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Imaging hypoxia with the PET-tracer F-18-fluoromisonidazole (F-MISO) -First experience

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Purpose/Objective: PET-CT has an established role in radiation therapy treatment planning of non-small cell lung cancer (NSCLC). In recent years, in addition to F-18-Fluorodeoxyglucose (FDG), more specific tracers are used to provide further information about the tumor biology as hypoxia, which has been associated with decreased sensitivity to radiotherapy and is known as a negative prognostic factor for tumor recurrence. F-18-fluoromisonidazole (F-MISO) can be used to visualize tumor hypoxia. Therefore, the aim of this study was to investigate the feasibility of F-MISO PET-CT in patients with NSCLC.

Materials and Methods: Five patients (5 men) with histological proven NSCLC were included in this prospective study. All of them underwent FDG- and F-MISO PET/CT before radiation therapy. All PET/CT-scans were performed on a Siemens mCT 64-scanner.
Data analysis was performed using the InterViewFusion software (Mediso Medical Imaging, Hungary). The FDG-positive tissue was segmented with a percentaged threshold of 40 % of the maximum standardised uptake value (SUV). The F-MISO-positive tissue was segmented with a threshold determined by 1.2 *background activity (measured in an equivalent contralateral region).
After co-registration of the two PET-CT examinations, ROIs were visually compared and absolute volumes were determined. A rigid-registration algorithm was applied resulting in a partial overlap between the FDG- and the F-MISO-positive tissue.

Results: In all patients the primary tumor and, if present, lymph node metastases showed high FDG uptake. However, accumulation of F-MISO in hypoxic subvolumes was rare and only one of five patients showed significant tracer uptake in two lesions. In this patient FDG-PET positive tissue showed only partial F-MISO uptake. For the first lesion (intrapulmonary metastases) the segmented F-MISO volume was only 45 % of the FDG-avid volume, for the second one (primary tumor) the relative difference was 67%.

Conclusions: F-MISO has the ability to segment hypoxic subvolumes in NSCLC. However in our patient collective only 20 % of the patients showed hypoxia. For further analysis, follow-up F-MISO scans are planned to evaluate changes during radiation therapy. However, due to small sample size, no final conclusions can be drawn at this moment.