Deep inspiration breath hold in breast radiotherapy: Are significant reductions in cardiac doses observed?

R Mamon¹, H Chesham, G Bee¹, H Ariyaratne¹,², B Lavery⁴, T Davies⁵, S Jansen van Rensburg¹

¹Cancer Partners UK, United Kingdom
²Mount Vernon Cancer Centre, Northwood, United Kingdom
³Oxford University Hospital, Oxford, United Kingdom
⁴Northampton General Hospital, Northampton, United Kingdom
Email research@cancerpartnersuk.org

Purpose/objective

Radiotherapy treatment for breast cancer increases the risk of major coronary events, with dose received by the heart (descending (LAD) coronary artery area) an area of particular concern. Published findings suggest an increase of stenosis in the mid and distal LAD coronary artery in breast patients where dosimetric hot-spots are observed within the structure. This study explores the use of deep inspiration breath hold (DIBH) as an effective method to reduce doses to the whole heart and LAD coronary artery during left sided breast radiotherapy.

Material & methods

• This retrospective study investigates 296 left-sided breast cancer patients treated with DIBH across Cancer Partners UK centres between January 2014 and December 2014.
• All patients underwent two CT scans, one in free breathing (FB) and one in DIBH using the Varian Synergy® (EXO) breathing control system.
• Planning was completed on the DIBH scan using Phillips Pinnacle® TPS and transferred to FB scan using volume transmission equivalence.
• An agreed internal standard atlas for whole heart and LAD contouring was followed to ensure consistency. A PRV margin of 10cm was added to the LAD.
• Mean dose to the whole heart was recorded for 296 patients along with 75 patients near maximum dose and mean LAD coronary artery doses, as per ICES 83.
• Treatment techniques include a three field tangential approach or a three field non-isocentric technique involving additional nodal irradiation.
• Dose regimens prescribed were either 40 Gy/15 Fr or 50 Gy/25 Fr.
• Patients were treated on Elekta Synergy or Versa HD linear accelerators using forward planned intensity modulated radiotherapy (IMRT).
• Statistical significance was validated using the Wilcoxon Signed Rank test.

Results

A statistically significant reduction in whole heart mean dose and LAD coronary artery near maximum dose and mean dose was demonstrated when using DIBH, see Table 1.

DIBH reduced whole heart mean dose in 99% (294/296), LAD coronary artery near maximum dose in 97% (293/296) and LAD coronary artery near max dose in 100% (296/296) of the patient population.

Table 1: Comparison of cardiac doses - DIBH vs. FB

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DIBH median (Gy)</th>
<th>FB median (Gy)</th>
<th>Median of differences (Gy)</th>
<th>Wilcoxon signed-rank test significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole heart mean</td>
<td>0.96</td>
<td>1.55</td>
<td>0.62</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dose/Gy</td>
<td>(0.76-1.16)</td>
<td>(1.00-2.00)</td>
<td>(0.56-0.69)</td>
<td></td>
</tr>
<tr>
<td>LAD mean dose/Gy</td>
<td>3.63</td>
<td>11.14</td>
<td>7.26</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(2.28-3.38)</td>
<td>(6.99-15.86)</td>
<td>(5.08-8.66)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAD near Max/Gy</td>
<td>19.66</td>
<td>36.81</td>
<td>17.11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(16.36-31.06)</td>
<td>(37.06-40.26)</td>
<td>(15.32-17.70)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

DIBH significantly reduces cardiac doses during left breast radiotherapy treatment. This study demonstrated a statistically significant reduction in whole heart mean, LAD coronary artery near maximum dose and mean doses. This technique has clear potential to decrease long-term cardiac complications in women having breast radiotherapy.

Additional work looking at long-term follow-up for individual patients in this cohort is required to highlight the clinical benefits of this technique. Furthermore, exploring predictive factors will help establish the required baseline for the patients that would benefit from this technique.

References


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