Can a consistent dose to the target volume in SBRT be obtained by prescribing on the mean ITV dose?

Purpose or Objective:
Dose fractionation, normalization and the dose profile inside the target volume varies significantly between different institutions and methods for lung SBRT. A comparison of dosimetric as well as outcome data amongst institutions is therefore difficult. Published planning studies have shown that, despite dose prescription on the covering isodose of the PTV, the mean dose in PTV and ITV varied significantly, in particular when comparing different dose delivery techniques. This multi-center planning study of the DEGRO AG Stereotactic Radiotherapy investigated whether a prescription on the mean ITV dose results in more comparable dose distributions among participating centers and methods.

Material and Methods:
CT images and structures of ITV, PTV and all relevant OAR for two patients with early stage NSCLC were sent to all participating institutions. Each institute created a treatment plan with the technique commonly used in the institute for lung SBRT. The specified dose fractionation was 3x21.5 Gy normalized to the mean ITV dose, this corresponds to 3x15Gy on the 65% isodose. Other constraints on ITV, PTV and OAR are given in Tab. 1. Kruskal-Wallis test was used to compare results for PTV and GTV doses between different delivery techniques.

Results:
57 plans from 27 institutions could be collected. These contained 8 Robotic Radiosurgery (RRS), 34 modulated plans (MOD), and 15 3D conformal (3D) plans. Only one plan could not fulfill the given constraints (high conformity index) while in 18 cases there was a minor deviation. Due to the normalization the mean ITV dose was identical in all cases and the median dose in the ITV varied only marginally (64.1-65.7 Gy). For both patients the median coverage of the ITV with the 90% Isodose was above 98% (94.2-100%). The median of the mean dose in the PTV did not differ significantly between the two patients (56.9 Gy vs 56.6 Gy). There was only a small difference between the techniques, with RRS having the lowest mean PTV Dose with 55.9 Gy followed by MOD plans with 56.7 Gy and 3D plans with 57.5 Gy having the highest as shown in Fig. 1. The Coverage of the PTV with the 70% Isodose (= 45Gy) showed no significant variation between the techniques however it was planner dependent (90-100%), with four plans being below 95% coverage (3 MOD and 1 3D plan). No significant difference could be found between the conformity indices. It was slightly lower for robotic radiosurgery and modulated plans.
(median 1.12) than for 3D conformal plans (median 1.18). For the different organs at risks no significant difference between the techniques could be found.

Conclusion:
This planning study showed that normalization on the mean ITV dose in combination with detailed constraints for the PTV and ITV can lead to consistent dose distributions for different delivery techniques. The only significant difference found was the mean PTV dose, but the difference was small.

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