POSITION-DEPENDENT OXYGENATION AND PERFUSION OF RENAL TRANSPLANTS AS MEASURED BY FUNCTIONAL MRI METHODS-THE BENT KNEE STUDY

Laila-Yasmin Mani[1], Maryam Seif [2,3], Florence Nikles[3], Gaëlle Diserens[3], Peter Vermathen[3], Bruno Vogt[1]

[1]Inselspital, Bern University Hospital, University of Bern, University clinic for Nephrology and Hypertension, Bern, Switzerland
[2]Balgrist University Hospital, University of Zurich, Spinal Cord Injury Center, Zurich, Switzerland
[3]University of Bern, Depts. Radiology and Clinical Research, Bern, Switzerland

OBJECTIVES

Interstitial fibrosis and tubular atrophy (IFTA) is the main cause for death-censored long-term kidney graft survival and is considered multifactorial. Iliac claudication with kinking is described in cyclists due to fibrous fixation of the iliac bifurcation or tethering by psoas side branches[1]. In renal transplants, a fibrous perigraft reaction develops postoperatively. Functional kinking due to tethering of iliac arteries by adjacent fibrotic tissue may occur during hip flexion leading to repetitive graft hypoperfusion. The purpose of this study was to assess perfusion and oxygenation of kidney grafts during hip flexion and extension using functional magnetic resonance imaging (fMRI) techniques[2].

METHODS

This prospective single center controlled intervention study enrolled 19 consecutive renal transplant recipients (age 48±13 years) with an estimated glomerular filtration rate (eGFR) according to chronic kidney disease epidemiology formula ≥30 ml/min/1.73 m^2. fMRI on a 3T-MR scanner including diffusion weighted (DWI), blood oxygenation level dependent (BOLD) and arterial spin labelling (ASL)-MRI was performed in hip position 0° and >90°. The protocol was performed before and after intravenous administration of 20 mg furosemide to account for potential magnetic field inhomogeneities. Position order was changed randomly (Fig.1). All subjects previously underwent standardized hydration and determination of eGFR. 16 regions of interest were placed manually in cortical and medullary regions in a blinded fashion. DWI yielded D1 (pure diffusion coefficient) and perfusion fraction (F_P), BOLD-MRI the relaxation rate R2* and ASL perfusion values.

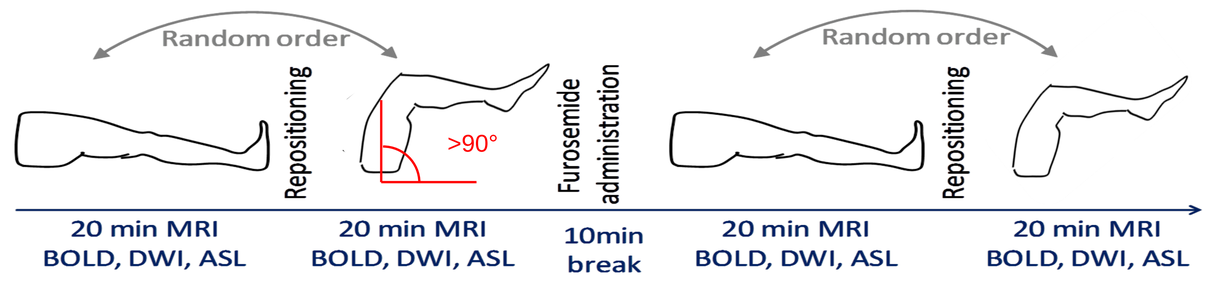

Figure 1. Sketch illustrating the protocol setup

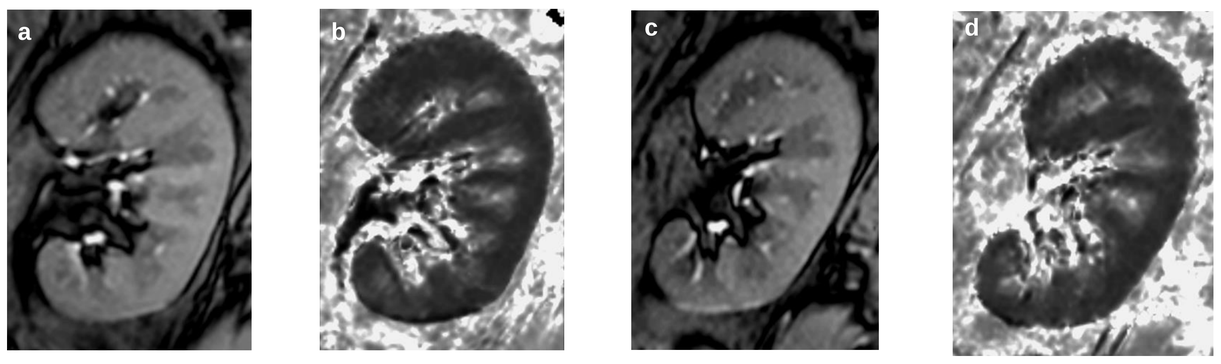

Figure 2. BOLD image examples in neutral (a, b) and flexed (c, d) hip position. Multiple gradient-recalled-echo sequence (TE= 6 ms) (a, c) and R2* maps (b, d)

RESULTS

DWI and BOLD-MRI were successfully completed in all 19, ASL in 17 subjects. Mean absolute values and standard deviations corresponded to published values. Furosemide reduced medullary R2* significantly in neutral hip position ($p<0.0001$). R2* values were not significantly different between hip extension or flexion (Fig.2). However, the medullary R2* ratio without/with furosemide was lower during hip flexion ($p<0.0005$) corresponding to a reduced response to furosemide. No significant difference between positions was shown for F_P and D1 except for medullary D1 which was higher during hip flexion after furosemide. In neutral hip position, medullary F_P increased after furosemide administration ($p<0.005$). Renal perfusion values were significantly higher ($p<0.03$) in flexed compared to neutral hip position, except for cortical perfusion before furosemide administration ($p=0.051$) (Fig. 3). R2* ratio without/with furosemide correlated negatively with age (cortex: $r=0.55$, $p=0.03$, medulla: $r=0.53$, $p=0.03$) and use of renin-angiotensin-aldosterone-system-inhibitors (RAASI) (medulla: $r=0.7$, $p=0.002$). ASL-derived perfusion changes correlated positively with age ($r=0.52$, $p=0.04$).

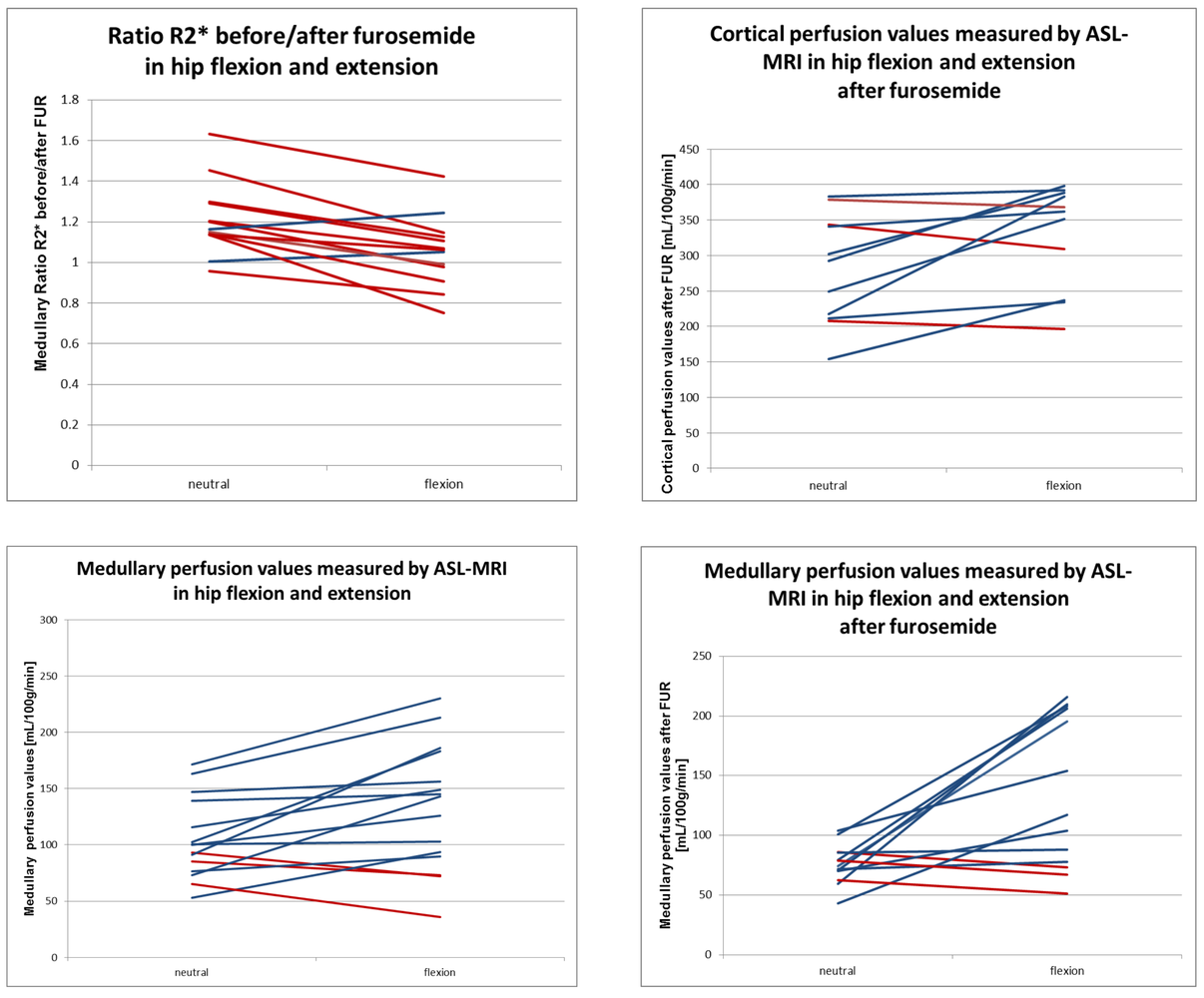

Figure 3. Selected results of BOLD and ASL-MRI measurememts (FUR= furosemide) in neutral hip position and flexion

CONCLUSIONS

The study demonstrates the feasibility and reliability of fMRI in renal grafts investigating two different body positions. Despite no significant difference in R2* values during both hip positions, R2* response to furosemide during hip flexion was blunted as described before in chronic kidney disease and hypertension[3]. In contrast to our hypothesis, perfusion as measured by ASL-MRI increased during hip flexion. This may be due to precluded blood outflow rather than reduced inflow during hip flexion. In conclusion, the results demonstrate an acute impact of hip flexion on functional parameters in the kidney graft.

REFERENCES:

1. Schep G, Bender MH, van de Tempel G, Wijn PF, de Vries WR, Eikelboom BC. Detection and treatment of claudication due to functional iliac obstruction in top endurance athletes: a prospective study. Lancet. 2002;359(9305):466-473.
2. Prasad PV. Functional MRI of the kidney: tools for translational studies of pathophysiology of renal disease. American journal of physiology. Renal physiology. 2006;290(5):F958-974.
3. Pruijm M, Hofmann L, Piskunowicz M, et al. Determinants of renal tissue oxygenation as measured with BOLD-MRI in chronic kidney disease and hypertension in humans. PloS one. 2014;9(4):e95895.

54 ERA
745--SP
Renal transplantation - Epidemiology & outcome I
Laila-Yasmin Mani
DOI: 10.3252/pso.eu.54ERA.2017
ePosters supported by F. Hoffmann- La Roche Ltd.
54th ERA-EDTA CONGRESS Madrid, Spain June 3rd-6th 2017
PosterSessionOnline.com