

Treatment outcomes of stereotactic body radiotherapy for early stage non-small-cell lung cancer and lung metastasis

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Background and Objective

- Stereotactic body radiotherapy (SBRT) is a highly precise local treatment with high dose per fraction, used mainly in lung tumors
- To report local control rate, patterns of failure, treatment-related toxicity, and determine factors predicting stereotactic body radiotherapy (SBRT) outcomes for primary and secondary lung tumors with competing risk analysis

Methods

- A retrospective cohort study
- All patients were diagnosed early stage non-small-cell lung cancer or lung metastases treated with SBRT from January 2009 to September 2018 in Ramathibodi Hospital
 - Inclusion criteria were histologically confirmed early stage NSCLC (T1-2N0M0), lung metastasis with known primary malignancy and good performance status (ECOG ≤ 2)
 - Exclusion criteria were missing data and re-irradiation to in-field region
- Primary endpoint: 1-year local control rate, using competing risk analyses with cumulative incidence curves
- Secondary endpoints: patterns of failure, SBRT-related toxicities, overall survival factors predicting local failure and SBRT-related complications

Results

- 59 patients with 98 lung lesions and median follow-up time was 16.8 months (0.1-71.7 months)
 - Primary NSCLC, 15.3%, and lung metastasis, 84.7%
 - Primary NSCLC group had older patients, more comorbidities and poorer performance status compared to the other
 - Majority of tumor origin and histopathology of the tumors were primary lung cancer, 49% and adenocarcinoma, 82.7%
 - Median maximal diameter of the tumor was 2.3 cm (0.1-8 cm)
- Dose prescriptions were various from 25-60 Gy in 1-10 fractions. Radiation was delivered by three linear accelerators as follows, with ray tracing, Acuros and Analytical Anisotropic Algorithm (AAA)
 - CyberKnife G4 system (Accuray Inc., Sunnyvale, CA) with radiosurgery systems and MultiPlan 2.0 planning system
 - Varian EDGE (Varian Medical Systems, Palo Alto, California)
 - Varian RapidArc (RA Varian Medical Systems, Palo Alto, CA)

Results and Discussion

Competing risk analysis

- Overall 1-year local control rate was 90.8% (93.4% in primary lung cancer and 90.1% in lung metastasis)
- The most common pattern of failure was distant failure, 46.9%. The follows were local and regional failure patterns, 12.2% and 6.1% respectively
- Of 9 (9.2%) lung tumors, pulmonary toxicities were observed which radiation pneumonitis grade ≥ 2 found in 8 (8.2%) lesions and pulmonary hemorrhage grade 5 found in 1 lesion in a patient
- Multivariate analysis of factors predicting local failure and radiation pneumonitis grade ≥ 2
 - Mean BED of the PTV < 100 Gy had more local failure compared to the dose ≥ 100 Gy, adjusted SHR 5.41 (95% CI 1.14-25.69), p-value = 0.034
 - 1-year local failure rates between mean BED of the PTV ≥ 100 Gy and < 100 Gy were 3% and 15.5%, respectively
 - The maximal diameter of the tumor > 5 cm had higher SBRT-pneumonitis, adjusted SHR 5.34 (95% CI 1.52-18.69), p=0.009.
 - Incidence of radiation pneumonitis grade ≥ 2 were 18% in the maximal diameter of the tumor > 5 cm and 2% in the tumor < 5 cm, p=0.009
- 1-year overall survival was 73.5%, primary NSCLC, 80%, and lung metastasis, 72.3%. Median overall survival was 16.8 months (0.1-71.7 months)

- Discussion:** Our study results were comparable in local control, toxicity and similar patten of failures with previous studies [1]. BED PTV mean should be one of SBRT planning indexes. Tumor size may not directly impact symptomatic radiation pneumonitis but higher ipsilateral lung doses. [2]

Conclusions

- Local control of lung SBRT was high with acceptable toxicity.
- BED PTV mean and the tumor maximal diameter > 5 cm were the predictive factors for local tumor control and radiation pneumonitis grade ≥ 2 , respectively
- Lung SBRT might not suitable for ultra-central lung tumors

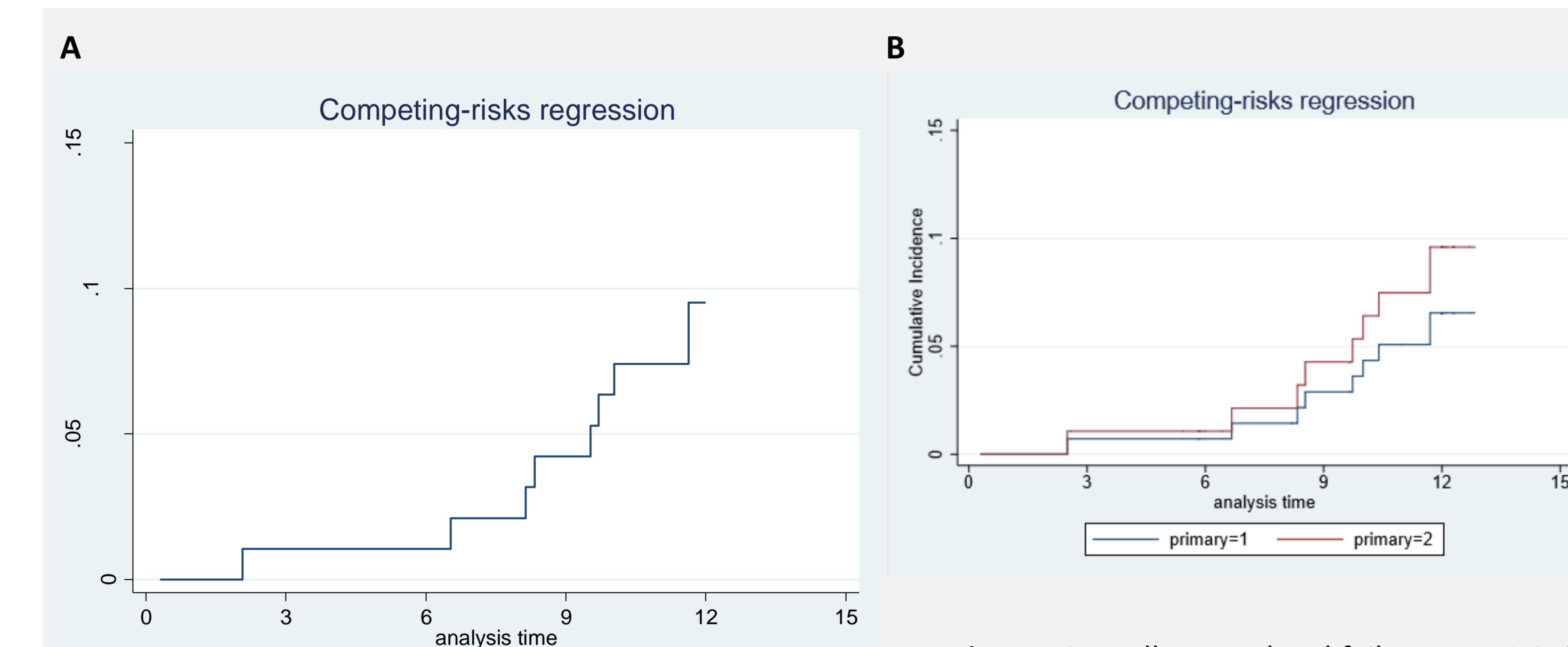


Fig.1A: Overall 1-year local failure rate 9.2%

Fig. 1B: 1-year local failure rate of primary lung cancer and lung metastasis = 6.6% and 9.9%

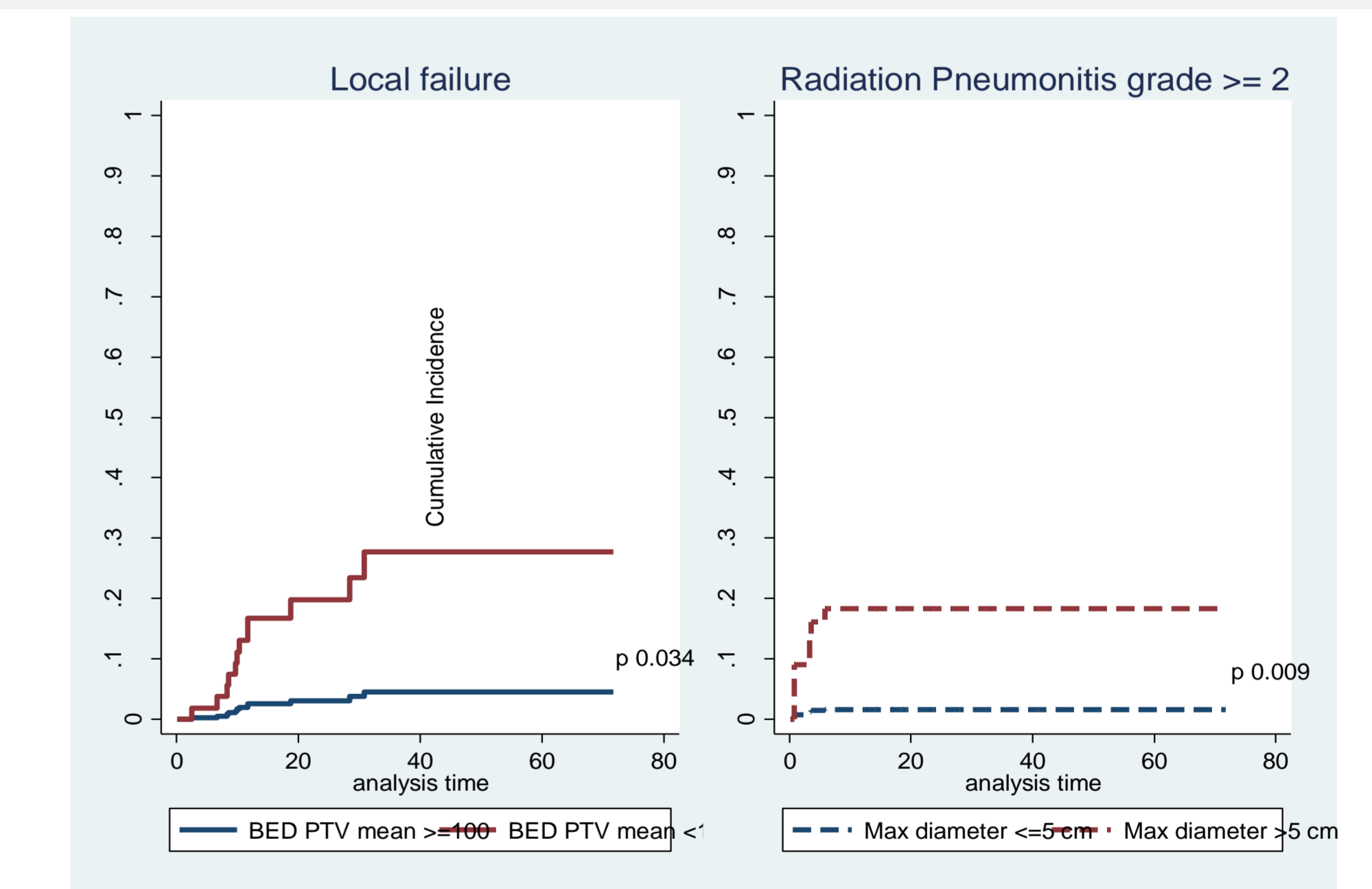


Fig. 2: Cumulative incidence curves of factors predicting local failure and radiation pneumonitis grade ≥ 2

References

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- Parker SM et al. Impact of Tumor Size on Local Control and Pneumonitis After Stereotactic Body Radiation Therapy for Lung Tumors. *Practical Radiation Oncology*. 2019. Jan;9(1):e90-e97

