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Target Definitionoforbital Embryonal Rhabdomyosarcoma (Rms) by Multimodality Imaging: An Original Article

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Abstract

Objective: *Treatments strategies for orbital embryonal rhabdomyosarcoma (RMS) may include surgery, radiation therapy (RT), and chemotherapy. Satisfactory survival outcomes may be achieved for orbital embryonal RMS by use of these therapies, however, adverse effects of administered treatments are major concerns regarding management given the long life expectancy of affected patients. Within this context, improving the toxicity profile of treatment has been a critical aspect of management. In terms of RT, contemporary techniques and proton therapy have been utilized for improving the therapeutic ratio. In this original article, we assessed target definition for orbital embryonal RMS with multimodality imaging.*

Materials And Methods: *Target definition for orbital embryonal RMS with multimodality imaging has been assessed with comparative evaluation.*

Results: *Precise RT planning has been performed by use of treatment planning systems at our tertiary cancer center. Optimal encompassing of treatment volumes with sparing of critical structures has been prioritized in RT planning to improve the therapeytic ratio. Definition of ground truth target volume has been done by the board certified radiation oncologists following comprehensive evaluation, colleague peer review, collaboration, and ultimate consensus to be utilized for actual treatment and for comparative assessments. Ground truth target volume has been found to be identical with target volume definition with CT-MR fusion based imaging.*

Conclusion: *Combined use of CT and MRI for accurate target and treatment volume determination procedure may be considered to improve the therapeutic ratio for orbital embryonal RMS management with RT despite the need for further supporting evidence.*

Keywords: *orbital embryonal rhabdomyosarcoma (RMS), radiation therapy (RT), magnetic resonance imaging (MRI)*

1. Introduction

Although rhabdomyosarcoma (RMS) is a rare tumor among group of mesenchymal malignancies as a whole, orbital RMS constitutes the most frequent soft tissue sarcoma in the head and neck region in children [1-3]. Tissue of origin is the pluripotent mesenchyme, and the prognosis may be rather favorable, however, orbital embryonal RMS may pose a formidable challenge to the ocular oncologist in terms of diagnosis and management [1-3]. Affected patients may typically present with a rapidly enlarging mass frequuently localized in the upper inner quadrant. While pain is not a typical symptom, proptosis and diplopia may occur. Also, edema may result from invasion of the eyelid. Majority of orbital RMS are of the embryonal subtype occuring in the first decade of life.

Treatments strategies for orbital embryonal RMS may include surgery, radiation therapy (RT), and chemotherapy. Satisfactory survival outcomes may be achieved for orbital embryonal RMS by use of these therapies, however, adverse effects of administered treatments are major concerns regarding management given the long life expectancy of affected patients. Within this context, improving the toxicity profile of treatment has been a critical aspect of management. In terms of RT, contemporary techniques and proton therapy have been utilized for improving the therapeutic ratio [4-7]. In this original article, we evaluated target definition for orbital embryonal RMS with multimodality imaging.

2. Materials And Methods

Target definition with multimodality imaging by incorporation of magnetic resonance imaging

(MRI) or by computed tomography (CT)-simulation images only has been assessed with comparative analysis in patients treated for orbital embryonal RMS. Ground truth target volume to be used as the reference for actual treatment and comparison purposes has been comprehensively determined by board certified radiation oncologists after meticulous evaluation, colleague peer review, collaboration, and ultimate consensus. Comprehensive patient assessment has been done including the lesion sizes, exact localizations, symptomatology, preferences, and expected outcomes of therapy. CT-simulator (GE Lightspeed RT, GE Healthcare, Chalfont St. Giles, UK) has been utilized for RT simulation for treatment planning. Planning CT images have been taken and then transferred to the delineation workstation (SimMD, GE, UK) for contouring of treatment volumes and surrounding critical structures. Either CT-simulation images only or fused CT and MR images have been used for the purpose of treatment volume definition for RT. Target determination with CT only and with incorporation of CT-MR fusion has been comparatively assessed. Synergy (Elekta, UK) linear accelerator (LINAC) has been used for treatment delivery with routine incorporation of Image Guided Radiation Therapy (IGRT) techniques with kilovoltage cone beam CT and electronic portal imaging.

3. Results

Precise RT planning has been performed by use of treatment planning systems at our tertiary cancer center. Optimal encompassing of treatment volumes with sparing of critical structures has been prioritized in RT planning to improve the therapeytic ratio. Definition of ground truth target volume has been done by the board certified radiation oncologists following comprehensive evaluation, colleague peer review, collaboration, and ultimate consensus to be utilized for actual treatment and for comparative assessments. Synergy (Elekta, UK) LINAC has been utilized for RT delivery. Target determination by CT-only imaging and by CT-MR fusion based imaging has been comparatively evaluated. As a result, ground truth target volume has been found to be identical with target volume definition with CT-MR fusion based imaging.

4. Discussion

Orbital RMS constitutes the most frequent soft tissue sarcoma in the head and neck region in children, and the prognosis may be rather favorable with contemporary therapeutic approaches [1-3]. Given the young patient population with long life expectancy, adverse effects of delivered therapies should be thoroughly considered for optimal management. Within this context, every effort should be made to improve the toxicity profile of treatment for this vulnerable patient population. Proton therapy has been introduced as a viable radiotherapeutic modality for improving the therapeutic ratio for patients suffering from orbital RMS [4-7].

Optimal sparing of critical structures and surrounding normal tissues is an important aspect of current RT practice in the era of state of the art therapies. Accurate target and treatment volume determination has been an area of extensive investigation to improve the therapeutic ratio. There has been unprecedented progress recently with considerable advances in radiation oncology discipline thanks to introduction of adaptive irradiation strategies along with excellent treatment delivery techniques with incorporation of Intensity Modulated Radiation Therapy (IMRT), Image Guided Radiation Therapy (IGRT), Adaptive Radiation Therapy (ART), Breathing Adapted Radiation Therapy (BART), automatic segmentation techniques, molecular imaging methods, and stereotactic irradiation strategies [8-43]. Regarding radiotherapeutic management of orbital RMS, promising results have been achieved by use of proton therapy [4-7]. Nevertheless, accurate treatment volume determination composes a more important part of state of the art therapeutic approaches given the introduction of recent treatment techniques and contemporary equipment. Excellent technologies including radiosurgical techniques may provide focused irradiation of well defined targets under stereotactic immobilization and image guidance to further improve precision and accuracy of radiotherapeutic management, however, target determination is very important given the typically high doses of irradiation given in a single or a few fractions with radiosurgery. From this standpoint, optimization of target and treatment volume definition is a critical aspect of RT for orbital embyonal RMS. Current IGRT techniques may offer improvements in target localization, and combined use of fused CT and MR images may significantly aid in precise target definition for accurate irradiation. In the literature, there have been many studies addressing the utilization of multimodality imaging for RT target definition [44-63]. We believe that our study may add to existing literature by addressing of multimodality imaging for target definition of orbital embryonal RMS.

In conclusion, combined use of CT and MRI for accurate target and treatment volume determination procedure may be considered to improve the therapeutic ratio for orbital embryonal RMS management with RT despite the need for further supporting evidence.

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