Wave Reflection: Wasted Effort in Left Ventricular Hypertrophy

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In an elegant paper in the current issue of the *American Journal of Hypertension*, Hashimoto et al. investigate the association between left ventricular hypertrophy (LVH) and “wasted effort.” Wasted effort is approximated by calculating the contribution of the reflected pressure wave to the aortic pressure wave during ejection. Thus, not only the magnitude of the reflected wave is taken into account but also its timing. Wasted effort is assumed to increase the workload of the heart without contributing to cardiac output. The study is interesting for several reasons.

The study shows that aortic pressure is higher in a group with LVH than in a comparable group without LVH, while brachial pressures are comparable. This is further evidence to prefer central pressure assessment and that central pressure is a better predictor than peripheral pressure.

More particularly, LVH is associated with “wasted effort.” This relation remains valid after adjustment for confounders as aortic diastolic pressure.

Another interesting finding is that pulse wave velocity (PWV) is not a determinant of wasted effort and neither is round trip travel time, determined from the pressure curve, as approximation of PWV. This shows that although aortic compliance is important as determinant of PWV, the magnitude of the reflected wave is mainly consequential. The authors suggest that in the group with LVH increased arteriolar tone may be responsible for the greater reflection magnitude.

The influence of the ventricle itself on the magnitude of the pressure augmentation is not discussed. As Westerhof and O’Rourke have described some 10 years ago, the hypertrophied heart acts as a flow source. This means that the ventricle tries to supply flow in the presence of the reflected wave. This results in a greater pressure augmentation with the same amount of peripheral reflection. Therefore, the causal relation that increased augmentation results in LVH, as suggested in the work of Hashimoto et al., is only part of the picture, since the hypertrophied ventricle also contributes to the wasted effort. Perhaps the finding that PWV is not related to wasted effort is indicative of the influence of heart on the pressure augmentation. Assessment of the pump function graph would be necessary to determine this ventricular contribution. Wave intensity analysis may shed some light on the interaction between the ventricle and aortic pressure.

Wasted effort is approximated by a simple formula, and as the authors suggest, there might be room for improvement. When pressure would be separated into its forward and backward components (waveform analysis), perhaps even a stronger relation could be obtained. Nonetheless, the relation is established and may help to better understand the treatment of hypertension.

Disclosure: Berend E. Westerhof owns shares of the BMEYE company; there is no conflict of interest.