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COMPARISON OF DOSIMETRIC CONSTRAINTS BETWEEN CONFORMATIONAL RADIOTHERAPY AND INTENSITY MODULATED RADIOTHERAPY, ON ORGANS AT RISK IN TREATMENT OF BRAIN TUMORS

Ghammad Sanae*, Abboud Fatimazhrae, Allouche Fadwa, Terrab Fatimazahrae, Bouhafa Touria, Alami Zenab and Hassouni Khalid

***Corresponding Author: Dr. Ghammad Sanae**

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SUMMARY

Over the past two decades, radiation delivery has evolved from conventional external beam two-dimensional RT (2DRT) to three dimensional conformal RT (3DCRT). In a further advance, intensity-modulated RT (IMRT) uses computed tomography-based planning and delivery of radiation, aided by computerized optimization of the intensities of multiple beams. This improves the ability to tightly conform the treatment volume to concave tumor shapes, while minimizing doses to organs at risk (OAR), it can provide significantly better tumor target coverage and sparing of sensitive normal tissue compared with 3DCRT. Intensity-modulated radiation therapy (IMRT) using dynamic or static multileaf collimators delivers highly conformal dose while sparing the surrounding normal structures. Using a conventional multileaf collimator can be made in a "dynamic" or "static" form. The dose-volume-histogram (DVH) is a common tool to express the dose that is delivered to targets and organs-at risk (OAR). A DVH contains information about the doses delivered to partial volumes (either absolute or relative) of targets or OARs. However, DVHs do not provide spatial information such as the location of the high- and low-dose regions ("hot" and "cold" spots) inside the volume of interest (VOI). Our big interest of our study is to compare target dose distribution and dose to normal tissue for brain tumors using intensity modulated and three dimensional conformal radiotherapy.

KEYWORDS: Intensity-modulated radiation therapy, three dimensional conformal radiotherapy, brain tumors, radiotherapy, comparison.

abbreviations

3DCRT= three dimensional radiotherapy
IMRT = intensity-modulated radiotherapy
OAR = organs-at risk
VOI = volume of interest
DVH = The dose-volume-histogram
3D = three dimensional
CT = scanner
PTV = planning tumor volume
DCAT = dynamic conformal arc therapy

INTRODUCTION

Radiation therapy plays an important role in the treatment of brain tumors. Among the irradiation techniques; three-dimensional conformal radiotherapy and IMRT. The objective is to compare dosimetric constraints on organs at risk using both techniques.

MATERIALS AND METHODS

This is a retrospective study of 14 cases of primary brain tumors collected in the radiotherapy department of CHU Hassan II in 2016. For which the maximum radiation dose of organs at risk is calculated (eyes, crystalline, optic nerves, optic chiasm, brainstem) by 3D and IMRT radiotherapy techniques. The analysis was based on a comparison of the dose constraints for each element of the risk organs between the two techniques.

RESULTS

As a result, there was a female predominance of 71.4%, the average age was 50 +/- 20 years, the most common symptom was HTIC syndrome found in 56%, the most common histological types were glioblastomas and meningiomas found in 28.6% of cases each. The local assessment was based on cerebral CT in 42.8% of cases. A significant statistical association was found between irradiation techniques (3D and IMRT) in favor of IMRT with respect to dose constraints on the following risk organs: optic nerves ($p < 0.018$) eyes ($p < 0.026$) crystalline ($p < 0.014$). On the optic chiasm and the cerebral trunk, the p were insignificant because of the limited number of patients.

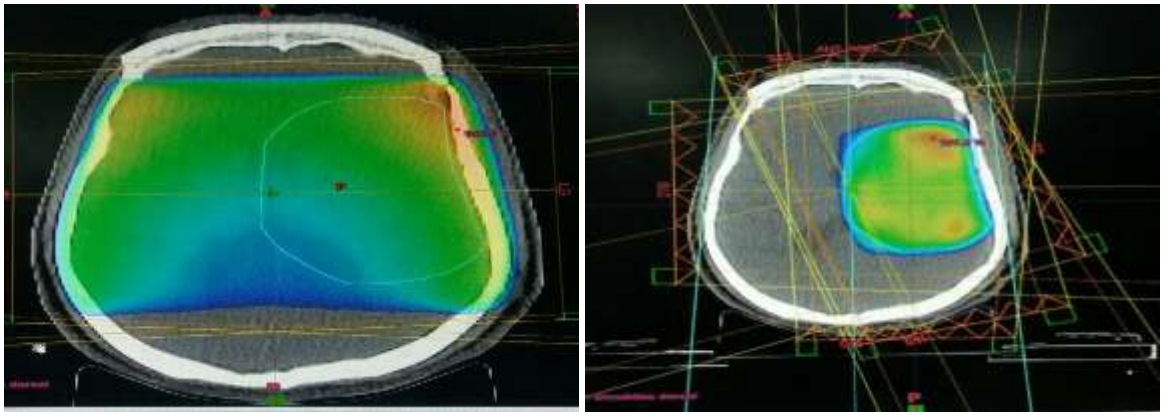

Figure 1 : Comparative images of dose distribution in RTC3D at the top and IMRT at the bottom.

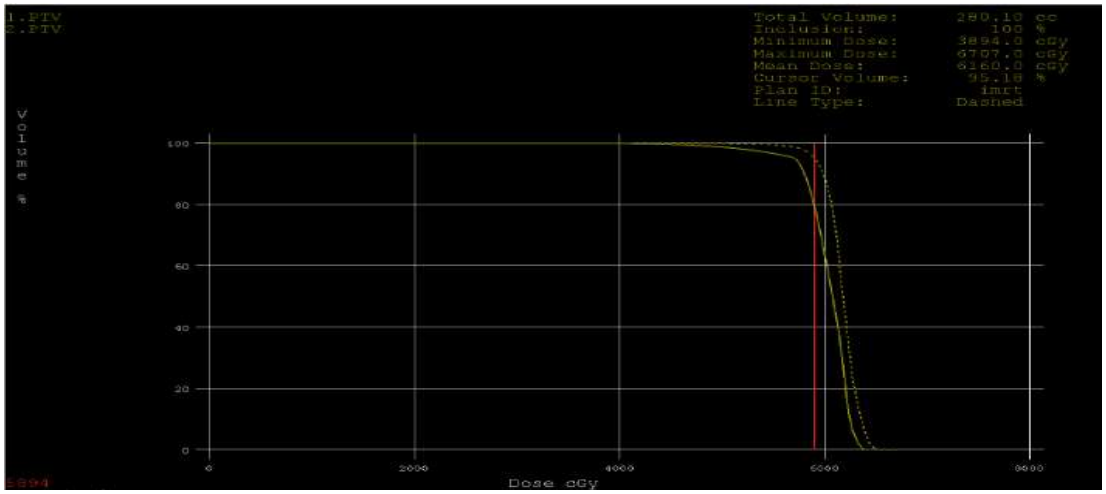

Figure 2: Dose volume histograms comparing: IMRT (dashed line) and 3DCRT (solid line) plans for PTV in a patient with glioblsatoma multiform (GBM)

DISCUSSION

The 3DCRT plans were still competitive for the small brain tumors, although the dosimetric parameters of the 3DCRT plans were a little worse compared with those for the DCAT plans. The number of beams in the 3DCRT plans was chosen to be the same as the number of arcs in the DCAT plans in this study. However, the beam number in 3DCRT planning (e.g., seven to eight beams) is usually more than the arc number in DCAT planning (e.g., about five arcs) in the clinic. Intensity-modulated radiotherapy was not recommended for treating a small brain tumor (PTV < 2 cm3).[4] For a small brain tumor, the number of beamlets is limited. That means the number of solutions that satisfy the dosimetric constraints is also limited. It is easy to imagine that the addition of intensity modulation to a fixed field arrangement should result in additional treatment improvement, which was also demonstrated by Baumert et al.[3]

CONCLUSION

In terms of brain tumors, the IMRT makes it possible to save more the OARs especially those in series (whose deficit engages seriously the functional prognosis such as the optic nerves, as well as the other OAR: the eyes are crystalline.

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