Received:
21 May 2015

Accepted:
21 May 2015

doi: [10.1259/bjr.20150412](https://doi.org/10.1259/bjr.20150412)

Cite this article as:

Krause M, Supiot S. Advances in radiotherapy special feature. *Br J Radiol* 2015; **88**: 20150412.

ADVANCES IN RADIOTHERAPY SPECIAL FEATURE: EDITORIAL

Advances in radiotherapy special feature

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Radiotherapy is one of the main cancer treatments and, together with surgery, one of the two treatment options with a curative potential in solid tumours. During the last decades, technology of radiotherapy has been improved very rapidly from two dimensional to three dimensional techniques and to further enhancement of precision by improvement of target volume coverage, steeper dose gradients leading to better normal tissue protection, motion management for mobile tumour situations and specific utilization and integration of imaging modalities.

This special feature covers some of these technological advances and shows also intersections to diagnostic radiology and nuclear medicine.

Stereotactic radiotherapy applied as a high single dose or (hypo)fractionated radiotherapy belongs to the most advanced photon radiotherapy techniques (doi: [10.1259/bjr.20150036](https://doi.org/10.1259/bjr.20150036)). While its use in small brain tumours such as single or oligometastases or benign tumours of the brain is very well established in many centres worldwide, and small lesions in the body such as early non-small-cell lung cancer or lung metastases have been treated with this technique for many years, there are still unresolved issues if tumours are situated close to organs at risk. These issues include the radiosensitivity of these normal tissues to the high doses per fraction, but also the mobility of tumours and normal tissues. Integration of imaging techniques is the basis of *motion management* (doi: [10.1259/bjr.20150100](https://doi.org/10.1259/bjr.20150100)) of such tumours. Modern imaging techniques are also used for *radiotherapy treatment planning* (doi: [10.1259/bjr.20150056](https://doi.org/10.1259/bjr.20150056)). Along with precise anatomical information, *functional imaging* (doi: [10.1259/bjr.20150014](https://doi.org/10.1259/bjr.20150014)) techniques, specifically positron emission tomography (PET), can increase the information about the individual disease. PET tracers that are specific to tumour features of radioresistance, e.g. hypoxia tracers, are of specific value for translational radio-oncological research as they have a high potential to serve as biomarkers for future stratification of patient groups to more individualized

radiotherapy or combined treatment schedules. Another application of PET, which is still in translational evaluation, is the monitoring of proton radiotherapy by detection of treatment-induced positrons directly after application of the radiotherapy fraction (doi: [10.1259/bjr.20150173](https://doi.org/10.1259/bjr.20150173)). Also therapeutic radionuclides may in future find their place in the context of radiotherapy. *Combined external beam radiotherapy (EBRT) and internal radiotherapy by radionuclides* (doi: [10.1259/bjr.20150042](https://doi.org/10.1259/bjr.20150042)) bound to, for example, molecular targeted antibodies have shown promising efficacy in pre-clinical studies. The advantage of such treatment approaches is that the potential of EBRT to irradiate the tumour and surrounding regional areas at risk is combined with the local dose escalation by radionuclides which, without radiotherapy, would be limited by haematological, kidney or hepatic toxicity.

As well as these technological advances, (radio)biology will play a major role in patient stratification approaches for treatment individualization. *Biology-based biomarkers* (doi: [10.1259/bjr.20150009](https://doi.org/10.1259/bjr.20150009)) are evaluated for prediction of normal tissue toxicity to identify, for example, specifically radiosensitive patients, but also for prediction of the individual tumour response to present standard treatments. Such biological-based biomarkers will within the coming decade increasingly be used in clinical routine to stratify patients with the same tumour entity and tumour stage in different treatment groups based on their marker profile. Such *personalized treatment* strategies lead to smaller and smaller groups of patients getting the identical treatment, implying that standard, large, two-arm randomized trials between few centres will be less and less applicable. Thus, *novel trial designs* are needed to provide evidence for personalized radio-oncological treatment approaches.

In addition to these technological and biological advances, the special feature provides a selection of articles covering *recent developments in clinical indications and treatment schedules* (doi: [10.1259/bjr.20150027](https://doi.org/10.1259/bjr.20150027)) for radiotherapy, reviews

on radiotherapy for benign disease (doi: [10.1259/bjr.20150080](https://doi.org/10.1259/bjr.20150080)) and exploiting determinants of radiotherapy toxicity to individualize radiotherapy (doi: [10.1259/bjr.20150172](https://doi.org/10.1259/bjr.20150172)). In addition, this special feature includes some opinion-based commentary articles highlighting present hot topics in the field, from radiation protection to regional radiotherapy in breast cancer (doi: [10.1259/bjr.20150124](https://doi.org/10.1259/bjr.20150124), [10.1259/bjr.20140853](https://doi.org/10.1259/bjr.20140853) and [10.1259/bjr.20150071](https://doi.org/10.1259/bjr.20150071)).

We feel that this selection of comprehensive articles and comments provides a good overview over the most recent and exciting developments in clinical and translational radiotherapy and describes future avenues of radiation research in oncology, especially as joint efforts between the three disciplines of diagnostic radiology, nuclear medicine and radiation oncology.