



Large artery damage and hypertension in end-stage renal failure (ESRD)

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The ill effects of hypertension are attributed to reduction in the caliber or the number of arterioles, resulting in increased total peripheral resistance (TPR). TPR is a determinant of mean arterial pressure (MBP) considered as constant over time. This does not take into account the fact that BP is an oscillatory phenomenon with systolic and diastolic BP being the limits of these oscillations. Moreover, while MBP and diastolic BP are almost constant along the arterial tree, systolic BP is amplified from the aorta to the brachial artery whose systolic BP only indirectly reflects the pressure in the aorta and LV¹. The appropriate term to define the arterial factor(s) opposing LV ejection is aortic input impedance which depends on TPR, arterial compliance, wave reflections, and inertance of blood column in the arterial tree. Arterial compliance and wave reflections are major determinants of systolic and diastolic BP, and the pressure wave amplitude, i.e. pulse pressure (PP) which is an independent cardiovascular risk factor.

ALTERATIONS OF AORTIC INPUT IMPEDANCE IN ESRD AND ITS CONSEQUENCES

Due to anemia or arteriovenous shunts, TPR is usually within normal values in ESRD patients. The aortic impedance is increased principally due to decreased arterial compliance (arterial stiffening), increased wave reflections and higher inertance^{2,3}. In ESRD changes in compliance are associated with arterial remodelling, principally intima-media thickening and the enlargement of arterial lumen³. The enlargement of the arteries increases the volume and mass of blood contained in the arterial tree and is responsible for increased inertance. The increased stiffness in renal failure is due to alterations of biomaterials characterized by increased elastic modulus (Einc)⁴ associated with arterial medial calcification, and low-grade inflammation. Besides arterial stiffness, early wave reflections represents major contribution to LV afterload and compromised coronary perfusion¹. Wave reflections are frequently increased in es-

sential hypertension and almost constantly increased in ESRD^{2,3}. The arterial stiffening estimated by changes in aortic pulse wave velocity is an independent predictor of survival in ESRD and general population⁵⁻⁶. Increased wave reflections independently from changes in arterial stiffness are also a strong predictor of survival in ESRD patients⁷. Improvement of arterial compliance and decrease in the effect of wave reflections could be obtained by antihypertensive treatment as observed with the calcium-channel blocker and ACE inhibitors⁸. It has been shown that improvement of aortic compliance and use of ACE inhibitors had favorable independent effect on survival in hypertensive patients with ESRD⁹.

REFERENCES

1. Nichols WW, O'Rourke MF: McDonald's blood flow in arteries: theoretical, experimental and clinical principles (4th edn.). Edward Arnold, London, 1998.
2. Safar ME, London GM: The arterial system in human hypertension. In: *Textbook of Hypertension* (ed. Swales JD). London: Blackwell Scientific. 1994. p. 85-102.
3. London GM, Guérin AP, Marchais SJ y cols.: Cardiac and arterial interactions in end-stage renal disease. *Kidney Int* 50: 600-8, 1996.
4. Mourad JJ, Girerd X, Boutouyrie P y cols.: Increases stiffness of radial artery wall material in end-stage renal disease. *Hypertension* 30: 1425-30, 1997.
5. Blacher J, Guérin AP, Pannier B y cols.: Impact of aortic stiffness on survival in end-stage renal disease. *Circulation* 99: 2434-2439, 1999.
6. Laurent S, Boutouyrie P, Asmar R y cols.: Aortic stiffness is an independent predictor of all-cause and cardiovascular mortality in hypertensive patients. *Hypertension* 37: 1236-41, 2001.
7. London GM, Blacher J, Pannier B y cols.: Arterial wave reflections and survival in end-stage renal failure. *Hypertension* 38: 434-438, 2001.
8. London GM, Pannier B, Guerin AP y cols.: Cardiac hypertrophy, aortic compliance, peripheral resistance and wave reflection in end-stage renal disease: comparative effects of ACE inhibition and calcium channel blockade. *Circulation* 90: 2786-96, 1994.
9. Guérin AP, Blacher J, Pannier B y cols.: Impact of aortic stiffness attenuation on survival of patients in end-stage renal failure. *Circulation* 103: 987-92, 2001.