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Exercise capacity predictors in hypertrophic obstructive cardiomyopathy patients assessed by multi-modality imaging

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Introduction

In HCM, with progression of disease, there is often a reduction in exercise capacity, likely due to diastolic dysfunction, mitral regurgitation (MR) and dynamic left ventricular outflow tract obstruction (LVOTO). However, there is considerable variation in exercise capacity despite similar diastolic dysfunction, LVOTO and MR. Aortic stiffness could be a possible contributor in HCM pathophysiology. Pulse wave velocity (PWV), measured by cardiac magnetic resonance (CMR), is a marker of aortic stiffness and is abnormal in HCM vs. controls.

Objective

To test the association between maximal oxygen consumption (VO2 max) and various clinical/imaging predictors in hypertrophic cardiomyopathy (HCM) patients with preserved ejection fraction.

Methods

Fifty consecutive, newly referred HCM patients (62% men, 44 +/- 13 years, 78 % on beta-blockers, 18 % hypertensives) underwent Doppler echocardiography (echo), cardiopulmonary exercise testing and CMR (1.5 T, Siemens, Erlangen, Germany) for symptom evaluation. Deceleration time (DT), myocardial performance index (MPI or isovolumic contraction time + isovolumic relaxation time/ejection time), post exercise MR and LVOT gradient (mm Hg) were measured on echo. VO2 max (ml/kg/minute) was measured. LV volumetric indices and PWV were measured on CMR. PWV (m/s) was measured as follows: $\Delta x/\Delta t$ (Δx = aortic path length between mid-ascending and mid-descending aorta measured on Half Fourier Acquisition in Steady State images and Δt = time delay between arrival of foot of PW between 2 points on velocity encoded images).

Results

On echo, maximal post-exercise LVOT gradient, degree of MR, DT, MPI, degree of MR and VO2 max were 104 ± 52 (range 65-198) , 1 ± 1, 240 ± 79, 0.7 ± 0.5 and 25 ± 6 respectively. On CMR, mean basal septal thickness (cm), PWV, EF, ESV and EDV index (ml/m2), were 1.9 ± 0.5 (range 1.6-2.3), 9.2 ± 7, 64 % ± 6, 32 ± 8, 87 ± 16, 110 ± 29 and respectively. Regression analyses testing the predictors of VO2 max are shown in table. Using the median cutoff for pV02 of 25 ml/kg/min, on receiver operator characteristic curve analysis, PWV was significantly associated with pV02 (area under curve = 0.70, p = 0.001). There was no association between age and PWV (r = 0.01, p-value 0.9), Table 1.

Conclusion

In HCM patients, aortic stiffness likely explains additional variations in exercise capacity, over and above LV thickness, MR, LVOTO and diastolic indices. Aortic stiffness is a potential therapeutic target in assessing improvements in exercise capacity in HCM patients.

Table 1:

	Univariate Analysis		Multivariate Analysis	
Variable	**Beta**	**p value**	**Beta**	**p value**
Age	-0.42	0. 003	-0.38	0.004
Pulse wave velocity	-0.38	0.007	-0.33	0.01
Gender	-0.09	0.5		
Body surface area	-0.17	0.2		
Hypertension	-0.17	0.3		
Beta-blockers	-0.03	0.9		
Deceleration time	-0.11	0.5		
Myocardial performance index	0.05	0.8		
Maximal post stress LVOT gradient	-0.13	0.4		
Post-stress mitral regurgitation	-0.11	0.8		
Basal end-diastolic interventricular septal thickness	-0.07	0.7		
ESV index	0.07	0.4		
EDV index	0.1	0.5		
LVEF	-0.06	0.7		