Letters To The Editor

The following is the abstract of the article discussed in the subsequent letter:

Carlhäll, C., L. Wigström, E. Heiberg, M. Karlsson, A. F. Bolger, and E. Nylander. Contribution of mitral annular excursion and shape dynamics to total left ventricular volume change. Am J Physiol Heart Circ Physiol 287: H1836–H1841, 2004. doi:10.1152/ajpheart.00530.2006.—The mitral annulus (MA) has a complex shape and motion, and its excursion has been correlated to left ventricular (LV) function. During the cardiac cycle the annulus’ excursion encompasses a volume that is part of the total LV volume change during both filling and emptying. Our objective was to evaluate the contribution of MA excursion and shape variation to total LV volume change. Nine healthy subjects aged 56 ± 11 (means ± SD) years underwent transesophageal echocardiography (TEE). The MA was outlined in all time frames, and a four-dimensional (4-D) Fourier series was fitted to the MA coordinates (3-D + time) and divided into segments. The annular excursion volume (AEV) was calculated based on the temporally integrated product of the segments’ area and their incremental excursion. The 3-D LV volumes were calculated by tracing the endocardial border in six coaxial planes. The AEV (10 ± 2 ml) represented 19 ± 3% of the total LV stroke volume (52 ± 12 ml). The AEV correlated strongly with LV stroke volume (r = 0.73; P < 0.05). Peak MA area occurred during middiastole, and 91 ± 7% of reduction in area from peak to minimum occurred before the onset of LV systole. The excursion of the MA accounts for an important portion of the total LV filling and emptying in humans. These data suggest an atrigenic influence on MA physiology and also a sphincterlike action of the MA that may facilitate ventricular filling and aid competent valve closure. This 4-D TEE method is the first to allow noninvasive measurement of AEV and may be used to investigate the impact of physiological and pathological conditions on this important aspect of LV performance.

Misinterpretation About the Contribution of the Left Ventricular Long-Axis Shortening to the Stroke Volume

To the Editor: In a recent article in the American Journal of Physiology-Heart and Circulatory Physiology, Carlhäll and coworkers (2) reported that the long-axis shortening of the left ventricle (LV), measured as the mitral annular excursion, only accounts for 19% of the stroke volume (SV).

The concept of almost invariable total heart volume during the heart cycle, with reciprocal filling and emptying of the LV and left atrium and almost constant outer diameter of the ventricle, is well established and confirmed by different modalities (1, 3–5). While the ventricle shortens in the long axis, the walls thicken, with an inward motion of the endocardial part of the wall but hardly any concentric motion of the epicardial part.

Concerning the question of the relative contribution of the systolic shortening of the LV to the total SV, two recent studies (3, 4) favor a contribution of ~80% (75% and 82%, respectively). The difference between these findings and the calculation by Carlhäll and coworkers (2) that the long-axis shortening, measured as the mitral annular excursion, only accounts for 19% of the total SV, must be discussed. In the study of Carlhäll et al., as well as in the studies concluding ~80% contribution, the volume change (∆V) during systole has been calculated as the cross-sectional area (A) times the change in length (∆L) of the LV (∆V = ∆L × A). As the cross-sectional area (in the short axis) varies very little, the volume change is almost proportional to the change in length of the ventricle.

The main difference between the study of Carlhäll et al. (2) and the studies showing ~80% contribution is that in the former, only the cross-sectional area under the mitral valves has been included in the calculation. The serious misinterpretation in that concept is that the volume change in the ventricle is not only dependent on this area, but instead the whole cross-sectional area of the LV, including the walls. The total volume change of the ventricle is then calculated, and as the volume of the myocardium is of course constant, the total volume change corresponds to the change in blood volume, the SV. The most convincing modality used to confirm this relation between the long-axis shortening of the LV and SV is MRI, which offers very high quality imaging and thereby reliable volume calculations (3).

REFERENCES


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