MR-guided Adaptive Stereotactic Radiotherapy: A New Paradigm in Radiotherapy

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Résumé

Introduction:
In May 2016 we have implemented sterotactic MR-guided adaptive radiation therapy at the VU University Medical Center by using the MRIdian system (ViewRay, Inc.). Our approach consists of: 1) MR-guided tumor setup; 2) daily online plan adaptation to account for inter-fractional changes; 3) patient-specific QA; 4) gated treatment delivery. The key points of the MR-guided adaptive workflow and the potential for better OAR sparing and delivery accuracy are shown.

Methods:

For each adaptive fraction a high-resolution MR acquisition for delineation and plan adaptation is taken. Scantime ranges from 17 sec. to 150 sec. according to protocol. Online plan (re-)optimization is done by keeping the same beam parameters as for the reference baseline-plan. Before treatment delivery online patient-specific QA evaluation of the adapted plan is performed with a 3%/3mm gamma comparison with the dose distribution from the TPS before accepting the adapted treatment plan for delivery. MR-guidance of gated treatmetns during delivery is performed in a single sagittal plan on the GTV with a safety margin of GTV + 3mm.

Results:

Well over 700 adaptive fractions in 130 patients under MR-guidance have been delivered to date. Treatment, generally delivered as hypofractionated SBRT included lesions in the pancreas, prostate, lung and liver. Plan adaptation was performed in a median time of 12 min and resulted nearly always in plans meeting the constraints of the clinical protocol. Online patient-specific QA was performed on average within 1.5 minutes resulting in average gamma pass-rate above 99% and gamma average value of 0.35.

Plan (re-)optimization results in better sparing of OARs while ensuring adequate coverage to the PTV. Median duration of treatments was 50 min and it was delivered with video assisted feedback to the patient with a monitor installed in the treatment room.

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Conclusions:
An online procedure for plan adaptation and delivery under MR-guidance was successfully implemented at our institution, resulting in median times of 12 min. for plan adaptation and 50 min. for treatment duration. A very good agreement in the patient-specific QA was obtained for all adapted fractions.