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【 EDITORIAL 】

Renal Blood Circulation as a Manifestation of Systemic Atherosclerosis

Takako Iino and Hiroyuki Watanabe

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Abnormalities in intra-renal arterial flow patterns imply parenchymal renal disorders (e.g., glomerulosclerosis, tubular fibrosis, and tubulo-interstitial lesions) or renal vascular diseases (1). The renal resistive index (RRI), which is widely used as a marker of kidney damage, is influenced by not only the renal blood circulation but also systemic hemodynamic factors. Recently, many researchers have devoted special attention to extra-renal factors influencing the RRI. For example, the RRI has a strong correlation with the parameters of systemic circulation, such as the pulse and mean blood pressure, heart rate, and arterial stiffness (2, 3). In the study published by Watanabe et al., the authors showed that the RRI is an independent predictor of multiple-site atherosclerosis, including the carotid artery, aorta, and the coronary artery, in patients with a preserved renal function (4). These findings support previous observations showing that an increased RRI has a strong relationship with extra-renal systemic arterial stiffness (5, 6).

Extra-renal systemic arterial stiffness reflects the cushioning capacity of arteries (7). An attenuated cushioning effect hemodynamically induces a decline in the renal function. In patients with a preserved renal function, abnormalities of the RRI may help predict a future decline in the renal function (8). Conversely, renal dysfunction worsens systemic atherosclerosis resulting from the activation of the renin-angiotensin-aldosterone system, oxidative stress, inflammation, or uremic toxins. In patients with renal dysfunction, an elevated RRI is a useful marker for predicting adverse cardiovascular events (9). Extra-renal systemic atherosclerosis and renal circulation are thus closely connected to each other.

In patients with chronic heart failure (CHF), the RRI similarly reflects kidney damage and/or an increased extra-renal systemic arterial stiffness. In addition, renal congestion, which is known as the main pathophysiologic finding in cardio-renal syndrome, induces an increase in the RRI. In patients with CHF, an increased central venous pressure leads to renal venous congestion. Recent studies have demonstrated that the RRI is associated with a worse prognosis in HF patients with a reduced ejection fraction (10). However, another group reported that the intra-renal venous flow profiles are strongly associated with the clinical outcomes, rather than the RRI, in HF patients (with a left ventricular ejection fraction of 49±19%) (11). Although assessing the renal circulation might be useful for stratifying HF patients, the prognostic value remains controversial. Large-scale comprehensive clinical studies are needed in order to clarify the association between HF and the renal blood circulation.

While many intriguing studies concerning the RRI are being accumulated, some questions remain unanswered. First, which is the most valid approach for analyzing the RRI is unclear. Second, the relationships of neurohormonal factors, the endothelial function, inflammation, genetic patterns, and aging with the RRI remain unclear. The clinical usefulness of RRI analyses might be demonstrated through future studies. The RRI may help provide additional predictive value to traditional parameters in various clinical situations.

The authors state that they have no Conflict of Interest (COI).

References

1. Radermacher J, Ellis S, Haller H. Renal resistance index and progression of renal disease. Hypertension **39**: 699-703, 2002.
2. Ennezat PV, Marechaux S, Six-Carpentier M, et al. Renal resistance index and its prognostic significance in patients with heart failure with preserved ejection fraction. Nephrol Dial Transplant **26**: 3908-3913, 2011.
3. O'Neill WC. Renal resistive index: a case of mistaken identity. Hypertension **64**: 915-917, 2014.
4. Watanabe I, Shintani Y, Terada S, et al. A clinical association between an increasing renal resistive index and the atherosclerotic burden in patients with a preserved renal function. Intern Med **59**: 909-916, 2020.

Department of Cardiovascular Medicine, Akita University Graduate School of Medicine, Japan
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Correspondence to Dr. Hiroyuki Watanabe, hirow@doc.med.akita-u.ac.jp

5. Raff U, Schmidt BM, Schwab J, et al. Renal resistive index in addition to low-grade albuminuria complements screening for target organ damage in therapy-resistant hypertension. J Hypertens **28**: 608-614, 2010.
6. Doi Y, Iwashima Y, Yoshihara F, et al. Association of renal resistive index with target organ damage in essential hypertension. Am J Hypertens **25**: 1292-1298, 2012.
7. Safar ME, Levy BI, Struijker-Boudier H. Current perspectives on arterial stiffness and pulse pressure in hypertension and cardiovascular diseases. Circulation **107**: 2864-2869, 2003.
8. Nosadini R, Velussi M, Brocco E, et al. Increased renal arterial resistance predicts the course of renal function in type 2 diabetes with microalbuminuria. Diabetes **55**: 234-239, 2006.
9. Doi Y, Iwashima Y, Yoshihara F, et al. Renal resistive index and cardiovascular and renal outcomes in essential hypertension. Hypertension **60**: 770-777, 2012.
10. Ciccone MM, Iacoviello M, Gesualdo L, et al. The renal arterial resistance index: a marker of renal function with an independent and incremental role in predicting heart failure progression. Eur J Heart Fail **16**: 210-216, 2014.
11. Iida N, Seo Y, Sai S, et al. Clinical implications of intrarenal hemodynamic evaluation by Doppler ultrasonography in heart failure. JACC Heart Fail **4**: 674-682, 2016.