



Assessment of Target Volume Definition for Irradiation of Hemangiopericytomas: An Original Article



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Abstract

Background: Hemangiopericytomas arise from the mesenchymal cells with pericytic differentiation. Clinical course of these rare tumors may be aggressive with high propensity for local recurrence and metastases. Radical resection is the treatment of choice for lesions amenable to surgery. Nevertheless, radiation therapy (RT) may have a role in management of hemangiopericytomas either as an adjunctive, salvage or primary treatment, or for palliation of metastases in selected patients. Target volume definition is a critical aspect of RT.

Objective: Aim of this study is to assess incorporation of multimodality imaging with magnetic resonance imaging (MRI) into target volume definition for irradiation of hemangiopericytomas.

Methods: In this study, treatment volume definition with multimodality imaging by incorporating MRI or by use of computed tomography (CT)-simulation images only was comparatively evaluated for patients with hemangiopericytoma.

Results: Ground truth target volume defined by the board-certified radiation oncologists following meticulous evaluation, colleague peer review, collaboration, and ultimate consensus was found to be identical with target determination based on CT-MR fusion based imaging in this study.

Conclusion: Accurate target volume determination is an indispensable part of RT for management of hemangiopericytomas. Incorporation of MRI in the target volume definition process may be considered for optimization of treatment volume designation for successful RT applications. Clearly, future studies are required to shed light on this issue.

Keywords: Hemangiopericytoma; Target Volume Definition; Magnetic Resonance Imaging (MRI)

Introduction

Hemangiopericytomas, firstly described by Stout and Murray in 1942, are solitary fibrous tumors arising from the mesenchymal cells with pericytic differentiation [1]. Clinical course of these rare tumors may be aggressive with high propensity for local recurrence and metastases [2,3]. Radical resection is the treatment of choice for lesions amenable to surgery [4]. Nevertheless, radiation therapy (RT) may have a role in management of hemangiopericytomas either as an adjunctive, salvage or primary treatment or for palliation of metastases in selected patients. Irradiation with conventionally fractionated RT (CFRT) or radiosurgery as Stereotactic Radiosurgery (SRS), Fractionated Stereotactic Radiation Therapy (FSRT), and Stereotactic Body Radiation Therapy (SBRT) or

Stereotactic Ablative Body Radiotherapy (SABR) can be utilized for management of numerous central nervous system (CNS) disorders and for several other malign and benign tumors throughout the human body with encouraging outcomes [5-26]. In the context of hemangiopericytomas, the role of irradiation has been investigated [27-29]. Although there has been controversy regarding the radiation dose and the role of adjuvant irradiation, several series report reasonable rates of local control with low toxicity particularly by use of stereotactic irradiation [30-34]. As the importance of target definition becomes more critical in stereotactic irradiation regimens with high fraction doses, incorporation of multimodality imaging for optimal treatment volume determination is judiciously utilized. Within this context,

we assessed the incorporation of multimodality imaging with magnetic resonance imaging (MRI) into target volume definition for irradiation of hemangiopericytomas in this study.

Materials and Methods

Treatment volume definition with multimodality imaging by incorporating MRI or by use of computed tomography (CT)-simulation images only was comparatively evaluated for patients with hemangiopericytoma in this study. Ground truth target volume which was used as the reference for actual treatment and comparison purposes was defined by the board-certified radiation oncologists after meticulous assessment, collaboration, colleague peer review, and ultimate consensus. Thorough evaluation was performed regarding the lesion size, lesion localization, symptomatology and patient preferences along with predicted results of treatment on an individual basis. Radiation treatment simulation for RT planning was performed at the CT-simulator (GE Lightspeed RT, GE Healthcare, Chalfont St. Giles, UK) available at our tertiary cancer center. Planning CT images were acquired and sent to the delineation workstation (SimMD, GE, UK) for outlining of treatment volumes and critical organs. Either CT-simulation images only or fused CT and MR images were utilized for target volume definition for RT. Treatment volume definition with CT only and by incorporation of CT-MR fusion was evaluated with comparative assessment. Definition of the ground truth target volume was performed by the board-certified radiation oncologists following meticulous assessment, collaboration, thorough evaluation, colleague peer review and ultimate consensus for use in actual treatment as well as for the purpose of comparative analysis. Treatments were delivered with the Synergy (Elekta, UK) linear accelerator (LINAC) by use of Image Guided Radiation Therapy (IGRT) techniques.

Results

The available treatment planning systems at our tertiary cancer center were used for radiation treatment planning. Priority was given for target coverage with optimal sparing of normal tissues. Synergy (Elekta, UK) LINAC was used for RT administration. Irradiation treatment volume definition by CT-only imaging and by CT-MR fusion based imaging was assessed comparatively. Ground truth target volume defined by the board-certified radiation oncologists following meticulous evaluation, colleague peer review, collaboration, and ultimate consensus was found to be identical with target determination based on CT-MR fusion based imaging in this study.

Discussion

Hemangiopericytomas are rare but aggressive tumors with high tendency for local recurrence and metastasis. RT has been utilized for improving local control rates and for palliation of metastases. There have been significant advances in the discipline of radiation oncology with introduction of adaptive irradiation

strategies and state of the art treatment delivery techniques including incorporation of automatic segmentation procedures, molecular imaging, Image Guided Radiation Therapy (IGRT), Adaptive Radiation Therapy (ART), Intensity Modulated Radiation Therapy (IMRT), Breathing Adapted Radiation Therapy (BART), and stereotactic irradiation with SRS, HFSRT, and SBRT [35-45]. Advanced irradiation techniques such as SRS offer improved precision and promising therapeutic outcomes, however, delivery of high doses in a single or a few fractions require accurate target definition. Accurate definition of RT treatment volumes is an indispensable part of irradiation for hemangiopericytomas. Avoidance of geographical misses and excessive RT toxicity are critical aspects of radiotherapeutic management. While outlining of larger RT treatment volumes can result in excessive radiation induced toxicity, determination of smaller than actual treatment volumes can lead to geographical misses with consequent disease progression. In this context, incorporation of multimodality imaging can be used for improving the precision of target localization, and integrated use of fused CT and MR images can facilitate optimization of treatment volume designation for successful RT applications. Indeed, several studies addressed the utility of multimodality imaging for RT target definition [46-63]. Our study may add to the literature given the limited data regarding the utility of multimodality imaging based target definition for irradiation of hemangiopericytomas.

Conclusion

In conclusion, accurate target volume determination is an indispensable part of RT for management of hemangiopericytomas. Incorporation of MRI in the target volume definition process may be considered for optimization of treatment volume designation for successful RT applications. Clearly, future studies are required to shed light on this issue.

Conflict of Interest & Acknowledgement

There are no conflicts of interest and no acknowledgements.

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