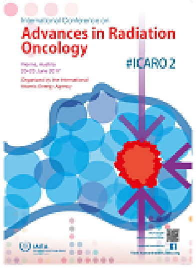

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Dose distribution characteristics and initial clinical results of two different dynamic tracking techniques for stereotactic body radiation therapy for solitary lung tumors

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Purpose / Objectives

Recently, stereotactic body radiation therapy (SBRT) using dynamic tumor tracking (DTT) techniques has been increasingly used. DTT technique has been successful in reducing the size of the PTV and doses to the normal tissue. In our hospital, we have been performing two different DTT techniques, namely, robot arm-based DTT (RA-DTT; CyberKnife System) and gimbal-based DTT (G-DTT; Vero-4DRT System). We investigated the dose distribution differences between the two techniques and the initial results of SBRT for solitary lung tumors treated with these DTT techniques.

Materials / Methods

Between March 2013 and December 2015, 28 cases received DTT SBRT in our hospital. Among them 10 received with RA-DTT and the other 18 received with G-DTT. There were 15 primary lung tumors and 13 metastatic lung tumors. Twenty-seven tumors were located in the lower lobe. Their median age was 73 (range: 40-88). The male to female ratio was 20 to 8. The TNM stages for primary lung cancers were T1a in 6, T1b in 6 and T2a in 3. Histologically, there were 6 adenocarcinomas, 4 Squamous, 2 NSCLC, and 3 histologically unknown tumors. As for the primary site of metastatic lung cancers, there were 4 H&N, 3 esophagus, 2 colon cancers, etc. Regarding the reasons for declining surgery, there were metastatic tumors in 13, poor respiratory function in 8, old age in 6, refusal of surgery in 3, etc. CTV ranged from 1.2 ml to 32.5ml (average 12.9+/-11.7ml). Average CTV of RA-DTT was 10.6+/-7.9ml and that of G-DTT was 14.1+/-13.4ml (p=0.4). Average total normal lung volume (TNLV) was 2654+/-714ml. Average TNLV of RA-DTT was 2882+/-865ml and that of G-DTT was 2489+/-565ml (p=0.22). Average respiratory tumor movement was 16.9 +/- 6.4 mm (range: 6.7 ˜ 31.2 mm). Fractionation regimen was 50Gy/4fr/1wk with the prescription point of D95 of PTV. Eighty to 100 beams were used for RA-DTT SBRT and 7 to 8 beams were used for G-DTT. Median follow-up period was 21.6 months (range: 2.6 to 37.7 months).

Results

Regarding dose distributions, average of maximum tumor dose was higher in RA-DTT (66.5+/-4.7 Gy vs. 59.1+/-2.9 Gy p<0.0001). Lung V20 was smaller in RA-DTT (4.9+/-1.6% vs. 8.0+/-4.9%; p<0.025). Lung V5 was similar in both techniques (25.3+/-6.9% vs.21.7+/-11.7%). Thus, the ratio V5/V20 was significantly smaller in G-DTT (5.36+/-1.65 vs. 3.00+/-0.90; p<0.0006).

Overall local control rate at 2 year (LCR2) was 96.3%. LCR2 was 100% for primary lung cancers, and 91.7% for metastatic lung cancers. Regarding overall survival rate at 2years, it was 87.5% for primary lung cancers and 75% for metastatic lung cancers. As for toxicities, 2 grade 3 radiation pneumonitis have been occurred. One of them was primary lung cancer and the other was metastatic. Lung V20 value of both cases was greater than 15%.

Conclusions

By dose distribution intercomparison, with the same D95 prescription, RA-DTT gives higher maximum tumor dose. The ratio of lung V5/V20 is higher in RA-DTT. Although our clinical results are preliminary, DTT SBRT for solitary moving lung tumors might be promising with high local control rate and acceptable toxicity. However, higher lung V20 value (> 15%) might cause severe radiation pneumonitis even if this technique has been reported to decrease V20 values significantly compared with static SBRT.

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