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SPICE Planning for Volumetric Modulated Arc Therapy SBRT in Early-Stage NSCLC: Some Like it Hot!

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Purpose/Objective(s): Stereotactic body radiation therapy (SBRT) is a standard of care treatment option for inoperable early-stage non-small cell lung cancer (NSCLC) due to favorable local control. Recent retrospective work has brought new interest upon characterizing dosimetric properties that lead to improved local control, especially in the era of volumetric modulated arc therapy (VMAT) in which greater flexibility in treatment dosimetry exists. This study aimed to retrospectively identify if, and how, our evolving institutional approach to dosimetric hotspot design in VMAT-SBRT impacts local tumor control for early-stage NSCLC. We hypothesize that hotspots greater than 115% of the prescription marginal radiation dose yield the best local control rates.

Materials/Methods: Patients with early-stage NSCLC treated with VMAT-SBRT from June 1st, 2018 to June 1st, 2023 at a single institution were reviewed with the primary endpoint being risk of local recurrence. Treatments were inclusive of standard "cool" plans with homogeneous dose distribution across the Planning Target Volume (PTV) and "hot" plans designed using a novel and evolving technique termed Stereotactic Planning with Intentional Central Escalation (SPICE). SPICE consists of creating a Definitive Target Volume (DTV) formed via the subtraction of any organs-at-risk planning risk volumes (OAR PRV) from the Internal Gross Tumor Volume (IGTV). Early on, the DTV was prescribed to at least 115% of the prescription dose, more recently striving for 130% of the prescription dose, allowing hotspots no greater than 160% within the DTV and hotspots no greater than 110% in regions of the PTV that overlap with an OAR PRV. Treatment hotspots were measured using the ratio of max point dose (Dmax) to the dose received by 95% of the PTV (D95%). Local control was assessed with "cool" plans (hotspot <115%) versus SPICE plans (hotspot ≥115%) via the Kaplan-Meier method.

Results: There were 114 treatments among 110 patients with a median follow up of 18 months. 9 local recurrences were observed with a 2-year local control rate of 87%. When stratified by planning technique, there were 81 "cool" plans with a hotspot <115% and 33 SPICE plans with a hotspot ≥115%. Only 1 of the 9 local recurrences occurred among patients with SPICE planning. The single SPICE-planned recurrence occurred in a centrally-located lesion at the site of PTV coverage compromise due to proximity of the main stem bronchus. The 2-year local control rate was 85% for "cool" plans compared to 92% for SPICE plans (p = 0.3).

Conclusion: SPICE planning for early-stage NSCLC has an encouraging local control rate. More patients and longer follow up is needed to confirm whether SPICE planning provides improved local control compared with "cool" plans. Additionally, further assessment of toxicities is needed to ensure SPICE planning is similarly safe without an increased risk of treatment-related adverse effects.

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Characterizing Post-Treatment Cardiac and Pulmonary Hospitalizations in Locally Advanced Lung Cancer: A Statewide Quality Consortium Analysis

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Purpose/Objective(s): Managing locally advanced non-small cell lung cancer (LA-NSCLC) includes chemoradiation and immunotherapy, presenting risks for delayed cardiac and pulmonary complications. This study hypothesizes that certain patient and treatment-related characteristics are predictors for these adverse events. We aim to quantify the incidence of post-treatment cardiac and pulmonary hospitalizations in LA-NSCLC patients and identify predictors to personalize treatment.

Materials/Methods: A prospectively gathered database of LA-NSCLC patients undergoing radiation in a statewide multicenter quality consortium was analyzed. From 2018 to 2023, hospitalization data due to lung and heart complications were compiled annually. Death and hospice entry were treated as competing risks when estimating cumulative incidence. Utilizing univariate and multivariate models, we explored potential associations with several patient demographic and treatment factors, including planning target volume (PTV), oxygen dependency, Eastern Cooperative Oncology Group (ECOG) performance status, Chronic Obstructive Pulmonary Disease (COPD), and radiation treatment dosimetry.

Results: Follow-up time ranged from 1 to 5 years post RT, with 1 year of follow-up in 66% (405/613) and 2 or more years of follow-up in 34% (208). In total, 128 patients were hospitalized for lung-related complications including COPD exacerbation (n = 44), pneumonia (n = 64), and pneumonitis (n = 17). Cardiac events led to hospitalization in 40 patients including arrhythmias (n = 20), congestive heart failure (CHF) (n = 8), pericardial effusion (n = 3), and myocardial infarctions (n = 8) The cumulative incidence of any lung-related hospitalization was 0.16 at one year and 0.28 at 3 years. The 1- and 3-year cumulative incidence of any cardiac-related hospitalization was 0.04 and 0.09 respectively. Notable predictors ($p<0.05$) of any lung and any cardiac related hospitalizations included ECOG status and baseline oxygen dependency. Mean lung dose and ECOG were identified as jointly significant predictors of pneumonitis-related admissions. Those treated with immunotherapy showed a reduced rate of cardiac admissions, likely due to healthier patients being selected for such therapies. Additionally, mean heart dose, was a significant predictor of any lung hospitalization, signifying a nuanced interaction of cardiopulmonary complications.

Conclusion: This "real world" analysis of a large prospectively gathered data from a statewide consortium has revealed significant associations between mean heart dose and ECOG performance status with the incidence of cardiac and pulmonary hospitalizations following LA-NSCLC treatment. Understanding these relationships further is necessary for the implementation of risk-tailored, patient-specific treatment modalities, aiming to improve long term quality of life of LA-NSCLC patients.

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