Does deep inspiration breath-hold reduce irradiated lung volumes in left-sided breast radiotherapy?

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Purpose/objective:
Deep inspiration breath-hold (DIBH) is utilised for left sided breast cancer treatments with intent to reduce cardiovascular radiation-induced side effects. Studies show this can be achieved whilst maintaining or improving target coverage and with an associated decrease in lung dose.¹,²
Cancer Partners UK have been using DIBH for left sided breast patients since February 2013 and we have previously reported the reduction of cardiac doses observed.³ This study assesses the effect of DIBH on lung doses for left sided patients treated at our centres.
The study also investigated how central lung depth (CLD) relates to lung doses since some centres still use CLD to assess or limit lung dose in breast irradiation.

Material & methods
- Study included 169 left breast cancer patients treated in 2014 using the Syatrion X (SDK) Respiratory Gating system and Forward-Planning IMRT.
- Includes 128 patients treated with tangential breast radiotherapy and 41 patients with additional nodal irradiation using a mono-isocentric technique.
- 40Gy/16Fr and 50Gy/24Fr prescriptions are included in this study.
- During the pre-treatment session two CT scans were acquired, one in DIBH and one in free-breathing (FB).
- The treatment was planned on the DIBH CT using Philips Pinnacle treatment planning system (TPS) and then, based on tissue volume equivalence, the plan was copied to the FB scan.
- Both plans were analysed to determine the CLD, and the volume (cc) and percentage of lung receiving at least 50% of the total dose (V50%). The bilateral lung V50% was also assessed and within the cohort of patients, 75 were re-evaluated to include the (isolation lung V50%) as used in the UK FAST trial.
- Wilcoxon-Signed Rank tests were used to compare DIBH and FB metallic statistics.
- Treatment was delivered on Elekta Synergy and VersaHD linear accelerators.

Results
Median and inter-quartile range (IQR) data in table 1 and figure 1 show that DIBH led to an increase in CLD and in volume (cc) of left lung in field, but a decrease in V50%V and in percentage volume of left lung in the field. A non-parametric Wilcoxon Signed Rank test was carried out which demonstrated the results were statistically significant (p<0.001) for all parameters.

Conclusions
DIBH led to an overall reduction in lung dose.
CLD is not an accurate measure of lung dose in DIBH. Dose volume information should be used during radiotherapy planning for breast cancer.

References

Acknowledgements: Cancer Partners UK Physics and Dosimetry Department.

Table 1. Comparison of median and inter-quartile range (IQR) for DIBH and FB.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DIBH median (IQR)</th>
<th>FB median (IQR)</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>V50%V, Volume of left lung in field (cc)</td>
<td>176 (144-200)</td>
<td>159 (91-190)</td>
<td>&lt;0.001</td>
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<tr>
<td>V50%V, Percentage of left lung in field (%)</td>
<td>6.7 (4.6-8.1)</td>
<td>10.3 (8.4-13.7)</td>
<td>&lt;0.001</td>
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<td>Central lung depth (cm)</td>
<td>19.7 (16.3-21.3)</td>
<td>17.0 (14.4-21.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Left lung V50%</td>
<td>6.7 (4.6-8.1)</td>
<td>11.0 (7.5-14.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Left lung V50% (V50%)</td>
<td>10.2 (7.1-11.0)</td>
<td>13.0 (10.6-14.9)</td>
<td>&lt;0.001</td>
</tr>
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*V50% available for subset of 75 patients. Wilcoxon matched-pairs signed rank test.

DIBH led to a reduction in the V50%V for 126 (76%) patients (Fig. 2). There was a small increase (15%) for 13 (8%) patients however cardiac doses were reduced in these cases.
For the subset of 75 patients the V50%V was analysed and there was a median reduction with DIBH from 13.7% to 10.3% with all cases within the optimal V50%V<12% constraint.

Figure 2. Change in lung V50%V with DIBH