

Geometric uncertainties in voluntary deep inspiration breath hold radiotherapy for locally advanced lung cancer

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Abstract

Background and purpose

Deep inspiration breath hold (DIBH) increases lung volume and can potentially reduce treatment-related toxicity in locally advanced lung cancer. We estimated geometric uncertainties in visually guided voluntary DIBH and derived the appropriate treatment margins for different image-guidance strategies.

Material and methods

Seventeen patients were included prospectively. An optical marker-based respiratory monitoring with visual guidance enabled comfortable DIBHs, adjusted to each patient's performance. All patients had three consecutive DIBH CTs at each of the treatment fractions 2, 16 and 31. DIBH reproducibility was evaluated as inter- and intra-fractional variations in lung volume, tumour position and differential motion between primary tumour and mediastinal lymph nodes.

Results

Lung volume increased by median 60% in DIBH. Inter- and intra-fractional lung volume variations were median 2.1% and 1.1%, respectively.

Inter- and intra-fractional uncertainties in 3D tumour position were 4.8 ± 2.8 mm and 1.7 ± 1.4 mm (mean \pm SD). Inter- and intra-fractional differential motion was 4.8 ± 3.3 mm and 0.0 ± 1.1 mm.

Conclusions

For single targets, visually guided voluntary DIBH radiotherapy is highly reproducible provided an image-guidance strategy with tumour registration is performed. If the primary tumour is separated from the mediastinal lymph nodes, inter-fractional differential motion remains a challenge and margins must be adapted to reflect the image registration strategy.