The UK HeartSpare study

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Introduction

Recent evidence suggests that the risk of major coronary events after breast radiotherapy is linearly related to mean radiation dose received by the heart and that there is no threshold dose below which this risk is nullified. In addition, these effects are visible within the first four years after radiotherapy, much earlier than had previously been recognised.

With numbers of breast cancer survivors increasing as a result of improvements in diagnosis and treatment, minimising the radiation dose received by the heart is one of the main priorities in current breast radiotherapy practice. However, breast radiotherapy is also one of the main users of UK radiotherapy time, accounting for approximately 30% of all radiotherapy treatments. As such, the challenge is to find effective solutions which will minimise the impact on radiotherapy resources, both financial and temporal.

The 2012 Royal College of Radiologists audit into current UK breast radiotherapy practices demonstrated that the use of cardiac shielding in breast radiotherapy is not widespread. No cardiac shielding was used in over half the cases and temporal.

The first stage of the study (IA) has been completed, and tested whether the voluntary breath-hold technique (VBH) is equivalent to breath-hold with ABC in terms of positional reproducibility and normal tissue sparing. The other parts of the study (stages IB and II) are actively recruiting. Stage IB aims to individualise heart-sparing breast radiotherapy by identifying factors predictive of benefit from treatment in VBH versus treatment in a prone treatment position. The final stage of HeartSpare (Stage II) aims to test whether roll-out of the VBH technique confirms effective heart-sparing and is taking place in five UK radiotherapy centres participating in the UK NCRI FAST-Foward trial.

HeartSpare IA: randomised evaluation of the voluntary breath-hold technique

Published in Radiotherapy and Oncology in 2013, this study compared VBH with ABC. The VBH technique used for the study does not require any specialised equipment or lengthy patient training. As with all breath-holding techniques, a surrogate is used to check chest wall position. The VBH technique uses either light fields or in-room lasers as its surrogate, and these are then viewed from the control room via CCTV. The primary endpoint for the study was displacement errors based on electronic portal imaging (EPI), although a number of secondary endpoints were also recorded including normal tissue doses, displacement errors based on cone beam CT (CBCT), patient comfort, radiographer satisfaction and time and cost implications. The study had a randomised cross-over design, meaning that patients were randomised to the technique with which they received their first seven fractions before switching to the second technique for their final eight fractions (total of 40 Gy in 15 fractions over three weeks).

Twenty-three patients were recruited between March and August 2012. The median age of patients recruited was 61 years, representative of the general breast cancer population. The oldest patient in the study was 82-years-old, and she completed both treatments without difficulty. The results of the study demonstrated no statistically significant difference between VBH and ABC in terms of positional reproducibility: the range of systematic errors (Σ) based on EPI for VBH and ABC respectively were 1.5-1.8 mm vs 1.9-2.0 mm and for random errors (σ) 1.7-2.5 mm vs 2.0-2.4 mm. Similarly, there were no statistically significant differences in normal tissue doses between the two techniques. Mean heart dose was 0.6 Gy for both techniques, mean left anterior descending coronary artery (LAD) dose 3.5 Gy (VBH) vs 3.8 Gy (ABC), and maximum LAD dose 30.6 Gy (VBH) vs 32.6 Gy (ABC). These results represent a 25% reduction in mean heart and maximum LAD doses, and a 50% reduction in mean LAD dose, relative to data from standard free-breathing left breast radiotherapy treatments at our centre.

Validated questionnaires were used to assess patient comfort and radiographer satisfaction with each of the techniques, and VBH was preferred by patients and radiographers alike (p=0.007 and p=0.03 respectively). It
was possible to complete radiotherapy planning CT scans for both techniques within a standard 30 minute session, although the mean time required for VBH was less than for ABC (24 vs 27 minutes, p=0.02). The mean time required for radiotherapy treatment sessions was 19 minutes for both techniques, however, this included CBCT imaging for study purposes. In our department we have found that with standard EPI-based imaging protocols and greater experience with the VBH technique, treatment times have reduced. VBH is now standard of care for all women requiring heart-sparing breast radiotherapy at our centre.

Next stages

The voluntary breath-hold technique used in HeartSpare IA was suitable for use in treating women who required whole breast or chest wall radiotherapy only. One group of women who we felt were disadvantaged by this were women who required nodal irradiation in addition to whole breast/chest wall treatment. We have now successfully developed and implemented the VBH technique for use in women requiring nodal irradiation. Although tangential field whole breast radiotherapy remains the current UK standard, it is likely that other techniques (eg partial breast irradiation, simultaneous integrated boost) will be incorporated into standard treatment algorithms for specific indications. Using the HeartSpare IA data, we have calculated the CTV-PTV margins required for using VBH in partial breast radiotherapy. The UK IMPORT HIGH trial uses simultaneous integrated boost IMRT for women at high risk of recurrence, and we plan to develop VBH for use in combination with this technique.

Since publication of the HeartSpare IA results we have had a great deal of interest in the VBH technique from other UK centres and further afield. It is extremely heartening that there is clearly a collective desire in the oncology community to implement heart-sparing breast radiotherapy into routine clinical practice. The initial roll-out of VBH in five UK centres participating in the UK NCRI FAST-Forward trial is underway. However, the overall aim of the study is to make heart-sparing breast radiotherapy available to all women in the UK. With this in mind we are currently finalising a strategy to disseminate the technique across the country through the use of training videos, seminars and workshops and hope to be able to offer training to interested centres in 2014.

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References


Figure 1

The low-dose bath created by IMRT. Axial CT slice taken from the treatment plan of a patient treated within the UK IMPORT HIGH trial demonstrating undesirable low dose irradiation of the heart with inverse planned IMRT.

Figure 2

Prone breast technique. Patient lying on the Orfit AIO Prone Breast Solution equipment used in HeartSpare IA breast radiotherapy.
Figure 3
The heart-sparing effect of VBH. Axial CT slices from the same patient at the same chest wall level in free-breathing (A) and using the VBH technique (B). Note that the heart (outlined in yellow) has been pushed down and away from the radiotherapy fields using the VBH technique.

Figure 4
Checking breath-hold consistency from the control room. Control room CCTV stills demonstrating the position of the light field relative to the marked field border for a right anterior oblique beam in free-breathing (A) and the aligning of the light field and marked field border once the patient is in breath-hold (B).