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Benefit of adaptation in MR-guided radiotherapy of lesions in the abdomen

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Aims
The precise treatment of tumor lesions in the abdomen is challenging due to inter- and intra-fractional anatomy variations. With MR-guided radiotherapy, daily plan adaption can be performed. Here we investigated the benefit of adaption in terms of tumor coverage and organ at risk (OAR) sparing.

Methods
SBRT radiotherapy treatment plans, created with IMRT and treated with a gated breathhold technique on the MRIdian system (Viewray) for patients with cancer in the abdomen were analyzed. We chose 7 consecutive patients with the identical fractionation scheme (5 fractions, prescription 30-40Gy) and compared the delivered (adapted) doses with the predicted doses (original plans computed on the MRI of the day). In the MRIdian system, there are 2 types of plan re-optimization available: predefined segments weight optimization or full re-optimization, which can be done if weight optimization is not sufficient. We analyzed tumor coverage and OAR sparing using GTV D95%, PTV D95% and OAR V26Gy. The studied OAR was either stomach, duodenum or bowel, depending on the proximity to the PTV. For the OAR, we investigated for how many fractions V26Gy<1cc was exceeded, compared with the predicted dose. The statistical analysis was done with a paired-sample Wilcoxon test with a significance level <0.05. For all analyzed structures, the median difference and interquartile range were reported.

Results
The plan was re-optimized for all patients in all fractions. A full re-optimization was needed in at least 2 out of 5 fractions for each patient; for the remaining fractions weight optimization was performed and considered as sufficient based on the original plan. The GTV and PTV coverage were improved in 54% and 63% of the fractions, respectively. The OAR volume receiving 26Gy was reduced in 83% of the fractions. The V26Gy<1cc for OAR was exceeded in 77% of the predicted doses (57% original dose), whereas this number was reduced for the adapted doses (60%). For 2 patients, the GTV and PTV coverage were intentionally reduced in the adapted (and for 1 patient in the original) plan in order to improve OAR sparing. In the entire cohort, the OAR spearing was significantly improved: difference V26Gy=-1.05 (-4.20; -0.07) cc, p=0.01, whereas the tumor coverage was not significantly reduced: difference PTVD95% =0.46 (-0.50; 0.88) Gy, p=0.86; difference: GTVD95% =0.32 (-0.55; 1.44) Gy, p =0.86.

Conclusion
Results of this study show that MR-guided adaptive radiotherapy can notably reduce the dose to the organs at risk, while maintaining the GTV and PTV coverage in abdominal cancer.

Primary author: Ms SPANIOL, Manon (Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Zurich, Switzerland)

Co-authors: Ms EHRBAR, Stefanie (Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Zurich, Switzerland); Mrs BOGOWICZ, Marta (Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Zurich, Switzerland); Ms CHAMBERLAIN, Madalyne (Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Zurich, Switzerland); Mr KRAYENBÜHL, Jérôme (Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Zurich, Switzerland); Dr GARCIA SCHÜLER, Helena (Department of Radiation Oncology, University Hospital Zurich

and University of Zurich, Zurich, Switzerland); Prof. GUCKENBERGER, Matthias (Radiation Oncology Department, Universitätsspital Zürich, Switzerland); Prof. ANDRATSCHKE, Nicolaus (Radiation Oncology Department, Universitätsspital Zürich, Switzerland); Dr TANADINI-LANG, Stephanie (Radiation Oncology Department, Universitätsspital Zürich, Switzerland)

Presenter: Ms SPANIOL, Manon (Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Zurich, Switzerland)

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