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Retrospective Analysis of Dosimetric Constraints and Steroid Use for Development of Radiation Pneumonitis in ILD Patients treated with SBRT for Non-Small Cell Lung Cancer: A Multi-institutional Study

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Abstract
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Abstract

Purpose: Patients with interstitial lung disease (ILD) and early-stage non-small cell lung cancer who undergo thoracic stereotactic body radiotherapy (SBRT) are at increased risk for severe pulmonary toxicity and death. Outcomes and associated risk factors in this unique population remain poorly characterized. We conducted a multi-institutional retrospective analysis to describe clinical, dosimetric, and treatment-related variables associated with outcomes in this population.

Methods: Patients with ILD were treated at two academic referral centers and were assessed. Baseline demographics, comorbidities, pulmonary function tests (PFTs), ILD subtype, and treatment details, including stage, dose, fractionation, centrality, baseline pulmonary function and lung dosimetry (V5-V60 in 5-Gy increments, mean lung dose), were extracted from the electronic medical record. Data on corticosteroid use (both baseline chronic steroids and peri-treatment prophylactic steroid regimens prescribed concurrent with radiation) was also collected. The primary outcome was symptomatic radiation pneumonitis (SRP), defined as clinical symptoms, medication use, or hospitalization for pneumonitis, whichever occurred first. Death from any cause was the secondary outcome. Data were summarized using count (frequency) and median (interquartile range) and compared between SRP groups (yes v. no) using the chi-square test and Mann-Whiteney U test for categorical and continuous variables, respectively.

Results: From 2021-2025, a total of 37 patients were included, with a median age of 71 years (range 65–75). The distribution of T stages was: T1a (8%), T1b (43%), T1c (35%), and T2+ (14%). The median prescribed dose was 50 Gy; the median number of fractions was 5. SRP occurred in 10 (27%) patients. Tumor size ($p< 0.02$) and T stage ($p< 0.03$) were significantly associated with SRP, while fractionation schedule or baseline pulmonary function were not. Multiple dosimetric factors were significantly associated with SRP, including increasing PTV volume, ipsilateral and bilateral V5, V10, V20, V30, V40, V50 and mean lung dose. Ipsilateral lung V20 (4.9% vs. 8.4%, $p < 0.01$) and bilateral lung V20 (2.5% vs. 4.5%, $p< 0.01$) were both significantly higher in the patients who experienced SRP. Nine patients received prophylactic corticosteroids, which showed a non-significant trend toward reduction of SRP rate (33% vs 0%, p=0.10). Mortality was observed in 10 patients (27%), 4 of whom had developed SRP. The mortality rate was not significantly different among patients who received prophylactic steroids compared to those who did not (10% versus 30%, p=0.42).

Conclusion: In this multi-institutional analysis, we found that nearly one-quarter of patients with ILD treated with SBRT developed SRP. We identified multiple dosimetric characteristics – including V5, V20, V40 - that were associated with SRP. Additional studies on interventions to reduce mortality in this high-risk population are ongoing.