Lower total arterial elastance augments regurgitant volume in aortic regurgitation

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Background: The Windkessel function of the arterial system maintains diastolic blood flow in arteries. In aortic regurgitation, this function may also augment regurgitation into the left ventricle (LV). The Windkessel function can be assessed using the concept of total arterial elastance (Ea), and lower Ea makes stroke volume (SV) greater. Therefore, lower Ea may make aortic regurgitant volume (RV) greater, and hence LV end-diastolic volume (LVEDV) greater. The purpose of this study was to clarify the relation of Ea to RV and LVEDV.

Methods: Fifty patients (38 men, 56±15 years) with chronic AR scheduled for surgical treatment were studied using an echo-tracking system to obtain carotid arterial diameter-change waveforms. Using these waveforms, we noninvasively obtained pressure waveforms and measured end-systolic pressure (ESP). RV, SV and other echocardiographic data were also obtained. Ea was given as Ea = ESP/SV.

Results: Ea, RV, LVEDV, and the ejection fraction (EF) were 0.77±0.24 mmHg/ml, 73±27 ml, 219±74 ml, and 56±11 %, respectively. RV steeply decreased with an increase in Ea (r = 0.57, p< 0.0001). Ea increased with age (r = 0.47, p<0.001). RV had no correlation with age and EF. LVEDV decreased with an increase in Ea (r = 0.35, p=0.012) and with an increase in EF (r = 0.55, p<0.0001). Ea had no correlation with EF. The multiple regression, LVEDV = 523 - 124xEa - 3.67xEF, was significant (r² = 0.43, p<0.0001).

Conclusions: Lower Ea (higher Windkessel function) paradoxically augments RV, and increases LVEDV.