Multi-centre image analysis of tumour-bearing mouse FDG-PET/(CT) data

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This multi-centre FDG-PET/(CT) image analysis project aimed to evaluate the impact of the image analysis method on dynamic preclinical FDG-PET/(CT) data comparability.

FDG-PET (n=6) and FDG-PET/CT (n=7) datasets from tumour-bearing mice were analyzed by trained and untrained investigators (n=8) from in total 7 different laboratories using their individual standard image analysis software and method for the respective organs. Apart from one investigator, the analysis was performed blinded. The investigators were asked to delineate the tumour, whole brain, muscle, heart or left ventricle, kidneys, liver and urinary bladder. Reporting included the used software program, intensity levels of the radiation scale, ROI/VOI size, delineation method, used image frame, activity concentration in the ROI/VOI (mean and max) and information on co-registration (PET/CT datasets).

The used image analysis software included three different programs. Images were analyzed in %ID/cc, SUV or kBq/ml. Organ delineation methods ranged from fixed objects (e.g. spheres) to manual delineation and semi-automatic methods using thresholding. For both datasets (FDG-PET and FDG-PET/CT), the smallest variation in the VOI sizes was obtained in the heart (50% CoV and 32% CoV), whereas the largest was obtained in the liver (234% CoV and 154% CoV), respectively. However, the different investigators obtained liver time-activity curves (TACs) given in SUVmean, which were nearly identical, whereas huge variations in the muscle, left ventricle and urinary bladder SUVmean TACs were obtained. Tumour SUVmean TACs also revealed high differences in the analysis methods (delineating the whole tumour or only the active volume). The inclusion of the CT data led to an improvement in the brain SUVmean TACs (reduction of the CoV from 14% to 5%, respectively). SUVmax TACs were almost identical in the

tumour, kidney and urinary bladder but exhibited some variations in all the other organs.

This is the first multi-centre study focusing on the influence of the image analysis method on the obtained results. We could show that the outcome of an FDG-PET/(CT) study heavily depends on the employed image analysis method. Especially the SUVmean changes with the region's position (e.g. muscle) and/or size (e.g. urinary bladder). Therefore, a standardized method for image analysis will be proposed based on the findings of this study.

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