Coronary flow velocity reserve during exercise stress echocardiography in hypertrophic cardiomyopathy

E.D. Palinkas¹, A. Palinkas², A. Zagatina³, K. Wierzbowska-Drabik⁴, A. D’Andrea⁵, Q. Ciampi⁶, R. Sepp⁷, V. Nagy⁷, I. Olivotto⁸, E. Picano⁹

¹University of Szeged, Doctoral School of Clinical Medicine, Szeged, Hungary
²Csongrád-Csanád County Health Care Center, Hódmezovásárhely-Makó, Department of Internal Medicine, Hódmezovasarhely, Hungary
³Research Cardiology Center “Medika”, Cardiology Department, Saint Petersburg, Russian Federation
⁴Medical University of Lodz, Department of Internal Diseases and Clinical Pharmacology, Lodz, Poland
⁵Umberto I Hospital, Nocera Inferiore, Department of Cardiology, Unit of Cardiology and Intensive Coronary Care, Naples, Italy
⁶Fatebenefratelli Hospital of Benevento, Benevento, Italy
⁷University of Szeged, Division of Non-Invasive Cardiology, Department of Internal Medicine, Szeged, Hungary
⁸IRCCS Meyer Children’s Hospital, Cardiology Unit, Florence, Italy
⁹CNR – National Research Council, Institute of Clinical Physiology, Pisa, Italy

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Background: Coronary flow velocity reserve (CFVR) can be assessed with transthoracic echocardiography (TTE) as the stress/rest ratio of coronary flow velocity (CFV). Reduced CFVR during vasodilator stress (adenosine or dipyridamole) is a powerful predictor of adverse outcomes in hypertrophic cardiomyopathy (HCM). However, the feasibility and correlates of CFVR during the more physiological - and recommended - exercise stress echocardiography (ESE) is unresolved.

Aim: To assess the feasibility and functional correlates of CFVR during exercise in HCM.

Methods: We studied 56 HCM patients (age=49±13 years, 33 [59%] males) and 44 age- and sex-matched healthy subjects with symptom-limited semi-supine ESE. ESE assessment included CFVR (stress/rest diastolic CFV) in the mid-distal left anterior descending coronary artery, systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate reserve (HRR, peak/rest heart rate).

Results: CFVR was feasible in 46/56 HCM patients and in 41/44 controls (82% vs 93%, p=0.138). Median CFVR was significantly lower in patients with HCM compared to controls (1.72 [1.48; 2.10] vs 2.57 [2.25; 3.30], p<0.001), see Figure 1. In HCM patients, among resting parameters, CFVR was inversely correlated with left ventricular maximal septal thickness (r=-0.308, p=0.038), end-systolic diameter (r=-0.393, p=0.007), resting DBP (r=-0.398, p=0.006) and resting SBP (r=-0.321, p=0.030), while in controls CFVR correlated only with resting DBP (r=-0.322, p=0.040). During exercise, HCM patients with lower CFVR (<1.72, i.e. 1.72) showed lower peak CFV (78±20 vs 96±24 cm/s, p=0.003) and lower HRR (1.55±0.29 vs 1.76±0.25, p=0.020), see Figure 2. Exercise duration, peak stress workload or metabolic equivalents were not related to CFVR. In multivariable analysis, resting CFV (b=-0.034, 95% CI -0.037 and -0.030, p<0.001), resting SBP (b=-0.003, 95% CI -0.005 and -0.001, p=0.020), peak stress CFV (b=0.019, 95% CI 0.017 and 0.021, p<0.001) and HRR (b=0.126, 95% CI 0.005 and 0.247, p=0.041) were independently associated with CFVR.

Conclusion: CFVR assessment by TTE in the left anterior descending coronary artery is feasible during semi-supine exercise in most HCM patients. CFVR is markedly reduced in HCM patients on effort, particularly in the presence of high resting CFV and low HRR.
**Figure 1.** Coronary flow velocity reserve elicited by exercise is significantly lower in patients with hypertrophic cardiomyopathy compared to age- and sex-matched healthy controls. HCM: hypertrophic cardiomyopathy.

**Figure 2.** Greater heart rate reserve is associated with greater coronary flow velocity reserve during exercise in hypertrophic cardiomyopathy.