Hemodynamic Impact of Hypertrophic Cardiomyopathy at Rest and During Supine Bicycle Exercise: Additional Value of Postprandial Assessment

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Abstract

A patient with severe, symptomatic hypertrophic cardiomyopathy (HCM) without a significant left ventricular outflow tract (LVOT) gradient at rest requires further evaluation. During exercise echocardiography (EE) performed on a supine bicycle, a latent or underestimated dynamic obstruction may be identified in real time, with postprandial assessment being particularly relevant.

Case report

A 42-year-old female patient had previous emergency department visits due to precordial discomfort radiating to the back and episodes of presyncope. During one episode, troponin elevation was observed. She subsequently underwent coronary computed tomography angiography, which demonstrated normal epicardial coronary arteries (Figure 1).

She had HCM with a septal diastolic thickness of 34 mm. Systolic anterior motion (SAM) of the mitral valve was absent at rest and under fasting conditions. The left ventricle was hyperdynamic, with an ejection fraction of 69% and global longitudinal strain of −13%. Atrial volumes were normal, and cardiac valves were competent (Figure 1).

While receiving propranolol, the patient underwent supine bicycle EE, a method that allows continuous assessment of myocardial contractility and changes in the left ventricular outflow tract (LVOT) gradient throughout the procedure (Figure 2). The first examination was performed in the morning under fasting conditions. She was then instructed to consume a meal of 1000-1500 kcal, predominantly composed of carbohydrates. On the same day, approximately 30 min after the meal, she returned for a repeat echocardiography (EE) study.

Keywords

Hypertrophic Cardiomyopathy; Exercise Test; Exercise; Postprandial.

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The initial workload was 25 W, with increments of 25 W every 2 min. The test was terminated at 75 W due to exhaustion and fatigue. Heart rate ranged from 56 to 120 bpm, with no chest pain, hypotension, or arrhythmias (Table 1). No murmur was audible at rest; however, during exercise, a grade 2/4 systolic murmur emerged at the left sternal border. The highest LVOT gradients were observed during the recovery phase, with heart rate below 100 bpm.

Under fasting conditions, the resting LVOT gradient was 8 mmHg, with no SAM. During exercise in the fasting state, the gradient reached 36 mmHg. In the postprandial condition, SAM was already detectable at rest, with a baseline gradient of 16 mmHg and a gradient of 48 mmHg during exercise (Figure 3).

Discussion

HCM has an estimated prevalence of 1:200-1:500 in the general population, although only a smaller proportion of cases (10%-20%) are clinically diagnosed. Clinical presentation reflects variations in preload and afterload, which influence dynamic obstruction and symptom expression. Physiological maneuvers may intensify dynamic obstruction and cardiac murmur; however, the postprandial state may produce a meaningful increase in the LVOT gradient both at rest and during exercise, even when additional maneuvers do not demonstrate a significant effect.[1-3]

The hemodynamic impact of obstructive HCM may vary substantially within the same patient, even under pharmacological therapy. Identification of greater hemodynamic burden may indicate the need for therapeutic optimization or consideration of additional strategies such as septal myectomy, septal ablation (alcohol or radiofrequency), or pacemaker implantation.[4]

Studies evaluating HCM during exercise frequently use treadmill testing or upright bicycle protocols, with LVOT gradient measurement performed after exercise cessation. In this case, a supine bicycle was used, allowing continuous assessment of cardiac dynamics and real-time gradient measurement without interrupting the examination.

In a substantial proportion of patients with HCM, the gradient may be exacerbated in the postprandial state. Between 30-60 min after a meal, systemic vascular resistance may decrease, mainly due to mesenteric arterial vasodilation, in addition to reduced venous return and preload. Subsequent adrenergic stimulation promotes

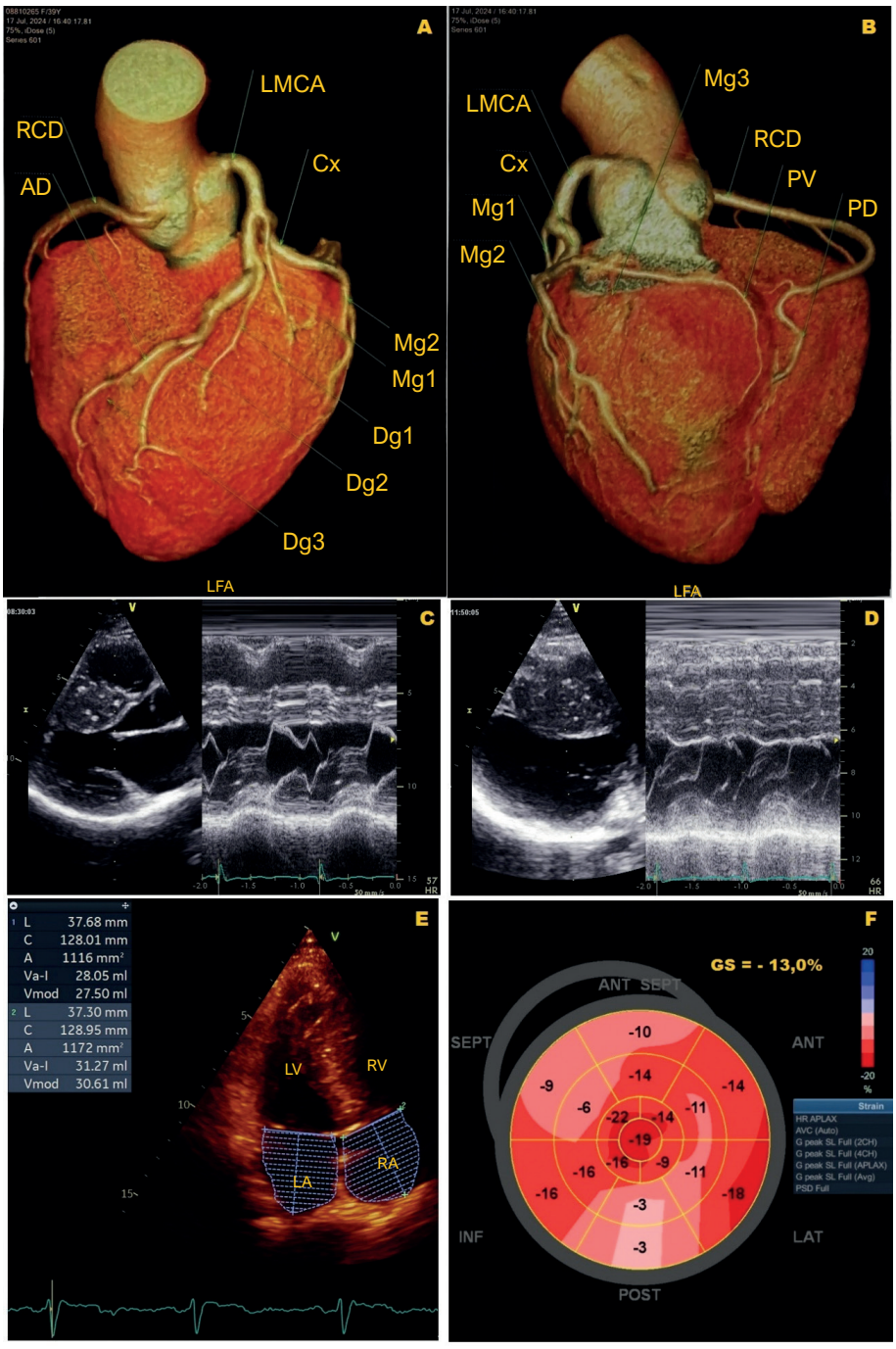

Figure 1 – *Structural and functional characterization in hypertrophic cardiomyopathy: coronary computed tomography angiography and multimodal echocardiographic assessment. A) Coronary computed tomography angiography – three-dimensional reconstruction showing the LMCA and its branches (anterior view); B) coronary computed tomography angiography – three-dimensional reconstruction showing epicardial coronary arteries and branches (complementary view); C) transthoracic echocardiography in two-dimensional and M-mode demonstrating myocardial morphology and wall thickening; D) transthoracic echocardiography in two-dimensional and M-mode with additional assessment of ventricular dynamics; E) echocardiography with atrial volumetric quantification (biplane method); F) LV GS analysis (polar map/bull's-eye). AD: left anterior descending artery; Cx: circumflex artery; Dg1: first diagonal branch; Dg2: second diagonal branch; Dg3: third diagonal branch; GS: global longitudinal strain; LA: left atrium; LMCA: left main coronary artery; LV: left ventricle; Mg1: first marginal branch (obtuse marginal); Mg2: second marginal branch (obtuse marginal); Mg3: third marginal branch (obtuse marginal); PD: posterior descending artery; PV: posterior ventricular branch; RA: right atrium; RCD: right coronary artery; RV: right ventricle.*

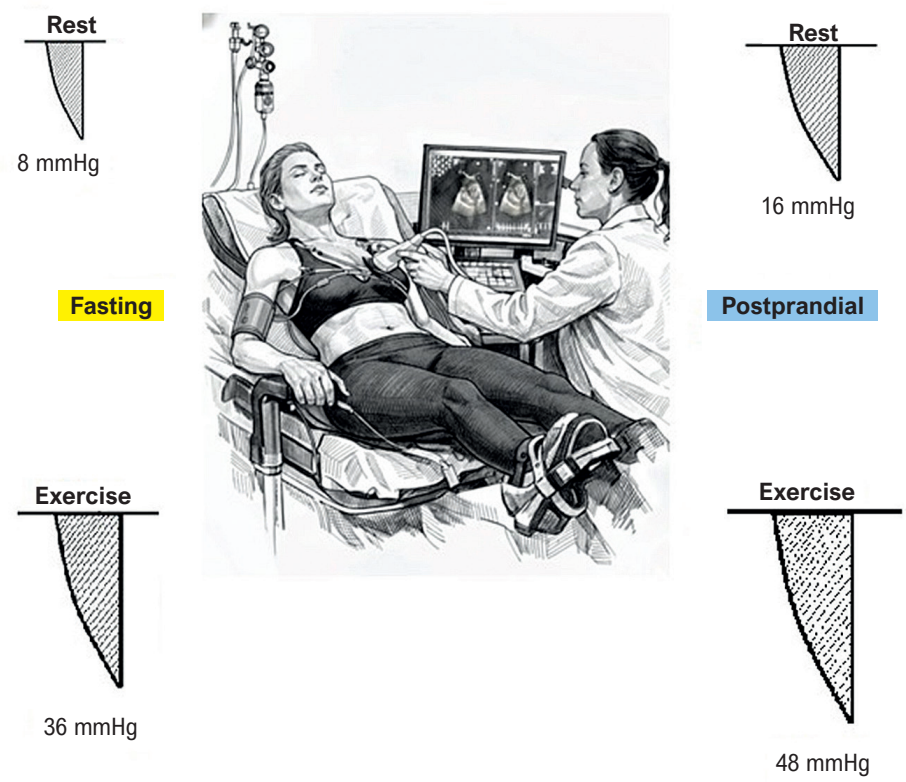

Figure 2 – *Hemodynamic Impact of Hypertrophic Cardiomyopathy at Rest and During Supine Bicycle Exercise: Additional Value of Postprandial Assessment.*

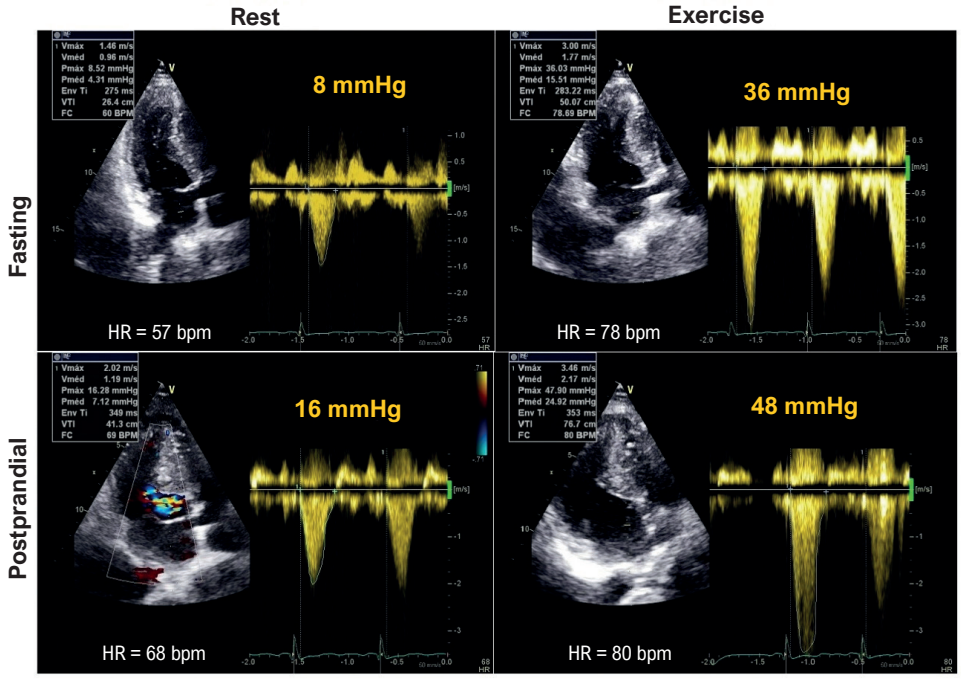

Figure 3 – *Variation in the left ventricular outflow tract gradient during fasting and postprandial states at rest and during exercise. HR: heart rate.*

Table 1 – Hemodynamic parameters

Variables	Rest	Exercise (75 W)	Recovery
Blood pressure – fasting	100 × 80 mmHg	150 × 90 mmHg	120 × 80 mmHg
Blood pressure – postprandial	100 × 70 mmHg	160 × 100 mmHg	100 × 80 mmHg
Heart rate – fasting	57 bpm	123 bpm	78 bpm
Heart rate – postprandial	68 bpm	120 bpm	80 bpm

increased inotropy and chronotropy. These hemodynamic interactions may intensify a pre-existing gradient or reveal a latent LVOT gradient.[3,5]

Studies assessing the LVOT gradient in patients with HCM during postprandial exercise generally include comparison with fasting evaluation to demonstrate potential differences. There is no standardized meal type. In general, moderate caloric intake (1000-1500 kcal) is recommended. The ideal composition remains uncertain, although carbohydrate-rich meals are frequently used.[3,5,6]

In cases of HCM with increased LVOT gradient in the postprandial state, pharmacological therapy may be initiated or adjusted. Patients should be advised to consume smaller, more frequent meals and maintain adequate hydration.[7,8]

Conclusion

In the assessment of HCM severity, postprandial evaluation is relevant both at rest and during exercise, contributing to therapeutic optimization and guidance on lifestyle modifications.

Author Contributions

Conception and design of the research: Abreu MEB, Abreu JS; Acquisition of data: Abreu MEB; Analysis and interpretation of the data: Abreu MEB, Diógenes TCP, Abreu JS; Writing of the manuscript: Machado IS, Abreu JS; Critical revision of the manuscript for intellectual content: Xerex HM, Abreu JS.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Universidade Estadual do Ceará under the protocol number 70990923.6.0000.5534. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

Use of Artificial Intelligence

The authors did not use any artificial intelligence tools in the development of this work.

Availability of Research Data

The underlying content of the research text is contained within the manuscript.

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