Monte Carlo calculations support organ sparing in Deep-Inspiration Breath-Hold intensity-modulated radiotherapy for locally advanced lung cancer - DTU Orbit (28/12/2018)

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Background and purpose: Studies indicate that Deep-Inspiration Breath-Hold (DIBH) is advantageous over Free-Breathing (FB) for locally advanced lung cancer radiotherapy. However, these studies were based on simplified dose calculation algorithms, potentially critical due to the heterogeneous nature of the lung region. Using detailed Monte-Carlo (MC) calculations, a comparative study of DIBH vs. FB was therefore designed.

Material and methods: Eighteen locally advanced lung cancer patients underwent FB and DIBH CT imaging and treatment planning with the Anisotropic-Analytical-Algorithm (AAA) for intensity-modulated-radio therapy or volumetric-modulated-arc-therapy using 66 Gy in 33 fractions. All plans were re-calculated with MC.

Results: Relative to FB, the total lung volume increased 86.8% in DIBH, while the gross tumor volume decreased 14.8%. MC revealed equally under- and over-dosage of the target for FB and DIBH, compared to AAA. For the Organs-At-Risk (OARs), DIBH reduced the mean heart dose by 25.5% (AAA) vs. 12.6% (MC), the total lung V5Gy/V20Gy by 9.0/20.0% (AAA) vs. 11.6/19.9% (MC).

Conclusions: MC calculations revealed (i) that DIBH compared with FB can significantly reduce the dose to the OARs even if the treatment planning is carried out with AAA, and (ii) inferior target dose coverage compared to AAA, irrespectively of FB and DIBH. The dose deviations were similar for FB and DIBH. The observed inferior target dose coverage relates therefore to the treatment planning algorithm rather than breathing technique. © 2015 Elsevier Ireland Ltd. All rights reserved.