Exercise-Induced Intraventricular Obstruction in a Child with Near Syncope and Chest Pain During Exercise

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Abstract We report the case of a 10-year-old girl with two episodes of light-headedness and chest pain during exercise. She had an unremarkable clinical record, physical examination, ECG, and echocardiogram. Noninvasive ischemia tests were positive, but coronary angiography was normal. Exercise stress echocardiogram revealed an exercise-induced intra-left-ventricular obstruction with a peak gradient of 78 mmHg and replicated her symptoms. After starting beta-blocker therapy her clinical status improved and no residual obstruction was detected. The authors review this unsuspected clinical condition, seldom reported in the adult population and, to our knowledge, never before in a child.

Keywords Intraventricular pressure gradients · Stress echocardiography · Syncope

Introduction

Syncope and *light-headedness* are frequent causes for cardiology referral and evaluation. Although they usually have a benign prognosis, some associated features such as occurrence during exercise or an accompanying chest pain might raise suspicion of more serious underlying pathology and warrant further cardiovascular testing [9].

In the adult population, exercise-induced intraventricular obstruction (EIVO) has been described in several reports, often associated with an array of symptoms [1, 4, 5]. Knowledge about EIVO is scarce and its mechanism and long-term prognosis are still uncertain.

We report the case of a 10-year-old girl referred to us due to *light-headedness* and chest pain during exercise who proved to have an EIVO.

Case Report

A 10-year-old girl was referred to our outpatient clinic complaining of two episodes of *light-headedness* and chest pain during strenuous physical exercise in the past weeks. She had started taking sport's classes a couple of months before and both episodes occurred during the class. Complete loss of consciousness never occurred.

She presented an unremarkable clinical record, with no family history of cardiovascular disease. Her physical examination showed a mild vibratory murmur (I/VI) at the left sternal border and was otherwise unremarkable.

Basal ECG and echocardiogram were normal. Twenty-four-hour Holter monitoring showed transient repolarisation changes in a VF-like lead and rare, isolated, supraventricular and monomorphic ventricular premature beats. A treadmill electrocardiographic stress test was performed, using the

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Bruce protocol. The test was stopped at 10 min 55 s due to fatigue. There was normal blood pressure progression and a maximal heart rate of 200 bpm was achieved. By 1 min of the recovery period she complained of chest pain, and by 3 min, a flat 0.1 mV ST depression was registered in lead III. Investigation proceeded with a single-photon-emission computed tomography (SPECT) test that showed mild ischemia in the antero-lateral wall of the left ventricle (LV). The patient was sent to the cath lab. Coronariography and

aortography as well as LV function and pressures were normal.

She was then submitted to an exercise stress echocardiogram, using the Bruce treadmill protocol. The test was stopped at 11 min 17 s due to fatigue. Basal echocardiogram was normal (Fig. 1), but by 11 min, there was an intra-left-ventricular peak gradient of 25 mmHg that increased to 78 mmHg in the immediate recovery period (Fig. 2). The patient complained of dizziness. There was no

Fig. 1 Stress echocardiogram: resting phase, *without significant*, left ventricular outflow tract gradient

Fig. 2 Stress echocardiogram: immediate recovery period left ventricular outflow tract gradient (78 mmHg)

evidence of systolic anterior movement of the mitral valve (SAM) or segmental contractility abnormalities.

She was started on bisoprolol (3.75 mg/day) and repeated the stress echocardiography 2 months later, showing no intraventricular gradient after 9 min 52 s of the Bruce protocol.

Discussion

Syncope and light-headedness occur frequently in the pediatric population [7] and often lead to a cardiology evaluation. Most frequently, they have a neurally mediated mechanism (vaso-vagal syncope) and a favorable prognosis. Some associated features, though, might raise suspicion for an underlying cardiac pathology, possibly carrying a worse prognosis and eventually requiring specific treatment [9]. Occurrence during physical exercise or association with chest pain should warrant further cardiovascular testing, looking for arrhythmia, valvular disease, LV outflow obstruction, and ischemia.

Exercise-induced intraventricular obstruction in patients with a normal basal echocardiogram has been described in several small series of adult patients [1, 5]. It should be considered an abnormal response to exercise because EIVO is apparently not found in healthy asymptomatic patients [2, 6] even there are no studies about this issue in normal children. It is usually associated with symptoms of angina and/or effort dyspnea. Patients might or might not have positive ischemia tests, such as an electrocardiographic stress test or SPECT, as was the case of the children we report. In this case, as there are normal coronary arteries, the noninvasive tests should be considered as false positives. EIVO has been reported in 36% of patients with cardiac Syndrome X (effort angina, positive ischemia tests, and normal coronariography) [5]. The magnitude of obstruction, as determined by the peak gradient, also seems to be related to the intensity of symptoms [3].

The mechanism of EIVO is not fully explained. Some conjectures include (1) an increase in nonobstructive physiological gradients, (2) end-systolic obstruction secondary to ventricular cavitory obliteration and (3) mid-systolic obstruction caused by SAM of the mitral-valve-restricting ejection [10]. The incidence of SAM is inconsistent in the different series, ranging from 6 to 70% [1, 5]. This might be related to the stress echocardiogram protocol used: Some authors perform the exam in the supine position, immediately after the treadmill exercised ends, and others, such as us, perform the echocardiogram during the entire period of the treadmill exercise.

Several morphological features of LV geometry in the basal condition seem to correlate to EIVO. Smaller,

thicker, and narrower outflow tract ventricles tend to develop EIVO more easily [1, 5].

Angina, dyspnea, and, as in our patient, light-headedness might, at least in some cases, be explained by transient reduced cardiac output, increased oxygen consumption, and diminished coronary perfusion. Likewise, the increase in intraventricular pressure and LV strain might contribute to ST depression on the stress test.

Similar to hypertrophic cardiomyopathy, negative inotropic therapy with beta-blockers has proven to decrease the peak gradient and improve symptoms and functional status [3]. However, the fact that the exercise was of a shorter duration on beta blocker therapy might also contribute to the absence of EIVO. As for prognosis, LV obstruction at rest in hypertrophic cardiomyopathy patients has been related to an increased risk of death and heart failure [8]. There are no data regarding the long-term clinical implications of EIVO in patients with a structurally normal heart. Larger patient series and long-term follow-up are necessary.

Angina, dyspnea, and light-headedness in an otherwise healthy child might be explained by EIVO. Greater awareness of this condition is needed to lead to a prompt and correct diagnostic approach using exercise echocardiography. Symptomatic and functional improvement might be achieved with the use of beta-blocker therapy. Long-term implications and clinical outcome are still unknown.

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