

# Assessing Acute Renal Transplant Rejection with BOLD MRI: Mean versus Delta R2\*

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## Introduction:

The purpose of our study is to determine if using the difference between mean medullary and cortical R2\* values (delta R2\*) is better than simply using the mean R2\* value in the medulla for differentiating groups with acute rejection versus ATN versus normal functioning renal transplants.

## Material and Methods:

This study was approved by our human subjects committee. Blood oxygen level dependent magnetic resonance imaging (BOLD MRI) was performed on 15 subjects with recent renal transplants. Five subjects had clinically normal functioning transplants, five had rejection and five had ATN on biopsy.

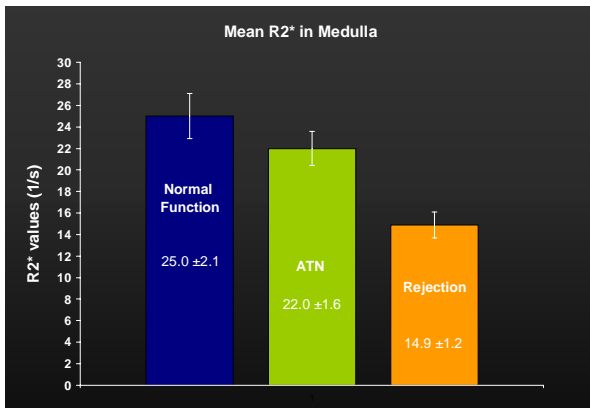
BOLD MRI was performed on a 1.5T system (GE Excite II, Waukesha, WI), using a 4-element torso coil. Three slices through the kidney (5mm thickness, 1mm gap) were obtained with a multi-echo gradient recalled echo sequence with 16 echoes. Each set of 16 T2\*-weighted images required 11 sec to obtain. The gray scale and color R2\* map were generated and ROI's were recorded in both the cortex and medulla. The color maps were used to avoid placement of the ROI's in an area of artifact and to visually observe the differences between subjects. R2\* values are expressed as mean +/-sd. The difference between the medullary R2\* and cortical R2\* (delta R2\*) was calculated as:  $\text{delta R2*} = \text{medullary R2*} - \text{cortical R2*}$ .

Statistical analysis of the mean cortical, medullary, and delta R2\* values was performed using the two-sample t-test, between normal and ATN, normal and rejection, and ATN and rejection.

## Preliminary Results:

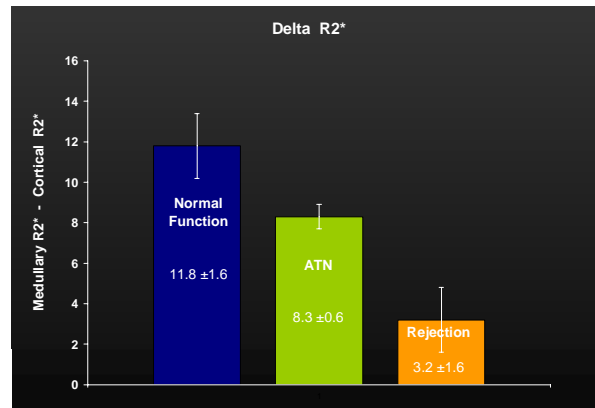
The mean and delta R2\* values are displayed in the figures below. For the medulla, the mean R2\* value steps down from 25.0/s to 22.0/s to 14.9/s, for normal function, ATN and acute rejection, respectively. The means were significantly different for the normal function vs. rejection and ATN vs. rejection groups (Table 1). In the delta R2\* data set, the difference in cortical and medullary R2\* values steps down from 11.8/s to 8.3/s to 3.2/s, for normal function, ATN and acute rejection, respectively. The delta R2\* values were significantly different for all three groups (Table 2).

Table 1:



Normal vs. ATN:  $p = 0.055$  (not significant)  
Normal vs. Rejection:  $p = 0.008$   
ATN vs. Rejection:  $p = 0.008$

Table 2:



Normal vs. ATN:  $p = 0.005$   
Normal vs. Rejection:  $p < 0.001$   
ATN vs. Rejection:  $p < 0.001$

## Conclusion:

MRI BOLD reveals significantly lower R2\* values in rejection, indicating changes in renal medullary oxygenation in these renal transplants compared with ATN and normally functioning transplants. The mean medullary R2\* value in the acute rejection group is significantly different from the ATN and normal function groups, however the mean medullary R2\* is not significantly different between normal and ATN. Using the delta R2\* value, greater statistical significance is achieved between groups. Furthermore, the delta R2\* method is able to distinguish between normal function and ATN. If these trends continue, MRI could potentially assess whether or not rejection is present, avoiding biopsy and the associated complications.

## References:

1. Prasad PV, et al. Breath-hold R2\* mapping with a multiple gradient-recalled echo sequence: Application to the evaluation of intrarenal oxygenation. JMRI 1997; 7:1163-1165.
2. Sadowski EA, et al. Assessment of Acute Renal Transplant Rejection with BOLD MRI: Initial Experience. Accepted for publication in Radiology.