

Doppler ultrasonography and hypertensive target organ damage

Recent advance in the ultrasonography enables to evaluate both morphological and functional changes non-invasively. Renal Doppler ultrasonography is useful to identify renal arterial stenosis by measuring acceleration time, renal aorta ratio (RAR) of peak systolic velocity (PSV) and resistive index (RI) (1, 2). Renal arterial stenosis can be diagnosed with 90 to 95% of sensitivity and specificity, when PSV is more than 1.8 m/sec, RAR more than 3.5 and difference of RI between stenotic and non-stenotic site in the kidneys is more than 1.5 (1, 2). The renal Doppler ultrasonography is also useful to evaluate the stages of chronic kidney disease (CKD) and renal prognosis (3). Morphological measurement of renal size by ultrasonography does not show correlation with CKD stages, however, RI increased according to the CKD stages. The renal prognosis and response to steroid therapy are better in the patients with RI of less than 0.70 (3). Thus, renal RI is a useful marker for non-invasive evaluation of CKD patients with hypertension, atherosclerosis, glomerulonephritis and diabetes mellitus.

Arterial lesions associated with hypertension progress simultaneously in the multiple target organs including kidney, heart, brain and ocular arteries. In this issue of the *Anatolian Journal of Cardiology*, Natale et al. (4) an interesting paper that compared 4 ultrasound parameters including carotid intima-media thickness (IMT), flow-mediated dilatation (FMD), renal resistive index (RRI) and central artery of retina resistive index (CARRI) at the same time in hypertensive patients has been published. In this study atherosclerosis in the various organs were evaluated by ultrasonography and scored; the carotid IMT visualizing atherosclerosis directly, score 0: ≤ 0.7 mm, 1: $>0.7 \leq 0.9$ mm, 2: >0.9 mm, FMD showing endothelial function with scores 0: $\geq 4\%$, 1: $\geq 2 < 4\%$, 2: >0.9 , RRI indicating renal arterio-arteriosclerosis with score 0: ≤ 0.60 , 1: $>0.60 \leq 0.75$, 2: >0.75 , and CARRI representing arterio-arteriosclerosis in the ocular vessels with score 0: ≤ 0.75 , 1: $>0.75 \leq 0.80$, 2: >0.80 . The total score of these four atherosclerosis parameters sum 0 to 8. The incidence of atherosclerotic diseases including cerebral stroke, ischemic coronary heart disease, carotid and low limb plaque made 16% in the lowest group with scores 0-4, 30% in the intermediate group with scores $>4-6$ and 54% in highest group with scores $>6-8$. Age, pulse pressure, and duration of hypertension were independently and significantly related with RRI, FMD, IMT, and CARRI, and the four-ultrasound parameters have significantly correlated with each other. Except for pulse pressure and duration of hypertension, basal clinical data including blood pressure,

lipids and glucose level and smoking did not show significant difference. The work lacked data of serum creatinine, CKD stages or kidney size by renal ultrasonography, Keith-Wagener classification of retinopathy, left ventricular hypertrophy by electrocardiogram or left ventricular wall thickness by ultrasonic echocardiography and ankle-brachial index. If the authors had included these data of classic hypertensive organ damage parameters and compared to the sum of the scores of IMT, FMD, RRI and CARRI, they could have shown that the values of ultrasonographic evaluation can be better indicators of atherosclerotic diseases than those classical markers. It should be clarified in this study what are the best combination of IMT, RRI, CARRI, FMD, and resistive index of brachial artery (RIBA) to predict cardio-cerebral vascular events, because these ultrasonographic parameters are not statistically independent risk factors, therefore the evaluation of all may not be necessary for the best prediction. From perspective of the clinical practice, carotid IMT for conducting artery and RRI for resistance artery seems to be sufficient to evaluate atherosclerosis in patients with hypertension. RRI showed significant correlation with IMT, FMD and RIBA in this study, and RRI also showed correlation with pulse wave velocity, a marker of arterial stiffness in atherosclerosis patients (5), so RRI also represent atherosclerosis in the conducting artery evaluated by carotid IMT, RIBA and FMD. The pre-clinical target organ damage in essential hypertension shows significant association with RRI (6), and cardio-renal events are predicted by RRI with eGFR (7). We have reported that RRI shows significant correlation with glomerulosclerosis and arteriosclerosis evaluated by renal biopsy (3). The resistive index measured by Doppler ultrasonography is a useful tool to evaluate target organ damage in hypertension non-invasively and repeatedly, and it is also a good marker for cerebral and cardio-renal events.

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