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Abstract

Dosimetric Evaluation of Stereotactic Radiosurgery Plans with Volumetric Modulated Arc Therapy (VMAT)

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Abstract

Objectives: Traditionally, LINAC based SRS has been performed with cones/conformal arcs. VMAT based SRS has the potential to provide better conformity, homogeneity while maintaining dose gradient and normal tissue sparing. Due to the lack of published data on VMAT based SRS, the study reviews volumetric modulated arc therapy (VMAT) SRS plan quality at Lankenau Medical Center in the last five years and compare with published historic data to evaluate the efficiency and efficacy of VMAT SRS.

Methods: 52 patients and 81 plans were analyzed. Evaluation criteria include the following: RTOG conformity index (CI) – defined as ratio of prescription dose to PTV; Homogeneity index (HI) – ratio of max dose to prescription dose; Modified dose gradient index (mGI) – ratio of tissue volume receiving 50% of dose to PTV volume; and radionecrosis indicator V12 – volume of healthy brain that receives 12 Gy or more. Plans are categorized by tumor size. Results are compared with published results of other technique, such as Gamma Knife/CyberKnife/LINAC cone based/LINAC conformal arc.

Results: Results are categorized into three groups based maximum tumor diameter, <2cm, 2-3cm, and >3cm. In the < 2cm group, prescription dose range from 10 Gy to 22 Gy. The CI has a mean value of 1.109±0.2 with confidence level (95%) of 0.059. The HI has a mean value of 1.099±0.030 with CL (95%) of 0.009. The V12 has a mean value of 4.55 CC and max value of 13.3 CC. The mGI has a mean value of 4.014±0.104 with CL (95%) of 0.210.In the 2-3cm group, prescription dose range from 10 Gy to 24 Gy. The CI has a mean value of 1.137±0.122 with CL (95%) 0.049. The HI has a mean value of 1.095± 0.026 with CL (95%) 0.010. The V12 has a mean value of 8.625 CC and max 23.1 CC. The mGI has a mean value of 3.786±0.632 with CL (95%) of 0.255.In the >3cm group, Rx range from 14 Gy to 20 Gy. The CI has a mean value of 1.123 ±0.031 and CL (95%) 0.070. The HI has a mean value of 1.101±0.018 and CL (95%) 0.0127. The V12 has a mean value of 15.84 CC and max 36.9 CC. The mGI has a mean value of 3.132±0.324 and CL (95%) of 0.232.

Conclusions: VMAT based SRS plans have superior homogeneity and conformity compared to Gamma Knife or Conebased treatment technique. It is especially import in treating irregular shaped tumors. V12 are comparable to published data. The lack of uniform dose gradient indicator makes it hard to compare with other published data. We use mGI and list our results here for future reference.

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