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In this issue

To start this issue, there is a guest editorial by Moallim, Maungwe and Chamunyonga, who discuss the use of cone beam computed tomography (CBCT) guided radiotherapy for locally advanced head and neck cancer. The authors consider the dosimetric impact of weight loss on volumetric modulated arc therapy (VMAT) and intensity modulated radiation therapy (IMRT) plans for selected organs at risk structures (OARs). It is common for head and neck patients to be affected by time trend errors as a result of weight loss during a course of radiation treatment. The objective of this planning study was to investigate the impact of weight loss on VMAT as well as IMRT for locally advanced head and neck cancer using automatic co-registration of the CBCT. The authors undertook a retrospective analysis of previously treated IMRT plans for 10 patients, with locally advanced head and neck cancer. A VMAT plan was also produced for all patients. They calculated the dose-volume histograms (DVH) indices for spinal cord planning at risk volumes (PRVs), the brainstem PRVs (SC + 0.5 cm and BS + 0.5 cm, respectively) as well as mean dose to the parotid glands. This study demonstrated a clinically significant impact of weight loss on DVH indices analysed in head and neck organs at risk. It highlights the importance of adaptive radiotherapy in head and neck patients if organ at risk sparing is to be maintained.

The next three papers are also on the subject of radiotherapy in head and neck cancer. In the next paper, Dawson, Taylor and Bragg, present their research into the exploration of risk factors for weight loss in head and neck cancer patients. Head and neck cancer patients receiving radiotherapy can experience a number of toxicities, including weight loss and malnutrition, which can impact upon the quality of treatment. The purpose of this retrospective cohort study was to evaluate weight loss and identify predictive factors for this patient group. 40 patients treated with radiotherapy since 2012 at the study centre were selected for analysis. Data was collected from patient records. The association between potential risk factors and weight loss was investigated. The authors concluded that younger patients and those with nodal disease were most at risk of weight loss. Other studies have identified the same risk factors along with several other variables. The relative significance of each along with a number of other potential factors is yet to be fully understood. Further research is required to help identify patients most at risk of weight loss; and assess interventions aimed at preventing weight loss and malnutrition.

In the third paper concerned with head and neck cancer patients, Stringer, Knowles, Finchett et al., develop a regime of care for patients with head and neck cancers undergoing intensity modulated radiotherapy (IMRT), with the support of a Health Advisor (HA) and temporary access to the mouth care product Caphosol™. A Health Advisor (HA) was temporarily employed to assess, monitor and refer patients as appropriate and ensure patients received and utilized supplies of Caphosol™. A retrospective audit was undertaken to provide a gap-analysis of current service. The data was used to develop a proforma for documenting assessments and monitoring lifestyle factors for IMRT patients. Assessments referrals and compliance, plus hospital admissions due to treatment related issues, were documented during the baseline audit and the temporary HA service and provision of Caphosol™. The authors conclude that it is recommended that a HA role be established within radiotherapy departments to facilitate lifestyle assessments, referrals and compliance with positive behaviour changes

(e.g. stopping smoking). The use of Caphosol™ as a routine part of mouth care regime for intensity modulated radiotherapy patients also warrants further investigation.

In the fourth paper, Nyarambi, Chamunyonga and Pearce, present their research into the evaluation of the impact of daily and weekly image guided radiotherapy (IGRT) protocols in reducing setup errors and setting appropriate margins in head and neck cancer patients. The method used was interfraction and systematic shifts for the hypothetical day 1–3 plus weekly imaging data was extrapolated from daily imaging data from 31 patients, a total of 964 cone beam computed tomography scans (CBCT). In addition, residual set-up errors were calculated by taking the average shifts in each direction for each patient based on the first three shifts and were presumed to represent systematic setup error. The CTV to PTV margins were calculated using van-Herk formula and analysed for each protocol. The results of this study show that a daily CBCT protocol reduces setup errors and allows setup margin reduction in head and neck radiotherapy compared to a weekly imaging protocol.

The next two papers are on the topic of prostate cancer. In the first paper, Ormerod and Jessop present an evaluation of support of patients with prostate cancer living with or beyond cancer treatment. This study was designed to evaluate whether radiographer-led on-treatment review clinics are meeting the needs of prostate patients receiving radiotherapy. Semi-structured interviews were used to elicit patient and staff perspectives. Seven patient and two staff interviews were audio-taped and the dialogue was manually transcribed. Interviews have been used extensively in qualitative research to produce breadth and depth of insight into participants' experiences and opinions. A thematic analysis of the data was carried out to identify key aspects of the review service for both patients and staff. The authors report that interviews produced an in-depth view of patient and staff experiences. Staff and patients identified core strengths and some areas for improvement within the local service.

The next paper by Hamilton, McKenzie, Wasiak and Fenton, considers the use of probiotics versus psyllium husk as a bowel preparation for prostate radiotherapy. The use of bowel preparation strategies to reduce the degree of rectal distension during prostate radiotherapy is well documented. This retrospective pilot study analysed and compared a probiotic agent against a psyllium-supplemented diet to establish the feasibility of probiotics as a bowel preparation for patients receiving radical radiotherapy for prostate cancer. A retrospective chart review of five patients taking probiotics and five taking psyllium husk (psyllium) during their course of radiotherapy treatment was conducted. On treatment cone beam CT (CBCT) scans were compared to planning CTs to quantify inter-fractional variation in rectal volume and distension. This retrospective analysis suggests that a probiotics-based bowel preparation that utilises Lactobacillus acidophilus and Bifidobacterium lactis may result in increased rectal volume and mean rectal cross-section area (CSA) variation throughout treatment in comparison to a psyllium-supplemented diet.

In the next original article, Yadav, Sharma, Ghoshal et al., present a long term follow up study of postmastectomy internal mammary node radiation in patients with breast cancer. The aim of the study was to see the impact of internal mammary node irradiation (IMNI) on disease-free survival (DFS) and overall survival (OS) in postmastectomy patients with breast cancer. Between 1978 and 1996, 153 women with stage II-III breast cancer were treated with post-mastectomy radiation therapy with IMNI. Their clinical, pathological and treatment characteristics were matched with 166 patients without IMNI. RT dose was 35 Gy to chest wall and 40 Gy to supraclavicular fossa and IMN in 15 fractions over 3 weeks with photons. All patients were planned with 2-dimensional (2D) technique. Adjuvant chemotherapy was administered to 41% and endocrine therapy to 52% of patients. Symptomatic patients were further assessed for late pulmonary and cardiac late effects. Conclusions made were that IMNI significantly improved DFS and OS in postmastectomy breast cancer patients. Benefit of IMNI was seen in patients with central/inner tumors and N2-3 disease.

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Late cardiopulmonary toxicities were comparable between the two groups.

The next three original articles are concerned with dosimetry. In the article by Kumar, Aparna, Aswathi, Anjana and Sitha, the authors study the dosimetric properties of the enhanced dynamic wedge using a Seven29 ion chamber array. The PTW Seven29 ion chamber array and solid water phantoms were used for the study. Primarily, the solid water phantoms with the 2D array were scanned using a computed tomography scanner at different depths. Using these scanned images, planning was performed for different wedge angles at 6 MV and 15 MV. A dose of 100 cGy was delivered in each case. For each delivery, the required monitoring units (MUs) were calculated. Using the same setup with a Varian Clinac iX, the calculated MU was delivered for different wedge angles. Subsequently, the different wedged dose distributions that had been obtained were analyzed using Verisoft software. A shoulder-like region was observed in the profile; this region reduced as depth increased. The percentage deviation between the planned and measured doses at the shoulder region fell within the range of 0.9% to 4.3%. The standard deviation between planned and measured doses at shoulder region in the profile fell within 0.08 ± 0.02 at different depths. The standard deviations between planned and measured wedge factors for different depths (2.5 cm, 5 cm, 10 cm, and 15 cm) were 0.0021, 0.0007, 0.0050, and 0.0001 for 6 MV and 0.0024, 0.0191, 0.0013, and 0.0005 for 15 MV respectively. On the basis of the studies that they performed, it can be concluded that the 2D ion chamber array is a good tool for enhanced dynamic wedge dosimetry.

In the next paper, Kumar, Sitha, Aswathi, Anjana, Aparna, present their study to determine the Source Dwell Positions of HDR Brachytherapy using 2D 729 Ion Chamber Array. The purpose of the study was to determine the dwell position of a high-dose-rate (HDR) brachytherapy Ir-192 source using a PTW Seven29 2D detector array. A Nucletron Microselectron HDR device and 2D array ionization chamber (PTW Freiburg, Germany) equipped with 729 ionization chambers uniformly arranged in a 27×27 matrix with an active array area of $27 \times 27\ cm^2$ was used for this study. Different dwell positions were assigned in the HDR machine. Rigid interstitial needles and a vaginal applicator were positioned on the 2D array, which was then exposed according to the programmed dwell positions. Afterwards, the positional accuracy of the source position was analyzed. This process was repeated for different dwell positions. The results were analyzed using an in-house-developed Excel program. Different random dwell position checks as well as dwell position measurements were performed by using radiochromic film. The dwell positions measured by the 2D array were found to be in good agreement with those measured by the film. The standard deviations between the doses obtained from the different dwell positions were 0.191828, 0.329973, 0.370632, and 0.779939, while the corresponding standard deviations of the doses at the vaginal cylinder were 0.60303, 0.242808, 0.242808, and 0.065309. When the planned and measured dwell positions were plotted, a linear relationship was revealed.

In the next paper, Takemura, Tanabe, Tokai, et al., consider the long-term stability of the Hounsfield unit to electron density calibration curve in cone-beam computed tomography (CBCT) images for adaptive radiotherapy treatment planning. To use CBCT for treatment planning, the Hounsfield unit (HU) - electron density (ED) calibration table for CBCT should be stable. The purpose of this study was to verify the stability of the HU values for the CBCT system (XVI system, ELEKTA AB, Sweden) over one year and to evaluate the effects of variation in HU-ED calibration curves on dose calculation. MATERIALS AND METHODS: A tissue characterization phantom was scanned with the field of view (FOV) of size S (FOV-S) and FOV of size M (FOV-M) using the CBCT system once a month for 1 year. A one port simple treatment plan was constructed on digital phantom images to validate dose distribution using mean HU-ED calibration curves and possible variations. The authors conclude that the CBCT system should be calibrated periodically in one year to use for dose calculation.

In the next paper, Fog, Schut, Sjøgren and Aznar, explore the potential role of modern

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radiotherapy techniques in the treatment of malignant spinal cord compression. The aim of the study was to investigate the doses given to the kidneys and the small intestines for 3 radiation therapy techniques (anterior-posterior fields, 3 fields and VMAT) for spinal cord compression patients with metastatic disease in the lower thoracic or lumbar spine and to monitor the time spent by clinicians and dose planners. Radiation therapy is one of the main treatment modalities for spinal cord compression (SCC). Typical palliative radiation therapy techniques have used anterior-posterior (APPA) fields or a 3 field technique. However, as delivery techniques have evolved dramatically over the past decades, volumetric arc therapy (VMAT) has gained wide acceptance. VMAT allows for a dose reduction in the organs at risk. Such a dose reduction may result in less toxicity. The use of the VMAT technique may require more time for contouring and planning compared with the APPA and 3-field techniques. Any potential dosimetric benefit of VMAT must not be outweighed by large amounts of extra time spent by clinicians and dose planners. VMAT plans were created for 20 patients, treated with radiation therapy for spinal cord compression and also the more traditionally used APPA and 3 field plans. The mean kidney doses and the volume of bowel which received 20 Gy, were extracted for each plan. The correlations between parameters for three techniques were determined. Furthermore, the time required contouring targets for 5 patients; and the time required to plan 5 patients, was recorded. Authors concluded that, patients treated for spinal cord compression in the lower thoracic or lumbar region may benefit from VMAT treatment, as it reduces the dose to the bowel and kidneys compared to APPA or 3-field treatments.

In the next paper, Marchant and Macwan, undertake a systematic literature review on the subject of the forward planned treatment planning technique for non small cell lung cancer stereotactic ablative body radiotherapy. The authors undertook a systematic review of six computerised databases and then summarises a forward planned lung stereotactic ablative body radiotherapy (SABR) treatment planning (TP) technique as a starting point for clinical implementation in the author's department based on current empirical research. The data was abstracted and content analysed to synthesize the findings based upon a SIGN quality checklist tool. The authors' findings of a four dimensional computer tomography (4DCT) scan should be performed upon which the internal target volume (ITV) and organs at risk (OAR) are drawn. A Set-up margin (SM) of 5mm is applied to account for inter-fraction motion. The field arrangement consists of a combination of 7 to 13 coplanar and noncoplanar beams all evenly spaced. Beam modifiers are used to assist in the homogeneity of the beam, although a 20% planning target volume (PTV) dose homogeneity is acceptable. The recommended fractionations by the UK SABR consortium are 54 Gy in 3#s (standard), 55–60 Gy in 5#s (conservative) and the 50–60 Gy in 8–10#s (very conservative). Conformity indices (CI) for both the target volume (TV) and OAR will be used to assess the planned distribution.) Authors conclude that an overview of a clinically acceptable forward planned lung SABR TP technique based on current literature as a starting point, with a view to inverse planning with support from the UK SABR consortium mentoring scheme.

To complete this issue, there is a case study, presented by Palled, Patil, Kumar and Shashidara, on a rare case of sinonasal teratocarcinosarcoma (TCS). Sinonasal TCS are highly aggressive and rare malignant tumors arising from the heterogeneous admixture of components of all the 3 germ cell layers. There are less than 60 cases that have been reported in the literature. In spite of aggressive therapy, the average survival is less than 3 years with multi modality therapy. Seventy percent of the patients who survived more than 1 year received a regimen of combined surgery and adjuvant therapies and this suggests that aggressive therapeutic approaches may improve the treatment outcome. Authors report a case study of sinonasal TCS treated with initial surgery followed with concurrent chemoradiotherapy using Intensity Modulated Radiotherapy (IMRT) technique. The concurrent chemotherapy and adjuvant chemotherapy consisted of Carboplatin and Etoposide. This aggressive treatment protocol of concurrent

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chemoradiation succeeded with adjuvant chemotherapy is well tolerated and produced 5 year loco-regional control and survival without any long term morbidities. Authors conclude that their treatment protocol was well tolerated and the outcome in this individual patient has been encouraging. This could justify a combined modality approach with post-operative Simultaneous Integrated Boost (SIB)-IMRT and chemotherapy (concurrent and adjuvant) for future patient with sinonasal teratocarcinosarcoma.

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