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[1,2,3].

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[4].

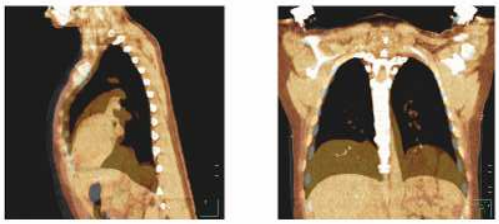
This study assesses the effect of DIBH on lung doses for left breast patients treated at our centres.

The study also investigates 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 includes 159 left breast cancer patients treated in 2014 using the SpiroDyn'rX (SDX) Respiratory Gating system and Forward-Planned IMRT.
- Includes 128 patients treated with tangential breast radiotherapy and 31 patients with additional nodal irradiation using a mono-isocentric technique.
- 40Gy/15# and 50Gy/25# 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 Phillips Pinnacle3 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 ipsilateral lung V18Gy was also assessed and within the cohort of patients, 75 were re-evaluated to include the ipsilateral lung V30% (as used in the UK FAST trial).
- Wilcoxon-Signed Rank tests were used to compare DIBH and FB statistics.
- Treatment was delivered on Elekta Synergy and VersaHD linacs.

Image 1.
Sagittal and coronal slice of fused FB and DIBH planning scans



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 V18Gy, V30% 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.

Figure 1. Comparison of DIBH & FB ipsilateral lung V18Gy (%) & V30% (%)

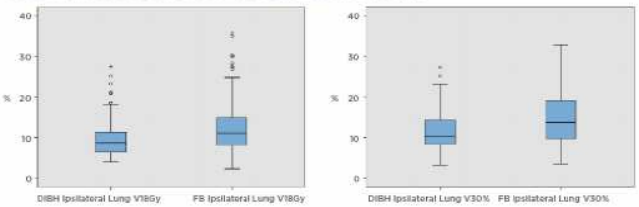


Table 1. Comparison of median and inter-quartile range (IQR) for DIBH and FB

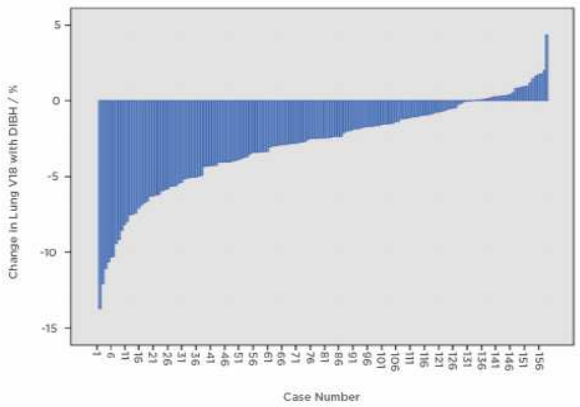
Parameter	DIBH median (IQR)	FB median (IQR)	p*
V50%, 'Volume of left lung in field' (cc)	176 (128 - 224)	139 (91 - 186)	<0.001
V50%, 'Percent of left lung in field' (%)	7.8 (5.6 - 10.1)	10.3 (6.9 - 13.7)	<0.001
Central lung depth (cm)	1.9 (1.7 - 2.1)	1.70 (1.4 - 2.0)	<0.001
Left lung V18Gy (%)	8.7 (6.4 - 11.1)	11.0 (7.5 - 14.6)	<0.001
Left lung V30% (%)*	10.2 (7.1 - 13.3)	13.8 (8.9 - 18.6)	<0.001

*V30% available for subset of 75 patients *Wilcoxon matched-pair signed rank test

DIBH led to a reduction in the V18Gy for 126 (79%) patients (Fig. 2). There was a small increase (<5%) for 13 (8%) patients however cardiac doses were reduced in these cases.

For the subset of 75 patients the V30% was analysed and there was a median reduction with DIBH from 13.7% to 10.3% with all cases within the optimal V30%≤15% constraint.

Figure 2. Change in lung V18% with DIBH



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

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