Single Slice vs. Whole Organ MR-Renography

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Background: Due to limited spatial coverage or time-consuming segmentation MR-Renography is commonly assessed only in a single central slice assuming that this slice is a legitimate substitution for the whole organ . Principally, assessment of the whole organ would allow for more representative information on perfusion and filtration. However, partial volume effects at the peripheral organ borders and inhomogeneity of the magnetic field might confound whole organ MR-Renography. The aim of this study was to compare single-slice MR-Renography with measurements of the whole organ.

Material and Methods: 15 MR-Renography measurements with 30 kidneys were included in this study. MR-Renography was performed with a dynamic 3D-MR-Angiography sequence (TWIST) at 3.0T (Magnetom VERIO, Siemens Healthcare Sector) with a spatial resolution of 2.6x2,6x2,6mm^3 and a temporal resolution of 2 seconds after injection a half body weight adapted dose of Gadobutrol (Bayer Healthcare Pharmaceuticals). Postprocessing was performed with an in-house-built software (PMI 0.4) using a 2-compartment-model yielding plasma flow (F_P), plasma volume (V_P) and glomerular filtration (GFR). The kidney cortex was segmented manually based on a deconvolution analysis. Analysis was performed for a central single slice and the whole organ based on absolute and relative contrast enhancement, the latter to compensate magnetic inhomogeneity. Statistical analysis was performed with the Wilcoxon sign rank-test for related samples and Pearson´s correlation coefficient.

Results: There were no significant differences between single slice and whole organ F_P, V_P and GFR and correlation was excellent for all parameters (r>0.95). However single slice results were slightly higher than for the whole organ measurements. In analysis based absolute enhancement there was a significant gradient between ventral and dorsal slices for F_P, V_P and GFR with a gradient of appr. (F_P 18%, V_P 21%, GFR 47%) based on magnetic field inhomogeneity. In the latter analysis F_P, V_P and GFR were slightly lower in peripheral slices, mostly attributable to partial volume effects.

Enhancement	Volume	F_P ml/100ml/min	V_P ml/100ml	GFR ml/100ml/min
absolute	Single Slice	382.3 ± 113.5	40.4 ± 7.4	24.3 ± 11.7
	Whole Organ	381.9 ± 113.5	43.4 ± 7.6	25.7 ± 12.1
relative	Single Slice	255.9 ± 101.5	27.1 ± 8.6	15.6 ± 7.3
	Whole Organ	216.1 ± 91.4	24.4 ± 8.3	14.1 ± 7.2

Table 1: Results of Single Slice and Whole Organ measurements

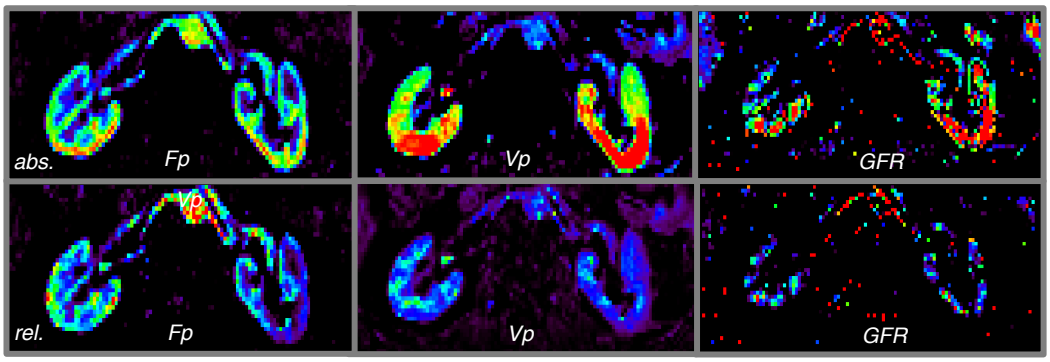

Figure 1: Exemplary transversal MR-Renography reformats based on absolute/relative Enhancement

Conclusion: Single slice MR-Renography is representative for the whole organ. When performing whole kidney perfusion one must consider partial volume effects and magnetic field inhomogenity. Assessment based on relative enhancement mitigates the latter effect, however T1-effects have to be considered when using this approach.

1. Notohamiprodjo, M., et al., *Comparison of Gd-DTPA and Gd-BOPTA for studying renal perfusion and filtration.* Journal of Magnetic Resonance Imaging, 2011.