ABSTRACT SUBMISSION FORM

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☐ Oral presentation preferred

PRESENTATION TITLE
Impact of repeated MR imaging for cervical cancer patients inside a combined brachy HDR and MRI treatment theatre.

AUTHOR(S)

ABSTRACT
Purpose:
To study the integrated workflow in a brachy HDR/MRI theatre and the impact of repeated MR imaging during brachytherapy (BT) applications. To evaluate adaptive interventions, and determine their dosimetric effect of organs at risk (OAR).

Materials & Methods:
Twenty patients (41 applications), treated from June 2016 until June 2017, have been analysed for this study. Patients were treated according to the EMBRACE II protocol within our normal clinical workflow. The BT schedule consisted of 2 HDR applications delivering 2 fractions each. Application and dose delivery was performed in our 1.5T MRI/HDR BT theatre. Full imaging including T2 weighted transversal, sagittal and coronal MRI scans was done before the application, after the application for treatment planning (MRplan), and prior to dose delivery for position verification (MRpre). During the application, short MRI scans could be made for guidance of needle depth and/or adapting bladder filling. Standard procedure was to start with empty bladder. Dependant on the anatomical situation bladder filling was changed in order to decrease bowel or sigmoid dose. Rectal gas was deflated before all MRI scanning. Target volumes and OAR’s were delineated and an optimized treatment plan was made, aiming at D90% CTVHR >90 Gy EQD2 and soft and hard constraints for OAR according to EMBRACE II. If the MRpre scan revealed changes in rectal or bladder anatomy compared to the MRplan scan, adaptations were applied in order to keep OAR’s similar to the planned situation, e.g. repeated gas deflation or change in bladder filling. In those cases, a new scan was made to evaluate the actual situation at time of dose delivery. Recontouring of OAR’s was done for all fractions on the scan, registered to the MRplan on applicator geometry. DVH analysis of the delivered dose was done for the OAR’s, expressed in Gy EQD2alpha/beta.
Results:
In more than 50% of the applications the short MRI scans during application resulted in adaptations: 3x applicator re-insertion, 7x adaptation of needle depth, and 18x change of bladder filling. MRpre scans (taken 2-4 h after the MRplan) resulted in about 20% in direct actions: 3x change of bladder filling and 13x extra rectal degassing (mean reduction D2cm³ rectum 2.3Gy, max 5.0Gy). All patients were treated with the intended treatment plan.
The differences between total delivered and total prescribed dose was for D2cm³ mean -0.8 (range -6.4, 4.2) Gy for bladder, 0.4 (-5.6, 5.8) Gy for rectum, 2.6 (-6.0, 7.5) Gy for sigmoid, -0.8 (-8.2, 8.9) Gy for bowel. These differences caused hard constraint violations in only 2 cases (1x bladder, 1x sigmoid Figure 1 and 2). This interventional approach resulted in smaller differences between delivered and prescribed dose compared to the period before initiating this standard procedure. An earlier observational study in that period showed a mean increase of D2cm³ of 2.1 (-5.3, 10.2)Gy for rectum (Nomden et al. 2014 R&O).

Conclusions:
Repeated MR imaging during BT application and before dose delivery allows for individualized interventions, especially adaptation of needle depth, bladder filling and removing rectal gas. MR imaging prior to dose delivery gives more accurate estimates of the actual delivered dose.