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Abstract

Stereotactic MRI-Guided Adaptive Radiotherapy (SMART) in Stage I NSCLC

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Objectives: Since 10% of patients develops a local relapse after SABR for stage I lung cancer, there is stil room for improvement. An approach for delivering breath-hold SABR under continuous MRI guidance was implemented at our center in May 2016, using an MR-guided radiation therapy unit. Daily plan re-optimization is performed for all treatment fractions, based on PTV coverage and organs at risk (OAR) constraints. We studied the dosimetric benefits of applying daily plan re-optimization in lung SABR.

Methods: Thus far, 55 fractions of SMART were performed in 7 pts at high risk for toxicity. Before each fraction, imaging was performed using 0.35T MR during shallow inspiration breath-hold (17 sec; res. 1.6_1.6_3.0mm). Setup was based on GTV. OARs within 3cm from the PTV were manually adjusted. The original plan was re-optimized for each fraction using the same number and direction of IMRT beams, to create a "plan of the day". QA included an independent dose calculation step for the new plan. Gated breath-hold delivery was performed under continuous MR-guidance with 3mm GTV-PTV margin. Video feedback to the patient was used to facilitate delivery. We evaluated the "predictive" plans (calculated baseline plans (with "anatomy of the day") with the re-optimized treatment plans (plan of the day).

Results: The average PTV was 22.2cc (range 4.2-40.1cc). SMART PTV's (GTV+3mm) measured on averageonly 61% (range 50.2-77.1%) of PTV's that would have been generated from free-breathing 4DCT scans (ITV+5 mm). The complete SMART procedure, including gated delivery during breath-hold could be completed within approximately 60 minutes per fraction. Median PTV coverage of the baseline and re-optimized plans were 90.4±6.8% and 95.0±0.2%, respectively. However, CTV coverage was adequate for both the baseline and reoptimized plans (98.6±3.6% and 99.3±2.6%, respectively). Re-optimization did not increase the lung V20Gy, which was on average 314cc and 311cc, for the baseline and re-optimized plans, respectively. As the relevant OARs varied between patients, it is not possible to draw general conclusions about OAR doses. However, all re-optimized plans ensured that OAR doses remained within preset constraints for each fraction. More data will be available and presented during the meeting.

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Conclusions: Reductions in PTV size due to both continuous image-guidance and gated delivery in breath-hold account for the greatest benefit of SMART for this subgroup of patients with high-risk lung cancer, but no clear advantage was observed for target coverage.