Assessment of tumor microcirculation in rectum carcinoma with regard to different pharmacokinetic models, intra-tumor heterogeneity and therapeutic effects after neoadjuvant radio-chemotherapy

A. M. Hoetker¹, P. Mildenberger¹, T. Junginger², C. Dueber¹, T. Hansen¹, M. Menig⁴, A. Pohlmann⁵, A. Heintz⁶, and K. Oberholzer¹

¹Klinik und Poliklinik für diagnostische und interventionelle Radiologie, Klinikum der Johannes-Gutenberg Universität Mainz, Mainz, Germany, ²Klinik und Poliklinik für Allgemein- und Abdominalchirurgie, Klinikum der Johannes-Gutenberg Universität Mainz, Mainz, Germany, ³Institut für Pathologie, Klinikum der Johannes-Gutenberg Universität Mainz, Mainz, Germany, ⁴Klinik und Poliklinik für Radioonkologie sowie Strahlentherapie, Klinikum der Johannes-Gutenberg Universität Mainz, Mainz, Germany, ⁵Klinik für Allgemein-, Viszeral- und minimalinvasive Chirurgie, St. Hildegardis Krankenhaus, Mainz, Germany

Purpose: Measurement of changes in DCE-MRI parameters of rectum carcinoma patients before and after neoadjuvant radio-chemotherapy using two slices per patient and measurement to compare the assessed results of different models (Brix/Tofts) between each other and the different slices.

Methods and Materials: DCE-MRI measurements of 30 patients with rectum carcinoma were performed on a 1.5 T MR system (TurboFLASH, FoV: 350mm, Matrix: 256x192, Slice: 7mm, TR/TE/TI: 7,0/3,86/120ms, Flip angle 12°, 200 Hz/px Bandwith, Voxel size 1,37x1,37x7mm³) during intravenous contrast media application before and after neoadjuvant radio-chemotherapy. For each measurement two slices were applied in maximal tumor extent. The resultant images were analyzed semi-quantitatively and quantitatively (Brix and Tofts compartment models).

Results: Significant changes were found for several parameters including the semi-quantitative time to peak (TTP, p<0.001) and the quantitative values kep from the Brix model (p<0.001), K from the Tofts model (p<0.001) and AuCtP (area under the curve till maximum enhancement, p<0.001). The percentage decrease in exchange rate parameters of the applied pharmacokinetic models was similar (both kep and K decreased about 50%). The two slices applied in maximal tumor extent showed no significant different results.

Conclusion: Neoadjuvant radio-chemotherapy results in a significant change of tumor microcirculation. Neither the slice selection in the maximal tumor extent affected the results in later analysis nor was it possible to find a relevant difference in therapeutic effects between the corresponding parameters of the pharmacokinetic models.