People Cannot Discover New Lands until They Have the Courage to Lose Sight of the Shore: Stress Echocardiography in Left Ventricular Outflow Obstruction

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Dynamic left ventricular outflow tract obstruction (LVOTO) is the most important clinical feature of hypertrophic cardiomyopathy. LVOTO was the strongest predictor of all-cause death and sudden cardiac death [1]. However, LVOTO can be observed in several different clinical settings. In fact, LVOTO may be promoted by anatomical conditions such as the pattern of hypertrophy of the basal septum frequently observed in elderly hypertensive people, the angulated origin of the aorta, the calcification of the mitral annulus, the disproportionate length of the anterior mitral leaflet, and the malposition or hypertrophy of the papillary muscles. Further, the development of LVOTO may be facilitated by a small volume of the left ventricle, sometimes due to volume depletion or preload reduction.

In 1992, transient LVOTO was hypothesized to be the cause of hypotension in more than one-third of normal subjects during dobutamine stress echo [2]. LVOTO was described as occurring both because of a systolic anterior motion of the mitral valve and as a result of hyperdynamic contraction of the mid-ventricular (papillary muscles) and apical regions of the left ventricle inducing cavity obliteration. The hypothesis was a matter of debate, and alternatively LVOTO was mainly related to higher baseline blood pressure [3].

In the same year, a relationship between dobutamine-induced dynamic mid-ventricular obstruction and chest

pain was suggested [4]. Two studies [5, 6] showed an excellent prognosis and beneficial effects of β -blocker therapy on symptoms in these subjects over a 2-year follow-up.

The review “Usefulness of stress echocardiography in assessment of dynamic left ventricular obstructions; case series and review of the literature” is an update on LVOTO in the work-up for effort angina or angina-equivalent symptoms [7].

Today, coronary CTA is the recommended first-line examination for patients with chest pain and low clinical likelihood of obstructive CAD. Noninvasive functional imaging to demonstrate myocardial ischemia is recommended in intermediate clinical likelihood of obstructive CAD [8].

In symptomatic patients in whom coronary CTA did not show an obstructive CAD, the reason for symptoms remains unexplained if no other diagnostic tests are performed. Saeed and Vegsundvåg are to be commended for showing the usefulness of the different technical options offered by echocardiography to give evidence of LVOTO as the possible cause for symptoms, and guide therapeutic decision making. In fact, β -blockers were demonstrated

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to be beneficial on symptoms and improve the quality of life.

Besides pre-existing anatomical and/or functional hemodynamic conditions, the role of catecholamine stimulation is intriguing in the scenario of LVOTO. In fact, a surge of catecholamines eliciting the LVOTO is the common denominator that several clinical situations, such as takotsubo syndrome, shock syndrome, anemic shock, and acute coronary syndromes, may have [9]. In its turn, LVOTO has to be regarded as the common final response of the left heart to different pathophysiological pathways. Symptomatic patients with LVOTO during dobutamine stress echocardiography did not have a greater incidence of takotsubo syndrome [10], nor an abnormal sympato-vagal balance [11]. Dobutamine stress test may induce LVOTO in patients with previous takotsubo, but it does not reproduce the morpho-functional features of the syndrome [12] at variance with cold pressor stress [13].

The current understanding of cardiac dynamics relies on the myocardial band concept, whereby the architecture of myocardial fibers differs among LV regions, implying different dynamic contributions to the development of the ejection upon contraction. The development of LVOTO suggests that catecholamines overstimulate the contraction of the basal and mid-ventricular myocardium with respect to the apical myocardium. Such a pattern of contraction differs from what the myocardial band

concept predicts for the spiral fibers whose contraction shortens the longitudinal length of the left ventricle and increases its circumferential thickening. More studies are needed to verify the hypothesis of a relationship between the response to catecholamines and the architecture of the myocardial fibers, perhaps in the scenario of an excess of regional cardiac catecholamine release/response. Alternative hypotheses to explain the increased response of the basal regions of the left ventricle are (1) the development of excessive LV afterload due to LVOTO and (2) an increase in wall stress, where myocardial curvature is greater with microvascular dysfunction and impaired perfusion [14].

What we know today is that LVOTO is the consequence of a pre-existent anatomical condition or a transient functional event due to hemodynamic changes. The finely tuned mechanisms behind its genesis and the link with symptoms remain a puzzle.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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