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Evaluation of Multimodality Imaging Based Vaginal Cuff Boost with Stereotactic Body Radiation Therapy (SBRT) for Endometrial Cancer: An Original Article

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ABSTRACT

Objective: Endometrial cancer is a significant public health concern for women with its critical incidence around the globe. The utilization of a vaginal cuff boost may be considered for patients deemed to be at a higher risk of vaginal recurrence. With improved stereotactic localization of well-defined targets under image guidance, Stereotactic Body Radiation Therapy (SBRT) offers a highly precise radiotherapeutic modality. More recently, SBRT has been used for vaginal cuff boost as an alternative to brachytherapy. Herein, we assess target definition for vaginal cuff SBRT with comparative analysis of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI).

Materials and Methods: In the context of this study, the endpoint has been targeting definition for vaginal cuff SBRT with comparative analysis of CT and MRI. All included patients were referred to the Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences for vaginal cuff SBRT. We undertook a comparative analysis of target definition by CT simulation images for SBRT planning and with MRI. CT simulations of the patients were carried out at CT-simulator (GE Lightspeed RT, GE Healthcare, Chalfont St. Giles, UK) available at our department. Also, MRI of patients were acquired and used for comparative evaluation.

Results: We found that CT and MRI defined target definition resulted in differences. Thus, we utilized fused CT and MRI for ground truth target volume definition for vaginal cuff SBRT.

Conclusion: From a radiation oncology perspective, our results may have implications for increased adoption of multimodality imaging-based target definition for vaginal cuff SBRT, nevertheless, the need for future studies to shed light on this critical issue may not be neglected.

Keywords: Endometrial Cancer; Vaginal Cuff; Stereotactic Body Radiation Therapy (SBRT); Target Definition

Abbreviations: SBRT: Stereotactic Body Radiation Therapy; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; RT: Radiation Therapy; IGRT: Image Guided RT; ART: Adaptive RT; LINAC: Linear Accelerator

Introduction

Endometrial cancer is a significant public health concern for women with its critical incidence around the globe [1]. Surgery, radiation therapy (RT), and systemic treatments may be used alone or in combination for management of endometrial cancer with respect to patient, disease, and treatment characteristics [2-7]. Recently, Stereotactic Body Radiation Therapy (SBRT) has emerged as a viable irradiation technique for management of a variety of cancers throughout the human body. The utilization of a vaginal cuff boost may be considered for patients deemed to be at a higher risk of vaginal recurrence. Cervical stromal invasion along with other factors including age, margin status, grade, extent of invasion, histology, and lower external beam RT doses may be regarded as critical issues to consider for optimal patient selection. Admittedly, recent years have witnessed critical advances in technology. Automatic segmentation techniques,

molecular imaging methods, Image Guided RT (IGRT), Intensity Modulated RT (IMRT), stereotactic RT, and adaptive RT (ART) techniques have been introduced for improved radiotherapeutic management of patients [8-49]. With improved stereotactic localization of well-defined targets under image guidance, SBRT offers a highly precise radiotherapeutic modality. High doses of radiation may be delivered in a single fraction or with a limited number of fractions, and highly conformal treatment with steep dose gradients around the target may allow for optimal irradiation with an acceptable toxicity profile. More recently, SBRT has been used for vaginal cuff boost as an alternative to brachytherapy [7]. Herein, we assess target definition for vaginal cuff SBRT with comparative analysis of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI).

Materials and Methods

Department of Radiation Oncology at University of Health Sciences serves a tertiary cancer center for patients from Turkey and abroad. By using state of the art irradiation techniques, a plethora of benign and malignant tumors are irradiated here. In the context of this study, the endpoint has been target definition for vaginal cuff SBRT with comparative analysis of CT and MRI. All included patients were referred to the Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences for vaginal cuff SBRT. We undertook a comparative analysis of target definition by CT simulation images for SBRT planning and with MRI. CT simulations of the patients were carried out at CT-simulator (GE Lightspeed RT, GE Healthcare, Chalfont St. Giles, UK) available at our department. Also, MRI of patients were acquired and used for comparative evaluation. The Linear Accelerator (LINAC) with the capability of sophisticated IGRT techniques has been utilized for stereotactic irradiation. After rigid patient immobilization, planning CT images were acquired at CT-simulator for vaginal cuff SBRT planning. Thereafter, acquired SBRT planning images have been transferred to the delineation workstation via the network. Target volumes and normal tissues were contoured on these images and structure sets were generated. Also, target definition has also been performed on MRI for comparison purposes. All patients underwent vaginal cuff SBRT at Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences.

Results

The current study has assessed target definition for vaginal cuff SBRT with comparative analysis of CT and MRI. Stereotactic irradiation procedures have been performed at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences. Prior to vaginal cuff SBRT, all included patients have been individually evaluated by a multidisciplinary team of experts from surgical oncology, radiation oncology, and medical oncology. Critical goal of vaginal cuff SBRT planning has been to achieve optimal target coverage without violation of critical organ dose constraints. IGRT techniques such as kilovoltage cone beam CT was used, and vaginal cuff SBRT has been delivered by Synergy (Elekta, UK) LINAC. We found that CT and MRI defined target definition resulted in differences. Thus, we utilized fused CT and MRI for ground truth target volume definition for vaginal cuff SBRT.

Discussion

Endometrial cancer is a significant public health concern for women with its critical incidence around the globe [1]. Surgery, radiation therapy (RT), and systemic treatments may be used alone or in combination for management of endometrial cancer with respect to patient, disease, and treatment characteristics [2-7]. Recently, SBRT has emerged as a viable irradiation technique for management of a variety of cancers throughout the human body. Admittedly, recent years have witnessed critical advances in technology. Automatic segmentation techniques, molecular imaging methods, IGRT, IMRT, stereotactic RT, and ART techniques have been introduced for improved radiotherapeutic management of patients [8-49]. With improved stereotactic localization of well-defined targets under image guidance, SBRT offers a highly precise radiotherapeutic modality. High doses of radiation may be delivered in a single fraction or with a limited number of fractions, and highly conformal treatment with steep dose gradients around the target may allow for optimal irradiation with an acceptable toxicity profile. More recently, SBRT has been used for vaginal cuff boost as an alternative to brachytherapy [7]. The utilization of a vaginal cuff boost may be considered for patients deemed to be at a higher risk of vaginal recurrence. Cervical stromal invasion along with other factors including age, margin status, grade, extent of invasion, histology, and lower external beam RT doses may be regarded as critical issue to consider for optimal patient selection.

In the context of radiation oncology, improved target definition and critical organ sparing should be considered among the pertinent aspects of optimal stereotactic irradiation. Determination of larger target volumes may lead to radiation induced toxicity, and definition of smaller than actual target volumes may result in decreased local control of the disease. It should be mentioned that adaptive irradiation approaches and multimodality imaging-based target definition may be suggested to improve radiotherapeutic results [50-106]. The current study has assessed target definition for vaginal cuff SBRT with comparative analysis of CT and MRI. Stereotactic irradiation procedures have been performed at our Radiation Oncology Department of Gulhane Medical Faculty at the University of Health Sciences. Prior to vaginal cuff SBRT, all included patients have been individually evaluated by a multidisciplinary team of experts from surgical oncology, radiation oncology, and medical oncology. The critical goal of vaginal cuff SBRT planning has been to achieve optimal target coverage without violation of critical organ dose constraints. IGRT techniques such as kilovoltage cone beam CT were used, and vaginal cuff SBRT has been delivered by Synergy (Elekta, UK) LINAC. We found that CT and MRI defined target definition resulted in differences. Thus, we utilized fused CT and MRI for ground truth target volume definition for

vaginal cuff SBRT. From a radiation oncology perspective, our results may have implications for increased adoption of multimodality imaging-based target definition for vaginal cuff SBRT, nevertheless, the need for future studies to shed light on this critical issue may not be neglected.

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