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P349 -Multiparametric Renal MRI to Assess Structure and Function in Chronic Kidney Disease

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PURPOSE: CKD progression is characterised by a combination of common pathological mechanisms including glomerular capillary hypertension and hyperfiltration, inflammation, vascular rarefaction, hypoxia and fibrosis. A number of advanced magnetic resonance imaging (MRI) techniques offer the potential to assess and quantify pathophysiological processes in the kidneys, with multiparametric MRI combining multiple measures within a single scan. We used a multiparametric renal MRI protocol to assess CKD patients, integrating multiple MRI measures and comparing with clinical and histological parameters.

METHODS: 44 participants were studied: 22 people with CKD stage 3-4 (eGFR 15-59ml/min/1.73m2) who had undergone renal biopsy; and 22 age-matched healthy volunteers (HVs). Persons with CKD underwent two MRI scans one week apart, HVs were scanned once. Scans were performed on a 3T Philips Ingenia scanner. Multiparametric MRI comprised longitudinal relaxation time (T1), Diffusion Weighted Imaging, renal blood flow (Phase Contrast MRI), cortical perfusion (Arterial Spin Labelling), and blood oxygen level dependent relaxation rate (R2*). Demographic data and medical history were collected, along with eGFR, urine protein:creatinine ratio (UPCR) and, in the CKD group only, measured GFR (iohexol clearance).

RESULTS: Mean age was 61±24 and 61±25years in CKD and HV groups respectively. Respective values for eGFR were 39±14 and 92±12ml/min/1.73m2 and median values for UPCR were 72 (IQR 108)mg/mmol and 6(IQR 9)ml/mmol. MRI results were as follows:

1. MRI evidenced excellent reproducibility in CKD (coefficient of variation<10% for most variables).
2. Some but not all individual MRI measures correlated: as expected, certain MRI measures were correlated (e.g. ASL perfusion and renal artery blood flow); lack of correlation between other MRI measures suggests that they are sensitive to different processes/pathologies.
3. MRI measures differed significantly between HV and CKD groups, including cortical, medullary and corticomedullary difference (CMD) in T1; cortical and medullary apparent diffusion coefficient (ADC); renal artery blood flow; and cortical perfusion.
4. Individual MRI measures correlated with clinical and histological parameters. eGFR correlated with cortical T1 (r=-0.68), T1 CMD (r=-0.62), cortical (r=0.54) and medullary ADC (r=0.49), renal artery flow (r=0.78), cortical perfusion (r=0.81). Log UPCR correlated with cortical T1 (r=0.61), T1 CMD (r=0.61), cortical (r=-0.45) and medullary ADC (r=-0.49), renal artery flow (r=-0.72), and cortical perfusion (r=-0.58). Cortical T1 and ADC, T1 and ADC CMD and cortical perfusion) differed between low/high interstitial fibrosis groups at thresholds of 30-40%.
5. Combinations of MRI measures predicted clinical parameters. Combining cortical T1 and perfusion was best to predict eGFR (r=0.87), whereas the optimal combination for proteinuria was T1 CMD and cortical ADC (r=0.61).

DISCUSSION: Multiparametric MRI parameters have good reproducibility in CKD, can be used to distinguish CKD from healthy kidneys, and correlate with clinical and histopathological measures. Future studies should focus on larger cohorts to identify the optimal combination of MRI measures to stratify patients with respect to prognosis and response to therapy.