Respiratory Gated CT Scanning for Radiotherapy Planning of Breast Cancer

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Adjuvant radiotherapy for breast cancer reduces the risk of local recurrence and improves long-term survival. The irradiation is typically delivered as two opposing tangential fields, encompassing the breast. The lung tissue adjacent to the breast is therefore included in the radiation fields, resulting in a risk of late lung toxicity. For the left sided breast cancer patients, the heart may be partially inside the irradiated area as well, resulting in high risk of cardiac toxicity as a late effect of radiotherapy.

Irradiation of lung and heart tissue may be reduced with application of respiratory management by means of inspiration gating or deep inspiration breath hold.

In deep or moderate inspiration, the total lung volume inflates considerably, while the absolute amount of lung volume included in the treatment field remains the same, resulting in decreased dose to the whole lung. Further, in inspiration the heart moves caudally away from the irradiated area, increasing the distance between the heart and the target and therefore resulting in considerably decreased risk of cardiac toxicity.

Without the respiratory management, compromising target coverage would be a necessity in order to spare the heart and the lungs: in case of omission of the internal mammary nodes from irradiation to spare the heart the overall survival will decrease.

Several techniques have been developed to manage respiratory motion during computed tomography (CT) image acquisition for radiotherapy planning. Respiratory gated CT scans for radiotherapy planning of breast cancer can be performed in inspiration, either as inspiration gating of the CT scanner or as deep inspiration breath hold (DIBH) scan.

A respiration signal can be applied from a surrogate placed on the patient’s thorax or measured with a spirometer. Regardless, it is crucial that the patients are able to breathe very regularly or hold their breath at a certain predefined level. The quality of the acquired CT images can be degraded by non-regular respiration pattern and/or poor DIBH, and will compromise the reproducibility and precision of during daily treatment, delivered in up to 33 fractions. Effective respiratory guidance is therefore necessary for patient compliance and treatment reproducibility: visually guided DIBH may be preferable to audio coached inspiration gating, showing superior reproducibility and patient compliance.

References:

4. Thorsen LB, Thomsen MS, Jensen I, et al. CT-planned internal mammary node radiotherapy in the DBCG-IMN study: benefit versus potential harmful effects. Submitted Acta Oncol