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Appraisal Of Target Definition for Anaplastic Thyroid Carcinoma (ATC): An Original Article Addressing the Utility of Multimodality Imaging

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Abstract

Objective: Anaplastic thyroid carcinoma (ATC) is a rare type of head and neck cancer with a relatively poor prognosis. Local recurrence may be encountered during the course of disease. Management of patients should be performed on an individual basis by use of a collaborative approah. Surgery serves as the main modality of management, however, radiation therapy (RT) may also be used for treatment. RT may play a crucial role as the supplementary or definitive therapy, and recurrent disease may also benefit from RT. Treatment of ATC may be challenging, however, RT has been used for ATC management. In this original research article, we explored treatment volume determination for ATC.

Materials and methods: Objective of this study has been to evaluate treatment volume determination for ATC irradiation based on CT only or fused CT-MRI. We have conducted a comparative analysis for assessment of treatment volume determination by CT simulation images only or by integration of MRI.

Results: Ground truth target volume has served as the reference for comparative evaluation, and our results revealed that use of fused CT-MRI based treatment volume determination was identical with ground truth treatment volume determination in the selected group of patients with ATC.

Conclusion: Multimodality imaging by incorporation of MRI in RT target definition process may be considered for patients with ATC. Admittedly, further studies are needed to shed light on this issue.

Keywords: Anaplastic Thyroid Carcinoma (ATC); Radiation therapy (RT); Magnetic Resonance Imaging (MRI)

Introduction

Anaplastic thyroid carcinoma (ATC) is a rare type of thyroid cancer with a relatively poor prognosis despite multimodality management [1-7]. Local recurrence is not uncommon during disease. Treatment of patients should be performed on an individual basis by use of a multidisciplinary therapeutic approach. Surgery may serve as the principal modality of management for ATC; however, radiation therapy (RT) may also be used for treatment. RT may play an integral role as the supplementary or definitive therapeutic option, and recurrent disease may also be treated by irradiation. Treatment of recurrent ATC may be more challenging, nevertheless, RT has been used for recurrent ATC management. Fortunately, improved therapeutic outcomes may be achieved in cancer management in the Millenium era by virtue of several advances in technology. In this context, quality of life issues and critical organ protection may be considered as pertinent aspects of contemporary irradiation strategies. Integration of contemporary treatment strategies and technologies such as molecular imaging methods, automatic segmentation techniques, Image Guided RT (IGRT), Intensity Modulated RT (IMRT), stereotactic RT, and adaptive RT (ART) may judiciously improve therapeutic outcomes [8-49]. However, improvements in target volume determination may be considered as a critical component of sophisticated RT strategies. Meanwhile, most common practice includes the use of Computed Tomography (CT) simulation for acquisition of radiation treatment planning images, however, incorporation of other imaging modalities such as Magnetic Resonance Imaging (MRI) may possibly add to the precision of target determination as addressed in other studies [50-93]. In this original research article, we assess target definition for irradiation of ATC.

Materials and Methods

Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences serves as a tertiary cancer center with the capability of treating a huge patient population from several places from Turkey and allied countries. In this context, we have been irradiating a variety of cancers annually for decades. Objective of this study has been to evaluate target definition for ATC irradiation based on CT only or fused CT-MRI. We have conducted a comparative analysis for evaluation of target definition by CT simulation images only or by incorporation of MRI. Main goal of this original research article was to assess the integration of multimodality imaging for target definition, nevertheless, delineation of critical structures, interobserver and interobserver variations have also been evaluated. Ground truth target volume was used for comparative analysis and has been defined by board certified radiation oncologists after meticulous assessment of all imaging and relevant data with thorough colleague peer review and consensus. Decision making process for optimal management has involved multidisciplinary input from experts on surgical oncology, radiation oncology, and medical oncology. Individualized patient assessment included consideration of patient, disease, and treatment related factors. Patient age, previous treatments, symptomatology, lesion size, performance status, lesion location and association with critical structures, expected outcomes of therapies, patient preferences and logistical issues were all considered.

A Linear Accelerator (LINAC) furnished with the capability of contemporary IGRT techniques was used for RT. After rigid patient immobilization, planning CT images have been acquired at CT simulator for radiation treatment planning. Then, acquired RT planning images were sent to the contouring workstation through the network. Target volumes and normal tissues were defined on these images and structure sets were generated. Either CT simulation images only or fused CT-MR images have been used for assessment and comparative analysis.

Results

This original research article has been designed to evaluate the use of multimodality imaging with incorporation of MRI for target definition in a selected group of patients with ATC. Irradiation of patients was performed at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Prior to irradiation, patients were assessed individually by a multidisciplinary team of experts from surgical oncology, medical oncology, and radiation oncology. Briefly, we performed a comparative analysis based on either CT only imaging or by fused CT-MRI to evaluate the use of this sophisticated approach. Optimal radiation treatment planning procedure included consideration of lesion sizes, localization, and association with surrounding critical structures. Radiation physicists were involved in radiation treatment planning process with consideration of reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU). Accurate radiation treatment planning procedure included consideration of electron density, tissue heterogeneity, CT number and HU values in CT images. Main objective of radiation treatment planning has been to achieve optimal coverage of treatment volume with minimal exposure of surrounding normal tissues. Ground truth target volume served as the reference for comparative assessment, and results of our study revealed that fused CT-MRI based target definition was identical with ground truth treatment volume definition in this selected group of patients with ATC.

Discussion

ATC is a seldom type of thyroid cancer with a relatively poor prognosis despite multimodality management [1-7]. Local recurrence is not uncommon during disease. Treatment of patients should be performed on an individual basis by use of a multidisciplinary therapeutic strategy. Surgery may serve as the main modality of management for ATC, nevertheless, RT may also be used for treatment. RT may play an integral role as the supplementary or definitive therapeutic option, and recurrent disease may also be treated by irradiation. Treatment of recurrent ATC may be more challenging; however, RT has been used for recurrent ATC management. Fortunately, improved therapeutic outcomes may be achieved in cancer management in the Millenium era by virtue of several advances in technology. Within this context, quality of life issues and critical organ protection may be considered as pertinent aspects of contemporary irradiation strategies.

Integration of contemporary treatment strategies and technologies such as molecular imaging methods, automatic segmentation techniques, IGRT, IMRT, stereotactic RT, and ART may judiciously improve therapeutic outcomes [8-49]. Nevertheless, improvements in target volume determination may be considered as an indispensable component of contemporary RT strategies. Meanwhile, widely accepted practice includes the use of CT simulation for acquisition of radiation treatment planning images, however, integration of other imaging modalities such as MRI may possibly add to the precision of target definition as suggested in other studies [50-93]. In this original research article, we evaluate target definition for irradiation of ATC. In conclusion, multimodality imaging with integration of MRI in RT target definition procedure may be used for patients with ATC. Clearly, further studies are required to shed light on this critical issue.

Conflict of Interest

There are no conflicts of interest and no acknowledgements.

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