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In this issue

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I am pleased to introduce the second issue of the *Journal of Radiotherapy in Practice* for Volume 20 published in June 2021. In this issue, there are 14 original articles on a range of topics and 2 literature reviews, one on liquid biomarkers for the management of paediatric neuroblastoma and a second on a review on the feasibility of using a PRESAGE® dosimeter in various radiotherapy techniques.

The technical note in this issue is on the strategies adopted to assist in triaging patients with brain tumours who are referred for radiotherapy during the COVID 19 pandemic and to provide safe and evidence-based care.

To complete this issue, the case study is a report of 2-year outcomes of moderately hypofractionated (70 Gy in 28 fractions), intensity-modulated radiotherapy (IMRT) and volumetric modulated arc therapy (VMAT) for localised prostate cancer.

In the first original article, Graveling, Jarral and Gore investigate if a radiographer-led radiotherapy pathway can provide an efficient service for patients requiring treatment for symptomatic skeletal metastases. A retrospective review of 425 courses of palliative radiotherapy was conducted. Data were analysed assessing diagnosis, dose/fractionation, time from referral to treatment, gender, age, inpatient/outpatient status and referring clinic location for radiographer- and Clinical Oncologist-led cohorts.

Findings of the study report that a radiographer-led service can facilitate faster access to treatment than a Clinical Oncologist-led pathway for an appropriately selected patient caseload.

In the next paper, Tolakanahalli, Tewatia and Paliwal present their study on the migration of Treatment Planning system using existing commissioned planning system. Commissioning of a new planning system involves extensive data acquisition which can be onerous involving significant clinic downtime. This could be circumvented by extracting data from existing Treatment Planning System (TPS) to speed up the process.

In this study, commissioning beam data was obtained from a clinically commissioned TPS (Pinnacle™) using Matlab™ generated Pinnacle™ executable scripts to commission an independent 3D dose verification TPS (Eclipse™). Profiles and output factors for commissioning as required by Eclipse™ were computed on a $50 \times 50 \times 50$ cm^3 water phantom at a dose grid resolution of 2 mm^3. Verification doses were computed and compared to clinical TPS dose profiles based on TG-106 guidelines. Standard patient plans from Pinnacle™ including IMRT and VMAT plans were re-computed on Eclipse™ TPS while maintaining the same monitor units. Computed dose was exported back to Pinnacle for comparison with the original plans. This methodology enabled them to alleviate all ambiguities that arise in such studies.

The authors conclude that migration of TPS is possible without compromising accuracy or enduring the cumbersome measurement of commissioning data. Economising time for commissioning such a verification system or for migration of TPS can add great quality assurance value and minimise downtime.

In the next paper, Rabus, Kirby, Nasole et al. undertake an evaluation of a Virtual Environment for Radiotherapy Training (VERT)-based module for Proton Radiotherapy Education and Training. In many countries, there is a skills gap in proton therapy with many staff unprepared to work with the new technology. The new VERT proton module provides learners with a simulated proton machine 3D environment. This project aimed to evaluate the role of VERT in training the radiotherapy workforce for the future use of protons.

A practical teaching session using VERT was deployed after a traditional teaching session had provided basic knowledge. A questionnaire deployed before and after VERT enabled comparison of knowledge, while a combination of Likert and open questions gathered participant feedback concerning the initiative.

A proton simulation module has been shown to be an enjoyable teaching tool that improves students' confidence in their knowledge of the underpinning theory and clinical usage of the modality. Learners felt better prepared to encounter protons in clinical practice. Future work will build on these findings using smaller group work and a more robust assessment tool to identify long-term impact of the training.

In the next study, Ansari, Zope and Yadav seek a new method for risk factor (RF) assessment of organs at risk (OARs) including conformity index (CI) in radiotherapy treatment plan. The aim of this study was to develop a new method to assess the degree of damage numerically for OARs along with CI assessment for the target.

The radiotherapy plans of 30 patients of different sites, diagnosed with cancer, were selected for this study. Out of 30 cases, 8 plans were of the head and neck, 2 for glioblastoma, 10 pelvis, 5 left breast and 5 were oesophageal plans.

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Conclusions drawn are RF CI is a comprehensive evaluation tool encompassing a wider range of clinically relevant parameters, isodose volumes and tolerance dose of OARs. It is an advance analysing method to check both the qualitative and quantitative nature of a conformal plan, and at the same time, it assesses the degree of damage of OARs. If RF ≥ 1, then OARs will be completely damaged as a result of irradiation. RF = 0, then OARs will remain safe during the course of irradiation.

In the paper by Khaledi, Wang, Hosseinabadi et al., authors investigate the effectiveness of proton boron fusion therapy (PBFT). In recent years, some publications have discussed the effectiveness of PBFT and present a theory that is based on the Q-value of three produced α particles in the reaction of protons with Boron (11 B). The claims are this reaction significantly increases the absorbed dose in the target volume. This current study re-evaluates this theory to show if PBFT really is effective.

A parallel 80 MeV proton beam was irradiated on a water medium with a cubic boron uptake region. The two-dimensional dose distribution and percentage depth dose of protons, alpha and all particles were calculated using tally F6 and Mesh-Tallies by MCNPX code.

The authors conclude the physical aspects, and the simulation results did not show any effectiveness of the PBFT for proton therapy dose enhancement.

In the paper by De la Llana, Castillo, Andres et al., the aim of the study was to propose a new metric to optimise isocentre location in a forward IMRT (fIMRT)-VMAT hybrid technique for a simultaneous integrated boost (SIB) in breast radiotherapy. The study evaluated the improvements of placing the treatment isocentre at the boost centre of mass (CoM) in a hybrid treatment for breast cancer radiotherapy.

Twenty-two patients were planned in two isocentre locations with two fIMRT tangentials to the breast and a VMAT to the boost. A SIB technique was used. Breast boost (BB) vector was investigated as a criterion for selecting an appropriate isocentre placement. Various metrics for boost, breast and hybrid plans were analysed using ANOVA statistics.

The hybrid fIMRT-VMAT technique centred at the boost CoM resulted equivalent to plans centred at the breast CoM, while benefiting from an enhancement in PTV boost coverage for patients with BB Vector superior to 5.

In the paper by Jacob, Sathyamurthy, Ramireddy et al., authors analyse the presentation, treatment strategies and outcomes of neuroendocrine carcinoma of cervix treated with a multi-modality approach.

The data of patients diagnosed with cervical cancer between October 2004 and November 2018 were retrieved, and 14 patients of neuroendocrine carcinoma cervix who received treatment were identified. The patients were analysed based on demographic characteristics, disease stage, pathological characteristics, treatment and follow-up. The median overall survival (OS) and disease-free survival were calculated.

The findings indicate that neuroendocrine carcinoma of the cervix is a rare but aggressive histological subtype. Combined modality approach with judicious use of systemic chemotherapy along with surgery and radiation therapy is essential for optimal outcomes.

In the paper by Sharbo, Hashemi, Bakhshandeh et al., authors evaluate the clinical efficacy and radiobiological outcome of IMRT modalities by using various collimator angles and non-coplanar fields for nasopharyngeal cancer (NPC).

A 70 Gy planning target volume (PTV) dose was administered for 30 NPC patients referred for IMRT. Standard IMRT plans were constructed based on the target and OARs volume and dose constraints recommended by RTOG. Using various collimator angles and non-coplanar fields, eleven extra IMRT protocols were investigated. Homogeneity indexes (HIs) and conformation numbers were calculated. Poisson and relative seriality models were utilised for estimating tumour control probability and normal tissue complication probabilities, respectively.

Findings indicate that using appropriate standard/non-coplanar IMRT protocols for NPC treatment could potentially reduce the probability of inducing secondary cancer in patients.

In the paper by Gopalakrishnan, Nair, Raghukumar et al., authors present their study to measure and compare the skin doses received by treated left breast and contralateral breast (CB) during whole breast radiotherapy using five treatment techniques in an indigenously prepared wax breast phantom.

Computed tomography images of the breast phantom were used for treatment planning and comparison of skin dose calculated from TPS with measured dose. PTV and CB were drawn arbitrarily on the CT images acquired for the breast phantom with 10 numbers of calibrated optically stimulated luminescent dosimeters (OSLDs) fixed on the surface of both breasts. The TPS calculated surface doses of PTV breast and CB for five treatment planning techniques, viz., Conventional wedge, Irregular surface compensator (ISC) based, Field in Field (FiF), IMRT and Rapid Arc techniques were obtained for comparison. The plans were executed in the machine with the OSLDs fixed at the same locations as in simulation. The TPS calculated mean dose at the surface of the treated left breast, and CB was noted for the 10 OSLDs from dose volume histograms and compared with the measured dose.

Analysis of the results shows that the FiF and ISC techniques are preferred when planning breast radiotherapy due to the reduced dose to the CB.

In the next paper, Shamsi, Iqbal, Jabeen et al. present their study to assess volume variations in target site due to changes in bladder filling and rectal content including air bubbles during SIB-IMRT of patients with squamous cell carcinoma of uterine cervix.

Ten patients diagnosed with squamous cell carcinoma of uterine cervix were enrolled in this analysis. All patients were planned to undergo SIB-IMRT using 10 MV beam. PTVtumour and PTVnodal were prescribed with 50.40 and 45 Gy dose, respectively. During planning, PTVtumour V95%, PTVnodal V95% and OAR (bladder, rectum, femoral heads and small bowel) volumes were measured from initial CT planning scans taken with full bladder. CT scans were acquired once in a week over the treatment period of 5.5 weeks. Intra-treatment scans with full bladder were then fused with the planning scans to determine variations in the target volume and the OAR volume. Changes in radiation dose to the PTVtumour and the PTVnodal were also assessed by comparing intra-treatment scans with the planning (first) scans.

The paper concludes inconsistent bladder and rectal volumes had a significant impact on target volume and dosage during an entire course of SIB-IMRT. For radiotherapy of gynaecological malignancies, data on variations in PTV should be acquired on daily basis to target radiation dose to the tumour site with accuracy.

In the paper by Sathyamurthy, Singh, Jose et al., authors present their study to analyse the presentation, diagnosis and patterns of care of extra osseous Ewing sarcoma treated at their institution 2008 to 2018.

Electronic medical records of extraosseous Ewing sarcoma patients treated between January 2008 and April 2018 were

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reviewed. Kaplan–Meier curves were plotted to assess the overall and disease-free survival with 95% confidence intervals. A univariate analysis was carried out to assess the impact of variables like surgical excision, completeness of surgery, completeness of chemotherapy and addition of radiation therapy on the survivorship.

The authors conclude that extraosseous Ewing sarcoma is a rare and aggressive tumour diagnosed by molecular techniques. Multimodality treatment including surgical resection with wide margins, adjuvant radiation when indicated and completion of systemic chemotherapy result in optimum outcomes.

In the paper by Tamilarasu and Saminathan, the authors compare the dosimetric performance of FFF and flattened beams (FB) utilising VMAT for craniospinal irradiation (CSI) planning.

Five medulloblastoma patients were randomly selected retrospectively, and forty plans were generated. The dose prescription to the PTV was 36 Gy in 20 fractions. VMAT plans were created using 6 and 10 MV FB and FFF. Final dose calculations were performed using Acuros XB and Analytical anisotropic algorithm. Dosimetric parameters like D 98%, D 95%, D 50%, V 110%, CI, HI, low-grade dose index, high-grade dose index, dose to the OARs and normal tissue mean dose were noted. The effect of low-dose volume on normal tissue was also analysed.

Conclusions drawn are FFF beams generate a highly conformal and homogenous plan in CSI cases. FFF beam plan reduced the non-tumour dose and will aid in reducing the probability of second malignancies.

In the next paper, Saad, Badawy, Abougabal et al. study the value of quantitative pentavalent 99 m Tc-dimercaptosuccinic acid scan in predicting progression-free survival (PFS) and OS in patients with glioblastoma multiforme. Glioblastoma multiform (GBM) is the commonest and the most aggressive primary brain tumour. Pentavalent 99 mTc-dimercaptosuccinic acid (99 m Tc (V)-DMSA) has been found to be a tumour-seeking agent. Pre-radiotherapy 99 m Tc (V)-DMSA positive scan was found to be significantly correlated with poor PFS and OS. This study aims at evaluating the impact of quantitative 99 m Tc (V)-DMSA tumour uptake before and after radiotherapy on PFS and OS in patients with GBM.

This is a prospective study including 40 patients with GBM. Single-Photon Emission Computed Tomography studies were done before and after adjuvant radiotherapy and were qualitatively and quantitatively evaluated. The retention index of the viable tumour was correlated with PFS and OS.

Findings indicate that the degree of 99 m Tc (V)-DMSA scan positivity is a poor prognostic factor for PFS and OS in GBM patients.

In the next paper, Bahhous, Zerfaoui, Rahmouni et al. study the enhancing benefits of bolus-use through minimising the effect of air-gaps on dose distribution in photon beam radiotherapy. Bolus material is frequently used on patient's skin during radiation therapy to reduce or remove build-up effect for high energy beams. However, the air-gaps formed between the bolus and the skin's irregular surface reduce the accuracy of treatment planning. To achieve a good treatment outcome using bolus, experimental investigations are required to choose its thickness and to quantify the air-gap effect.

Measurements for a 6 MV photon beam with a fixed source surface distance were carried out using the 31021 Semiflex 3D chamber into the water phantom. First, the depth of maximum dose and the dose value at the surface were evaluated as a function of bolus thickness for some square fields. Second, to test the effect of the air-gaps ranged from 5 to 30 mm with a step of 5 mm between the bolus and the phantom surface, a water-equivalent RW3 (Goettingen White Water) slab form of 10 mm thickness was considered as a bolus.

The results of this study suggest that a maximum air-gap value lower than 5 mm is desirable for an efficient use of the bolus technique.

In the first of two literature reviews, Osei, Al-Ani, Al-Asady et al. report on the clinical and emerging liquid biomarkers used in risk assessment, screening for early detection and diagnosis, prognostication and monitoring of the response of treatment of neuroblastoma in paediatric patients. The review concludes that liquid biopsy assays with wide ranges of clinical applications are emerging to hold incredible potential for advancing cancer treatment and has greater promise for diagnostic purposes, identification and tracking of tumour-specific alterations during the course of the disease and to guide therapeutic decisions.

In the second literature review, Shamsi, Buzdar, Jabeen et al. review the feasibility of using PRESAGE® in various complicated radiotherapy techniques by comparing its measured doses with 2D films and TPS calculated doses.

The technical note is presented by Balakrishnan, Sebastian, Rajkrishna et al., who propose strategies to assist in triaging patients with brain tumours who are referred for radiotherapy during the COVID 19 pandemic and to provide safe and evidence-based care.

This article is a tool to aid in triaging and prioritising brain tumour patient management, and this is for consideration during the pandemic only and not as a strategy for permanent practice change.

To complete this issue, the case study is by authors Arce, Solorio, Mendoza et al. and is a report on the 2-year outcomes of moderately hypofractionated (70 Gy in 28 fractions), IMRT and VMAT for 30 patients with localised prostate cancer.

Professor Angela Duxbury

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