Deep inspiration breath hold radiotherapy for breast cancer: CPUKs approach to improving outcomes in left-sided breast cancer radiotherapy - an evidence-based review

Interim 42 cohort patient study

March 2015

Spirometry-monitored deep breathing technique to increase the accuracy of radiotherapy treatment
Deep inspiration breath hold radiotherapy for breast cancer

Overview

More than 37,000 patients with breast cancer received radiotherapy in the UK in 2012\(^1\). With the support of increasingly sophisticated techniques, breast cancer survival rates are improving.

But as more people live with or beyond the disease, doctors are also encountering more instances of individual’s presenting with longer term healthcare issues as a direct consequence of the treatment that was designed to help save their lives.

One such consequence is damage to the heart from radiation if the organ is caught in the field of radiation during radiotherapy treatment. This can often be the case with individuals being treated for left-sided breast cancer resulting in these patients having a greater risk of experiencing cardiovascular side effects in the years following their treatment\(^2-5\).

In fact, a recent analysis of more than 30,000 women\(^6\) treated with radiotherapy for left-sided breast cancer demonstrated a three per cent increase in the risk of death for every 1Gy – the basic measure of radiation dose – received by the heart. The analysis also showed that this risk begins within five years of treatment and that up to 88% of patients with left-sided breast cancer treated with radiotherapy are likely to have screen detected deformities of the cardiac muscle within the first five years after their treatment\(^3,7,8\).

Furthermore, this risk is not short-term but rather continues into the third decade after treatment\(^3,4\). Additionally, the risk is even greater in women with pre-existing cardiac risk factors e.g. smoking and obesity, and is further exacerbated if the woman is having other therapies that also have negative effects on the heart e.g. Anthracyclines\(^3\).

A particular radiotherapy technique, spirometry-monitored deep inspiration breath-hold (DIBH) has been specifically designed to alleviate these risks. By adopting this DIBH technique during radiotherapy treatment, which can move the heart away from the radiation fields, the risk of a patient experiencing the side effects or even dying as a result of their treatment can be reduced\(^7\).

This whitepaper outlines an initial study that Cancer Partners UK conducted, which was peer-reviewed at ESTRO 2014\(^5\). The study involved looking at treatment planning data from 42 left-sided breast cancer patients treated with spirometry-monitored DIBH in its centres during 2013/14 and the resulting effects on cardiac dose and cardiac risk.

The study found that the risk of serious cardiovascular side effects and death is higher in patients who do not receive DIBH.

Click here to view a SlideShare of the study
How does deep inspiration breath-hold work?

Deep inspiration breath-hold (DIBH) involves a patient learning to hold their breath for a short time (just a matter of seconds) whilst their radiation dose is administered.

This simple action lifts the chest cavity away from the heart and the expanded lungs move the heart deeper into the body. This then allows the beam to treat the breast tissue whilst avoiding or reducing the dose to vital organs such as the heart.

To ensure this ‘deep breath’ is consistent, a mouthpiece is used and goggles are worn, which displays a simple green and red light system to help guide the patient when to take the breath, how much breath to take in and when to release it. If at any time the patient loses control of their breath, the system automatically cuts out and the treatment stops.

The interim study and its key findings

Cancer Partners UK conducted an interim study which involved looking at treatment planning data from 42 left-sided breast cancer patients treated with DIBH in its centres during 2013/14 and the resulting effects on cardiac dose and cardiac risk.

During the planning process two CT scans are taken – one while the patient is free-breathing (FB) and one while the patient is performing a deep breath. Using these images radiation delivery plans are designed against both the free-breathing and the deep-breath scans.

This enables a comparison of heart dose between DIBH and a FB technique, to ensure the patient benefits from the right technique for them.

Every patient is trained before receiving the treatment, with as many preparation visits as is required to make them feel comfortable and fully prepared for their role in the procedure.

Click on the link below to watch the video which provides an introduction to DIBH.
Figure 1: Heart mean dose

Figure 2: Heart near max dose, D 1%

Figure 3: Ipsilateral volume of lung receiving 50% of prescribed dose, V 50%

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DIBH median (IQR)</th>
<th>FB median (IQR)</th>
<th>Median difference DIBH - FB (IQR)</th>
<th>Wilcoxon signed-rank test significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart mean dose/Gy</td>
<td>0.94 (0.44)</td>
<td>1.47 (0.61)</td>
<td>-0.40 (0.48)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Heart near max dose ((D_{1%}))/Gy</td>
<td>3.59 (2.05)</td>
<td>9.48 (15.13)</td>
<td>-4.79 (16.28)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Lung V(_{50%})/%</td>
<td>6.36 (3.20)</td>
<td>8.06 (4.45)</td>
<td>-1.39 (1.80)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Central lung depth/cm</td>
<td>1.80 (0.40)</td>
<td>1.65 (0.68)</td>
<td>0.20 (0.28)</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>

By comparing the plans of 42 patients receiving DIBH, the interim study illustrated a median decrease of 0.4Gy in the mean dose received by the heart. Additionally, the total percentage of lung receiving dose was reduced, which was investigated under another Cancer Partners UK study[5].
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Interim conclusion

The results of the study showed that DIBH has a significant effect in reducing the risk of cardiac damage in patients receiving left-sided breast radiotherapy[5]. DIBH should therefore be utilised for all left-sided breast treatments.

Statistically, DIBH has the potential to prevent 2 deaths and 3 major cardiac events per 1000 patients treated with DIBH[6].

Additional considerations when assessing patient eligibility

Some literature has raised concerns about a potential risk associated with raised blood pressure and oxygen levels observed in some small breath-hold studies[3]. Although there is no evidence of clinical harm as a result – and the proven benefits of reducing radiation-induced heart damage strongly outweigh the theoretical risk here – patients should still be assessed to make sure they are suitable for DIBH.

Cancer Partners UK is developing protocols to ensure all patients treated with DIBH for left-sided breast cancer undergo a pre-participation cardiac assessment and have their blood pressure, heart rate and blood oxygen saturation (SpO2) levels monitored before, during and after treatment.

In all cases, the patient’s personal history and physiological risk factors should also be considered when assessing a patient’s eligibility for DIBH.

DIBH adoption in the future

Spirometry-monitored DIBH is not yet widely available on the NHS. In a recent unofficial NHS audit of DIBH use, only 33 per cent of responses stated that they used some form of DIBH. The small increase in time and expense to adopt and train for the technique may be one explanation.

All eight Cancer Partners UK centres across the UK offer DIBH to patients. After assessing for eligibility and capability, 90% of all of our left-sided breast cancer patients have been treated with this technique.

Results from a further, larger scale study of almost 300 patients will be due for release later in 2015.

To receive updates on this study, please contact enquiries@cancerpartnersuk.org or visit www.cancerpartnersuk.org

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References:


