Feasibility of dual-mice abdominal DW-MRI and dynamic ^{18}F-FDG-PET in a recently installed sequential 7 Tesla MRI-PET system

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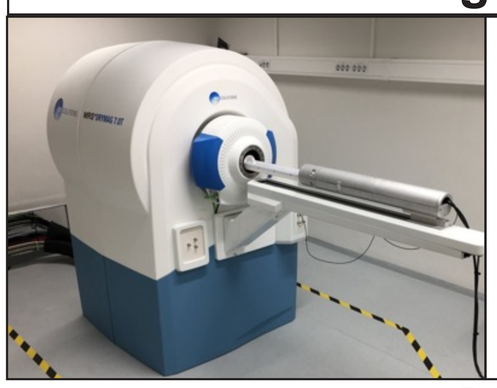
Background



MIC
Molecular Imaging Center

A new, small-animal sequential 7Tesla MRI-PET clip-on system (MR Solutions, UK) was recently installed at the core facility for imaging, Molecular Imaging Center, University of Bergen, Norway

We present the first ongoing study employing abdominal diffusion weighted (DW)-MRI and whole-body dynamic ^{18}F-FDG-PET using a dual-bed chamber in tumor-bearing mice

Method

Mice subcutaneously injected with patient-derived grade 3 endometrial cancer organoids underwent MRI-PET at tumor size ~ 30 – 300 mm^3.

Prior to imaging, mice were fasted overnight to minimize gastrointestinal background uptake from ^{18}F-FDG.
Before placement in the imaging bed, mice were anesthetized followed by lateral tail-vein canula insertion.
Breathing monitoring was available in one of the two mice, and temperature was kept constant throughout the scan.

Dual-mice imaging chamber

Imaging protocol

Step	Time	Comment
Anesthetize, weigh	5-10 min	Gas anesthesia
Teil vein cannulation	5-10 min	Necessary for PET
Scout	30 sec	Localizer/signal
Auto shim, calibrations	2 min	
Manual shim	~5 min	Required for DWI
T2, 1 avg	2 min	Verify positioning
T2, 3 avg	6 min	
Pre-EPI	1.5 minutes	Required for DWI
DWI	11 minutes	
Dynamic FDG	1 hour	Inject ~8 MBq (x2)
Scan time	90 min	

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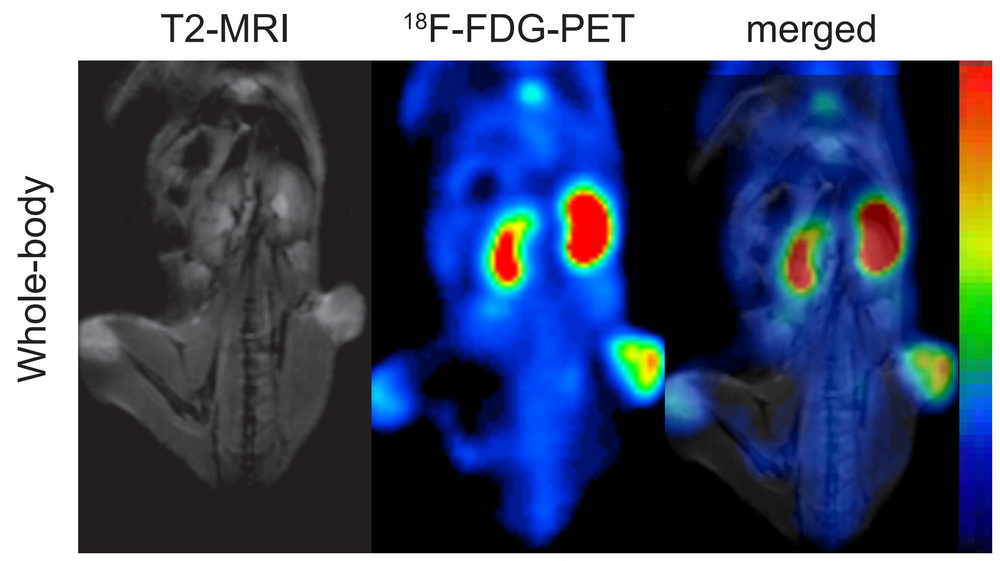
Related work

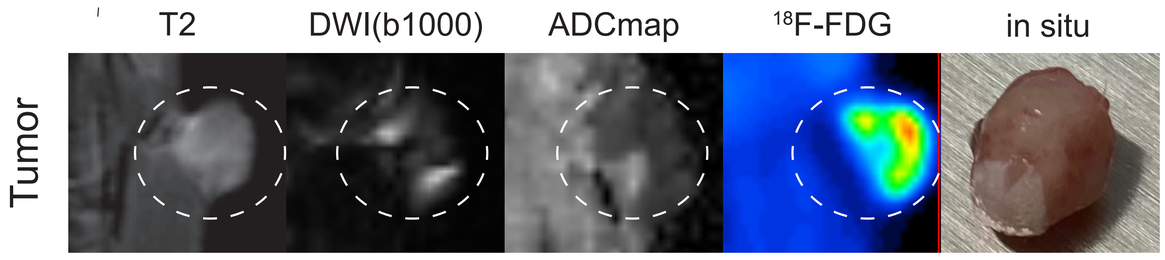
Results



Representative whole-body T2-MRI and ^{18}F-FDG-PET displaying one of the two mice. The mouse shown has tumors in the left and right flank.

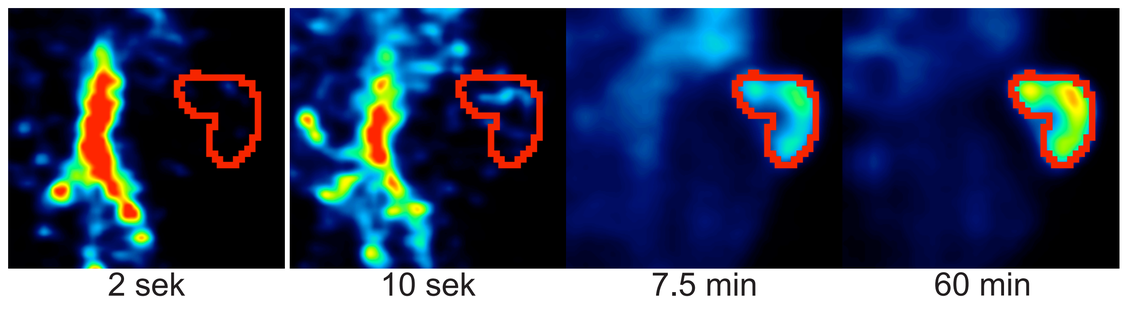
Coronal T2-weighted images were acquired using TE/TR 45/3500 ms, 3 averages, field of view 60x60 mm, resolution 0.25x0.23mm, slice thickness 0.8 mm.

Static PET images were reconstructed using the list-mode data from 30 to 60 min post ^{8}F-FDG injection. Reconstructions were performed applying a OSEM algorithm by two iterations and 32 subsets yielding voxel size of 0.42 mm^3 corrected for randoms and scatter.



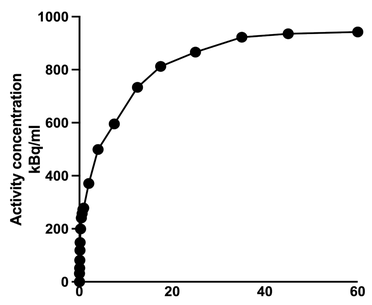
The tumors were clearly visualized on T2-weighted, DW-images with corresponding apparent diffusion coefficient (ADC)-maps and on ^{18}F-FDG-PET images.
Coronal DW-MRI was acquired using b-values of 0 and 1000 s/mm^2 (TE/TR 50/5000 ms, 4 averages, field of view 56x56 mm, resolution 0.54x0.54mm, slice thickness 0.54 mm).
ADC-parametric maps were generated and analyzed using VivoQuant 2020 (Invicro), and PET-images were analyzed using PMOD (Version 4.1).

Dynamic ^{18}F-FDG uptake in tumor



Dynamic images were reconstructed into the following time frames: 5 × 2s, 5 × 10s, 2 × 120s, 3 × 300s, 4 × 600s (19 frames).

^{18}F-FDG was genereosly provided from the Center for Nuclear Medicine/PET, Haukeland University Hospital



Summary

To date we have successfully acquired T2, DWI and ^{18}F-FDG-PET data in 8 mice, in a total of 14 scans (at multiple time-points). One non-tumor bearing mouse unfortunately died (stopped breathing) during image acquisition.

MRI tumor volume, ADC-values and metabolic tumor parameters from PET (SUV_{mean}/$_{max}$/$_{peak}$, MTV and TLG, Patlak) can be quantified and multiple imaging sessions are well tolerated in mice.

Preclinical MRI-PET imaging represents a promising and feasible imaging platform for non-invasive monitoring of tumor growth, and changes in tumor microstructures and metabolic features during tumor progression can be quantified.