Are renal resistive indices kidney-specific ultrasound markers?

– Detection of left ventricular diastolic dysfunction as a further extrarenal confounder. –

Background

Ultrasound renal resistive indices (RRI) are discussed as independent predictors for progression of chronic kidney disease (CKD). However, they also mirror systemic atherosclerosis. Accordingly, they correlate with carotid intima media thickness (IMT) and with pulse pressure as a marker of arterial stiffness. Furthermore, RRI are associated with left ventricular hypertrophy. Since increased arterial stiffness and left ventricular hypertrophy are leading causes of impaired left ventricular diastolic function we tested the hypothesis that diastolic dysfunction might represent a further extrarenal factor affecting renal resistive indices in patients with chronic kidney disease. In addition, we tested whether the difference of resistive indices in spleen and kidney (DI-RISK) allows us to eliminate extrarenal factors on RRI in order to gain more specific information on kidney damage.

Methods

We recruited 195 patients with CKD stage I – V in a prospective cohort study. Renal (RRI) and splenic (SRI) resistive indices were measured. Left atrial volume index (LAVI) and tissue doppler E/e' ratio provided assessment of diastolic function. IMT and pulse pressure as extrarenal markers were measured. Finally, the DI-RISK was calculated in order to adjust the RRI for extrarenal factors. For assessing kidney function estimated glomerular filtration rate (eGFR) was calculated by MDRD equation. Patients were followed for 1,8 ± 0,5 years and the occurrence of the combined end point – defined as dialysis treatment or death – was recorded. For Kaplan-Meier analyses, patients were stratified according to threshold values of 80 (RRI) or 13 (DI-RISK), respectively.

Results

RRI were significantly associated with eGFR ($r = -0.358$; $p < 0.001$), IMT ($r = 0.506$; $p < 0.001$), pulse pressure ($r = 0.578$; $p < 0.001$), age ($r = 0.661$; $p < 0.001$) and heart rate ($r = -0.187$; $p = 0.010$) which is consistent with previous studies. Moreover, RRI correlate significantly with E/e' ratio ($r = 0.468$; $p < 0.001$) and LAVI ($r = 0.300$; $p < 0.001$) as measures of diastolic dysfunction. The association remained significant after adjustment for age, pulse pressure, IMT, heart rate and eGFR. DI-RISK is selectively associated with eGFR in univariate ($r = -0.247$; $p < 0.001$) and in multivariate regression analysis. However, in contrast to renal resistive indices DI-RISK did not show any association with cardiovascular risk factors, IMT or echocardiographic parameters. During follow-up, RRI ⩾ 80 and DI-RISK ⩾ 13 both predicted the combined end point.

Conclusion

We characterize diastolic dysfunction as an additional extrarenal factor that affects renal resistive indices. This supports the hypothesis that renal resistive indices should not be regarded as kidney-specific parameters whereas the DI-RISK might become a more organ-specific ultrasound marker. Furthermore, first follow-up data suggest the prognostic value of increased DI-RISK values as a predictor for the combined end point, defined as dialysis treatment and death. The ongoing follow-up of this patient cohort will have to reveal how far the DI-RISK predicts long-term renal outcome in CKD patients.