MARTÍN DONATO MTSAC

Smooth Muscle Cells as a Novel Factor Responsible for Increased Vascular Stiffness in Hypertension

Sehgel NL, Zhu Y, Sun Z, Trzeciakowski JP, Hong Z, Hunter WC, et al. Increased vascular smooth muscle cell stiffness: a novel mechanism for aortic stiffness in hypertension. **Am J Physiol Heart Circ Physiol 2013;305:H1281-7**

Hypertension is a highly prevalent disease whose complications are responsible for a considerable proportion of deaths. Although in the last decades a significant progress has been made in its treatment, hypertension is still a relevant health problem worldwide.

It is known that arterial stiffness is part of the pathophysiological mechanism of hypertension and that this change per se magnifies the whole process. Moreover, recent studies suggest that increased arterial stiffness precedes hypertension and is an important factor in the development of atherosclerosis. Therefore, control of arterial stiffness emerges as a new strategy and therapeutic challenge.

Different studies assessing vascular stiffness in the context of hypertension have focused on the endothelial extracellular matrix. However, the contribution of hypertension to changes on the mechanical properties of vascular smooth muscle cells is less well known. Smooth muscle cells are one of the main components of the arterial medial layer and are one of the chief therapeutic targets in the treatment of hypertension. In this sense, several studies have shown that high blood pressure alters the proliferation, orientation and force generation of this tissue, all associated with increased arterial stiffness.

The purpose of this study was to test the hypothesis that changes in the intrinsic stiffness of vascular smooth muscle cells per se, and not only those involving the endothelium or extracellular matrix, contribute to increased total vascular stiffness.

To test this hypothesis, spontaneously hypertensive rats (SHR), which are able to develop a significant increase in arterial pressure in the term of a few weeks, were used. In addition to increased arterial pressure, SHR evidenced increased pulse wave velocity. Since elastic arterial stiffness depends not only on arterial pressure but is also affected by the endothelium, in vitro aortic stiffness in non-pressurized conditions and free from the contribution of vascular endothelium was also measured. Wall stress of aortic ring segments assessed at different degrees of stretching, as well as tangential elastic stiffness increased in SHR. These results confirm that aortic wall stiffness is raised in arterial hypertension, independently of blood pressure and changes in vascular endothelium.

To assess how smooth muscle cell stiffness may contribute to aortic stiffness independently of extracellular matrix changes and hyperplasia, the authors developed a reconstituted aortic tissue model, whereby the cell density and extracellular matrix protein content were controlled. Individual smooth muscle cell stiffness was also assessed by atomic force microscopy. Results showed that SHR tissue stiffness was 1.5 higher and that smooth muscle cell individual stiffness was 2 times greater compared with control rats.

This study shows, in hypertensive rats, that there is increased elastic stiffness of aortic smooth muscle cells, together with augmented total stiffness of the vessel.

Exclusively increased smooth muscle cell stiffness could be the consequence of elevated blood pressure or a specific "innate" increase of this hypertension model. Thus, it would be relevant to study these changes and the contribution of different vascular components to aortic stiffness in other models of arterial hypertension. Moreover, the temporal evolution of smooth muscle cell stiffness changes during the aging process would be essential to understand the underlying mechanisms of this pathology.

Finally, it would be interesting to assess whether the individual stiffness of smooth muscle cells is also modified in resistance arteries during the development of arterial hypertension.

Rev Argent Cardiol 2014;82:249. http://dx.doi.org/10.7775/rac.v82.i3.4369