Alteration of Left Ventricular Function with Dobutamine Challenge in Patients with Myocardial Bridge

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Background/Aims: The aim of this study was to identify changes in left ventricular (LV) performance in patients with a myocardial bridge (MB) in the left anterior descending coronary artery during resting and in an inotropic state.

Methods: Myocardial strain measurement by speckle-tracking echocardiography and conventional LV wall-motion scoring was performed in 18 patients with MB (mean age, 48.1 ± 1.7 years, eight female) during resting and intravenous dobutamine challenge (10 and 20 μg/kg/min).

Results: Conventional LV wall-motion scoring was normal in all patients during resting and in an inotropic state. Peak regional circumferential strain increased dose dependently upon dobutamine challenge. Longitudinal strains of the anterior and anteroseptal segments were, however, reduced at 20 μg/kg/min and showed a dyssynchronous pattern at 20 μg/kg/min. Although there were no significant differences in radial strain and displacement of all segments at rest compared with under 10 μg/kg/min challenge, radial strain and displacement of anterior segments at 20 μg/kg/min were significantly reduced compared with posterior segments at the papillary muscle level (44.8 ± 14.9% vs. 78.4 ± 20.1% and 5.3 ± 2.3 mm vs. 8.5 ± 1.8 mm, respectively; all p < 0.001), and showed plateau (40%) or biphasic (62%) patterns.

Conclusions: Reduced LV strain of patients with MB after inotropic stimulation was identified. Speckle-tracking strain echocardiography identified a LV myocardial dyssynchrony that was not demonstrated by conventional echocardiography in patients with MB.

Keywords: Myocardial bridging; Echocardiography, stress

INTRODUCTION

Myocardial bridge (MB), a congenital coronary anomaly [1,2], is a clinical condition with several clinical manifestations such as stable or variant angina, myocardial infarction, and sudden death [1-7]. The association of MB with anginal chest pain or abnormal results of noninvasive tests often constitutes an important clinical issue. Although phasic external vessel compression due to MB may induce significant reductions in diastolic coronary diameter [8] and endothelial dysfunction [9], controversy exists concerning the clinical and prognostic relevance of MB and the optimum therapy for symptomatic patients with this anomaly.

If noninvasive investigational tools could help clarify signs of ischemia in patients with MB, especially when the patient had angiographic findings of systolic compression of a coronary vessel only, adequate therapy might be possi-
ble. Standard stress echocardiography using visual assessment of wall motion to detect abnormalities is qualitative and subjective, and variability exists among observers and among institutions. Advanced echocardiographic techniques such as strain imaging, which is now widely used in resting echocardiograms, may also be applied to stress studies. This technique may provide a more quantitative and sensitive assessment of abnormalities in myocardial function and therefore reduce the difficulties inherent in stress echo interpretation.

We previously reported a quantitative assessment of myocardial function of symptomatic patients with MB using two-dimensional strain-based on speckle tracking [10]. In this study, we sought to investigate the effects of alterations in the inotropic stimulation induced by dobutamine challenge on myocardial function in patients with MB with speckle-tracking echocardiography strain-derived variables.

**METHODS**

**Study population**

Low-dose dobutamine stress echocardiography (DSE) was performed in 18 patients (mean age, 48.1 ± 11.7 years; eight female) with exertional chest pain. Coronary angiography showed only MB of the mid segment of the left anterior coronary artery (LAD) without any significant atherosclerosis in either coronary artery. Quantitative coronary analysis software (Philips Medical System, Veenpluis, Netherlands) showed a more than 50% narrowing of the mid LAD by MB. Patients with hemodynamic and electrical instability and structural heart disease were excluded. None of the patients presented concomitant coronary stenosis or any present or previous cardiac events. All patients had normal conventional wall-motion scoring based on the standards of the American Society of Echocardiography, and echocardiography ruled out concomitant hypertrophic cardiomyopathy in all patients. Demographic data, including age, gender, and cardiovascular risk factors were recorded. The institutional review board of the Maryknoll Medical Center approved the study protocol. All study subjects gave informed consent before enrollment.

**Coronary angiogram**

A biplane cardio-vascular system with charge-coupled device digital imaging for intervention and diagnosis (INTEGRIS BV 5000, Philips Medical System) was used to visualize the coronary artery. Quantitative measurements were analyzed by a workstation with dedicated software (WIN 32 ver. 3.3). For this purpose, the coronary segment of interest, including the total length of the myocardial bridge with the adjacent non-obstructed proximal and distal segments, was identified. Boundaries of this segment were then detected automatically and corrected manually if necessary. Absolute vessel diameters were determined using the guiding catheter as a reference. The percent diameter stenosis at the most severe site was automatically calculated from the computer estimation of the original dimension of the artery along the MB, defined as an interpolation between proximal and distal reference diameters. Angiographic lumen diameter evaluation was performed at end systole, when the diameter of the vessel was smallest, and during mid-diastolic frames. To determine interobserver variability for quantitative angiographic measurements of systolic and diastolic lumen diameter reductions, images from a random subset of 18 patients were analyzed by two independent observers (SMK and HGL) blinded to each other’s results.

**Echocardiographic evaluation**

Conventional and strain echocardiographic examination were performed on all subjects lying in the left lateral supine position using the 2.5-MHz transducer on the Vivid 7 Dimension ultrasound equipment (General Electric, Horten, Norway). Images from parasternal short-axis views at three levels (mitral valve, papillary muscle, apex), and apical four-chamber, three-chamber (apical long axis), and two-chamber views of the left ventricle (LV) were obtained at end-expiratory apnea and were stored in cineloop format for subsequent offline analysis. Three heartbeats were collected from each view and analyzed off-line with an EchoPAC dimension system (General Electric). The LV was divided into six segments (anterior, inferior, lateral, posterior, septal, anteroseptal), each of which was then subdivided into three segments (basal, medial, apical).

**Speckle-tracking echocardiography**

LV images sampled at appropriate frame rates (60/sec) during DSE were post-processed using the speckle-track-