**2017 Global Cardio-oncology Summit Abstract:**

**Heart sparing techniques for breast and internal mammary chain radiotherapy**

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**Purpose/objectives:**

Published data demonstrate a 4.4% overall survival benefit associated with inclusion of the internal mammary chain (IMC) in the radiotherapy (RT) target volume in patients with breast cancer. Survival gains will be maximised by minimising radiation doses to heart and lungs.

This dosimetry study compares the ability of breath-hold techniques in 3D conformal radiotherapy, arc therapy and protons to achieve target volume constraints whilst minimising dose to heart and left anterior descending coronary artery (LAD) with a view to defining implementable class solutions for irradiating the IMC.

**Materials and methods:**

Breast tissue, level I-IV axillary and IMC lymph nodes were outlined using ESTRO consensus guidelines in 14 patients scanned in both free breathing (FB) and breath hold (BH). Eighty eight loco-regional RT plans, prescribed to 40Gy/15 fractions were produced using four techniques: 3D-conformal radiotherapy (CRT) wide-tangents (WT), volumetric-modulated arc therapy (VMAT) using a ‘bow-tie’ approach, Tomotherapy (FB only) and proton beam therapy (PBT). The Wilcoxon-ranked sum (5% significance level) and Friedman tests (2.5% significance level to account for multiple comparisons) were used to compare dose metrics.

**Results:**

<table>
<thead>
<tr>
<th>Planning Constraint</th>
<th>WT_BH</th>
<th>WT_FB</th>
<th>VMAT_BH</th>
<th>VMAT_FB</th>
<th>Tomotherapy_FB</th>
<th>PBT_BH</th>
<th>PBT_FB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Heart Dose (Gy) ≤ 4</td>
<td>2.2 (1.4-3.3)</td>
<td>5.4 (3.4-6.8)</td>
<td>2.3 (1.7-3.6)</td>
<td>3.9 (3.5-5.3)</td>
<td>6.4 (5.5-7.5)</td>
<td>0.4 (0.4-0.7)</td>
<td>1.0 (1.0-1.0)</td>
</tr>
<tr>
<td>Heart V₁₇Gy (%) ≤ 10</td>
<td>1.1 (0.0-2.8)</td>
<td>9.3 (5.4-12.6)</td>
<td>0.9 (0.9-3.0)</td>
<td>6.0 (4.5-9.0)</td>
<td>3.0 (2.5-5.5)</td>
<td>0.2 (0.2-0.5)</td>
<td>1.4 (1.2-1.5)</td>
</tr>
<tr>
<td>LAD Maximum Dose (Gy) Optimal ≤ 17</td>
<td>28 (16.4-37.9)</td>
<td>39.2 (37.2-39.6)</td>
<td>26.8 (12.5-33.5)</td>
<td>36.6 (35.7-38.1)</td>
<td>23.8 (19.9-27.8)</td>
<td>7.1 (6.0-14.4)</td>
<td>16.6 (10.1-21.3)</td>
</tr>
</tbody>
</table>

**Table 1:** Median (Interquartile range) heart doses
Conclusion

Several radiotherapy techniques are capable of meeting target and non-target tissue dose constraints in patients undergoing IMC radiotherapy. Heart doses are halved using breath hold irrespective of the radiotherapy technique used. On paper, proton beam therapy techniques deliver the best coverage with the least dose to the normal tissues but the feasibility of delivering these plans and radiobiological consequences of set-up errors remain to be determined.

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