Conclusions: This analysis showed a MDC with a statistically significant advantage in favor of sequence A for both CTV and nodal subvolumes. Nevertheless, MDC in sequence B for CTV and subvolume 1 were close to 0.80 and therefore clinically reliable, with a time sparing of 93%. Final analysis will confirm the clinical reliability and feasibility of the system and the total time sparing for both the Delineator and the Reviewer.

PO-0753

Use of [18F]-fluoromisonidazole PET for radiotherapy planning in head and neck squamous cell carcinomas

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Purpose/Objective: Positron emission tomography (PET) with [18F]-fluoromisonidazole (FMISO), a tracer of hypoxia, is particularly useful in radiotherapy with potential dose escalation on hypoxic subvolumes. However, the definition of FMISO volumes remains problematic due to the low contrast of the images and the absence of consensus about the segmentation methods.

Materials and Methods: The aim of this methodological study about the use of FMISO PET for radiotherapy planning is to determine the best timing for acquisitions and to study different volume segmentation methods. For this purpose, 15 patients with head and neck squamous cell carcinomas (HNSCC) underwent FMISO-PET/Computed tomography (CT) with several acquisitions at 2, 3 and 4 hours after injection of the tracer and three different automatic segmentation methods of PET volumes were tested. The first method was a fixed thresholding, the FMISO volume being defined by all voxels having an activity ≥ 1.4 of the activity of the background (A0). The second method was an adaptive thresholding based on the ratio between the maximum tumour activity (A1) and A0 (R1/n). The third method was a stochastic algorithm, the fuzzy locally adaptive Bayesian (FLAB) method. Tumour volumes were also manually delineated on the CT images by the radiation oncologist.

Results: For one patient, no hypoxia was observed. For eight patients, hypoxia was observed in the primary tumour and nodes, for two in the primary tumour only and for four in the nodes only. The calculated mean R1/n was 2.5 (range 1.7-2.9), 3.1 (range 2-4.5) and 3.4 (range 2.3-6.1) for images acquired at 2, 3 and 4 hours respectively. It appears that the best contrast is obtained on the 4 hour-acquisition. At 4 hours, the mean FMISO volumes were 18.9 cc (range 0.1-81) with the fixed threshold, 9.5 cc (range 0.9-33.1) with the adaptive threshold and 12.5 cc (range 0.9-38.4) with the FLAB method. The volumes defined with the adaptive threshold were also the smallest. The fixed threshold led to larger volumes (199% of the adaptive volumes) and the FLAB volumes were intermediate (132% of the adaptive volumes). CT volumes were much larger with a mean of 39.1 cc (range 1.2-116) corresponding to a value more than 4 times larger than the FMISO adaptive volume.

Conclusions: Compared to CT Imaging, FMISO PET imaging in HNSCC enables to define restricted volumes, on which a potential increase of the radiation dose is possible. For a radiotherapy application, images must be acquired 4 hours after injection to provide a better contrast. Adaptive or stochastic methods are more appropriate to FMISO volume segmentation. Indeed, FMISO images are low contrasted and fixed thresholding leads to overestimated volumes. However, because of the lack of published data, additional work is required before using FMISO PET to guide dose painting in intensity modulated radiotherapy.

PO-0754

Stereotactic radiotherapy of liver metastases: 4DCT treatment planning and MRI follow-up on normal tissue response

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Purpose/Objective: SBRT is increasingly considered an alternative to surgical resection of liver metastasis or liver related cancers. Our clinical workflow consists of precise target localization; analysis of tumor motion due to respiration; highly conformal dose distribution; and image-guidance at the time of dose delivery. Tumor and normal tissue response is monitored through morphological changes by MRI. Quantitative in vivo data of the hepatic tolerance to irradiation is very limited. However, such knowledge is essential for the treatment strategy in patients with multiple or large tumors or in situations with a small parenchymal reserve after liver resection. In a feasibility study for further healthy liver sparing, four consecutive patients with liver lesions were retrospectively evaluated.

Materials and Methods: Clinical cases consist of (1) solitary metastases/breast cancer; (2) four metastases/cholangiocellular carcinoma; (3) R1-resected gallbladder cancer; (4) multiple metastasis/bladder cancer. For all patients a 4D-CT scan was performed. GTV contours of the single calculated respiratory phases (10 in total) were transferred to the average CT of the 4D-CT data to generate the ITV. Highly conformal dose coverage was achieved by Varian VMAT using 6 MV photons. Dose prescription ranged from 5 to 7 Gy (60% isodose surrounding the PTV) to 25 x 1.8 Gy (ICRU). MRI was carried out before and 6 weeks/month after therapy. MR-sequences were conducted with T1-w GRE enhanced by hepatocyte-targeted Gd-EOB-DTPA. MRI data sets were merged with the planning CT including the dose distribution. Reviewers indicated the border of hypointensity on T1-w images (loss of hepatocyte function) or hyperintensity on T2-w images (edema). The potential of healthy liver sparing was estimated by the threshold dose for these morphological changes.

Results: Analysis of the 4D-CT data resulted in a mean target motion from 5 to 9 mm in magnitude. Kilo-voltage CBCT scans were created before each fraction to verify and adjust the target localization. Image fusion of the average treatment planning CT and kV-CBCT scans resulted in patient repositioning in a maximum of 6 mm magnitude per fraction. The dose to the liver was within accepted guidelines (700 ml healthy liver receiving less than 15 Gy). The minimum dose resulting in visible signal intensity changes (edema/loss of hepatocyte function) was approximately 20 Gy (Fig. 1). Depending on the number, size and location of the metastases and the healthy liver volume, the remaining healthy volume (excluding the 20 Gy liver subvolume) measures from 10 to 40%.

Conclusions: In SBRT of liver metastases, 4D-CT data is required for target motion management and treatment planning. In this preliminary retrospective evaluation, a threshold dose of approximately 20 Gy inducing focal loss of liver function was detected after 4 weeks by MRI. Further investigation is warranted to assess the correlation between morphological changes in the mean dose exposure to the liver and clinical outcome.