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In this issue

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In this issue

I am pleased to introduce the 'in this issue' for the second issue of the *Journal of Radiotherapy in Practice* for Volume 18 published in June 2019. In this issue, there are 15 original articles on a range of topics. The first paper is on the subject of the value of pre-application clinical department visits in radiotherapy. To complete this issue is a literature review on the integrating patient radiation response with genomics for personalised and targeted radiation therapy (RT) and a technical note on the clinical experience of using the Delta 4 phantom for pre-treatment patient-specific quality assurance in modern radiotherapy.

In the first article, Bridge, Callender, Edgerley and Gordon undertake a qualitative evaluation of the value of pre-application clinical department visits in radiotherapy. The mandatory clinical radiotherapy department visit undertaken by potential applicants aims to provide understanding of the profession and therefore reduce attrition. Increasing pressure on clinical departments makes visits a logistical challenge. This additional step may also present an unnecessary barrier to applicants. With no evidence relating to visits, this study aimed to explore the perceptions of both students and clinical educators concerning potential benefits and challenges.

A focus group interview method was utilised to gather in-depth qualitative data concerning the clinical department visit experiences from first year undergraduate students and clinical educators.

The findings of the study indicate that the clinical visit has value to applicants in affirming their decision to study radiotherapy. There is variation in expectation and content for these visits and they are logistically challenging. Nationally agreed guidelines for visit structure and content could improve visit efficiency and effectiveness. A national clinical visit form may reduce workload for educators and applicants.

In the next article, Khan and Green study the patterns of practice in palliative radiotherapy for bone metastases in UK centres. There is abundant evidence of the comparative efficacy of single-fraction (SF) radiotherapy and multi-fraction (MF) radiotherapy when treating patients with bone metastases. Despite this, previous surveys have shown SF schedules to be underutilised. The aim of this study was to determine current patterns of practice in patients with bone metastases.

An electronic audit was performed among 46 physicians within seven hospital trusts in the United Kingdom. The audit comprised four hypothetical cases in which consultants and registrars chose which dose and fractionation they would recommend and their reasons for this recommendation.

The findings indicate the most common radiotherapy schedule selected was SF. However, there are inter-institution differences regarding the use of SF radiotherapy. Furthermore, the survey had shown that a third of respondents recommended a MF regime, despite evidence supporting the efficacy of a SF schedule.

In the article by Murray, Gilleece and Shepherd, the authors evaluate the effectiveness of the clinical research radiographer (CRR) undertaking the on-treatment review of clinical trial patients receiving radiotherapy for prostate cancer.

Radiotherapy clinical trials are at the forefront of modern-day prostate cancer patient management. Patients are reviewed during treatment by clinical oncologists or competent on-treatment review radiographers to minimise treatment toxicities. CRRs routinely monitor and gather research data from patients participating in clinical trials. The aim of this paper is to evaluate the effectiveness of the CRR undertaking the on-treatment review of clinical trial patients.

An experienced CRR within the Northern Ireland Cancer Trials Network was supervised by a clinical oncologist to undertake the role of the on-treatment review of patients receiving radiotherapy for prostate cancer. The CRR explored published literature and compiled this written evaluation as part of their advanced practice learning.

The findings highlight that co-joining the roles and responsibilities of the CRR and the on-treatment review radiographer enhanced the quality of care offered to the patients participating in clinical trials.

In the next article by Khan, Shakil, Tahir, Rafique, Iqbal, Zahoor, Rehman, Iqbal and Chow, the authors undertake a selection of gamma analysis acceptance criteria in intensity modulated radiotherapy (IMRT) quality assurance (QA) using Gafchromic EBT3 film dosimetry. This study reports the justification and selection of acceptable gamma criteria with respect to low (6 MV) and high (15 MV) photon beams for IMRT QA using the Gafchromic EBT3 film.

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A five-field step-and-shoot IMRT was used to treat 16 brain IMRT patients using the dual-energy DHX-S linear accelerator (Varian Medical System, USA). Dose comparisons between computed values from the treatment planning system (TPS) and Gafchromic EBT3 film were evaluated based on gamma analysis using the Film QA Pro Software. The dose distribution was analysed with gamma area histograms generated using different gamma criteria (3%/2 mm, 3%/3 mm and 5%/3 mm) for the 6 and 15 MV photon beams to optimise the best distance to agreement (DTA) criteria with respect to the beam energy.

The results of this study suggest that high-energy photon beams required relaxed DTA criteria for the brain IMRT QA, while low-energy photon beams showed better results even with tight DTA criteria.

The article by Radaideh is an investigation of the variations in surface dose, with and without the use of a Klarity® mask (Orfit Industries America, Wijnegem, Belgium), using IMRT and three-dimensional conventional radiotherapy (3D-CRT). Thermoluminescent dosimeters together with a phantom were used to examine acute skin toxicity during nasopharyngeal cancer treatment. These plans were sequentially delivered to a perspex phantom. Dosimeters were placed in five fixed regions over the skin. A Klarity mask for immobilisation was used to cover the head, neck and shoulder. The phantom was irradiated with and without a Klarity mask using IMRT and 3D-CRT, respectively.

The results of this study revealed that IMRT significantly increases acute skin toxicity, compared with conventional radiotherapy. Although it is recommended to use the Klarity mask as a sparing tool of normal tissue, it increases the risk of skin toxicity.

The next article by Niyas, Abdullah, Noufal and Vysakh is on the subject of QA testing of the linear accelerator using an electronic portal imaging device (EPID). The EPID is primarily used for patient setup during radiotherapy sessions and can also be used for dosimetric measurements. In this study, the feasibility of EPID in both machine- and patient-specific QA is investigated through the use of a comprehensive software tool for effective utilisation of the EPID in their QA protocol.

Portal Vision aS1000, an amorphous silicon portal detector attached to the Clinac iX linear accelerator, was used to measure daily profile and output constancy, various multi-leaf collimator (MLC) checks and patient plan verification. Different QA plans were generated with the help of Eclipse treatment planning system (TPS) and MLC shaper software. The indigenously developed MATLAB programmes were used for image analysis. Flatness, symmetry, output constancy, field width at half maximum and fluence comparison were studied from images obtained from TPS and EPID dosimetry.

The findings of this study recommend the EPID as a versatile dosimetry system in a comprehensive QA protocol. The measured data revealed the reliability and consistency of the portal detector. In combination with the MATLAB analysis software, EPID has immense potential for QA checks in radiotherapy.

In the next article by Moujahed, Ghedira, Drissi, Kallel and Kochbati, the authors present their findings on the early outcomes of conformal radiotherapy (CR) in the treatment of cavernous sinus meningioma (CSM).

Cavernous sinus tumours represent 1% of all intracranial neoplasms, and 41% of them are CSMs. The disappointing results of the microsurgical approach in the treatment of CSM have led to the evaluation of a more conservative strategy, such as CR and stereotactic radiosurgery (SRS). The authors report their experience using CR in the treatment of CSM, aiming to evaluate local control, clinical response and radiation-induced toxicity.

A total of 18 patients with CSMs, treated from 2011 to 2017, were retrospectively reviewed. Based on these findings, CR has proved to be relatively safe and effective therapeutic option in the treatment of CSM, whether used as first-line or as adjuvant treatment. CR may be particularly effective for tumours that are not amenable to SRS, owing to lesion size (>30–35 mm) and/or proximity to the optic apparatus (<3 mm).

In the article by Darko, Osei, Fleck and Rachakonda, the authors present their study on a retrospective dosimetric evaluation of volumetric modulated arc therapy (VMAT) plans for prostate cancer treatment. RT remains a common and effective treatment modality for patients with locally advanced prostate cancer. Technological advancements over the past decade have resulted in the introduction of IMRT planning and delivery techniques that maximise the dose of radiation delivered to the prostate while sparing organs at risk (OAR). A more recent and evolving IMRT technique, VMAT, involves a continuous irradiation at a constant or variable dose rate while the gantry rotates around the prostate using one or more arcs.

This paper reports on a dosimetric evaluation of the implementation of VMAT technique for prostate cancer treatment. A retrospective analysis of VMAT plans for 300 prostate cancer patients treated during the period of January 2012 to December 2014 was performed. Two prescription cohorts of patients treated to a dose of 78 Gy in 39 fractions as the primary RT treatment, and 66 Gy in 33 fractions as a post-op or salvage XRT, were considered.

The findings show that highly conformal radiation dose distribution for the treatment of prostate cancer is achievable with a VMAT technique. It provides evidence to support the adoption of such conformal technology in many disease sites such as the prostate. The authors believe their experience reported here could help form the foundation for individual institutions to evaluate and develop the most suitable planning criteria tailored to their own needs and priority.

In the article by Yamada, Kurokawa, Kunogi, Sakamoto and Sasai, the authors study the effects of late rectal bleeding after VMAT for patients with locally advanced prostate cancer. The late adverse effects following RT for prostate cancer involve the urinary and lower gastrointestinal tracts, with continuous rectal bleeding being the most serious issue.

A total of 73 patients with localised prostate cancer were treated with RT using VMAT with an image-guided RT system. Patient age at the start of irradiation ranged from 54 to 81 years (median, 71 years). The follow-up period ranged from 23 to 87 months (median, 57 months). The prescribed total irradiation dose was 76 Gy in 38 fractions.

The findings were that VMAT may provide better accuracy and involve fewer time constraints for patients compared with other IMRT methods. The incidence of late rectal bleeding in VMAT is almost equivalent to that of other IMRT methods.

The aim of the article by Munirathinam and Pawaskar was to evaluate the influence of the flattened and flattening filter free beam (FFF) 6 MV photon beam for liver stereotactic body radiation therapy (SBRT) by using VMAT in deep inspiration breath hold (DIBH) and free breathing condition.

A total of eight patients with liver metastasis (one to three metastasis lesions) were simulated in breath hold and free breathing condition. VMAT-based treatment plans were created for a prescription dose of 50 Gy in 10 fractions, using a 230°

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coplanar arc and 60° non-coplanar arc for both DIBH and free breathing study set. Treatment plans were evaluated for planning target volume dose coverage, conformity and hot spots. Parallel and serial OAR were compared for average and maximum dose, respectively. Dose spillages were evaluated for different isodose volumes from 5 to 80%.

The conclusions of this study are DIBH and FFF is a good combination to reduce the treatment time and to achieve better tumour conformity. No other dosimetric gain was observed for FFF in either DIBH or free breathing condition.

In the article by Sresty, Raju, Sharma, Kumar, Ahamed and Bajwa, the authors evaluate which patients may benefit for selection for gated treatment based on the information from four-dimensional computed tomography (4D-CT) imaging in SBRT of non-small cell lung cancer (NSCLC).

SBRT is widely used for the treatment of stage-I NSCLC. Patient-specific motion correlated with 4D-CT could be essential for hypo-fractionated SBRT. All patients undergoing SBRT do not require motion management during the dose delivery. The objective of this study was to evaluate which patients may benefit from gated SBRT.

Treatment plans of 20 patients of stage-I NSCLC were analysed. Conventional and 4D-CT scans were taken. Internal target volume and planning target volume (ITV and PTV) were determined on the CT datasets. The $PTV_{all\ phases}$ was created using 4DCT datasets and PTV_{15mm} created using conventional CT data were compared. Also, $ITV_{all\ phases}$ were compared with ITV created from maximum intensity projections (ITV_{MIP}). Suitability of patients for motion management-based treatment delivery was also evaluated.

The findings indicate 4D-CT is a main requirement in SBRT to identify the patients who can benefit from motion management during the dose delivery.

The next article by Shamsi, Iqbal, Gifford and Buzdar analyses the dosimetric characteristics of proton beams of multiple energies using different snout sizes.

The Hitachi synchrotron was used for the extraction of eight proton beam energies (100–250 MeV). Dosimetric measurements were taken in a water phantom which was irradiated with the proton beam coming from the gantry system at angles 0, 90, 180 and 270° using a large and a medium snout. The range of the beam energies in the phantom, their corresponding centre modulation depth (CMD) and width of spread out Bragg peak (SOBP) were measured by using a Markus chamber. A double scattering technique was employed for the creation of SOBPs.

The findings are flatness and symmetry were found within explicit limits with both medium and large snouts. The large snout produced higher beam output than that of the medium snout at the centre of SOBP. This exploration can be extended to the determination of beam output, flatness and symmetry with a small snout.

In the article by Bencheikh, Maghnouj, Tajmouati, Dadouch and Benjelloun, the authors present their study on the determination of geometrical margins in external beam radiotherapy for prostate cancer. The focus of this work was to find the optimal clinical target volume (CTV) to PTV margins for prostate cancer for high radiotherapy treatment quality. This study was carried out on 20 patients treated using the standard accelerator used in radiotherapy treatment of prostate cancer.

Unfortunately, this article has now been retracted by agreement between the authors and the editor, Professor Angela Duxbury. The authors had obtained verbal but not written permission from the hospital where the study was carried out to publish the data collected. At the hospital's request, the authors have asked for the article to be retracted.

In the article by Mahdavi, Hoseinnezhad, Mahdavi and Mahdavizade, the authors present their study to determine the dose enhancement factor of gold nanoparticles in a dosimeter gel and construct percentage depth dose curves, using the optical CT system and the Monte-Carlo simulation model, to determine the effect of increasing the dose, caused by increasing the concentration of gold nanoparticles at depths in the gel.

The Magic-f Gel was made based on the relevant protocol in the physics laboratory. To determine the amount of the increase in the absorbed dose, the gold nanoparticles were added to the gel and irradiated. An increase in the dose after adding nanoparticles to the gel vials was estimated, both with the optical CT system and by the Monte-Carlo simulation method.

The enhancement of the dose after adding gold nanoparticles was confirmed both by experimental data and by simulation data.

In the literature review presented in this issue, the authors Osei, Xu and Osei undertake a review of integrating patient radiation response with genomics for personalised and targeted RT.

The success of RT for cancer patients is dependent on the ability to deliver a total tumoricidal radiation dose capable of eradicating all cancer cells within the CTV. However, the radiation dose tolerance of the surrounding healthy tissues becomes the main dose limiting factor. The normal tissue adverse effects following radiotherapy are common and significantly impact the quality of life of patients. The likelihood of developing these adverse effects following radiotherapy cannot be predicted based only on the radiation treatment parameters. However, there is evidence to suggest that some common genetic variants are associated with radiotherapy response and the risk of developing adverse effects.

This paper reports on a review of recent studies in the field of radiation genomics investigating the association between genomic data and patient's response to RT, including the investigation of the role of genetic variants on an individual's predisposition to enhanced radiotherapy radiosensitivity or radioresponse.

The evidence suggests that the potential for early prediction of treatment response and patient outcome is critical in cancer patients to make decisions regarding continuation, escalation, discontinuation and/or change in treatment options to maximise patient survival while minimising adverse effects and maintaining patients' quality of life.

To complete this issue, the technical note is presented by Srivastava and Wagter. The purpose of this work was to qualitatively analyse the treatment planning dose delivered, due to the complexity of treatment plans, using the Delta 4 phantom (Scandidos, Uppsala, Sweden). This device consists of diode matrices in two orthogonal planes inserted in a cylindrical acrylic phantom. Each diode is sampled per beam pulse so that the dose distribution can be evaluated on segment-by-segment, beam-by-beam or as a composite plan from a single set of measurements.

A total of 95 simple and complex radiotherapy treatment plans were delivered to the QA device. The planned and measured dose distributions were then compared and analysed. The gamma index was measured for different pathologies.

Overall, good agreement was observed between measured and calculated doses in most cases with gamma values above 1 in >95% of measured points. The Delta 4 device is accurate and provides reproducible results.

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