Feasibility and challenges of a cumulative dosimetry using different dosimetry software after External Beam Radiotherapy (EBRT) and Molecular Radiotherapy (MRT) treatments

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Abstract

a) Background: External Beam Radiotherapy (EBRT) and Molecular Radiotherapy (MRT) are cancer treatments with distinct irradiation patterns. This study investigates a methodology enabling voxel-based biologically effective dose (BED) superposition on 2 different software.

b) Methods: An anthropomorphic thorax/heart phantom (5220-RS800T) containing various ^{177}Lu inserts was imaged at 4 time-points (SPECT/CT). EBRT planning was performed using Eclipse V15.6. MRT and cumulative dosimetry was performed using PLANET® Dose V3.3 and OpenDose3D V1.0 (independently).

The EBRT CT was registered (rigid) against the MRT CT reference (D0), thereby allowing EBRT segmentations and absorbed dose (AD) maps to be aligned with the MRT dataset. 3D cumulative BED maps and BED-volume histograms were generated using the linear-quadratic model.

c) Results: AD maps to liver, lungs, tumours (2) were calculated for EBRT and MRT. On OpenDose3D, the larger tumour received 10 Gy and 21.7 Gy from MRT and EBRT, respectively, while the liver and lungs exposition was smaller (≤ 2.8 Gy for the liver, <0.1 Gy for lungs). On PLANET® Dose, the results were consistent, with mean ADs in tumours and OARs differing by less than 0.2 Gy compared to OpenDose3D. After BED conversion on OpenDose3D, the larger tumour reached 10.1 Gy and 60 Gy from MRT and EBRT, respectively. OARs remained below 4 Gy.

d) Conclusion: This work represents a proof of concept of combined EBRT and MRT integration in treatment planning systems. Applications to 7 patients with various cancers treated by combined radiotherapy are currently processed and will be presented.

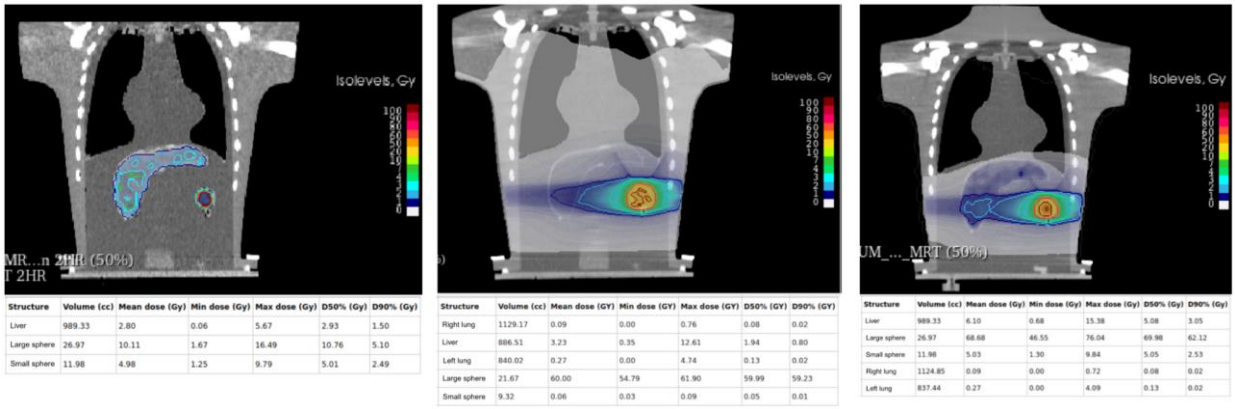

Figure 1: 3D voxel-level BED maps generated in OpenDose3D (left: MRT BED, center: EBRT BED, right: BED sum)