Purpose:

Several mathematical models exist to predict secondary cancer risks from radiotherapy treatment. In this study, we aimed to compare three dosimetry-based models in the application of stereotactic body radiotherapy (SBRT) of early-stage non-small cell lung cancer (NSCLC) with three radiotherapy treatment modalities.

Methods:

Ten patients who received definitive SBRT for early-stage NSCLC were retrospectively selected. For each patient, a helical tomotherapy (HT) plan, a three-dimensional conformal radiotherapy (3D-CRT) plan, and a volumetric modulated arc therapy (VMAT) plan were generated to deliver 50 Gy to the planning target volume in five fractions. The excess absolute risk (EAR) for secondary lung cancer occurrence was calculated using three risk models: the linear-exponential model, the plateau model, and the linear model. The sensitivity of the EAR to the prescription dose was evaluated by varying the prescription dose in the range of 40 to 60 Gy.

Results:

Based on the linear-exponential model, the average EAR's (in occurrences per 10,000 patients per year) were 8.4+/-2.7, 8.3+/-2.1, and 8.4+/-1.9 for the HT plans, 3D-CRT plans, and VMAT plans respectively with 40 Gy prescription dose, and 9.4+/-2.5, 9.0+/-2.1, and 9.3+/-1.8 with 60 Gy. Based on the plateau model, the average EAR's were 10.7+/-3.9, 10.6+/-3.0, and 10.9+/-2.8 with 40 Gy, and 12.9+/-4.2, 12.6+/-3.4, 12.9+/-3.1 with 60 Gy. Based on the linear model, the average EAR's were 29.1+/-13.4, 29.4+/-11.4, and 30.0+/-11.1 with 40 Gy, and 43.8+/-20.1, 44.0+/-11.0, 45.1+/-16.6 with 60 Gy. The difference in EAR's were not statistically significant among the HT, 3D-CRT, and VMAT plans.

Conclusions:

Three secondary cancer risk models, as well as three SBRT treatment modalities, were compared. There was no significant difference in secondary lung cancer risks among the three treatment modalities in this study.