Real-time tracking of hepatic tumors using the Vero gimbaled linac system

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Abstract

Objectives: To report on the clinical application and dosimetric comparison of real-time tumor tracking (RTTT) using Vero SBRT gimbaled linac system for hepatic tumors versus respiratory gating/ITV treatments.

Methods: We evaluated three patients with liver lesions from hepatocellular carcinoma or metastases treated at our institution from 2013 until January 2016 with RTTT. All patients had 4D CT scans using Varian Real-time Position Management respiratory gating system at the time of simulation. Minimum intensity, maximum intensity, and average intensity projections were obtained for all patients. Fiducial markers were contoured on each phase and their relative motion was tracked. The treatment fields were copied onto each phase of the 4D CT and shifted according to the relative motion of the fiducials to simulate an RTTT treatment. The doses were then summed to evaluate volumetric dose. We report a conformity index (CI100), defined as the ratio of volume receiving prescription dose to the volume of the PTV, as well as CI70 and CI50, where these are computed using volumes receiving 70% and 50% of the prescription dose, respectively.

Results: Volume receiving prescription dose was decreased using RTTT treatment in all cases. CI100 ranged from 0.98 – 1.09 for RTTT compared to 1.06-1.24 for an ITV-style treatment. CI70 and CI50 were increased for RTTT treatments (ranges 2.51–2.57, 4.69–4.93) relative to ITV treatments (range 2.31–2.55, 4.47–5.77) for all but one patient. Absolute PTV volumes were decreased by 0, 20, and 30% when using RTTT versus ITV/gating style treatments.

Conclusions: Real-time tumor tracking reduces the volume receiving prescription doses for hepatic tumors, but can increase the relative amount of irradiated tissue when compared to ITV/respiratory gating-style treatments. This increase in normal tissue irradiated should be considered when planning RTTT treatments.