Volumetric Modulated Arc Therapy Treatment Protocol for Hypo-fractionated Stereotactic Body Radiotherapy for Localized Prostate Cancer

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Introduction

A single arm Phase IIa clinical trial has been initiated to obtain systematic quality of life data after a hypo-fractionated course of stereotactic body radiotherapy for the treatment of localized prostate cancer. Our principal aims are: to quantify the quality of life based upon validated QOL questionnaire tools that document three separate domains (urinary, bowel, and sexual) over the course of 2-5 years after treatment; to quantify tumor response using the standard of care PSA-based patterns after radiotherapy; to report any significant adverse events using standardized case report forms (CRF).

Objectives

To establish treatment planning, image guidance and treatment delivery protocol for a prospective single arm Phase IIa clinical trial designed to obtain systematic quality of life data after a hypo-fractionated course of Stereotactic Body Radiotherapy (SBRT) for the treatment of localized prostate cancer.

Methods

Treatment planning, image guidance and treatment delivery protocol for hypo-fractionated prostate SBRT was developed with RapidArc VMAT using Novalis Tx, Exactrac stereoscopic imaging and Cone Beam Computed Tomography (CBCT). Three patients were included in our initial investigation prior to the start of the protocol and seven additional patients have since been added to the investigation and treated. The dosimetric and other clinical consequences of number of arcs, table rotations, collimator angle and photon beam energy have been investigated.

Results

VMAT plans with ±45 degree collimator rotations required on average 38% less monitor units compared to plans with no collimator rotations and 20% less monitor units than plans with ±22.5 degree rotations. Plans with ±45 degree collimator rotations provided more homogeneous dose distribution with an average of 6% less maximal dose. VMAT plans with two arcs provided improved conformity and homogeneity with an average of 3% lower maximal dose compared to single arc plans. However, increasing the number of arcs to three did not provide any significant improvement. Introduction of ±5 and ±10 degree table rotations between arcs did not result in any significant dosimetric improvements. The selection of photon beam energy between 6MV and 10MV did not provide any notable dosimetric differences either.

Conclusions

The final selection of the protocol includes two coplanar 10 MV Rapid Arcs with ±45 degree collimator rotations. This prospective clinical trial is designed to deliver 5 fractions of 8 Gy with the prescription dose covering the 95% of the planning target volume. The beam-on time for each of the coplanar arcs is approximately 2 minutes. For the purpose of intrafraction motion management, two Rapid Arcs are further split to 4 half arcs with approximately one minute treatment time for each segment (Figure 1). The patient is stereoscopically imaged and repositioned if necessary using ExacTrac prior to the delivery of each arc. Additionally, CBCT is obtained prior to each fraction for the purposes of confirmation of ExacTrac positioning and volumetric evaluation of bladder and rectal filling.

Update

Since the submission of this abstract 6MV high dose rate mode with 1000MU/min maximum dose rate has been adapted for this study. The beam on time for each of the half arcs is approximately 40-50 seconds reducing potential large organ movements. At the time of this poster preparation 21 patients have been treated with the presented protocol.

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