Developments in Radiotherapy
Questions and Answers

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Radiotherapy technologies and techniques are developing at a brisk pace. These Qs and As present an overview of the main innovations and their implications for the management and care of patients.
How do new technologies in radiotherapy contribute to improving cure and control?

New technologies aim to deliver a higher radiation dose to the tumour, whilst at the same time decreasing the dose to critical organs and tissues, thereby improving the therapeutic ratio. This can be defined as the ratio between the dose required to produce unacceptable toxicity and that required for therapeutic effect.¹

What are some of the problems with introducing new technologies in radiotherapy?

Introducing new technologies into radiotherapy is, in many senses, simply too easy. There are plenty of manufacturers trying to market new equipment, but this does not mean that it will be used effectively. Specialist staff need time to commission and calibrate the equipment and clinical staff need to become familiar with the new equipment, whilst maintaining the delivery of the current service.

Some of the new technologies (IMRT, IGRT, particle therapy, IORT) have not yet been subjected to rigorous evaluation. They are marketed on the basis of what they promise clinically, and there is some emerging evidence that the theoretical advantages have been translated into clinical improvements. The task of fully evaluating them will, however, take at least the next decade.

What is IORT?

IORT stands for intraoperative radiotherapy. The idea of delivering radiotherapy to a tumour, or tumour bed, under direct vision at the time of open surgery has always been an attractive concept. The treatment can be precisely directed to the target without the need for elaborate techniques involving imaging, delineation of target volume, simulation and verification. What you see is exactly what you get. Vulnerable normal tissues can be physically excluded from the area that is treated. The advantage from the patient’s point of view is convenience. A single treatment, given during an operation that they would be having in any event, can replace a pro-

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tracted course of treatment as an outpatient.
Until recently, the problem has been with the practicalities. Either an anaesthetised patient with an open wound has to be moved to a radiotherapy department for treatment on a linear accelerator, or a specially shielded operating theatre has to be built with a linear accelerator within it. However there are many new approaches that now make intraoperative radiotherapy feasible. These include high-dose-rate interstitial after-loading, portable linear accelerators with electron beam treatment facilities and limited shielding requirement – the PRS device (photon radiosurgery), a fully portable device about the size of an electric drill that produces 50 kV X-rays.

Clinical trials of IORT are underway for a variety of tumours. The most widespread use at present is as an alternative to post-operative breast radiotherapy in women treated with lumpectomy for early breast cancer.

Figure 1. Main side-effects of radiotherapy by site

**BRAIN**
Increased intracranial pressure – headaches, vomiting, dizziness, hair loss, fatigue, sleepiness, cognitive changes

**HEAD & NECK**
Oral mucositis, xerostomia (dry mouth), dental decay leading to osteoradionecrosis (late effect), dysphagia & eating problems, pain, speech difficulties

**CHEST/BREAST**
Oesophagitis, radiation pneumonitis (late effect), cardiac damage (late effect), lymphoedema (late effect), brachial plexus damage (late effect)

**ABDOMEN**
Nausea and vomiting

**PELVIS**
Cystitis and other urinary problems, proctitis, abdominal discomfort, diarrhoea, radiation enteritis (late effect), sexual problems, infertility (late effect)

**All AREAS**
Fatigue
Skin reactions

What are the advantages of proton therapy?
Proton therapy is particularly useful for tumours at specific sites, for example tumours of the base of the skull, and its advantages are purely physical. The particles stop abruptly at a certain depth within the body, which can be directed by an appropriate choice of beam energy. Biologically, protons have much the same effect, for any given dose, as X-rays. Protons are particularly suitable for treating tumours which lie at depth but immediately above a sensitive normal tissue, such as the brainstem or spinal cord.

The absolute number of patients who might benefit from proton therapy is relatively small. This is because of the rarity of the tumours for which protons offer specific advantage. In Europe, about one proton therapy facility is probably required per 5 million population. This implies that proton therapy should be located at specialised referral centres, and is not necessary for every radiotherapy department.

When radiotherapy is combined with chemotherapy or targeted therapies, can you give a lower dose of radiotherapy?
No. The effect of radiotherapy is more certain than the effect of the chemotherapy or targeted therapy. So adding drug treatments to radiotherapy still means that the patient receives the same dose.

What other trends and techniques are important?
Over the years, there have been a number of developments in fractionation (frequency of dose administration). Probably one of the most important is CHART (continuous hyperfractionated accelerated radiotherapy), whereby the overall radiation dose is delivered over a shorter number of days because patients are treated three times a day, seven days a week. The rationale for hyperfractionation (radiotherapy given several times a day) is that smaller doses per fraction can be administered, which, in theory, reduces the late effects of treatment. The rationale for acceleration (radiotherapy administered over a shorter period of time overall) is that tumour cells are unable to proliferate during the radiotherapy course. Randomised trials of CHART have shown statistically significant improvements in the survival of patients with lung cancer, but CHART requires considerable resources to implement and is not widely available.

Combining radiotherapy with chemotherapy and/or targeted therapies is another important development, which has been shown to improve local control and survival in a number of cancers.

Are the side-effects of radiotherapy the same as they have always been?
Yes and no. Because we are using much more combined modality therapy, patients often experience a greater range of side-effects, different patterns of toxicity and more severe acute side-effects overall. Also, because many of the treatment combinations are new, we have not had enough time to understand the long-term effects of these treatments.
What can nurses do to improve side-effects?

It is very important that nurses improve their knowledge of radiotherapy side-effects. Seeing a patient with severe toxicity sometimes makes nurses think treatment ought to be stopped. However, in most cases, this is inadvisable as it will reduce the effectiveness of the treatment. Supportive care and symptom management, which enables the patient to continue his/her treatment, should be the main goal. The problem is that not enough evidence is available to guide the management of radiotherapy side-effects.

The side-effects of radiotherapy tend to affect the area being treated (Figure 1). Supportive care measures including nursing and pharmacological interventions, information/education and psychological care are addressed in the book by Faithfull and Wells.²

Should we be encouraging patients undergoing treatment for cancer to stop smoking?

We used to take a negative approach to this question, thinking that if people are going to die anyway, and if smoking is one of the few enjoyments left to them, why should we deny them their few last pleasures? However, treatment nowadays is more likely to be successful and patients are living longer with, and beyond, cancer. We have evidence that continued smoking makes the side-effects of treatment worse and, at the same time, makes treatment less likely to be successful. Continuing to smoke will therefore have a double adverse effect on the therapeutic ratio.

The diagnosis of cancer provides an important opportunity for intervention in terms of public health. If we can encourage and support patients so that they are able to stop smoking, we could extend this to their families and friends and they, too, might stop smoking. This is the concept of using the diagnosis of cancer as a “teachable moment”.

Research studies have shown that nurse-led smoking cessation interventions can be effective in a range of patient groups.³ Interventions are based on the ‘5 A’s approach’ – Ask, Advise, Assess, Assist, Arrange follow-up – and on motivational interviewing. Even simply asking patients if they smoke and encouraging them to think about giving up is an important start.

How can nurses improve their knowledge of radiotherapy side-effects?

EONS has recently launched an on-line module for nurses (http://www.eonslearning.com). This four-week course will include video presentations, lecture notes, weblinks, activities and discussion boards, facilitated by four EONS members who have expertise in radiotherapy care – Sara Faithfull, Birgitte Grube, Lena Sharp and Mary Wells. The course will cover why people develop side-effects to radiotherapy, patient experiences, management of side-effects and changing practice. The on-line module is being piloted for a small number of nurses working in radiotherapy across Europe, but EONS hopes to roll it out so that it becomes more widely available. A sample page can be seen in Figure 2.

This article has been compiled using presentations from the EONS-7 Congress and discussions with the authors. Details of the references cited in this article can be accessed at www.cancernurse.eu/communication/eons_newsletter.html