# Contrast enhanced MR-Perfusion of renal Tumors for Monitoring of neoadjuvant antiangiogenic Therapy

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**Purpose**: Contrast enhanced MR-perfusion with high temporal resolution has proven to be able to disclose changes in renal perfusion in different renovascular and renoparenchymal diseases[1]. Renal tumors and their metastases are mostly hypervascular and may therefore be subject to antiangiogenic neoadjuvant therapy[2]. The purpose of this study was to analyze renal tumor perfusion with MR-perfusion techniques and to evaluate the potential effects of neoadjuvant therapy on tumor perfusion.

**Material and Methods:** Ten patients with normal renal function (age 48±15y), 9 patients with RCC before (age 66±11y) and 4 patients after neoadjuvant antiangiogenic therapy (age 56±18y) underwent contrast enhanced MR-perfusion of the kidney. All examinations were performed on a 1.5T scanner (Magnetom Avanto, Siemens Medical Solutions) using a Turbo-FLASH-sequence (TR 277msec/TE 0.95 msec/FA 12°; 4 slices; slice thickness 8mm; in-plane resolution 3.3x2.3mm; temporal resolution 0.25sec/slice; acquisition time 220sec). A standard dose of 7ml Gd-DTPA (Magnevist®, Bayer-Schering-Pharma, Germany) was applied at a flow rate of 4ml/sec. Semiquantitative analysis was performed with the IDL-software "Platform for Research in Medical Imaging"[3] (PMI) 0.3. Regions of interest were defined for normal kidney parenchyma and for the tumor, separately. Calculation of semiquantitative parameters included the maximum contrast enhancement ratio (CER), upslope, time to peak (TTP) and signal intensity behavior in the recirculation phase ($\Delta_{40\text{-}220sec}$). Morphologic appearance of the tumor was described based on contrast enhanced and non-enhanced standard T1- and T2-weighted TSE-sequences. Statistical analysis was performed with paired t-tests.

**Results:** Normal kidney parenchyma showed a characteristic perfusion curve with a steep upslope (22.6±9.9 %/sec), early arterial peak (maximum CER 167.7±37.3%; TTP 13.5 ± 3.6 sec) and a contrast uptake ($\Delta_{40\text{-}220sec}$ 6.8±5.1 %/min) during the recirculation phase due to medullary collection. There was no significant difference in the perfusion dynamics of normal kidneys and kidneys affected by tumors. Pre-therapeutic RCC presented as hypervascular solid tumors (Figure 1) showing no significant difference in the maximum CER (181.4%±83.4) and TTP (16.9±3.2 sec). In contrast to normal renal parenchyma, $\Delta_{40\text{-}220sec}$ was negative in tumors (-9.7±7.4 %/min) in terms of a wash out (Figure 2).
All 4 RCC under antiangiogenic therapy showed signs of necrosis and hemorrhage, a decreased perfusion (maximum CER 32.8±12.2%) (Figure 3), loss of the early arterial peak (TTP 130.2±22.8 sec) and a positive $\Delta_{40\text{-}220sec}$ 2.5±1.2 %/min (Figure 4) in terms of a contrast media uptake.

**Conclusions:** Our preliminary results suggest that contrast enhanced MR-perfusion has the potential to describe and distinguish distinct perfusion patterns for RCC before and after neoadjuvant antiangiogenic treatment and therefore may become a valuable diagnostic tool to monitor tumor perfusion under antiangiogenic treatment.

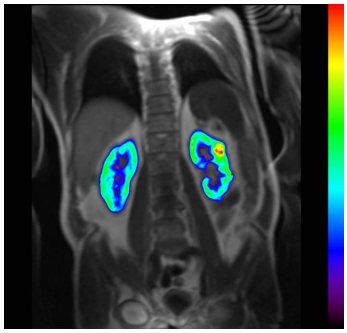

**Figure 1:** Perfusion map of a hypervascular untreated RCC

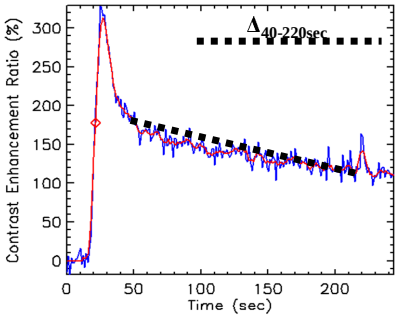


**Figure 2:** Perfusion curve of the same untreated RCC

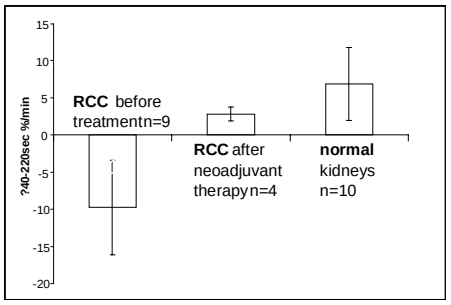


**Figure 5**: $\Delta_{40\text{-}220sec}$ of RCC before and after neoadjuvant treatment and normal kidneys

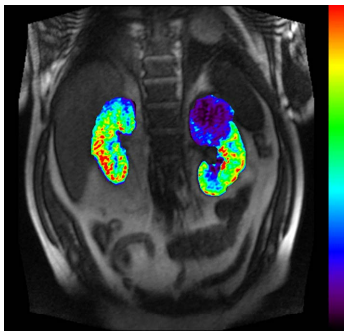

**Figure 3:** Perfusion map of a RCC after neoadjuvant therapy

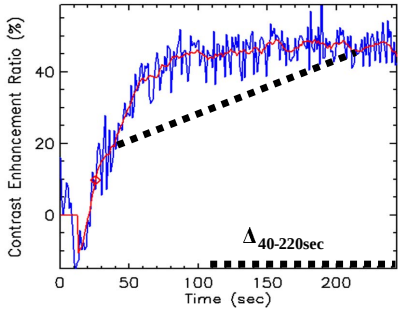


**Figure 4:** Perfusion curve of the same neoadjuvantly treated RCC

**References**

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3. Sourbron S, M. D, S. M, et al., Pixel-by-pixel deconvolution of bolus-tracking data: optimization and implentation. Phys Med Biol., 2007. Jan 21(52(2)): p. 429-47.