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In this issue

Cite this article: Duxbury A. (2019) In this issue. *Journal of Radiotherapy in Practice* 18: 1–4. doi: 10.1017/S1460396918000651

I am pleased to introduce the ‘in this issue’ for the first issue of Volume 18 of the *Journal of Radiotherapy in Practice*, published in March 2019. In this issue, there are 15 original articles on a range of topics: the first paper is on the subject of the use of artificial intelligence (AI) in radiation medicine. To complete this issue, there are two literature reviews: one review considers the psychological issues of women with cancer of the vulva while the other reviews the availability of the options for breast intraoperative radiotherapy.

In the first paper, Gillian, Milne, Harnett, Purdie, Jaffray and Hodges examine the professional implications of introducing AI in healthcare using radiation medicine as a testing ground. This study evaluated the perceptions of radiation medicine professionals on clinical and professional risks and benefits and their evolving roles and responsibilities in using AI.

Radiation oncologists (ROs), medical physicists (MPs), treatment planners-radiation therapists (TP-RTTs) and treatment delivery radiation therapists (TD-RTTs) at one cancer centre in the preliminary stages of implementing an AI-enabled treatment planning system were invited to participate in uni-professional focus groups. Semi-structured scripts addressed the perceptions of AI, including thoughts regarding changing roles and competencies. Sessions were audio-recorded, transcribed and coded thematically through consensus-building.

A total of 24 participants (four ROs, five MPs, seven TP-RTTs and eight TD-RTTs) were engaged in four focus groups of 58 minutes average duration. Emergent themes addressed impact of AI on quality of care, changing professional tasks and changing competency requirements. Time-consuming repetitive tasks such as delineating targets, generating treatment plans and quality assurance were thought to be conducive in offloading AI. Outcomes data and adaptive planning would be incorporated into clinical decision-making. Changing workload would necessitate changing skills, prioritising plan evaluation over generation and increasing inter-professional communication. All groups discussed on AI reducing the need for TP-RTTs, though displacement was thought more likely than replacement.

The authors conclude that it is important to consider how professionals perceive AI to be proactive in informing change, as gains in quality and efficiency will require new workflows, skills and education.

In the second article, Wong, Leung and Kwong present their study proposing a novel perimeter-based index (PBI) that is capable of evaluating the accuracy in the appraisal of auto-segmentation software. The relationship between the proposed index and the amount of the contouring time that could be saved was studied. The performance of two other commonly used similarity indices, namely dice similarity coefficient (DSC) and the modified normalised average Hausdorff distance (MNAHD), were also evaluated.

Ten nasopharyngeal cases and ten prostate cases that were previously treated with intensity-modulated radiotherapy (IMRT) technique were recruited as the validation cases in this study. Three observers were invited to contour four structures (bladder, rectum, brain stem and parotid gland) on CT images of the validation cases without any aids. The contouring time taken was recorded as the manual contouring time. By using atlas-based auto-segmentation software, three sets of contours were generated for each validation case with different library sizes to produce different degrees of similarity level. The values of the three similarity indices of the auto-segmented contours were calculated. The observers were asked to edit the auto-segmented contours and the editing time was recorded.

The correlation between the editing time and the similarity indices was studied. The amount of time saved was calculated by subtracting the editing time from the manual contouring time. The performances of the PBI, DSC and MNAHD were evaluated using the Pearson correlation coefficient and receiver operating curve analysis.

The conclusions of the study indicate that the proposed index showed a stronger relationship to the amount of contouring time saved. It is a simple tool that could be used to evaluate the performance of different segmentation algorithms.

In the next paper, Lozares-Cordero, Font-Gómez, Gandía-Martínez, Méndez-Villamón, Villa-Gazulla, Miranda-Burgos, Alba-Escorihuela and Jiménez-Puertas present their study of a dosimetric and acute toxicity comparison of endometrial cancer patients treated with either Axxent (Xoft, Inc.) electronic and interstitial brachytherapy versus interstitial high dose rate brachytherapy (HDRBT).

Between 2015 and 2017, 94 patients with postoperative endometrial cancer were treated at their centre with the Axxent electronic brachytherapy (eBT) system. The V_{150} and V_{200} were evaluated prospectively for each plan. The mean age of patients was 65.9 years (age range 33–84), with different tumour staging. Of the 94 patients, 37 received exclusive adjuvant brachytherapy (25 Gy in five sessions); the remaining patients received external beam

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radiotherapy (EBRT) with a regimen of 23 sessions of 2 Gy each to the entire pelvis, followed by eBT (15 Gy in three sessions). In addition, the absorbed doses received by the organs at risk (OAR), urinary bladder, rectum and sigmoid colon were compared with HDRBT plans, evaluating D_{2cc} , $V_{50\%}$ and $V_{35\%}$.

Median follow-up was undertaken for each of the 94 patients to assess the toxicity of the treatment: vaginal mucosa toxicity, rectal and urinary toxicity; and results are presented for acute toxicity, toxicity at 1 month after the end of treatment and follow-up after 12 months for a portion of patients according to Radiation Therapy Oncology Group toxicity criteria.

The authors conclude that the results of treatment with the Axcent eBT unit are very good, as no recurrence was observed and the toxicity of the treatment is very low. The increase in V_{150} and V_{200} had not produced an increase in vaginal mucosa toxicity, and the doses in the OAR were lower than in the plans implemented through HDRBT with Ir-192 or Co-60. eBT is a good alternative to treat endometrial cancer in centres without conventional HDR availability. To date, there are limited published studies reporting on outcomes from patients treated with eBT.

In the study by Muzumder, Nirmala, Vashishta, Avinash, Raj, Sebastian and Kainthaje, the authors present their review of compliance, toxicity and efficacy in weekly versus three-weekly cisplatin concurrent chemo-radiation (CCRT) in locally advanced head and neck cancer (LAHNC).

In this retrospective study, weekly cisplatin 50 mg flat dose was compared with three-weekly cisplatin 100 mg/m², when given in CCRT in LAHNC with curative intent. The study outcomes were compliance, toxicity, loco-regional control (LRC), disease-free survival (DFS) and overall survival (OS).

A total of 84 patients received CCRT from January 2013 to June 2017, 40 in weekly and 44 in three-weekly arm. There was no difference between the arms not completing scheduled radiation therapy or chemotherapy. Patients receiving 200 mg/m² cisplatin was higher in the three-weekly arm compared to the weekly arm (75 versus 40.9%; $p < 0.0015$). Compared to three-weekly arm, more patients in weekly arm developed grade ≥ 3 mucositis (52.5 versus 15.9%, $p = 0.0004$), day care intravenous hydration (82.5 versus 38.6%, $p < 0.0001$) and in-patient admission (55.0 versus 18.2%, $p = 0.0004$). The 2-year LRC, DFS and OS in weekly versus three-weekly arm were: 70 versus 61.4% ($p = 0.406$); 67.5 versus 56.8% ($p = 0.314$) and 67.5 versus 61.4% ($p = 0.558$), respectively. The median time to LRC, DFS and OS was not reached.

The study concluded that weekly cisplatin is comparable to three-weekly cisplatin in terms of compliance, disease control and survival, but has an increase in grade three mucositis and higher admission rates for supportive care.

In the study by Kausar, Mani, Azhari and Zakaria, the authors present their study on the development of a patient-specific quality control (QC) process and recommend a suitable passing rate for QC, irrespective of the dosimetric tools used.

IMRT and volumetric arc radiotherapy (VMAT) plans of five head and neck (HN) and five prostate patients were selected for the patient-specific QC. These plans were generated using the Eclipse TPS v11.0 (Varian Medical System, Palo Alto, CA, USA) 6 MV photon from a Varian TrueBeam linear accelerator (Varian Medical Systems) for each case. Each of the IMRT and VMAT plans was measured by 2D ion chamber arrays (MatriXX) and electronic portal imaging device (EPID) respectively. The passing rates of the dosimetric tools were calculated using criteria of 3%/3 mm.

The results of this study showed that both the dosimeters can be used in patient-specific QC. Although the EPID-based IMRT and VMAT QC is more advantageous in terms of time saving and ease to use, hence for patient-specific QC, both the ion chamber arrays (MatriXX) or EPID can be used.

The next study by Atiq, Atiq, Shamsi, Iqbal, Altaf and Buzdar is an analysis of various dose homogeneity indices essential for the evaluation of therapeutic plans using IMRT on cervix patients. Integral dose (ID) to healthy surrounding organs is also computed.

The effectiveness of different homogeneity indices (HIs) (A, B, C and D) were explored for IMRT plans using a 15 MV photon beam. A total of 18 patients were selected at random for treatment of cervix cancer and dose of 50 Gy was delivered in 25 equal fractions.

The data suggest that HI calculated using the four formulas provided good quality plans. The results advocate that all the studied HIs can be effectively used for assessment of uniformity inside the target volume. However, values of HI C were closest to the ideal value as compared with other three formulas, hence it is considered a better measure to compute homogeneity of dose within target volume. ID gave satisfactory results for surrounding normal tissues such as rectum and bladder and significant critical tissue sparing was achieved using IMRT technique.

In the next paper, Zarifi, Ahangari, Jia and Tajik-Mansoury validate the GATE Monte-Carlo code for simulation of proton therapy using the National Institute of Standards and Technology library data. In this study, the GATE code which is based on Geant4 was used for simulation. The proton beams in the therapeutic energy range (5–250 MeV) were simulated in a water medium, and then compared with the data from National Institute of Standards and Technology in order to investigate the accuracy of different physics lists available in the GATE code. In addition, the optimal value of SetCut was assessed.

Based on an investigation into the range calculation precision and simulation yield, the QGSP_BIC_EMU physics and the optimal SetCut was recommended to be 0.1 mm.

In the next paper, Ibrahim, Attalla, Naggat and Elshemey present their study to compare the dosimetric performance of three-dimensional conformal radiotherapy (3D-CRT), a relatively available technique in developing countries, to IMRT in the treatment of different stages of nasopharyngeal carcinoma (NPC).

According to their diagnostic stages 40 NPC patients are divided into two equal groups. Three planning techniques, such as 3D-CRT, seven-field IMRT (7F-IMRT) and nine-field IMRT (9F-IMRT), are compared. Dose prescriptions of 70 and 66 Gy are delivered in 35 fractions to gross planning target volume (PTV1) and bilateral retropharyngeal carcinoma (PTV2), respectively.

The study concludes 3D-CRT is an acceptable alternative treatment technique for stage I NPC patients in developing countries suffering from the lack of advanced radiotherapy treatment techniques. 3D-CRT and 7F-IMRT have comparable performance in PTVs whereas 9F-IMRT is superior in PTVs and OARs.

In the next paper, Vashum, Singh, Das, Vasudevan and Azharuddin present their findings on the quantification of DNA double-strand break (DSB) induced by radiation and chemotherapy in cervical cancer cells: in vitro study.

In this study, the effects of radiotherapy and chemotherapy on DNA DSB in cervical cancer cells are analysed by the phosphorylation of the protein.

The cervical cancer cells (HeLa cells) were cultured and exposed to ionising radiation. Radiation sensitivity was measured by clonogenic survival fraction after exposing to ionising radiation. Since the phosphorylation of H2A.X declines with time, the DNA damage was quantified at different time points: 1 hour, 3 hours and 1 week after exposure to the radiation. The analysis of γ -H2A.X was undertaken by the Western blot technique. The protein expression was observed at different dose of radiation and combination of both radiation and paclitaxel.

The results demonstrated that a low-dose hypersensitivity was observed at about 0.5 Gy. One week after radiation at 0.5, 0.8 and 2 Gy, there was no expression of phosphorylated H2A.X. Previous experiments, on the expression of phosphorylated H2A.X (γ -H2A.X) in terms of foci analysis, were found to peak at 1 hour and subsequently decline with time. In cells treated with the DNA damaging agents, the expression of phosphorylated H2A.X decreases in a dose-dependent manner when treated with radiation alone. However, when combined with paclitaxel, at 0.5 Gy, the expression peaked and reduces at 0.8 Gy and slightly elevated at 2 Gy.

In this study, the peak phosphorylation was observed at 3 hours post irradiation, indicating that DSBs are still left unrepaired.

In the paper by Khan, Tahir, Rafique, Iqbal, Zulfiqar, Zahoor, Rehman, Iqbal and Chow, the authors report their study to commission a radiochromic film dosimetry system using the timely EBT3 film. They carried out dosimetric evaluations on different characteristics of photon beams (e.g., flatness, symmetry and penumbra) in radiation dose delivery.

A Varian linear accelerator producing 6 and 15 MV photon beams with a 120 multileaf collimator was used in this study. PTW ionisation chamber was used to measure the beam characteristics such as symmetry, flatness and penumbra and measurements and to commission the radiochromic EBT3 film dosimetry system. The results of irradiated films were analysed using the radiochromic film QA Pro software 2016.

Results of the comparison between the ionisation chamber and film measurement show that their radiochromic EBT3 film dosimetry system is reliable and cost effective in the output measurement of a linear accelerator. The measurements confirm that the EBT3 film dosimetry agreed well with the ionisation chamber, and can be used as a re-validation tool for linear accelerator quality control.

The next paper is a comparative contouring study of tumour bed (TB) localisation after oncoplastic breast conservative surgery by Fawzy, Lasheen, El-Din, Wessam, Khallaf and Moussa. The purpose of this study was to investigate modalities of TB localisation of target volume delineation (clinically CT, ultrasound (US) compared to surgical clips-guided) and the impact of their differences on delineated TB volumes.

A total of 27 patients who underwent oncoplastic breast conservative surgery with surgical clips insertion (at least three) were included. CT and US imaging for TB localisation were done 3–4 weeks postoperatively in the same treatment position. TB was delineated four times, guided by surgical clips, clinical data, CT (seroma) and US. A plan was done for each TB delineated. The four delineated volumes were compared regarding volumetric differences, geographical miss index and overlap index.

Significant differences in shifts and indices were detected between each of modalities compared to surgical clips. Thus, in the setting of oncoplastic breast surgery, surgical clips should be routinely used for TB localisation. In view of the larger volumes of breast tissue excised and the extensive remodelling that are inherent to oncoplastic procedures, the concept of TB boost irradiation should be re-challenged.

The paper by Rabiei, Yousefnia, Zolghadri and Shamsaei is concerned with the preliminary dosimetric evaluation of ^{90}Y -(4-[[bis(phosphonomethyl)carbonyl]methyl]-7,10-bis(carboxymethyl)-1,4,7,10-tetraazacyclododec-1-yl) acetic acid (^{90}Y -BPAMD) as a potential agent for bone marrow ablative therapy.

Bone-seeking radiopharmaceuticals are potential therapeutic tools for bone marrow ablation in patients with multiple myeloma. In this procedure, estimation of radiation absorbed dose received by the target and non-target organs is one of the most important parameters that should be undertaken. This research revolves around the absorbed dose to human organs after ^{90}Y -BPAMD injection.

^{90}Y -BPAMD complex was successfully prepared under optimised conditions. The human absorbed dose of the complex was estimated based on the bio-distribution data based on rats by radiation-absorbed dose assessment resource method. The target to non-target absorbed dose ratios for the complex was compared with these ratios for ^{166}Ho -DOTMP, as the main radiopharmaceutical for bone marrow ablation.

As expected, the highest amounts of absorbed dose were observed in the bone surface and the bone marrow with 2.52 and 2.29 mGy/MBq, respectively. The red marrow recorded the most absorbed dose ratios for ^{90}Y -BPAMD as these were much higher than those ratios for ^{166}Ho -DOTMP.

The findings from the results indicate that ^{90}Y -BPAMD has interesting characteristics compared with ^{166}Ho -DOTMP and can be considered as a potential agent for bone marrow ablative therapy for the patient with multiple myeloma.

In the paper by Zaman, Kakakel and Hussain, the authors undertake a comparison of anisotropic analytical algorithm (AAA) and Acuros XB (AXB) dose calculation algorithms with electron gamma shower (EGSnrc) Monte-Carlo for modelling lung and bone heterogeneities encountered during enhanced dynamic wedge (EDW) radiotherapy dose delivery.

In three heterogenous slab phantoms, water-bone, lung-bone and bone-lung, wedged percentage depth doses (PDDs) with EGSnrc, AAA and AXB algorithms for 6 MV photons for various field sizes (5×5 , 10×10 and 20×20 cm²) and EDW angles (15°, 30°, 45° and 60°) have been scored.

This study demonstrated the limitation of the AAA (in certain scenarios) and accuracy of AXB for dose estimation inside and around lung and bone in-homogeneities. The dose perturbation effects were found to be slightly dependent on the field size with no obvious EDW dependence.

In the study by Mahmoudi, Geraily, Shirazi, Nia, Bakhshi and Maleki, their aim was to calculate penumbra widths of single and 201 beams for different collimator sizes of the Gamma Knife machine model 4C using EGSnrc/BEAMnrc Monte-Carlo simulation code and compare the results with EBT3 film dosimetry data.

To investigate the physical penumbra width (80% to 20%), the single beam and 201 beams profiles were obtained using EGSnrc/DOSXYZnrc code and EBT3 films located at the isocentre point in a spherical Plexiglas head phantom.

Conclusions of the study identify that the differences between measured and simulated penumbra widths are in an acceptable range. However, for more precise measurement in the penumbra region in which dose gradient is high, the Monte-Carlo simulation is recommended.

In the paper by Asres, Mathuthu and Mdziniso, the authors investigate source head fluence modulation in cobalt-60 teletherapy by using a 3D physical compensator and secondary collimator jaw motion.

The Oncentra treatment planning system was used to develop three hypothetical plans by secondary collimator jaw motion. A clinical MDS Nordion Equinox 80 cobalt-60 teletherapy unit was used to acquire conventional water phantom beam characteristics. Fluence modulation experiments were executed at 5.0 cm depth in a PTW universal IMRT verification phantom using calibrated Gafchromic EBT2 and RTQA2-1010 film batches. Gafchromic EBT2 film was used to sample intensity maps generated by secondary collimator jaw motion, yet Gafchromic RTQA2-1010 film sampled maps from the 3D physical compensator. The SSDs used were 75.0 and 74.3 cm for the Gafchromic EBT2 and Gafchromic RTQA2-1010 film measurements.

The findings indicate that lateral beam profiles generated from water phantom measurements were used to establish source head fluence modulation on the film measurements. The source head fluence of a Co-60 teletherapy beam could be modulated by secondary collimator jaw motion and using a 3D physical compensator.

In the first of two literature reviews, authors Boden and Willis explore the psychosocial issues of women with cancer of the vulva. Cancer of the vulva is rare, and it is a disease commonly diagnosed in elderly women, but the incidence in younger women is rising. Many patients diagnosed and treated for vulval cancer face physical, social, sexual and psychological challenges. This review aims to highlight the key psycho-social issues experienced by patients with cancer of the vulva, and through critical evaluation of the available evidence, identify implications for practice in order to improve the holistic care for this patient group.

A search of English literature was performed using Medline, PubMed, CINAHL and PsycINFO. Search terms included vulva or vulval cancer, psychosocial, psychosexual impact and quality of life. Articles were excluded if they focussed on cancers other than gynaecological and vulval cancers.

The authors conclude that although there are numerous reports on the psychological and psychosocial problems faced by gynaecological cancer patients, there was a paucity of literature

pertaining to patients with cancer of the vulva. This is consistent with previous research. Studies show a significant negative psychosocial impact experienced by these women. Common themes are isolation, loneliness, stigmatisation and lack of information for patients and their carers, themes spanning over three decades. Nevertheless, more recent studies consistent with the patient's needs, listening to women's narratives on living with cancer of the vulva, are an essential study if we need to help with the psychosocial issues experienced by these women. They underline a necessity to raise awareness among healthcare professionals and the general public to improve holistic support for this particular group of women.

In the second literature review Baghani, Moradmand and Aghamiri conduct a review on the available intra-operative radiotherapy (IORT) modalities for breast irradiation as well as dedicated IORT machines and associated treatment procedures.

Breast IORT is a partial irradiation technique that delivers a single fraction of radiation dose to the TB during surgery. The use of this technique is increasing (especially in the Middle East) and, therefore, it is essential to have a comprehensive approach to this treatment modality. The main IORT trials and corresponding clinical outcomes are also studied.

A computerised search was performed through MEDLINE, PubMed, PubMed Central, ISI web of knowledge and reference list of related articles.

The authors found that IORT is now feasible using two main modalities, including low-KV IORT and intraoperative electron radiotherapy (IOERT). Employment of dedicated machines and usage of treatment procedure for mentioned modalities are quite different. The outcomes of implemented clinical trials showed that IORT is not inferior to EBRT in specifically selected and well-informed patients and can be considered as an alternative to EBRT.

In conclusion, although the clinical outcomes of introduced IORT methods are comparable, based on the review results, it could be inferred that IOERT is the most effective technical method, in view of the treatment time and dose uniformity concepts. The popularity of IORT is mainly due to the distinguished obtained results during breast cancer treatment. Despite the presence of some technical challenges, it is expected that the IORT technique will become more widespread in the immediate future.

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