

MR-Linac Guided Motion-Adaptive Stereotactic Radiotherapy for the Treatment of CT-Indiscernible Intravascular Renal Cell Carcinoma Tumors

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Abstract

Published 04/02/2023

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Categories: Medical Physics, Radiation Oncology, Urology

Keywords: mr-guided stereotactic body radiotherapy, renal cell carcinoma, mr-linac

How to cite this abstract

Shanker M, Yu H, Yang J, et al. (April 02, 2023) MR-Linac Guided Motion-Adaptive Stereotactic Radiotherapy for the Treatment of CT-Indiscernible Intravascular Renal Cell Carcinoma Tumors. Cureus 15(4): a846

Abstract

Objectives:

IVC tumor thrombus (IVC-TT) is a life-threatening consequence of advanced renal cell carcinoma (RCC). Stereotactic-ablative body radiotherapy (SBRT) is a potentially feasible and safe option for patients who are not surgical candidates; however, renal disease-restricted contrast use and poor visualization of thrombi with conventional CT impairs precise planning and treatment delivery. Magnetic-resonance linear accelerator (MR-Linac)-based therapy allows advanced visualization of IVC-TT boundaries for improved delineation, inter- and intrafraction monitoring, and online adaptive radiation therapy. We present the first report of this advanced radiation treatment strategy in RCC patients with IVC-TT.

Methods:

Demographics, tumor, and treatment characteristics, toxicity, and local control outcomes of IVC-TT patients treated with 1.5T MR-Linac at a single institution were retrospectively evaluated. Patients received 40-50Gy in four fractions. Planning target volume (PTV) margins utilized were 3-5 mm anisotropically. Utilizing online adaptive planning, treatment plans were re-optimized in each fraction based on setup position and anatomical changes

Results:

Between December 2021-February 2022, four patients underwent MR-guided SBRT for IVC-TT. Median follow-up was 6.6 months (IQR 5.7-7.8). 75% of patients had a Mayo Level III IVC, with one patient having a level IV extension. Two patients were on concurrent Cabozantinib at time of SBRT. At simulation visualization of the tumor-IVC interface was indiscernible with standard non-contrast CT but visualized with MR-based simulation and during treatment using MR guidance. Median tumor volume of 17.9cc (IQR 10.1-62.2). At the time of last follow-up, no patients had local progression, and no adverse events were associated with SBRT. Three patients demonstrated a partial radiological response according to RECIST criteria and one patient had stable disease. Intrafraction visualization showed asymmetrical motion of the IVC-TT target with greater superior-intrahepatic vs. infra-hepatic regional motion.

Conclusion(s):

MR-Linac-guided SBRT enabled daily visualization of tumors that would have been indiscernible with standard non-contrast CT. Excellent local control was attained despite the use of narrow margins. Adaptive planning allowed for enhanced fractional target coverage and decreased normal tissue dose.