JACC: CARDIOVASCULAR IMAGING VOL. 11, NO. 6, 2018

PUBLISHED BY ELSEVIER

ORIGINAL RESEARCH

Prognostic Value of Exercise-Stress Echocardiography in Asymptomatic Patients With Aortic Valve Stenosis

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ABSTRACT

OBJECTIVES This study sought to evaluate the prognostic value of mean pressure gradient (MPG) increase and peak systolic pulmonary artery pressure (SPAP) measured during exercise stress echocardiography in asymptomatic patients with aortic stenosis (AS).

BACKGROUND Exercise testing is recommended in asymptomatic AS patients, but the additional value of exercise-stress echocardiography, especially the prognostic value of MPG increase and peak SPAP, is still debated.

METHODS We enrolled all consecutive patients with pure, isolated, asymptomatic AS and preserved ejection fraction ≥50% and normal SPAP (<50 mm Hg) who underwent symptom-limited exercise echocardiography at our institution. Occurrence of AS-related events (symptoms or congestive heart failure) or occurrence of aortic valve replacement was recorded.

RESULTS We enrolled 148 patients (66 ± 15 years of age; 74% males; MPG: 47 ± 13 mm Hg; SPAP: 34 ± 6 mm Hg). No complications were observed. Thirty-six patients (24%) had an abnormal exercise test result (occurrence of symptoms, fall in blood pressure, and/or ST-segment depression) and were referred for surgery. Among the 112 patients with a normal exercise test result, 38 patients (34%) had abnormal exercise echocardiography scores (MPG increase >20 mm Hg and/or SPAP at peak exercise >60 mm Hg). These 112 patients were managed conservatively. During a mean follow-up of 14 ± 8 months, an AS-related event occurred in 30 patients, and 25 patients underwent surgery. Neither MPG increase >20 mm Hg nor peak SPAP >60 mm Hg was predictive of occurrence of AS-related events or aortic valve replacement (all $p > 0.20$). In contrast, baseline AS severity was an important prognostic factor (all $p < 0.01$).

CONCLUSIONS In this observational study including 148 patients with asymptomatic AS, we confirmed and extended the importance of exercise testing for unveiling functional limitation. More importantly, neither the increase in MPG nor in SPAP at peak exercise was predictive of outcome. Our results do not support the use of these parameters in risk-stratification and clinical management of asymptomatic AS patients. (J Am Coll Cardiol Img 2018;11:787-95)

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Dr. Melissopoulou was supported by Association Citadelle Recherche et Formation du Citadelle Chateau Rouge de la Citadelle de Liège. The COFRASA (NCT00338676) and GENERAC (NCT00647088) studies are supported by grants from Assistance Publique-Hôpitaux de Paris (Projet Hospitalier de Recherche Clinique [PHRC] National 2005 and 2010, and PHRC regional 2007). Dr. Vahanian has received speaker honoraria from Edwards LifeSciences, Valtech, and Abbott Vascular. Dr. Messika-Zeitoun has received honoraria/research grants from Edwards LifeSciences, Valtech, Abbott Vascular, Cardiowave, and Mardil. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received November 8, 2016; revised manuscript received February 14, 2017, accepted March 2, 2017.

ISSN 1936-878X/$36.00 http://dx.doi.org/10.1016/j.jcmg.2017.03.020

ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

AS = aortic valve stenosis

AVA = aortic valve area

AVR = aortic valve replacement

CAD = coronary artery disease

LVEF = left ventricular ejection fraction

MPG = mean pressure gradient

PV = peak velocity

SPAP = systolic pulmonary arterial pressure

Aortic valve stenosis (AS) is the most common valvular heart disease in Western countries (1,2). Aortic stenosis affects approximately 5% of the population older than 70 years of age, and its prevalence is due to increase dramatically with the aging of the population. Management of patients with severe AS, either symptomatic or with left ventricular systolic dysfunction, is clear, and these patients should be promptly referred for surgical or percutaneous aortic valve replacement (AVR) (Class I indication) (3,4). In contrast, management of asymptomatic severe AS remains a matter of controversy due, on one side, to the risk of sudden death without preceding symptoms and irreversible myocardial dysfunction and, on the other side, to the risk of surgery and prosthetic valve complications. Thus, identifying subsets of asymptomatic AS patients with preserved left ventricular ejection fraction (LVEF) who have the highest likelihood of developing symptoms or AS-related events over the short term and who may benefit from an early or prophylactic surgery rather than a watchful waiting is a critical clinical challenge.

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Exercise testing is strongly recommended in physically active asymptomatic AS patients and has shown both its safety and its important prognostic value (5-7). The abnormal exercise test results that show symptoms or abnormal blood pressure responses are Class I and IIa recommendations for surgery, respectively (3,4). In the last decade, exercise echocardiography has gained considerable interest. According to the current European Society of Cardiology guidelines, surgery may also be considered in patients who are at low operative risk demonstrating normal exercise performance but increased mean pressure gradient (MPG) with exercise by >20 mm Hg or systolic pulmonary hypertension (Class IIb). However, the level of evidence is low, and the use of exercise echocardiography is not mentioned in the American College of Cardiology/American Heart Association recommendations. To further improve the level of evidence, we reviewed all asymptomatic AS patients who underwent exercise echocardiography at our institution and specifically evaluated the additional prognostic value of exercise echocardiography.

METHODS

STUDY DESIGN. We enrolled all consecutive patients with at least moderate asymptomatic AS (MPG ≥20 mm Hg) who underwent exercise echocardiography testing between January 2005 and December 2014 at our institution. Exclusion criteria were LV systolic dysfunction (LVEF <50%); congenital stenosis, except for bicuspid valve, rheumatic disease, and systolic pulmonary hypertension at rest (systolic pulmonary artery pressure [SPAP] >50 mm Hg); and associated aortic regurgitation or other valvular disease of grades ≥2 to 4. All patients underwent a comprehensive transthoracic echocardiography test at rest, followed by symptom-limited exercise echocardiography. All echocardiography procedures were performed by experienced operators using iE33 (Philips Healthcare, Andover, Massachusetts) or Vivid 7 (General Electrics, Chalfont, St. Giles, United Kingdom) ultrasonography systems. Follow-up examinations were performed by telephone interviews with the treating cardiologist, or the patients, or were collected from medical records.

REST ECHOCARDIOGRAPHY. Severity of AS was assessed based on peak velocity (PV), MPG, and aortic valve area (AVA), calculated using the continuity equation, as recommended (8). Severe AS was defined by an AVA of <0.6 cm^2/m^2, a PV of >4 m/s, or an MPG of >40 mm Hg. Left ventricle mass was calculated using the Devereux formula and indexed to body surface area; LV hypertrophy was defined by an LV mass index >95 g/m^2 in women and >115 g/m^2 in men (9). LVEF was assessed visually or using the modified biplane Simpson's method. Systolic pulmonary artery pressure was estimated based on the modified Bernoulli equation using continuous wave Doppler.

EXERCISE-STRESS ECHOCARDIOGRAPHY. Patients performed exercise-stress echocardiography in a semisupine position on a bicycle ergometer under blood pressure (BP) measurement and continuous 12-lead electrocardiographic monitoring. Workload was increased every 1, 2, or 3 min by 20/30 W, depending on age and physical ability. At each stage, LV systolic function, occurrence of LV wall motion abnormalities, MPG, and SPAP were measured using echocardiography. Criteria for positivity of the exercise test result and of the echocardiographic part of the test (presented below) were analyzed independently. A positive exercise test result was defined by the occurrence of symptoms (dyspnea, angina, or syncope), the fall in systolic BP or rise <20 mm Hg, ST-segment depression ≥2 mm or sustained ventricular arrhythmia. A positive echocardiographic stress result was defined as an exercise-induced MPG increase >20 mm Hg, a peak SPAP >60 mm Hg, an impaired LVEF, or the occurrence of left wall motion abnormalities (LWMA). Patients with a positive