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An Original Article Revisiting the Utility of Multimodality Imagıng For Refıned Target Volume Determinatıon Of Recurrent Kidney Carcinoma

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Abstract

Objective: Cancers of the kidney include a variety of histological subtypes with different disease processes and clinical behaviour. Renal cell carcinoma (RCC) arises from the renal cortex, and accounts for the majority of kidney cancers. Radiation therapy (RT) may serve as a viable modality for management of kidney cancer. Currently, Computed Tomography (CT) simulation serves as a widely accepted method for acquisition of RT planning images. Nevertheless, incorporation of other imaging modalities such as Magnetic Resonance Imaging (MRI) may possibly improve the precision of targeting. In this original research article, we would like to investigate the utility of multimodality imaging for refined target volume determination of recurrent kidney carcinoma.

Materials and Methods: Included patients were those referred to Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences for recurrent kidney cancer management. Focused subject of our investigation was about target definition by CT only imaging or by integration of fused CT-MRI.

Results: We have performed a comparative assessment for target and critical organ definition by use of either CT only imaging or by fused CT-MRI. Lesion size, location and association with critical surrounding structures were all considered for optimal RT planning. As for the result of this study, comparative analysis by using the ground truth target volume as the reference demonstrated that use of fused CT-MRI based target definition was identical with ground truth target volume definition for patients irradiated for recurrent kidney cancer.

Conclusion: This study supports the utility of multimodality imaging for accurate RT of recurrent kidney cancers. Admittedly, further studies may be required address this important aspect of radiotherapeutic management.

Abbreviations: Recurrent kidney cancer; Radiation therapy (RT); Magnetic Resonance Imaging (MRI)

Introduction

Cancers of the kidney include a variety of histological subtypes with different disease processes and clinical behaviour. Renal cell carcinoma (RCC) arises from the renal cortex, and accounts for the majority of kidney cancers. Subtypes of RCC include clear cell, papillary, chromophobe, and oncocytoma variants. Local failure is a known pattern of recurrence for kidney cancers, and multidisciplinary management plays a central role for optimal treatment. Radiation therapy (RT) may serve as a viable modality for management of kidney cancer [1-4].

In the millenium era, advances in therapy of kidney cancer lead to potentially improved treatment results, and issues regarding quality of life and critical organ sparing may be considered as important aspects of radiotherapeutic management. Molecular imaging techniques, automatic segmentation methods, Intensity Modulated RT (IMRT), stereotactic RT, Image Guided RT (IGRT), and adaptive RT (ART) strategies critically refined the implementation of RT [5-45]. However, major advances have come up with the requirement for improved target definition which should be regarded as a very critical part of contemporary radiotherapeutic management. Currently, Computed Tomography (CT) simulation serves as a widely accepted method for acquisition of RT planning images. Nevertheless, incorporation of other imaging modalities such as Magnetic Resonance Imaging (MRI) may possibly improve

the precision of targeting and this critical issue has been mentioned by many different studies in the existing body of literature [46-84]. By virtue of this original research article, we would like to emphasize the utility of multimodality imaging for refined target volume determination of recurrent kidney carcinoma.

Materials and Methods

Included patients were those referred to Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences for recurrent kidney cancer management. Focused subject of our investigation was about target definition by CT only imaging or by integration of fused CT-MRI. We have conducted a comparative analysis to assess target definition with CT simulation images only or with incorporation of MRI. As a critical endpoint, principal outcome measure has been to find out the utility of multimodality imaging for target definition of recurrent kidney cancers, nevertheless, delineation of normal tissues, interobserver and intraobserver variations have also been evaluated. Comparative analysis has been done, and the ground truth target volume was considered as the reference. Ground truth target volume delineation was a critical procedure which has been run by board certified radiation oncologists with detailed evaluation of all imaging and other data accompanied by meticulous colleague peer review and collaboration. Treatment decisions have been taken after critical and individualized patient assessment with multidisciplinary input from experts on surgical oncology, radiation oncology, and medical oncology. Patient, disease, and treatment related parameters were all assessed. Previosuly delivered therapies, patient age, symptomatology, lesion size and localization, performance status, contemplated outcomes of suggested therapies, patient preferences and logistical issues have all been considered in the decision making process.

Irradiation has been performed by use of a Linear Accelerator (LINAC) furnished with the sophisticated IGRT technology. After immobilization of the patients, planning CT images were acquired at the CT simulator for radiation treatment planning. Later, obtained RT planning images have been transferred to the delineation workstation via the network. Target volumes and normal tissues have been defined on these images and structure sets have been generated for the patients. Either CT simulation images only or fused CT-MR images were utilized for the purpose of comparative evaluation with detailed analysis.

Results

Our purpose was to address the role of multimodality imaging with integration of MRI for radiotherapeutic management of recurrent kidney cancer in this original research article. Irradiation of patients has been executed in Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Prior to initiation of RT, all patients were evaluated by multidisciplinary input from relevant disciplines of surgical oncology, radiation oncology, and medical oncology. To summarize, we have performed a comparative assessment for target and critical organ definition by use of either CT only imaging or by fused CT-MRI. Lesion size, location and association with critical surrounding structures were all considered for optimal RT planning. Also, radiation physicists who had expertise on this subject were involved in RT planning process with consideration of reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU). Precise RT planning process included critical consideration of electron density, tissue heterogeneity, CT number and HU values in CT images. An important objective of radiation treatment planning was to maintain optimal target coverage with minimal exposure of surrounding normal tissues. As for the result of this study, comparative analysis by using the ground truth target volume as the reference demonstrated that use of fused CT-MRI based target definition was identical with ground truth target volume definition for patients irradiated for recurrent kidney cancer.

Discussion

Kidney cancers may include a variety of histological subtypes which may exhibit different disease processes and clinical behaviour. RCC originates from the renal cortex, and accounts for majority of kidney cancers. RCC subtypes include clear cell, papillary, chromophobe, and oncocytoma variants. Local failure may be considered as an important pattern of recurrence for kidney cancers, and collaborative management plays a critical role for optimal treatment. RT may be regarded as a viable modality for management of kidney cancers [1-4].

Recently, advances in therapy of kidney cancer lead to potentially improved treatment results, and issues regarding quality of life and critical organ sparing may be considered as important aspects of radiotherapeutic management. Intensity Modulated RT (IMRT), stereotactic RT, Image Guided RT (IGRT), and adaptive RT (ART) strategies along with molecular imaging techniques and automatic segmentation methods have refined the use of RT [5-45]. Nevertheless, these major advances warrant the need for improved target definition as a critical component of sophisticated RT strategies. In the meantime, CT simulation remains to be the widely accepted technique for acquisition of RT planning images. However, incorporation of other imaging modalities such as MRI may potentially improve the accuracy of targeting, and this aspect of radiotherapeutic management was addressed in several studies [46-84]. By conducting this study, we aimed to emphasize the role of multimodality imaging for refined target volume determination of recurrent kidney cancers.

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Conclusion

In conclusion, this study supports the role of multimodality imaging for accurate RT of recurrent kidney cancers. Admittedly, further studies may be required address this important aspect of radiotherapeutic management. s

Conflict of Interest

There are no conflicts of interest and no acknowledgements.

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