Back to advance [1]

Harnessing the power of radiotherapy

Together, the ICR and The Royal Marsden are developing innovative, increasingly precise radiotherapy techniques to improve outcomes and reduce side effects

OUR PIONEERING RESEARCH

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Since the turn of the 20th century, the ICR and The Royal Marsden have pioneered the use of radiation as a therapy for cancer, helping to transform the way patients are treated. Today, with radiotherapy contributing to the cure of 40 per cent of patients, the drive to improve outcomes and minimise side effects is at the core of the research carried out at the BRC.

Our institutions have played a major role in the development of modern high-precision techniques such as intensity-modulated radiotherapy (IMRT) and image-guided radiotherapy (IGRT). These target radiation doses precisely to the shape of tumours, reducing toxicity and side effects. A prime example of our work in this field is the PARSPORT trial, which compared IMRT with conventional radiotherapy treatment for head and neck cancers a decade ago. Following the trial?s success, every eligible head and neck cancer patient in the UK has been offered IMRT as standard treatment.

Professor Kevin Harrington [6], Professor of Biological Cancer Therapies at the ICR and Consultant Clinical Oncologist at The Royal Marsden, says: ?In the past 10 years, IMRT, IGRT and stereotactic body radiotherapy [SBRT] have been our focus. We aim to increase cure rates and improve the rate of toxicity and the functional outcome of patients treated with this approach. The support of the BRC has been vital, as it has given us the opportunity to fund new research in these pioneering techniques and improve the standard treatment for cancer patients everywhere.?

> Radiotherapy plays a vital role in the treatment of cancer, with half of all patients receiving it at some stage

CYBERKNIFE

The leading edge of targeted treatment

In 2011, The Royal Marsden became one of the first NHS trusts to install the latest model of CyberKnife. Via a robotic arm, the machine delivers concentrated, precisely targeted SBRT from almost any angle. X-ray cameras track the position of the tumour ? which tends to move as the patient breathes during radiotherapy ? and enable CyberKnife to continually reposition

the beam, minimising damage to healthy tissue.

The Royal Marsden and the ICR?s international randomised PACE trial compares CyberKnife with surgery and conventional radiotherapy, which are the current standard treatment for prostate cancer. The aim of the study is to show that CyberKnife can offer men with localised prostate cancer outcomes equivalent to ? or even better than ? the standard treatment. It is hoped that the results will demonstrate that CyberKnife treatment is effective over a shorter period of time and results in fewer side effects, thus lessening the impact on a patient?s quality of life.

Professor Kevin Harrington, Professor of Biological Cancer Therapies

ROLLING OUT BENEFITS

One recent example of our work in minimising side effects was the BRC-funded HeartSpare project, which was so successful and cost-efficient that the technique it piloted has been introduced in hospitals nationwide. Radiation aimed at breast tumours can sometimes also hit the heart, potentially causing long-term problems.

In the HeartSpare study, women with localised left-sided breast cancer were asked to hold

their breath for 20 seconds during radiotherapy. This helped to pull the heart away from the radiation beam, reducing the risk of heart disease years later.

Dr Anna Kirby [7], Consultant Clinical Oncologist at The Royal Marsden and the ICR, says: ?The method has been rolled out to many cancer centres across the UK. It is now being explored further through the HeartSpare Plus study, which has extended the technique from patients with localised disease to those with cancer that has spread to the lymph nodes.?

HIGHER DOSES, LOWER COSTS

As well as improving outcomes and reducing side effects, some of our trials have demonstrated the effectiveness of shorter radiotherapy treatment plans, which are more convenient for patients and help the NHS to reduce costs. Led by the ICR and The Royal Marsden, the START trial involved nearly 4,500 women with breast cancer across the UK.

The 10-year results were published in 2013, and proved that giving patients a lower total dose of radiotherapy in fewer, larger treatments (or ?fractions?) was as effective as the international standard of 25 fractions. This meant that treatment times could be reduced from five weeks to three, with patients receiving just 15 fractions.

Stemming from this success is FAST-Forward, a Phase III, multicentre randomised controlled trial that is recruiting now. This trial aims to find evidence to support reducing the length of treatment further ? from three weeks to one week ? for women with early-stage breast cancer following primary surgery.

?The BRC?s vital support has allowed us to fund research in pioneering radiotherapy techniques and improve the standard treatment for cancer patients everywhere?

Prostate cancer benefits

Breast cancer is not the only tumour type for which radiotherapy treatment plans can be shortened. The CHHiP trial, which involved more than 3,200 men between 2002 and 2012, has shown similar benefits for prostate cancer patients. Standard IMRT for prostate cancer is delivered in five daily fractions each week for about seven weeks.

In the CHHiP trial, some patients received hypofractionated radiotherapy, which involves fewer fractions but higher doses. Some patients received the standard 37 fractions, while those receiving hypofractionated radiotherapy had only 19 or 20. The results of the trial ? which were published in The Lancet Oncology ? could mean that men need fewer trips to hospital over just four weeks, without reducing the quality and impact of their treatment

Lead investigator Professor David Dearnaley [8], Professor of Uro-Oncology at the ICR and Consultant Clinical Oncologist at The Royal Marsden, says: ?These data are encouraging news for men, with excellent control rates and a low side-effect profile seen across the trial. Giving patients larger doses of radiotherapy for a shorter time will mean fewer hospital trips and less radiotherapy needed overall. ?These findings are the result of many years of

research using radiotherapy techniques developed at The Royal Marsden and the ICR. The new method is safe and effective, and we recommend it as a new standard of care.?

Our next steps

Making radiotherapy kinder and more precise continues to be a priority for the future. Although there have been huge advances in precision radiotherapy, some challenges still remain. The ICR and The Royal Marsden work closely together to accelerate the development of innovative new types of radiotherapy that will benefit patients.

Researchers are using advanced imaging techniques and biological markers to enhance the targeting of radiation therapy. This will create new, more effective forms of radiotherapy with fewer side effects.

New imaging techniques are also allowing researchers to precisely pinpoint tumours and monitor their movement within the body so that radiotherapy can be delivered more accurately. Much of this research is in preparation for the arrival of the state-of-the-art MR Linac at the ICR and The Royal Marsden (see right).

This machine combines radiotherapy with a magnetic resonance imaging (MRI) scanner so that clinicians can make real-time adjustments to radiation therapy and constantly target the tumour. The overall benefit to the patient has been a key focus of our radiotherapy research in the past, and will continue to be in the future. There are currently seven BRC-supported radiotherapy trials under way ? with a further 10 in follow-up ? and patient and public involvement (PPI) is central to how we set up and run them.

For example, the DELINEATE study, which is recruiting now, is looking at new ways of planning and delivering radiotherapy for patients with localised prostate cancer that has a medium to high risk of spreading. Researchers are using IMRT to plan radiotherapy and IGRT to deliver treatment accurately, allowing a higher dose to be precisely targeted at the tumour, while the rest of the prostate gland receives a standard dose

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MR LINAC

A new era in radiotherapy

The ICR and The Royal Marsden will be the first organisations in the UK ? and among the first in the world ? to install a state-of-the-art MR Linac radiotherapy machine. It will be in place by summer 2016 and clinical research studies will begin in 2017, as part of a pioneering research collaboration with manufacturer Elekta.

The MR Linac combines the technologies of a magnetic resonance imaging (MRI) scanner and a linear accelerator to precisely locate tumours, tailor the shape of X-ray beams in real time and accurately deliver doses of radiation to moving tumours. The machine will be installed at The Royal Marsden and ICR?s Sutton site and is being funded through a £10 million grant from the Medical Research Council.

Professor Harrington says: ?We are part of an international consortium of leading research centres that will ensure the few selected worldwide organisations to have an MR Linac will share research ideas. By liaising with the consortium, we will avoid research duplication, so that the studies the ICR and The Royal Marsden run on the MR Linac will be for the benefit of cancer patients worldwide.?

Further reading

- PARSPORT [10]
- HeartSpare [11]

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