PhD3

BIOQIC

Quantitative characterization of tumor flow-metabolism mismatch by PET and MRI

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Application Area: Cancer **Modality:** MRI, PET, PET-MR **Related:** PhD 4, 5, 12, 13, 14

Background

Previous studies, using consecutive PET imaging with 2-[^{18}F]-fluoro-2-deoxy-D-glucose (FDG) and [^{15}O]water for quantitative characterization of glucose metabolism and blood flow, suggested that detection and quantitative characterization of flow-metabolism mismatch is clinically useful in various tumor entities(1). However, consecutive imaging is prone to errors of spatial registration and additional variability due to varying delay between the two scans and change of tumor status during this time interval.

Hypothesis

Simultaneous acquisition of PET and MRI with a PET/MRI hybrid system improves the accuracy of detection and quantitative characterization of flow-metabolism mismatch.

Methods

The project is centered on PET/MRI hybrid imaging for simultaneous acquisition of metabolism (by the PET component) and blood flow measures (by the MRI component). The project will comprise setup and optimization of acquisition protocols, image processing, tracer kinetic modelling, and multivariate image analysis.

Work Packages

WP1: Image derived input function

WP2: FDG-PET / perfusion MRI

WP3: Multivoxel pattern analysis

year 1 — *year 2* — *year 3*

WP1: Generation of the arterial input function for tracer kinetic modelling(2-5) of (dynamic) PET in simultaneously acquired PET/MRI data. This will build on MRI-based delineation and motion tracking of a large artery within the acquisition field-of-view.

WP2: Optimization of simultaneous FDG-PET/ perfusion weighted MRI for generation of parametric maps of regional cerebral blood volume, regional cerebral blood flow and mean transit time.

WP3: Identification of novel measures for quantitative characterization of flow-metabolism mismatch in tumors from the parametric maps generated in WP2 using machine learning tools such as multi-voxel pattern analysis(6).

Clinical Translation

In the follow-up of this PhD project, prospective clinical studies are envisioned to evaluate the clinical utility of the methods developed in the project.

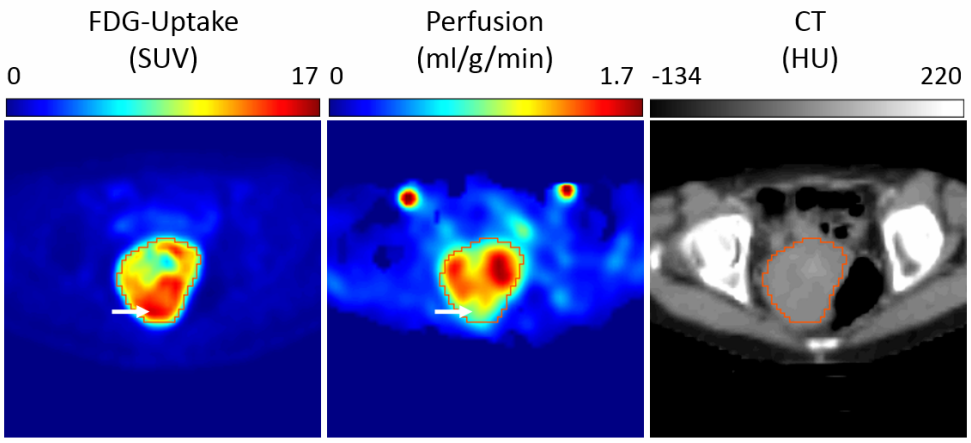

Figure: Transversal slices of consecutive FDG PET/CT (left/right) and [^{15}O]water PET (middle) in a patient with advanced cervical carcinoma prior to therapy. There is significant flow-metabolism mismatch predominantly in the dorsal part of the tumor (arrows). From (1).

Literature

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