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## Lung volume assessment for a cross-comparison of two breathing-adapted techniques in radiotherapy.

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### PURPOSE:

To assess the validity of gated radiotherapy of lung by using a cross-check methodology based on four-dimensional (4D)-computed tomography (CT) exams. Variations of volume of a breathing phantom was used as an indicator.

### METHODS AND MATERIALS:

A balloon was periodically inflated and deflated by a medical ventilator. The volume variation ( $\Delta V$ ) of the balloon was measured simultaneously by a spirometer, taken as reference, and by contouring 4D-CT series (10 phases) acquired by the real-time position management system (RPM). Similar cross-comparison was performed for 2 lung patients, 1 with free breathing (FB), the other with deep-inspiration breath-hold (DIBH) technique.

### RESULTS:

During FB,  $\Delta V$  measured by the spirometer and from 4D-CT were in good agreement: the mean differences for all phases were 8.1 mL for the balloon and 10.5 mL for a patient-test. End-inspiration lung volume has been shown to be slightly underestimated by the 4D-CT. The discrepancy for  $\Delta V$  between DIBH and end-expiration, measured from CT and from spirometer, respectively, was less than 3%.

### CONCLUSIONS:

Provided that each slice series is correctly associated with the proper breathing phase, 4D-CT allows an accurate assessment of lung volume during the whole breathing cycle ( $\Delta V$  error <3% compared with the spirometer signal). Taking the lung volume variation into account is a central issue in the evaluation and control of the toxicity for lung radiation treatments.