AbstractID: 9592 Title: 4D Imaging of lung cancer patients treated with stereotactic body radiotherapy (SBRT): Assessment of target volumes

Purpose: To compare target volumes assessed via 4D and free-breathing CT scans for patients treated with peripheral lung lesions.
Materials and methods: The target volumes of five lung cancer patients imaged using 4D-CT and treated with hypo-fractionated SBRT (12 Gy/Fxn x 4Fxn) were retrospectively analyzed. For each patient 6-to-8 CT datasets were acquired between inhale and exhale respiratory phases on a Philips 16 slice 4D-CT scanner. The GTV was segmented on each dataset using a maximum-intensity-projection (MIP) method and an ITV (ITV_{4D}), representing the composite of GTVs, was formed. The ITV_{4D} was expanded uniformly 5mm to generate a PTV (PTV_{4D}). The GTV was also contoured on the free-breathing scan and expanded using population-based margins of 5mm and 10mm in the axial and longitudinal planes, respectively, to form a free-breathing-based PTV (PTV_{FB}), following RTOG #0236. Finally, a target volume defined as a composite of GTVs contoured on only the inhale and exhale datasets was generated to form the ITV_{Inh_Exh}.
Results: For three of five patient images, PTV_{4D} was substantially larger than PTV_{FB} (average increase of 33%; max.=65%). In one case the volumes were equivalent and in the remaining case PTV_{4D} was 11% smaller than PTV_{FB}. Significant shape changes were also observed in some instances between PTV_{4D} and PTV_{FB} suggesting that PTV_{FB} was improperly designed. The ITV_{Inh_Exh} was smaller than the ITV_{4D} in all cases (mean=31%; max.= 78%, smaller) suggesting that the inhale and exhale breathing phases sometimes fail to capture the largest extents of tumor motion in the respiratory cycle.
Conclusion: Results suggest that, based on 4D imaging, the use of population-based margin expansions may not adequately account for tumor motion of peripheral lung tumors. This may be of increased consequence in the SBRT setting, where the overall effects of motion may be escalated given the small number of fractions.
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