

EARLY EXPERIENCE OF STEREOTACTIC BODY RADIOTHERAPY IN PATIENTS WITH PRIMARY AND METASTATIC LUNG TUMORS

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Purpose : To investigate the clinical outcomes of patients with primary and metastatic lung tumors treated by CyberKnife[®] (CK) stereotactic body radiotherapy (SBRT).

Methods : Between November 2005 and June 2008, we treated 19 patients with SBRT at Taipei Medical University-Wan Fang Hospital. The SBRT was delivered by CK tumor tracking system. Tumor response and treatment-related toxicity were evaluated by follow-up image study. Treatment-related toxicities were scored by Common Terminology Criteria for Adverse Events version 3.0. In this study, we reviewed their medical records retrospectively.

Results : We treated 47 lung tumors in 19 patients using CK SBRT. Eleven tumors in 8 patients were primary lung cancer, and 36 tumors in 11 patients were metastatic lung cancer. The locations of 9 tumors were central, whereas the others were peripheral. The tumor volumes were ranged from 1.1 to 110.5 ml (median, 9.5 ml). The radiation doses were ranged from 22 to 60 Gy, given in 2 to 4 fractions. The prescribed doses were normalized at 76% to 85% of the planned isodose. With a median follow-up interval of 12 months, we observed that grade 2 radiation pneumonitis (RP) occurred in 3 patients (1 central; 2 peripheral), whereas we found that grade 3 RP occurred in 2 patients with central lesions. According to the univariate analysis, female ($p = 0.038$) and central lesion ($p = 0.042$) were two predictive factors to the occurrence of grade ≥ 2 RP. One grade 4 tracheal complication (tracheoesophageal fistula) and one grade 5 bronchial complication (bronchial necrosis) were observed in two patients who had centrally located recurrent tumors and had been previous treated with external beam radiotherapy. Four of the evaluable patients (16 patients) had responded completely (25%), seven exhibited partial response to treatment (43.8%), and two had stable disease (12.5%). Three patients had tumor progression after SBRT (18.7%). The 1-year overall survival (OS) was 63%, and the 1-year local progression-free survival (PFS) was 84.2%. The 1-year local PFS was 87.5% for primary lung cancer and 81.8% for metastatic lung cancer ($p = 0.87$). The 1-year local PFS for central and peripheral lesions was 80% and 85.7%, respectively ($p = 0.63$).

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Conclusion : Our study showed that SBRT using the CK system was effective for treating primary and metastatic lung tumors, providing better local control and shorter treatment course compared with those treated with conventional fractionated radiotherapy. Our study also showed two predicting factors for RP. Finally, using SBRT to treat centrally located tumor or re-irradiate recurrent tumor require additional caution due to higher risk of having complication. Thus, we suggest that more studies are needed in the future to confirm those findings in this study.

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Key words: CyberKnife[®], Stereotactic body radiotherapy, Lung tumor, Radiation pneumonitis

INTRODUCTION

Stereotactic body radiotherapy (SBRT) has been used to deal with tumors outside of the central nervous system for more than 10 years. Due to recent advances in imaging and radiotherapy technique, dose escalation for improving therapeutic gain has become feasible. Several clinical studies have been reported to have the efficacy of SBRT in treating primary or metastatic lung tumors, and promising local control rates of 80% or greater [12, 23, 26, 35, 38, 40].

The major concern is the tolerance of treatment-related normal tissue toxicities from prescription of a large fraction size. Less standard dose-volume constraints for organs at risk (OARs) in SBRT have been studied compared with those in conventional radiotherapy. When using SBRT in treating lung tumors, a new strategy of dose constraints needs to be investigated. Furthermore, care must be taken particularly when treating central lesions (i.e. tumors close to trachea or carina) [7].

This retrospective analysis was conducted to investigate the clinical outcome in patients with lung tumors treated with SBRT.

METHODS

Patient Eligibility

We reviewed the medical records retrospectively between November 1, 2005 and June 30, 2008 for lung cancer patients who received SBRT. We found that 47 lung tumors in 19 patients treated by CyberKnife[®] (CK, Accuray Inc., Sunnyvale, California, USA) at Taipei Medical University-Wan Fang Hospital. All cases were discussed by the multi-disciplinary thoracic oncology team.

In this study, the selection criteria for CK treatment included: (1) pathological confirmation of malignancy, (2) inoperable lung tumor due to excessive risk or patient's refusal for surgery, (3) performance status being equal or smaller than 2 according to Eastern Cooperative Oncology Group (ECOG) scale, and (4) favorable pulmonary function with forced expiratory volume in the first second (FEV1) being greater than 70% or breath-holding time being more than 10 seconds.

Stereotactic Treatment

The CK stereotactic radiosurgery system is a frameless, image-guided robotic radiosurgery device which has a 6-MeV linear accelerator mounted on a robotic arm to deliver