RADIOTHERAPY – THE STATE OF THE NATION

As cancer treatment becomes more complex, how can we provide a 'World Class Radiotherapy Service'?

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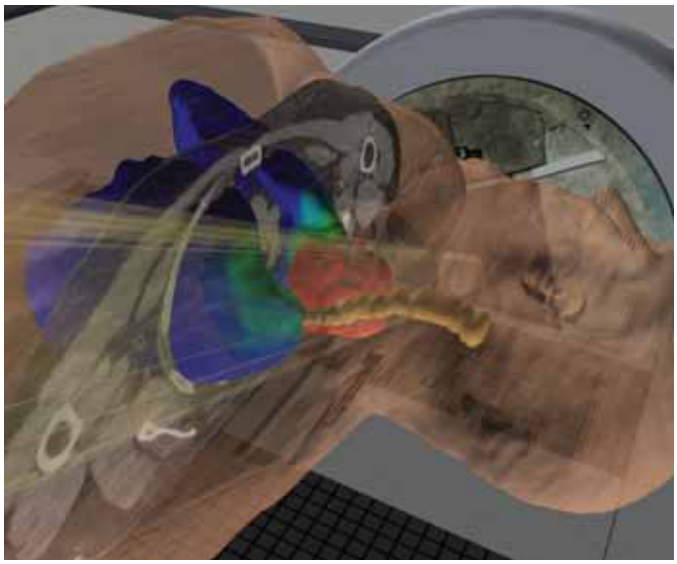
Since the discovery of radium by Pierre and Marie Curie, radiation has been used to treat cancer. Treatment has evolved from the use of radioactive metals closely applied to a cancer to using sophisticated computer controlled machines that deliver megavoltage radiation beams while rotating around a patient.

Radiotherapy can be used with 'palliative' intent, to relieve symptoms or pain or with 'curative' intent. When used curatively, it may be part of a multi-modality strategy, eg following breast conserving surgery or as sole treatment, eg where radiotherapy of the larynx allows retention of speech, which has obvious quality of life benefits. Radiotherapy is also often combined with chemotherapy. This improves the cancers' sensitivity to radiation, improving treatment efficacy and therefore cure rates.

The majority of radiotherapy in the UK is delivered using Linacs, machines that produce high energy X-ray or electron radiation 'beams'. Electrons are used to treat targets closer to the skin while X-rays can deliver dose to the deeper diseased organs (eg prostate). A single X-ray beam can be used, however, for deeper 'targets' two or more beams are generally used in order to reduce the dose to the healthy organs and tissues that lie between the skin and the 'target'. This strategy reduces the 'collateral damage' to the tissues lying close to the target.

The aim of curative radiotherapy is to attain the highest radiation 'dose' possible at the target whilst delivering the lowest 'dose' possible to surrounding un-diseased tissues. This is achieved using a 'conformal approach' where radiation-attenuating devices shield the un-diseased tissues. This approach reduces the side effects associated with radiotherapy.



Intensity modulated radiotherapy (IMRT) is a more sophisticated method of conformal therapy and is so effective that it now allows 'escalated' doses to be delivered. It maintains healthy tissues below any trigger doses for side effects. This increases the probability of controlling the disease, while keeping the risk of side effects low. By allowing greater shielding of normal tissue, side-effects are lowered, for example by decreasing the dose to the parotid gland in head and neck IMRT, the dry mouth side effect traditionally associated with radiotherapy was reduced.

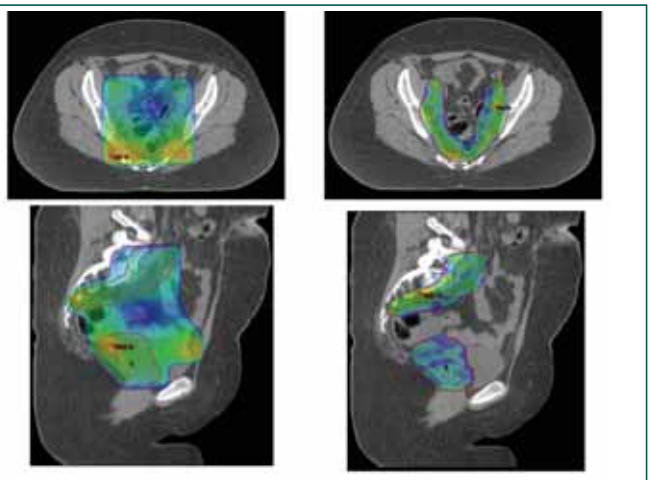
When delivering radiotherapy, accuracy is very important and breathing, cardiac motion and other natural processes can cause issues. Motion out of the treatment beams will reduce effectiveness and for other tissues movement will increase the risk of side effects. Treatment machines typically have X-ray imaging attachments to ensure that the target is accurately irradiated by the beams.

So called Image Guided Radiotherapy (IGRT) and IMRT are now common place and are considered the standard for prostate, head and neck cancers.

THE STATE OF THE NATION

Under the leadership of Professor Sir Mike Richards, the work of the National Radiotherapy Advisory Group (NRAG) and its operational committee, the National Radiotherapy Implementation Group (NRIG), roll-out of these techniques was implemented. In the UK there was a slower uptake of advanced radiotherapy techniques than in North America and other European countries. In 2012 work was undertaken to identify barriers to progress. Lack of specialist computer systems/licences, training of staff and staffing deficits were cited. Following this the Radiotherapy Innovation Fund (RIF) was announced by David Cameron to address such issues. Departments would commit to implementing IMRT to an agreed level of approximately 25% of those treated to 'curative intent'.

Departments were directed to submit short business cases and project plans, for subsequent rapid implementation and these were peer reviewed to extract a picture of requirements. A unique 'confirm and challenge' process followed. Each department presented their plans to a panel of experts. Plans were refined and advice was provided to less experienced departments. The final step required a prioritisation and revision with achievable milestones. Having received this revised intelligence and commitment from each department the leadership of NRIG was able to go back to ministers to argue that a fund of £23m would achieve the desired 'universal' goal. This enhanced level of funding was granted and Trust Chief Executives were informed of their funding in December 2012.



The images show a pelvic radiotherapy target on a CT scan, defined by the volume enclosed by the red line, we aim to have as little dose as possible to the area outside the red line. On the left images show the area irradiated by conformal radiotherapy and on the right the images show the area spared irradiation by IMRT

THE CHALLENGE

The vision of NRAG/NRIG was to ensure England had a 'World Class Radiotherapy Service'. The RIF programme was a great success in improving radiotherapy provision in England. It equalised the national 'contemporary' baseline. Ever-evolving technology means that challenges remain in keeping radiotherapy techniques current. One of the authors starts public lectures with the statement that in radiotherapy "We are techno-junkies" then follows up with "Actually, we are improvement junkies".

Wider implementation of imaging technology will improve the delivery of highly precise radiotherapy. MRI and PET imaging provide information about the functional state of tumours and may allow more aggressive treatment of cancer when a particularly persistent or radiotherapy insensitive tumour is detected. This could mean that diseases that traditionally responded poorly could be more effectively treated or patients for whom elongated and aggressive treatment was not appropriate might receive gentler options. In conjunction with other medical developments, such as genetic screening, this could allow personalised medicine in radiotherapy.

The majority of contemporary machines have imaging capabilities that allow the progress of the treatment to be assessed over the course of its delivery. This means that Adaptive Therapy, where adjustments are made to ensure everything 'stays on track', is now being investigated in a few centres.

A recent radiotherapy development known as Stereotactic Ablative Radiotherapy (SABR) is currently being offered in England for lung treatments. It has the potential for a broad range of both lung patients and those with other cancers (liver and spine for example). SABR utilises the IMRT and IGRT technologies described above, but is novel in that the treatments are given over a few days rather than protracted over a number of weeks which clearly provides a socio-economic benefit to patients. The treatment is considered more aggressive and potentially has a greater clinical effect.

CHALLENGES OF RADIOTHERAPY

One of the key issues and challenges for the continued advancement of provision of a world class radiotherapy service is that of funding. The current reimbursement system is 'tariff-based' and there is some compensation for different levels of treatment complexity but it is largely out-dated in its assumptions. No reimbursement mechanism exists for advanced imaging (such as MRI or PET) for radiotherapy treatment design, meaning imaging needs funding from a single payment that already carries the burden of several highly complex process steps including CT imaging. This restricts the purchase of dedicated scanners or the use of existing ones in the hospital. SABR treatments are often reimbursed as a simple multiple of the 'treatment days' delivered, meaning a department may lose up to 90% of the income per patient if it uses this new (desirable) technique.

Funding from Radiotherapy activity tends to be absorbed into Trust accounts and the departments themselves do not have access to the income. Business cases for new or even replacement equipment become long drawn-out processes that often fail or are dramatically cut back within the wider Trust 'Capital plan'. Whilst the radiotherapy community must exist within economic realities, the advancement of clinical services is often stifled due to outdated financial models. It is recognised by most that sensible revenue funding could promote a more sustainable service that relies less on 'frequent rescue' payments and more on business principles.

The radiotherapy community in England remains dedicated towards improving the care of our patients and striving for the provision of a sustainable 'World Class Service' of which England can be proud.