

Appraisal of Target Definition for Recurrent Cancers of the Supralottic Larynx

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ABSTRACT

Objective: Laryngeal cancers are among the most common of head and neck tumours which may cause considerable morbidity and mortality worldwide [1-7]. Nevertheless, successful results may be achieved by a multidisciplinary therapeutic approach. Surgery, chemotherapy, and radiation therapy (RT) may be utilized for laryngeal cancer management with respect to disease extent. Herein, we assessed target definition for recurrent cancers of the supraglottic larynx to explore the utility of multimodality imaging.

Materials and Methods: Objective of this study has been to assess target definition for recurrent supraglottic laryngeal cancer irradiation based on CT only or fused CT-MRI. We performed a comparative analysis evaluation of target definition by CT simulation images only or by incorporation of MRI. Besides assessment of integrated multimodality imaging for target definition, we also evaluated normal tissue delineation, interobserver and interobservers variations.

Results: Ground truth target volume has been utilized as the reference for comparative assessment, and our results have demonstrated that utilization of fused CT-MRI based target definition was identical with ground truth target definition in the selected group of patients with recurrent supraglottic laryngeal cancer.

Conclusion: Incorporation of MRI in RT target definition may be suggested for patients with recurrent supraglottic laryngeal cancers despite the need for further supporting evidence.

Keywords: Supraglottic Laryngeal Cancer; Radiation Therapy (RT); Magnetic Resonance Imaging (MRI)

Abbreviations: RT: Radiation Therapy; MRI: Magnetic Resonance Imaging; IGRT: Image Guided RT; IMRT: Intensity Modulated RT; ART: Adaptive RT; CT: Computed Tomography; AAPM: American Association of Physicists in Medicine; ICRU: International Commission on Radiation Units and Measurements

Introduction

Laryngeal cancers are among the most common of head and neck tumours which may cause considerable morbidity and mortality worldwide [1-7]. Nevertheless, successful results may be achieved by a multidisciplinary therapeutic approach. Surgery, chemotherapy, and radiation therapy (RT) may be utilized for laryngeal cancer management with respect to disease extent. Surgery may offer favourable outcomes; however, adverse effects of surgical interventions should be considered. RT may be used as the single management modality or as part of multidisciplinary management

for laryngeal cancers. It has also been proposed that laryngeal preservation strategies could be followed according to patient, tumor, and treatment characteristics. RT may also have a role as salvage treatment for recurrent disease. Advances in technology may obviously result in improved therapeutic outcomes for cancer in the millennium era.

Considering the critical location of laryngeal cancers in close vicinity of vital neurovascular structures, it is a priority to individualize patient management with multidisciplinary collaboration. Both the tumor and administered treatments may cause quality of life

impairment in affected patients, and adverse effects of management should be considered at the outset. Quality of life issues and normal tissue sparing must be considered as critical aspects of contemporary radiotherapeutic strategies. Integration of modernized treatment approaches 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 clearly result in improved radiotherapeutic outcomes [8-49]. However, improvements in target definition must be considered as an indispensable component of sophisticated RT protocols. In the meantime, widely adopted practice includes use of Computed Tomography (CT) simulation for acquisition of radiation treatment planning images, nevertheless, incorporation of other imaging modalities such as Magnetic Resonance Imaging (MRI) may admittedly add to the precision of target definition as suggested by other studies [50-96]. Herein, we assessed target definition for recurrent cancers of the supraglottic larynx to explore the utility of multimodality imaging.

Materials and Methods

We have been treating a huge patient population from several places from Turkey and abroad at Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences as a tertiary cancer center. In this context, variety of benign and malignant tumours are irradiated at our center for decades. Objective of this study has been to assess target definition for recurrent supraglottic laryngeal cancer irradiation based on CT only or fused CT-MRI. We performed a comparative analysis evaluation of target definition by CT simulation images only or by incorporation of MRI. Besides assessment of integrated multimodality imaging for target definition, we also evaluated normal tissue delineation, interobserver and interobservers variations. Ground truth target volume was used for comparative analysis, and it has been defined by board certified radiation oncologists following meticulous assessment of all imaging and relevant data with thorough colleague peer review and consensus. Decision making process for optimal patient 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 localization and association with normal tissues, expected results of proposed treatment alternatives, patient preferences and logistical issues were also considered. Linear Accelerator (LINAC) with the capability of sophisticated IGRT techniques was used for irradiation. After rigid patient immobilization, planning CT images have been acquired at CT simulator for RT planning. Afterwards, acquired RT planning images were sent to the contouring workstation by the network. Target volumes and critical structures were defined on these images and structure sets were generated. Either CT simulation images only or fused CT-MR images were utilized for evaluation and comparative analysis of data.

Results

We have designed this original research article to evaluate the use of multimodality imaging with incorporation of MRI for RT target definition in a selected group of patients with recurrent supraglottic laryngeal cancer. Treatment of patients has been performed at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Before irradiation, patients have been assessed individually by a multidisciplinary team of experts from surgical oncology, medical oncology, and radiation oncology. Briefly, we carried out a comparative analysis based on either CT only imaging or by fused CT-MRI to assess the utility of this contemporary approach. Optimal RT planning process included consideration of lesion sizes, localization, and association with surrounding normal tissues. Radiation physicists have been included in RT planning procedure with consideration of reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU). Accurate RT planning procedure included consideration of electron density, tissue heterogeneity, CT number and HU values in CT images. Main goal of RT planning was to accomplish optimal encompassing of target volumes with minimal exposure of surrounding normal tissues. Ground truth target volume has been utilized as the reference for comparative assessment, and our results have demonstrated that utilization of fused CT-MRI based target definition was identical with ground truth target definition in the selected group of patients with recurrent supraglottic laryngeal cancer.

Discussion

Laryngeal cancers account for a significant proportion among head and neck tumours and may cause considerable morbidity and mortality worldwide [1-7]. However, optimal therapeutic outcomes can be achieved by a multidisciplinary and collaborative treatment strategy. Surgery, chemotherapy, and RT can be used for laryngeal cancer management with regards to disease extent and other characteristics. Surgery can offer favourable treatment results in a considerable proportion of affected patients, nevertheless, untoward toxicity of surgical interventions must always be considered. RT can serve as the single treatment modality in certain circumstances and may also be utilized as part of multidisciplinary treatment of laryngeal cancers. Also, it has also proposed that laryngeal preservation strategies might be followed with respect to patient, tumor, and treatment characteristics. RT can also play a role as salvage treatment for recurrent cancer. Unprecedented improvements in technology can apparently lead to better treatment results for cancer in the millennium era. Considering the critical localization of laryngeal cancers in close neighbourhood of vital neurovascular structures, it should be considered as a priority to individualize patient management with multidisciplinary collaboration. Both tumour and utilized treatments can lead to quality-of-life deterioration in affected patients, and adverse effects of management should be considered at

the outset. Quality of life considerations and critical organ protection should be considered as pertinent aspects of sophisticated RT approaches. Incorporation of contemporary therapeutic strategies and technologies such as molecular imaging methods, automatic segmentation techniques, IGRT, IMRT, stereotactic RT, and ART can lead to better RT results [8-49]. Nevertheless, improvements in target definition must be considered as an indispensable component of sophisticated RT protocols. Nowadays, more common practice includes use of CT simulation for acquisition of RT planning images, however, integration of other imaging modalities such as MRI can possibly add to the accuracy of target definition as suggested by other studies [50-96]. To conclude, incorporation of MRI in RT target definition may be suggested for patients with recurrent supraglottic laryngeal cancers despite the need for further supporting evidence.

Conflict of Interest

None.

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