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

Corresponding author: Ben J. Slotman

1. Department of Radiation Oncology, VU University Medical Center 2. Radiation Oncology, VU University Medical Center, Amsterdam, The Netherlands 3. Radiation Oncology, VU University Medical Center 4. Radiation Oncology, VU University Medical Center 5. Radiation Oncology, VUMc Medical Center 6. Radiation Oncology, VU University Medical Center 7. Radiation Oncology, VU University Medical Center

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Abstract

Objectives: Since 10% of patients develops a local relapse after SABR for stage I lung cancer, there is still 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 5cm 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+5mm) measured on average only 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, CT 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.

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.