

Evaluation of the feasibility and reproducibility of BOLD MRI in healthy volunteers compared to kidney transplant patients – Preliminary study

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Purpose: T_2^* weighted BOLD MRI is sensitive to deoxyhaemoglobin levels,¹ and therefore provides an insight into intra-renal oxygen bioavailability.²⁻⁴ This study was performed firstly to assess the oxygenation state of healthy native and transplant kidneys and, secondly, to evaluate the feasibility and reproducibility of BOLD MRI in healthy volunteers and compare this to kidney transplant patients.

Materials and Methods: The local ethics committee approved the study protocol and written informed consent was obtained from all the patients. Seven healthy volunteers (age range, 23 – 65 years), were imaged twice on different days, and six transplant patients (age range, 9 – 14 years) were imaged once. All patients had clinically normal functioning transplants.

Oblique-coronal BOLD data volumes for all volunteers were acquired on a 1.5 T Siemens Avanto scanner (Siemens Medical Solutions, Erlangen, Germany) with a dedicated abdominal TIM 32 channel body phased array coil. The body matrix and six elements of the inbuilt spine matrix were used for signal reception. BOLD MRI was performed using a multi-gradient-recalled-echo sequence with 12 echoes. Four or five coronal sections were acquired with a 5-mm section thickness and no gap. TR/TE = 81/5.92-58.7 ms, flip angle = 30°. Volunteers were asked to hold their breath throughout the data acquisition.

Several regions of interest encapsulating cortical and medullary regions were selected using the analytical package MIStar (Apollo Medical Imaging, Melbourne, Australia). From each of the regions a T_2^* value was obtained. An average of these values was obtained so as to produce one T_2^* value for the cortical part of the kidney and another for the medullary part. R_2^* (s^{-1}) values were obtained by calculating the inverse of the T_2^* values.

Results and Conclusion: In healthy volunteers, the R_2^* values of the cortex ($R_2^* = 12.97 s^{-1} \pm 0.90$) were significantly lower than those obtained for the medulla ($R_2^* = 19.49 s^{-1} \pm 2.28$). Paired t -tests for intra-individual comparison of both the cortical and medullary R_2^* values showed no statistically significant difference (p -values > 0.1).

In renal transplant patients with stable renal function, R_2^* values obtained were very similar to those obtained for the healthy volunteers (cortical $R_2^* = 11.56 s^{-1} \pm 1.72$, and medullary $R_2^* = 19.60 s^{-1} \pm 2.80$). These results show that BOLD MRI is both feasible and reproducible even when dealing with very young transplant patients, and provide a basis for future studies investigating children with abnormal renal function.

References:

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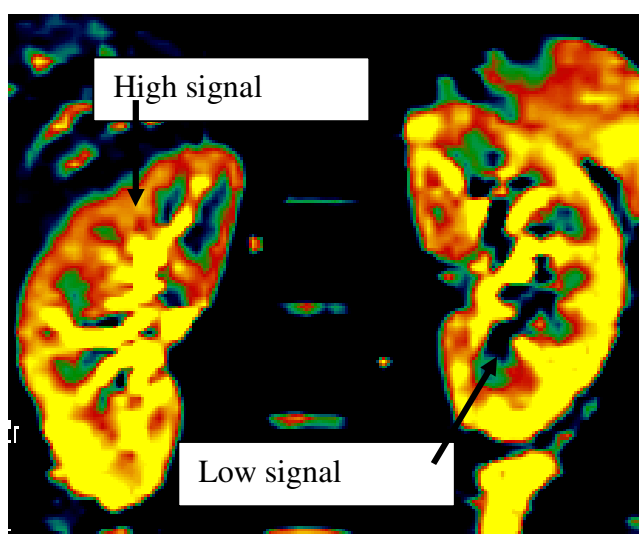


Figure 1: BOLD image of a healthy volunteer showing high signal intensity in the cortex and low signal intensity in the medullary regions.