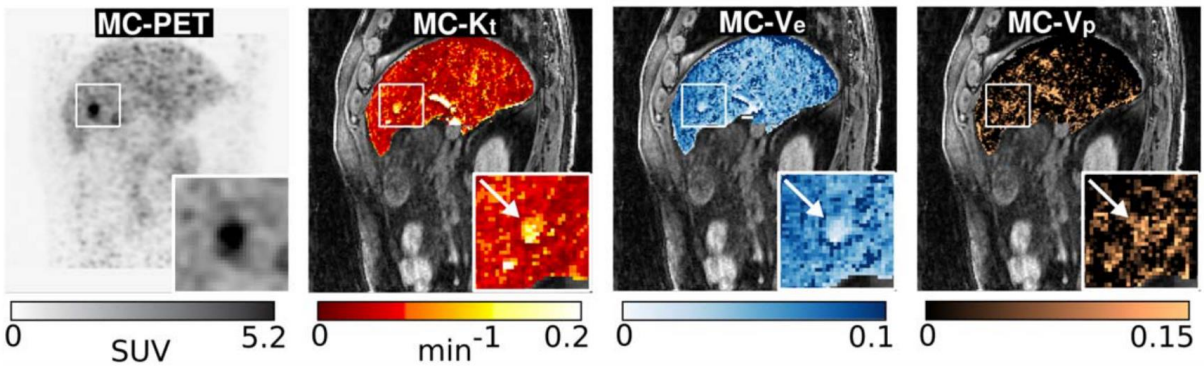
Characterization of hepatic lesions by simultaneous FDG PET, DCE-MRI, DWI and MRE

PIs: Marcus Makowski, Christoph Kolbitsch, Winfried Brenner, Ingolf Sack

Theme: Fluid transport

Background: Recent research has shown that metabolic function is related to mechanical and biophysical variables of soft tissue such as perfusion pressure, tissue osmotic pressure, and intracellular osmotic stress. These variables can be quantified in vivo with high spatial resolution using multiparametric MRI, including dynamic contrast-enhanced MRI (DCE), diffusion-weighted MRI (DWI), and MR elastography (MRE), and correlated with glucose metabolism as seen by FDG PET. To ensure the same state of blood flow and metabolic burden in the liver, PET and multiparametric MRI data should be acquired simultaneously in a hybrid PET-MRI system.



Multiparametric assessment of liver lesions with PET and quantitative DCE-MR (Kt: endothelial permeability, ve: fractional volume of contrast agent in the tissue extravascular extracellular compartment, vp: fractional volume of contrast agent in the blood plasma). Image taken from Ippoliti et al., PMB, 2021.

Hypothesis: Synchronous in vivo detection of blood perfusion, viscoelasticity and glucose metabolism improves the diagnosis and characterization of liver lesions in patients.

Methods: One of the major challenges in abdominal PET-MRI is respiratory motion, which leads to motion artifacts and misalignment between MRI and PET. Therefore, motion correction strategies which have been developed in previous BIOQIC projects will be incorporated into the proposed PET-MRE examinations. In addition, PET-MRE of the liver will be developed, which is challenging given the limited field homogeneity of PET-MRI scanners.

Collaboration: The PhD student will work closely with clinical experts in radiology (Prof. Makowski) and nuclear medicine (Prof. Brenner) and with experts in MR physics (Prof. Sack, Dr. Kolbitsch). All developed methods will be evaluated in patients early in the project ensuring fast clinical translation.

Impact: The proposed project will provide, for the first time, the data needed to comprehensively model and ultimately understand the relationship between metabolism, blood flow, and tissue mechanics in liver lesions.

Please contact Ingolf Sack (ingolf.sack@charite.de) for any further questions on this project.