



Conclusion: By changing the treatment modality from tomotherapy to fixed-beam IMRT, we could reduce the liver dose and the probability of RIHT without scarifying the target coverage, especially in patients whose liver dose is high.

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A planning study of dose escalation FET PET active gliomas by IMRT, VMAT and IMPT

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Purpose or Objective: Gliomas are the most common brain tumor in adult patients and radiotherapy plays an important role in the treatment. Nonetheless, the clinical outcome for these patients remains poor, due to early local failure, suggesting the need for higher tumor doses. This study investigates the feasibility of dose escalating an amino acid 18F-fluoro-ethyl-tyrosine (FET) PET defined biological target volume (BTV) in glioma patients by IMRT, VMAT and IMPT.

Material and Methods: Seven patients were eligible for this study. All patients received a pre therapeutic FET-PET/CT and MRI. To compare, standard IMRT treatment plans giving 60 Gy in 30 fractions to the BTV and 46 Gy to the CTV(46 Gy) were calculated. CTV(46 Gy) was defined as tumor and/or tumor cavity plus 2 cm. The BTV was generated from the FET PET image and covered a tumor-to-brain cut-off ratio of FET uptake ≥ 1.6 (pre-surgery) ≥ 2.1 (post-surgery). Both BTV and CTV(46 Gy) were checked visually and adapted to anatomic barriers. Planning target volumes, PTV boost and PTV(46 Gy) were generated by adding 3 mm uniformly to the BTV and CTV(46 Gy), respectively. The standard IMRT plans were used to define the base level of dose to the organs at risk (OAR) and PTV(46 Gy) homogeneity. To evaluate the dose to the OAR the mean OAR was used and the PTV(46 Gy) homogeneity was defined as the volume of PTV(46 Gy) subtracted PTV boost which received 107% of the prescribed 46 Gy. Then, IMRT, VMAT and IMPT dose escalating treatment plans were calculated in order to get the highest achievable mean PTV boost dose, without increasing the mean dose to critical OAR and without decreasing the PTV(46 Gy) homogeneity. For all plans the dose boost was given as the integrated boost over 30 fractions. All treatment plans were carried out using the Eclipse treatment planning system (Varian Medical systems, Palo Alto, CA, USA).

Results: A standard IMRT plans were calculated for all patients and the base level for PTV(46 Gy) homogeneity was found to range between 65 % to 86 %, with a median value of 77%. Dose escalating, while maintaining this homogeneity, was found feasible using all three techniques. The obtainable mean and maximum doses were respective 77.1 Gy and 82.5 Gy for IMRT, 79.2 Gy and 87.4 Gy for VMAT and 85.1 Gy and 89.9 Gy for IMPT. On top of the significant increase in mean and maximum PTV boost dose obtained for IMPT, the PTV(46

Gy) homogeneity can be decreased to a median value of 30.4%.

Conclusion: Dose escalating a FET PET based target volume to above 77 Gy in 30 fractions by IMRT, VMAT, and IMPT without increasing both the PTV(46 Gy) homogeneity and the mean dose to the OAR was found feasible. For IMPT the PTV(46 Gy) homogeneity could be substantially reduced, implicating the reduction of the risk of brain necrosis despite the increased mean and maximum PTV boost doses.

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Radiosurgery of brain metastases. A dosimetric comparison between VMAT and Dynamic arc plans

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Purpose or Objective: Brain metastases are a very frequent situation in advanced cancer and whole brain radiotherapy (WBRT) has long been considered the standard of care. Stereotactic radiosurgery has been shown to be effective in terms of survival and quality of life for patients with a better prognostic profile and a limited number (1 to 3) of brain metastases. More recent experiences have shown the efficacy of stereotactic radiation for multiple brain metastases as well. This may allow deferment of WBRT, in order to limit the risk of acute toxicity and late neurocognitive decline. The goal of the present study was to test from a dosimetric point of view a new planning software, BrainMetastases® (BM) (BrainLab®, Feldkirchen - Germany), and to compare it with RapidArc (RA)® plan TPS. (Varian®, Palo Alto CA, USA)

Material and Methods: We retrospectively re-planned 12 patients treated for 2 or more brain metastases in our institute. Median age was 53 (range 41-63). The most frequent number of metastases per patient was 3 (range 2-10). The new BM software creates a dynamic arc plan following a simple PTV and geometrical constrains and calculates it with the pencil beam algorithm. For all the patients we studied, a plan using both BM and RA with different prescriptions (1x20Gy, 5x7Gy, RTOG protocol) and for RA plans we also considered two different plans with 6MV and the 10FFF beams. Finally the dosimetric parameters were extracted from the DVHs.

Results: As PTV constraint we decided that the prescribed dose should cover the 90% of the PTV volume. With this normalization we obtained a better conformity index for RA plan and a smaller Healthy Brain mean dose with the BM plan. In particular for the patients with 3 metastases with 6MV beam and the 5x7Gy prescription the CI99% was 1.0 ± 0.18 and 1.56 ± 1.30 and Healthy Brain mean dose 3.0 ± 1.2 Gy and 2.4 ± 1.1 Gy and V20Gy 13.0 ± 6.4 cm³ and 9.6 ± 6.5 cm³ respectively for RA and BM technique. Also the time for optimization and calculation are 14.4 ± 5.53 minutes and 3.63 ± 1.48 minutes. The algorithm implemented in BM is the pencil beam and evaluated the dose every 5° and in Eclipse is Acuros XB and the calculation is performed every 2°. A more detailed analysis concerning the OAR sparing will be reported.

Conclusion: Plan optimisation using BM software provides a satisfactory dose distribution with a good conformity index and organs at risk sparing; the results are comparable with a VMAT plan. Reduction of time for optimisation and calculation seems to favour the BM software, with a similar OAR safety. Nevertheless these assumptions need to be balanced with the clinical experience which is currently ongoing in different institutes.