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Stereotactic radiotherapy for brain metastasis: dosimetric comparison between tomotherapy and cone-based LINAC techniques.

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Purpose

Stereotactic radiotherapy or stereotactic radiosurgery are often used to treat metastasized tumors in the brain. Recent advanced technologies allowed different treatment modalities with different output dose characteristics. The aim of this study was to compare and to evaluate dosimetric aspects of stereotactic radiotherapy through the use of two techniques: cone-based LINAC (CBL) versus helical tomotherapy (HT) modalities.

Materials and Methods

Four patients who experienced single brain metastasis and received stereotactic radiotherapy were included in the study. Patients were subjected to 1-mm slice thickness computed tomography simulation. Gross tumor volume (GTV) was defined by contouring the visible lesions on MRI images while planning treatment volume (PTV) was obtained by 2 mm isotropic extension of the GTV. Each contouring dataset of the patients was replanned with both tomotherapy (Raystation v11B TPS) and cone-based LINAC treatment planning system (BrainLab Elements v 1.5 TPS). The cone-based LINAC modality was realized with small cone-based FFF beams. The delivered dose was 27 Gy in three fractions (9 Gy per fraction). For each treatment plan, the Paddick Conformity Index (PCI), the inverse Paddick Conformity Index (iPCI), the Gradient Index (GI), the PTV-coverage values, the beam-on time and the volume receiving 18 Gy (V18) were calculated and compared for both treatment modalities. Results were analyzed with Wilcoxon signed-rank test.

Results

The median volume of lesions was 3 cc. PTV coverage, PCI and iPCI were similar for both treatment modalities: median values were respectively 95.4%, 0.86, 1.2 for CBL and 95.5%, 0.86, 1.1 for HT. GI and beam-on time were statistically significantly lower with CBL with a median value of GI of 2.95 versus 6.83 (for HT) and with a beam-on time of 253 seconds for CBL versus 476 seconds for HT. Also V18 improved with CBL with a median value of 5.5 cc compared to 8 cc with HT.

Conclusion

In our study among the two treatment modalities analyzed, the cone-based LINAC had the best dose gradient although with similar PTV coverage, PCI and iPCI compared to tomotherapy. Also the beam-on time obtained with CBL system was lower with a halved value respect to the tomotherapy system. Thanks to this result patients can be treated with shorter time and a greater comfort. The cone-based approach also provided significantly better V18 values compared with HT improving toxicity profile with the same efficacy. The outcome of our preliminary analysis has encouraged us to preferably treat patients with cone-based LINAC modality in order to obtain better dose distribution, improving toxicity profile and shortening treatment time.