

MR Elastography of Renal Transplants: Correlating Stiffness with Interstitial Fibrosis and Tubular Atrophy

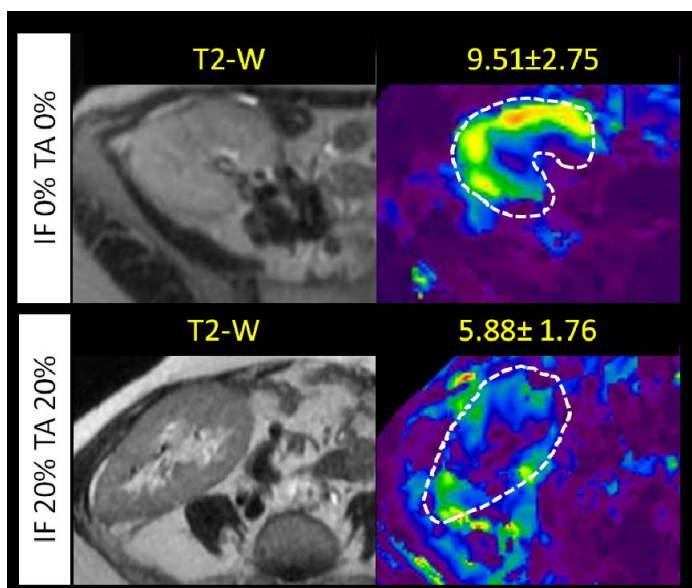
Sudhakar Kundapur Venkatesh¹, Gang Wang¹, Thomas Paulraj Thamboo², Eugene Liu¹, Edwin PY Siew¹, and Vathsala Anantaram³

¹Diagnostic Imaging, National University Health System, Singapore, Singapore, ²Pathology, National University Health System, Singapore, Singapore, ³Nephrology, National University Health System, Singapore, Singapore, Singapore

Introduction. Chronic allograft nephropathy is the common cause of renal allograft failure. CAN is characterized by interstitial fibrosis and tubular atrophy (IFTA) and other associated changes like glomerulosclerosis, arterial sclerosis, tubulitis and arteriolar hyaline changes. Currently percutaneous biopsy is the only method available to evaluate this process. MRE can be performed on native kidneys (1) as well as transplant kidneys (2). We performed MR Elastography of renal transplants to see if there is any correlation between stiffness measured with MRE and the grade or severity of interstitial fibrosis (IF) and tubular atrophy (TA).

Methods: MRE was performed on 20 adult subjects (9 males and 11 females) who received a renal transplant. Three patients had a recent transplant with no post op complications or altered allograft functions and were considered to represent a normal functioning renal transplant. The remaining 17 patients received transplant (6 months to 19 years) and had a recent renal biopsy for allograft dysfunction (mean 3.4 months, range 1-8 months). All subjects were scanned on a 1.5T clinical MR scanner (HDXT, GE Healthcare, Waukesha, WI) with an 8-channel phased-array body coil. A standard passive driver was placed over the transplant and secured with an elastic strap. We performed MRE with three different frequencies of 60Hz, 90Hz and 120Hz during free breathing using a 2D GRE sequence standardized for liver MRE. Two to four slices of 10mm thickness was obtained with a matrix of 256 x 128. The renal parenchyma stiffness was measured by placing regions of interest on the automatically generated stiffness maps. The mean and standard deviation of the stiffness values were obtained. The stiffness was then correlated with grade of interstitial fibrosis and tubular atrophy.

Results: MRE was successfully performed in 19 subjects in all the three frequencies. In one subject there was motion artifacts and therefore excluded from analysis. There were no procedure related complications. At histology interstitial fibrosis was present in 14 (mild-10, moderate-1, severe-3) and tubular atrophy in 14 (mild-10, moderate-1, severe-3) and there was no IFTA in 2 subjects. There was no significant correlation between the degree of IF, degree of tubular atrophy and the renal parenchyma stiffness. We grouped recent transplants and the transplant without any IF and TA as representing normal group. The normal group showed higher stiffness values as compared to those IF and TA at all three frequencies (60Hz: 4.75kPa vs. 4.28kPa, P=0.238; 90Hz: 7.3kPa vs. 6.2kPa, P=0.041; 120Hz: 8.81 kPa vs. 7.1kPa, P=0.012) with significant differences seen only at 90Hz and 120Hz.



Discussion: There was no correlation between the degree of fibrosis or tubular atrophy and stiffness measured with MRE similar to an earlier study (2). Our study demonstrates significant differences between the normal transplants and those with IFTA suggestive of complex relationship between stiffness values and interstitial fibrosis. Possibly atrophy contribute significantly to stiffness. Our study shows that stiffness measured with MRE may not correlate with degree of interstitial fibrosis as IFTA is a complex process and involves changes including tubular atrophy, glomerular sclerosis, arteriolar hyalinosis, and vascular changes which may affect the stiffness. Also the changes in medulla are not considered for assessing at histology which possible may contribute to stiffness measured.

References

1. Venkatesh SK et al ISMRM 2009
2. Lee C et al ISMRM 2011