ASSESSMENT OF RENAL PERFUSION IN TYPE 2 DIABETES MELLITUS USING ARTERIAL SPIN LABELING MAGNETIC RESONANCE IMAGING

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INTRODUCTION

- Diabetic nephropathy (DN) is a microvascular complication of diabetes mellitus and a leading cause of chronic kidney disease; hemodynamic changes have been described since its early stages. Analitical variables are used for the diagnosis of renal disease in diabetic patients, however they are not sensitive enough to detect early functional disturbances.
- Arterial spin labeling magnetic resonance imaging (ASL-MRI) is an attractive noninvasive approach for assessing renal function as it provides a quantitative measure of perfusion without the use of an exogenous contrast agent. Available data demonstrates that ASL-MRI can provide reliable measures of kidney perfusion both in healthy subjects and renal transplant recipients.

OBJECTIVE To evaluate the clinical utility of ASL-MRI to detect perfusion deficits in patients with diabetic nephropathy.

METHODS

ASL-MRI technique was performed to evaluate renal blood flow (RBF) in two groups of subjects:

- healthy controls (HC) with no history of renal disease (n=24).
- type 2 diabetic patients (n=28).

All subjects underwent clinical examination and MRI at 3T (MAGNETOM Trio, Siemens). The MRI study included T1-weighted and T2-weighted anatomical imaging sequences followed by the ASL sequence, that combined pseudo-continuous labeling with a single-shot balanced steady-state free precession readout, in a navigator gated free-breathing acquisition. The axial labeling plane was placed perpendicular to the aorta and located approximately 10 cm over the kidneys. One slice through both kidneys was imaged.

Twenty-five pairs of ASL images were acquired and postprocessed to minimize residual motion using ANTs (Advanced Normalization Tools). Renal blood flow was quantified from the mean perfusion weighted image in units of mL/100g/min, using a single-compartment model. Regions of interest (ROIs) depicting the renal cortex were drawn by a trained nephrologist on the RBF maps. Cortical RBF was computed as the averaged value within the ROI. Values were compared between control and patient groups using a two-sample T test.

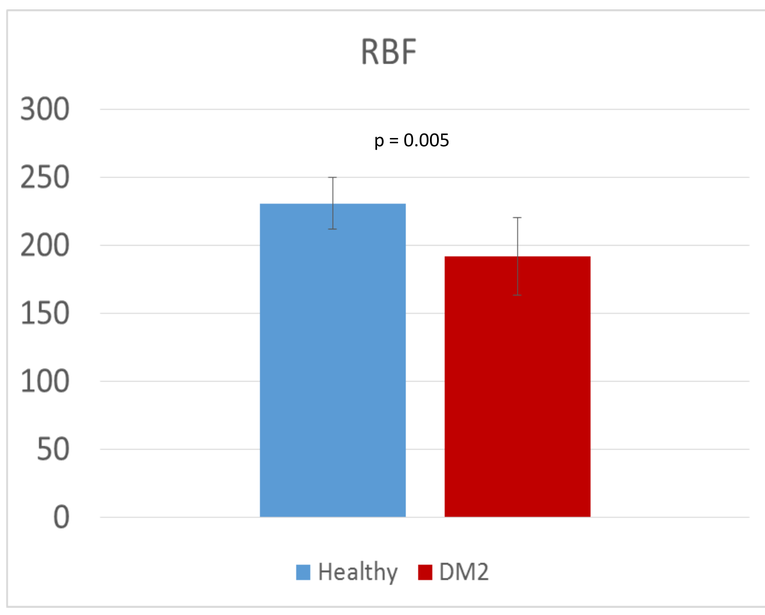
RESULTS

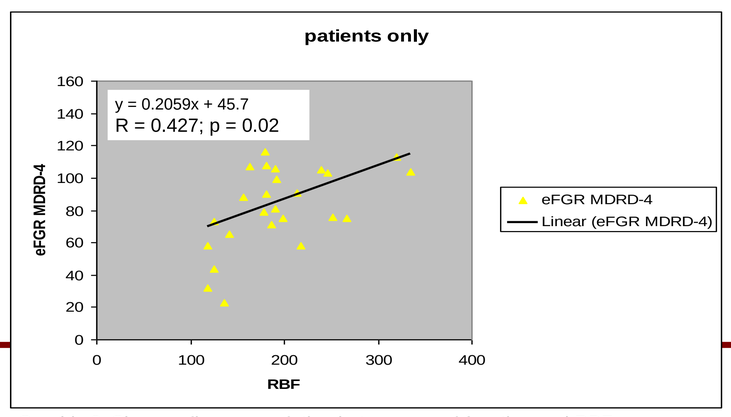
There were no statistically significant differences in clinical variables, between case and control groups, apart from age and glucose metabolism (table 1). Figure 1.A shows an RBF map obtained in a healthy subject and 1.B the RBF obtained in a diabetic subject.

- Cortical RBF in healthy volunteers was 230.8 (37.5) mL/100g/min, shown as mean (standard deviation), in good agreement with values reported in the literature.
- In diabetic patients, RBF was reduced to 191.8 (56.4) mL/100g/min.
- The difference in RBF between groups was statistically significant (p=0.005). Graphic 1.

Table 1. Clinical variables between case and control groups.	Healthy subjects n=24	Type 2 diabetic patients n=28	p
Age (years)	56.1 (10.3)	65.1 (9.5)	0.003
BMI (kg/m^2)	27.0 (4.3)	29.8 (5.3)	
MAP (mmHg)	93 (13)	94 (15)	
PP (mmHg)	48 (15)	57 (18)	
Hgb (g/dL)	13.9 (1.3)	14.2 (1.4)	
Glucose (mg/dL)	93 (17.8)	138 (47.5)	0.001
HbA1c (%)	5.8 (0.3)	7.01 (1.24)	0.004
Mean Creatinine (mg/dL)	0.81 (0.19)	1.01 (0.47)	
eGFR MDRD-4	96.9 (16.7)	96.3 (27.6)	
uACR	25.8 (16.0)	209.8 (248.6)	

BMI: body mass index; MAP: mean arterial pressure; PP: pulse pressure; Hgb: hemoglobin; uACR: urinary albumin/creatinine ratio; CKD: chronic kidney disease.





Graphic 2. Shows a linear correlation between renal function and RBF.

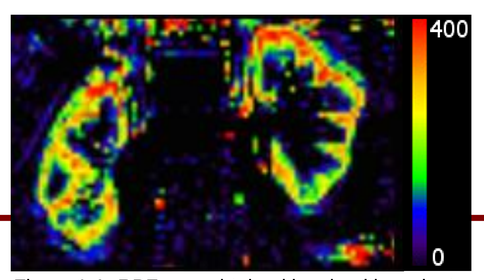


Figure 1.A. RBF map obtained in a healthy volunteer

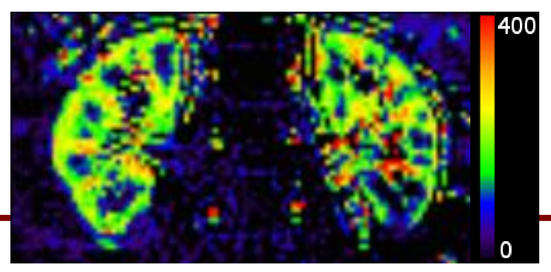


Figure 1.B. RBF map obtained in a diabetic subject

CONCLUSIONS

ASL-MRI is able to demonstrate differences in renal perfusion between patients with diabetic nephropathy and healthy controls. The diminished cortical blood flow may be associated with early hemodynamic changes. Further research to determine if there are differences depending on the stage of DN is required.

REFERENCES

1. Ebrahimi et al. Renal relevant radiology: renal functional magnetic resonance imaging. Clin J Am Soc Nephrol, 9: 395-405 (2014).
2. Rapacchi et al. Towards the identification of multi-parametric quantitative MRI biomarkers in lupus nephritis. Mag Reson Imaging, 33: 1066-1074 (2015).
3. Wang et al. Amplitude-modulated continuous arterial spin-labeling 3.0-T perfusion MR imaging with a single coil: feasibility study. Radiology, 235: 218-28 (2005).
4. Tan et al. Renal perfusion imaging with two-dimensional navigator gated arterial spin labeling. Mag Reson Med, 71:570-9 (2014).

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