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ARE WE HELPING CANCER PATIENTS QUIT SMOKING USING SMOKING CESSATION PROGRAMS? A SYSTEMATIC REVIEW AND META-SYNTHESIS OF THE LITERATURE
Stacey M. Yemchuk, R. Gabriel Boldt, David A. Palma, Alexander V. Louie
London Regional Cancer Program, London, ON

Purpose: Although cigarette smoking contributes to approximately one third of cancer diagnoses, the effects of smoking on patient outcomes after a diagnosis of cancer are less clear. The purpose of this study was to evaluate the impact of the Smoking Cessation Program at our institution over a 12-month period, and to perform a meta-synthesis of the literature on the effects of smoking on cancer patient outcomes.
Methods and Materials: The Smoking Cessation Program at our institution was launched in March 2014. All new cancer patients are screened for tobacco usage. Smokers are counselled regarding cessation benefits and offered referral to the program. A Smoking Cessation Champion contacts the patient to provide information and counselling. Further follow up is via an interactive voice response telephone system. To assess the success of this program, accrual data at each step of the pathway were collected monthly during the year 2015 and evaluated. To supplement our institutional data, a qualitative review of the literature was performed in Medline by a clinical librarian to assess the impact of smoking on cancer patient outcomes and to review the most effective smoking cessation interventions.
Results: Data collected from the Smoking Cessation Program indicate that in 2015, 18% of new patients were current/recent tobacco users. While 93% of smokers were advised of cessation benefits and offered referral, only 16% accepted and only 4% of those enrolled in the automated follow up system. In our review of the literature, 160 studies were identified. After abstract screening and review, several detrimental effects of smoking on cancer patient outcomes were described, including: decreased overall survival, increased risk of disease recurrence/progression, increased side effects, reduced performance status, increased rate of second primary cancers, impaired quality of life, and reduced efficacy of treatment. Proposed mechanisms by which these effects occur include decreased immune response and fibroblast proliferation, genomic instability, resistance to apoptosis, increased angiogenesis, and tissue hypoxia. A meta-analysis of smoking cessation interventions reported that abstinence rates were highest (37% at six months) in patients using a nicotine patch for > 14 weeks with supplementary nicotine replacement therapy (NRT) agents as needed. The addition of behavioural intervention to pharmacological agents doubles abstinence rates.
Conclusions: Continued cigarette smoking is detrimental to cancer patient outcomes. The Smoking Cessation Program at our institution has been less successful than those described in the literature. Limitations of the program include challenges in patient access to NRT and minimal follow up. The program is currently undergoing modifications, including initiation of education sessions to engage clinicians in promoting smoking cessation and prescribing NRT.

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MEETING THE INTERNATIONAL LYMPHOMA RADIATION ONCOLOGY GROUP CRITERIA TO DELIVER RADIOTHERAPY FOR LYMPHOMAS - A QUALITY IMPROVEMENT STUDY AT THE TOM BAKER CANCER CENTRE
Peter Mathen, Christine Molnar, Theresa Trotter, Doug Stewart, Alex Balogh
University of Calgary, Calgary, AB
Purpose: Recent guidelines published by the International Lymphoma Radiation Oncology Group (ILROG) have described best practices for design and delivery of radiation in Hodgkin (HL) and non-Hodgkin lymphoma (NHL). Involved site radiation treatment (ISRT) is the goal of treatment, and requires that treatment planning incorporate pre-treatment PET and/or CT findings. Ideally, imaging studies should be obtained in the treatment position and using planned immobilization devices.
Methods and Materials: At our institution, PET imaging is obtained for almost all new HL and NHL diagnoses, with patient supine and arms up being the standard image acquisition position. To meet the new ideal criteria of imaging studies being obtained in the treatment position and using planned immobilization devices, the nuclear medicine department at Foothills Medical Centre (single site performing all PET scans in the Calgary zone) was requested to scan all new HL and NHL patients on a flat couch, and to acquire images with arms up (for optimal interpretation of body images) and arms down (for potential finding of head and neck involvement of HL or NHL). While a deep inspiration breath hold technique would be ideal for the body scan (as this technique has been shown to reduce lung toxicity when RT is used to treat the mediastinum), this is not feasible due to the length of time of PET image acquisition.
Results: The new PET scan technique was applied from April 1 - November 30, 2015. Three hundred and seventy-three patients were scanned. Use of the flat RT couch was discontinued after one month, due to weight of the couch creating a back injury risk for the technologists. Of the 373 patients scanned, 55 (14.7%) received curative intent radiation therapy, either as sole treatment or consolidation treatment. In 37 (9.9% of scanned patients), PET fusion was done to aid in target definition of ISRT.
Conclusions: Due to resource constraints, and audit of utilization of PET information for RT planning, there was a mutual decision to resume standard PET image acquisition procedures for new HL and NHL patients as of December 1, 2015. While the criteria of obtaining PET images in the treatment position and using planned immobilization devices is the ideal as per the ILROG guidelines, the low number of patients who receive RT as part of treatment for HL/NHL, and the even lower number for whom PET fusion was done to aid in target definition of ISRT, make this approach impractical and costly in our institution. Work is ongoing to identify the 15% of patients for whom curative intent RT is planned as sole or combined modality therapy, after staging is completed, to determine how ILROG best practice guidelines for RT delivery could be implemented.

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A RETROSPECTIVE STUDY COMPARING RADIOTHERAPY PLANS FOR NON-SMALL CELL LUNG CANCER WITH GROSS TUMOUR DELINEATED ON FREE BREATHING CT SCAN VERSUS 4D CT SCAN
Kate Johnson, Naseer Ahmed, Sankar Venkataraman, Shaun Loewen, Ethan Lyn
University of Manitoba, Winnipeg, MB

Purpose: Modern radiotherapy with 4D CT image acquisition for lung cancer radiation planning is precise and captures tumour motion, reducing the risk of missing gross disease during treatment. We undertook this study to compare gross tumour volume (GTV), planning tumour volume (PTV) and dose volume histograms (DVH) for organs at risk (OAR) with traditional 3D conformal radiotherapy (3DCRT) and plans generated on Internal Target Volume (ITV) with 4DCT.
Methods and Materials: Fifteen patients with non-small cell lung cancer (Stage III, IV) were enrolled in the study. 3D and 4D CT simulation data sets were acquired at the same setting. GTV for primary and/or nodal disease was contoured on free breathing CT scan and 3DCRT plans were obtained. ITV was contoured on 4D for primary and nodal disease on all 10 respiratory phases and radiation plans were generated with same beam geometry as in 3DCRT plans. GTV, ITV, PTV and DVH on both plans were analyzed and compared. Overlap between the two PTVs was analyzed with Dice Coefficient.
Results: Mean GTV was 115 cm^3 for 3D and 139 cm3 for 4D ($p = 0.0091$). Mean PTV_3D was 505cm^3 and mean PTV_4D was 463cm^3 ($p = 0.33$). Ninety-five percent of the prescribed dose covered 97.8% of PTV_3D and 89.0% of PTV_4D ($p = 0.0036$). Mean V20 to the lungs was 24.6 cGy for 3D and 23.4 cGy for 4D plans ($p = 0.055$). Mean V40 to the heart was similar in both plans. Mean max dose to the cord was 2609 cGy for 3D and 2560 cGy for 4D

(p = 0.16). Mean dice coefficient for PTV_3D and PTV_4D was 78%.
Conclusions: ITV_4D was larger than GTV_3D which was missed on free breathing CT scan and hence compromised PTV_4D coverage with 95% isodose. DVH for OAR was not statistically different. Tumour delineation on 4D captures tumour motion and improves PTV coverage with the prescribed dose.

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DOSIMETRIC COMPARISON OF THREE TECHNIQUES FOR SPINE STEREOTACTIC BODY RADIOTHERAPY
Saif Aljabab[1], Balamurugan Vellayappan[2], Eric Vandervoort[3], Jamie Bahm[3], Robert Zohr[3], John Sinclair[3], Janos Szanto[3], Shawn Malone[3]
[1]University of Ottawa, Ottawa, ON
[2]National University Cancer Institute, Singapore
[3]The Ottawa Hospital Cancer Centre, Ottawa, ON

Purpose: The use of Stereotactic Body Radiotherapy (SBRT) in patients presenting with oligo-metastatic spine disease has increased. However, technical challenges remain due to the concave target juxtaposed with the spinal cord. It remains unclear if a particular technique allows for superior target volume coverage whilst sparing critical structures. We aimed to evaluate the dosimetric advantages between three modalities for spine SBRT: CyberKnife (CK), Volumetric Modulated Arc Therapy (VMAT) and Helical Tomotherapy with Dynamic Jaws (HT).
Methods and Materials: Datasets from 10 consecutive patients treated with CK were utilized. Contours were based on the International Spine Radiosurgery Consortium Consensus Guidelines. All patients were planned to receive 24 Grays (Gy) in 2 fractions, with the primary goals of: 1) maintaining the max tolerance of the cord (≤ 17 Gy) or cauda equine (≤ 20Gy); and 2) the clinical target volume (CTV) to receive at least 95% of the prescribed dose. During planning priority was given to OAR tolerance. Treatment plans were generated by separate dosimetrists on the technique-specific software then compared using Velocity AI. Parameters of comparison include target volume coverage, maximum cord (or cauda) dose, Conformity Index (CI), Gradient Index (GI), Homogeneity Index (HI), treatment time per fraction (TT) and monitor units (MU) per fraction. Statistical analysis was performed with STATA v14.
Results: CTV mean D98% coverage was significantly worse with VMAT (85.7%) versus CK (93.9%) and HT (91.2%, p = 0.01). The CTV mean D2% and mean HI were significantly greater in CK (129.7%; 41.86) versus VMAT (109.5%; 26.96) and HT (107.6%; 21.17, p < 0.01 for both). There was no difference in mean CI between CK (0.58) and HT (0.60) both were more conformal than VMAT (0.42, p < 0.01). Mean GI was sharpest in CK (3.96) versus HT (4.86) and VMAT (10.28, p < 0.03). VMAT had the least treatment time and MU usage per fraction (8.5 minutes, 9764 MU) versus HT (27 minutes, 11419 MU) and CK (62.4 minutes, 14059 MU, p < 0.01). There was no significant difference between the three techniques in the maximum dose to the cord or cauda equina.
Conclusions: CK and TOMO plans were both able to achieve conformal target coverage while respecting cord tolerance. Dose heterogeneity was significantly larger in CK. VMAT required the least treatment time and MU, but had the least steep GI, CI and target coverage especially for concave shaped targets.

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NEW ASPECTS REGARDING THE RADIATION OF THALAMIC GLIOMAS
Edwin Boelke[1], Christiane Matuschek[2], Wilfried Budach[1], Anne Haymann[3]
[1]Heinrich Heine University, Dusseldorf, Germany
[2]University of Dusseldorf, Dusseldorf, Germany
[3]MD Anderson, Houston, TX

Purpose: Thalamic tumours represent 5.2% of all intracranial tumours and are typically diagnosed in the paediatric population. These tumours arise from glial cells with an aggressive behavior and a high grade histology. They have a poor prognosis. The aim of this study was to find new approaches for defining the clinical target volume for these tumours.
Methods and Materials: Clinical data was collected form archived files of 30 patients diagnosed with thalamic gliomas based on pathologic and radiologic criteria.
Results: Three patterns of tumour spread were found. The first pattern followed the thalamic tributaries of the posterior part of the internal cerebral veins. These were the anterior and superior thalamic veins. For the second pattern the close proximity of the internal cerebral vein branches of the superior thalamic veins was a potential route of spread between the medial surfaces of the thalami. In addition to spread across the midline tumours could also spread along the adjacent tectal, pineal and/or vermian veins. The third pattern of thalamic tumour spread was found in gliomas which use the anterior tributaries of the internal cerebral venous architecture of the posterior and inferior branches from the basal vein of Rosenthal.
Conclusions: Thalamic gliomas spread upon the peritumoural architecture of the perivenous/subglial Scherer structures and this knowledge should be used for redefining the clinical target volume for radiation therapy in thalamic gliomas.

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THE RELATIONSHIP BETWEEN HOT FLASHES AND TESTOSTERONE RECOVERY FOLLOWING 12 MONTHS OF ANDROGEN SUPPRESSION FOR MEN WITH LOCALIZED PROSTATE CANCER IN THE ASCENDE-RT TRIAL
Maryam Dosani, W. James Morris, Scott Tyldesley, Tom Pickles
British Columbia Cancer Agency, Vancouver, BC

Purpose: This study was designed to characterize the proportion of men who experience hot flashes (flashes), their peak intensity and cessation in relation to testosterone (TT) levels, with androgen deprivation therapy (ADT). These relationships have not been described in the literature previously. We also characterize testosterone recovery following 12 months of ADT in men undergoing external beam radiation therapy (EBRT) (+/- brachytherapy boost).
Methods and Materials: This is a pre-specified secondary analysis of the ASCENDE-RT clinical trial, which is a multicenter, randomized trial of dose-escalated EBRT versus low-dose-rate brachytherapy for men with unfavourable-risk localized prostate cancer. Three hundred and ninety-eight men were randomized. All received 12 months of ADT with luteinizing hormone releasing hormone (LHRH) agonist plus a non-steroidal anti-androgen for at least one month. TT was measured every two months until eight months, at one year, every three months until 24 months, every six months until five years, and yearly thereafter. Patients were censored at last follow up or at date of PSA failure. TT recovery was defined as any single serum TT above threshold, as defined below. Presence and intensity of flashes were assessed every four months until one year, every six months until five years, and yearly thereafter.
Results: TT and hot flash data were available in 392 patients. Analysis was restricted to 334 patients in which baseline (pre-ADT) TT was collected. Median age at first LHRH injection was 68 years (range 45-86). Median follow up from date of ADT to last assessment of flashes was 6.1 years. Median TT at baseline was 13.1 nmol/L. All patients with baseline TT ≥ 5 (91% of study cohort) recovered TT to this threshold with a median time to recovery of 9.6 months. Eighty-seven percent of patients with baseline TT ≥ 7.5 (84% of study cohort) recovered TT to this threshold after a median of 12.7 months. Eighty-one percent of patients with baseline TT ≥ 10 (68% of study cohort) recovered TT to this threshold after a median time of 18.2 months. Ninety-four percent of men experienced flashes at some point. Flashes were first reported at a median of 4.0 months from first LHRH injection, when the TT had fallen to castrate. Peak intensity of flashes also occurred at this time and TT level. Median time of cessation of flashes was 7.6 months following cessation of ADT, when median TT had risen to 5.7 nmol/L. Ninety-one percent of