1
THE POTENTIAL BENEFIT OF ESOPHAGEAL SPARING DURING PALLIATIVE RADIOTHERAPY FOR LUNG CANCER
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Purpose: A 2007 meta-analysis of several randomized controlled trials assessing optimal doses for palliative lung radiation concluded that radiation doses of 35 Gy/10 or greater improved overall survival at one and two years compared to lower doses at the cost of an increased toxicity related to esophagitis. Esophageal sparing has been proposed as a mechanism of reducing this toxicity. A planning study was initiated to assess the potential impact of esophageal-sparing IMRT (ES-IMRT) for palliative lung radiotherapy, compared to the current standard of care using parallel-opposed pair beams (POP).

Methods and Materials: In this institutional research ethics board-approved study, patients with lung cancer treated to a dose of 30 Gy in 10 fractions between August 2015 and January 2016 were identified. Additional inclusion criteria required the D50 to contain at least 5 cm of esophagus. The radiation treatment plans were optimized using ES-IMRT by limiting the max esophageal point dose to 80% of the prescription. This was achieved by creating a 5 mm ring around the esophagus. If any portion of the GTV was within this ring, the isocentre was compromised such that a point dose could receive as low as 80% of the intended prescription. Both the clinical POP and optimized ES-IMRT plans were evaluated for the likelihood of esophagitis (≥ Grade 2) and pneumonitis (≥ Grade 2), using published Lyman-Kutcher-Burman normal tissue complication probabilities (LKB-NTCP) models. The input parameters for the LKB models were D50 = 44.9, n = 0.34, m = 0.34 and D50 = 29.9, n = 1, m = 0.41 for esophagitis and pneumonitis, respectively. The mean normalized total dose (NTD mean) of the PTV, and the mean dose to the esophagus (esophageal mean) and lung (lung mean) were determined.

Results: A total of 13 patients met our inclusion criteria and were analyzed, of which 11/13 had the GTV directly abutting the esophagus. The median [range] of the GTV and PTV were 90.6 cc [22.3 – 199.8] and 321.8 cc [164.1 – 564.9], respectively. Using an 8 mm ITV for PL-IMRT, swallowing would result in a global C outcome rate of 4%, among 732 cases reviewed between June 1 and December 2015. Conclusions: Routine peer review of RT plans improved plan quality prior to treatment delivery. The optimal timing for QA meetings was deemed to be at the post-planning stage. Widespread successful rollout demonstrated the feasibility of the documentation approach across disease sites.

2
QUANTIFYING THE OUTCOME OF RADIATION THERAPY PEER REVIEW AND IDENTIFYING THE OPTIMAL TIMING FOR QUALITY ASSURANCE MEETINGS WITHIN THE RADIOTHERAPY PLANNING PROCESS
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Purpose: To document and evaluate outcomes of weekly disease-site specific, radiation therapy (RT) peer review quality assurance (QA) rounds at a Canadian cancer centre. Methods and Materials: In compliance with Canadian Partnership for Quality Radiotherapy QA guidelines, seven disease-site specific, RT QA rounds were conducted by Radiation Oncologists (ROs) at a mid-sized cancer centre but outcomes were not formally categorized or documented. From January 6 to May 5, 2015, outcomes of each case reviewed at (i) Breast, (ii) Head and Neck (including thyroid and cutaneous cases) and (iii) Lung tumour QA rounds were recorded prospectively. Each RT plan was assigned an outcome: A (no change required), B (issue to consider for future patients), or C (change required before next fraction). Following an initial audit, a standard nomenclature was developed and adopted by all seven disease-site QA meetings from June 2015.

Results: Two hundred and eleven RT plans prescribed by 20 ROs were peer reviewed at 43 QA meetings. Twenty-eight percent were reviewed after contouring (prior to plan development) and 72% were reviewed after RO plan approval. For plans reviewed post-contouring, 26% had a ‘B’ and 10% had a ‘C’ outcome. For post-planning reviews, the ‘B’ and ‘C’ rates were 12% and 9%, respectively. Eighty-eight percent of ’C’ outcomes resulted in plan changes prior to further RT. Only 55% of ‘C’ deviations would have been detected at the post-contouring stage. The most common reason for a B or C outcome was a recommendation for change in target volume definition. Adoption of this classification across all seven disease sites resulted in a global C outcome rate of 4%, among 732 cases reviewed between June 1 and December 2015. Conclusions: Routine peer review of RT plans improved plan quality prior to treatment delivery. The optimal timing for QA meetings was deemed to be at the post-planning stage. Widespread successful rollout demonstrated the feasibility of the documentation approach across disease sites.

3
LARYNGEAL MOTION DYNAMICS USING 4D-COMPUTED TOMOGRAPHY AND DYNAMIC MAGNETIC RESONANCE IMAGING
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Purpose: To assess the dynamics of laryngeal motion in early glottic cancer in order to determine safe margins for partial larynx IMRT (PL-IMRT), as well as to evaluate dosimetric advantage of PL-IMRT.

Methods and Materials: This prospective study included patients with T1-2N0 glottic cancer treated with whole larynx IMRT (WL-IMRT). Pre- and mid-treatment 4D-CT allowed for assessment of larynx excursion during swallowing and in resting position. Sagittal MRI fluoroscopy was also obtained to assess swallowing frequency. For 10 patients, PL-IMRT plans were calculated using margins derived from 4D-CT analysis.

Results: Twenty patients were accrued between 2015 and 2016. Over two minutes, median swallowing frequency was 1 (0-5) and was significantly reduced to 0 with instruction not to swallow. Median mid-treatment swallowing frequency was 0, even without specific instructions. Median amplitude of larynx excursion during swallowing was 23 mm (15-30), 1 mm (0-3), 6 mm (2-9) and 1 mm (0-3) in the superior, inferior, anterior and posterior directions, respectively, and remained similar mid-treatment. When not swallowing, median larynx excursion reached 4 mm (1-6) and 2 mm (1-2) in superior-inferior and antero-posterior directions, respectively. 4D-CT analysis unexpectedly revealed that the planning CT had not been acquired in resting position in one patient. In up to 30% of patients, anatomic changes resulted in a 4 mm larynx shift in the SI direction and 2 mm in the AP direction in mid-treatment compared to pre-treatment imaging. PL-IMRT would have allowed for a relative reduction of mean doses to the ipsilateral carotid, contralateral carotid, contralateral arytenoid and larynx of 72%, 84%, 61% and 26%, respectively. Using an 8 mm ITV for PL-IMRT, swallowing would only result in CTV excursions beyond the 95% IDL for a median of 0.8 seconds (0.2-1.8).