Neurocognitive Dysfunction in Chronic Kidney Disease (CKD) patients - correlations with DTI

J. Zhuo1, S. Seliger2, D. Lefkowitz1, J. Betz1, S. Roys1, and R. Gullapalli1

1Radiology, University of Maryland School of Medicine, Baltimore, MD, United States, 2Nephrology, University of Maryland School of Medicine, Baltimore, MD, United States

INTRODUCTION: Chronic kidney disease (CKD) affects nearly 10 million adults in the US, and these individuals suffer from diminished functional capacity, worse cognitive function1, and a greater risk of dementia2 relative to individuals without renal disease. The purpose of this study is to determine whether alterations in the brain white matter accounts for lower neurocognitive function in CKD patients. We examined cerebral changes in 41 older adults with stage 3-4 CKD using whole brain and regional analysis as well as voxel-based morphometry of diffusion tensor imaging (DTI) in correlation with their neurocognitive performance.

METHODS: 41 stroke-free, dementia-free older adults with stage 3-4 CKD (age: 71.5±8.4, estimated glomerular filtration rate (eGFR) 36.4±9.6 cc/min) were enrolled. Neurocognitive assessment included tests of psychomotor speed (Grooved pegboard tests, Trail-Making test part A), verbal and non-verbal memory (Visual recall, logical memory), visuospatial function (Judgment of Line Orientation), attention/concentration (Digit span tests,), mental flexibility/executive function (Stroop color-word interference test, Symbol-digit substitution test), and category fluency.

RESULTS: Among CKD patients, both whole brain white matter FA and ADC mean value were strongly correlated with Grooved pegboard test (r = -0.36 for FA and r=0.53 for ADC, p<0.03) and Symbol-digit substitution test (r=0.36 for FA and r=-0.37 for ADC p<0.03). Although there was a trend for mean FA to correlate with Trail-making test and digital span test, this trend was not significant (p<0.07). Similarly ADC exhibited a trend with the Trail-making tests and visual recall immediate test but was not significant (p<0.1 & p<0.7 respectively. Table 1 shows the correlation coefficients between FA/ADC values for the various regions and the neurocognitive scores (only tests that yield a significant correlation are included in the table). Figure 1 shows two representative voxel-based p-value maps of significantly correlated FA/ADC with Grooved pegboard test (Figure 1(a)) and Visual recall-immediate (Figure 1(b)). All significant correlations were in the direction of more disrupted white matter (greater ADC, lower FA) with declining neurocognitive function.

CONCLUSION: In this study, we observed lower FA and higher ADC (indicating white matter disruption) that correlated with poor performance on various cognitive tests. An alteration to white matter structure - possibly correlated with poor performance on various cognitive tests. An alteration to white matter structure - possibly altered cognition (Digit span, Trail-Making part A and B, Grooved pegboard, dominant hand (a) and Visual recall, immediate (b) tests. Red shows positive correlation and blue shows negative correlation.


![Figure 1](image-url)