5) and 18F-FCho PET (GB n=5 and RN n=5) were acquired with continuous arterial blood sampling. Arterial input function (AIF) corrections, KM and GA were performed.

Results: The influx rate (K_1) of 18F-FDG uptake described by a 2-compartmental model (CM) or using Patlak GA, showed more trapping (k_3) in GB (0.07 min^{-1}) compared to RN (0.04 min^{-1}) (p=0.017). K_1 of 18F-FET was significantly higher in GB (0.06 ml/ccm/min) compared to RN (0.02 ml/ccm/min), quantified using a 1-CM and Logan GA (p=0.036). 18F-FCho was rapidly oxidized complicating data interpretation. Using a 1-CM and Logan GA no clear differences were found to discriminate GB from RN.

Conclusions: Based on our results, we concluded that using KM and GA both 18F-FDG and 18F-FET were able to discriminate GB from RN. Although KM is the only method for absolute quantification, based on our semi-quantitative results and due to the laborious set-up for obtaining an AIF, SUV is proposed for translation into the clinic. 18F-FCho PET did not allow discrimination between GB and RN.

Biography

Julie Bolcaen has finished her Master's in Biomedical Sciences (Option Radiation Science) at Ghent University in 2011 with great distinction. She has a special interest in neurosciences and medical imaging of the brain. At the moment, she has been working as a PhD student from 5 years at the Department of Nuclear Medicine of Ghent University Hospital. Her focus is on PET/MRI imaging of high-grade brain tumors. Since 2013, she is a member of the organizing committee of the Belgian Molecular Imaging Community. Two papers were published in 2014 and 2 new papers are currently submitted.

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