

Purpose: Irradiation during DIBH for lung SABR allows the use of small safety margins. This strategy therefore requires high in-treatment tumor repositioning accuracy through real-time information on patient's internal anatomy. Moreover, eligible patients often suffer from comorbidities that challenge the treatment feasibility. Mechanically-assisted and non-invasive ventilation (MANIV) has the potential to reduce the patient's work of breathing while ensuring excellent positional breath-holds reproducibility without the need of instantaneous tumor imaging.

Methods: Lung SABR (5 x 11 Gy) with MANIV was delivered to two patients whose lesions were marked by a gold fiducial. The 3D planning CT was acquired during a mechanically-induced apnea. A back-up free-breathing 4D CT was also performed. The PTV was generated by an empirical 7mm isotropic GTV dilation. The mechanical ventilator produced perpetual cycles of exhalations and 30 seconds apneas by alternating two pressure levels with oxygen-enriched air. Using surface imaging, the beam was interrupted when the monitored surface was out of tolerances. The 3D residual fiducial motion during irradiation was reconstructed off-line with a 2D-3D inference model based on intra-fraction cone beam CT frames. The delivered dose to the GTV was then recomputed from the tumor trajectory, imaging logfiles and RT plan data for different PTV sizes.

Results: All 10 fractions were successfully delivered with a mean delivery time of 49.0 ± 11.2 minutes. 95.5%/98.2% of 3D fiducial deviations were below 5 mm for the left lower lobe and right upper lobe lesions, respectively. PTV volumes generated by an isotropic extension of 3mm, 5mm and 7mm were 7.4cc/5.4cc, 13.2cc/9.8cc and 21.3cc /16.0cc while PTV-ITV was 26.1cc/17.9cc, respectively. This resulted in a relative change between planned and delivered GTV D99% of +2.7%/-4.78%, +2.1%/-2.43% and +2.3%/-1.57%, respectively.

Conclusion: MANIV appears to be a promising technique allowing to perform accurate gated lung SABR in the environment of a conventional linear accelerator.