Determination of T1-DCE MRI based blood flow heterogeneity in normal kidneys and renal pathology.

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Purpose/Introduction:

Renal MRI has the potential to provide anatomical and functional information [1-3]. The aim of this study was to determine the age dependence of T1-DCE MRI based renal blood flow heterogeneity in normal kidneys and to compare it with the results obtained in some examples of renal pathology.

Subjects and Methods:

Imaging was performed in 15 subjects without known renal disease and in three pathological cases. Average normal patient age was 50 years (SD 18). The pathological cases included an acute renal failure (ARF) at week 0 and 3, an end stage glomerulonephritis (GN) and a significant left renal artery stenosis (RAS) with mild right RAS. All experiments were approved by the local ethical board. Single slice IR-prepared Flash (TR 4.4 ms/ TE 2.2 ms/ TI 180 ms/ FA 50°/ matrix 128*256/ dynamics 400, temporal resolution 0.3 s/slice) was performed during the injection of 10 ml Gd-DTPA. Perfusion post-processing was performed offline using software written in-house in IDL. Signals were converted to tracer concentrations and deconvolved with an aorta AIF with a optimized deconvolution procedure [4]. Parametric maps of renal blood flow (RBF) were calculated. The parameter renal blood flow heterogeneity H(RBF) was introduced in analogy with the approach in histopathology as the standard deviation of the cortex RBF divided by RBF and calculated in each patient. The age dependence of H(RBF) in the normal group was studied.

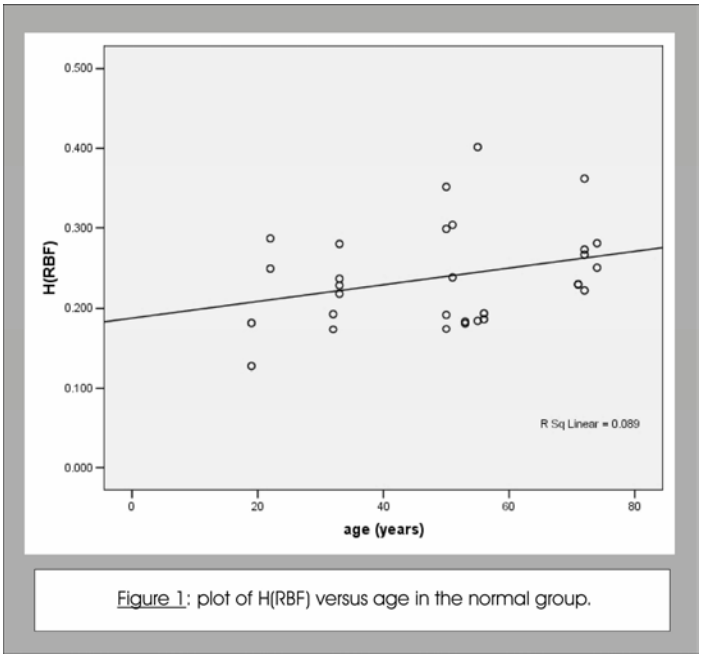

Figure 1: plot of H(RBF) versus age in the normal group.

Results:

Figure 1 presents a plot of H(RBF) versus age in the normal group. The data did not allow a significant correlation between these two parameters to be established (Pearson r = 0.3 , p = 0.1). The values of H(RBF) in the pathological cases (as well as the average results in the normal group for comparison) are presented in the figure 2. The bar graph indicates an increased H(RBF) in the glomerulonephritis case and a slightly lowered value in the acute phase of renal failure. No difference with normal values was found for the acute renal failure after recovery and in the patient with RAS.

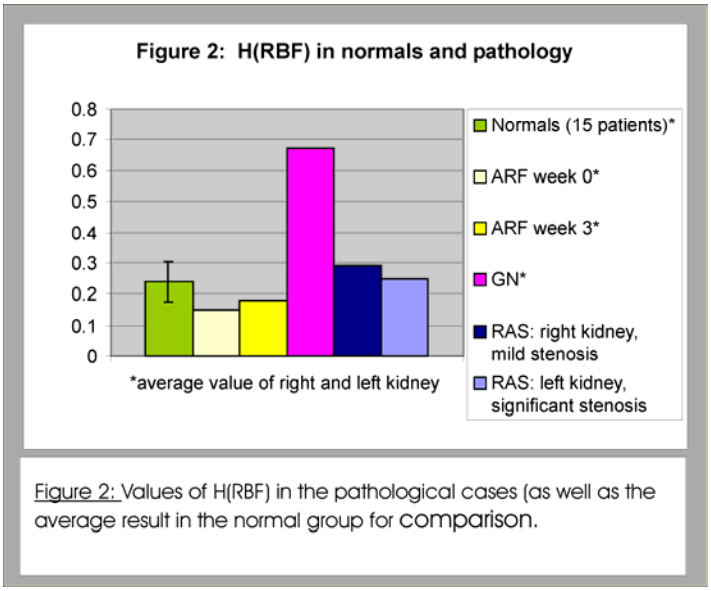

Figure 2: Values of H(RBF) in the pathological cases (as well as the average result in the normal group for comparison.

Discussion/Conclusion:

While at first glance there does seem to be a tendency for H(RBF) to increase with age, this tendency cannot be established statistically on the basis of the present data. It would, however, be consistent with literature on aging [5] and with findings on heterogeneity of cortical circulation based on semi-quantitative measurements in CT [6]. The sensitivity of the technique to demonstrate altered blood flow heterogeneity in the cases of some significant pathology was shown in the pathological examples. The observed reduction in the case of ARF could be explained by the need to access somnolent glomeruli in kidney failure. At present, there is no obvious explanation for the increase in case of GN. More data are needed to confirm these preliminary findings.

References:

[1] Hermoye L. (2004) MRM 51: 1017-1025
[2] Schoenberg S. (2003) MRM 49: 288-298
[3] Dujardin M. (2005) MRM 54: 841-9
[4] Sourbron S. (2004) PMB 49: 3307-3324
[5] Ueda K. (1974) NRIZ 11:147-156
[6] Kojima S. (2000) AJH 13:346-352