Myocardial Work During Isometric Exercise: From Physiology to Clinical Practice

Rodrigo Bellio de Mattos Barretto,[1] *Carlos Eduardo Suaide Silva*[2]

Universidade de São Paulo, Instituto do Coração,[1] *São Paulo, SP – Brazil*

Diagnósticos da América AS,[2] *Barueri, SP – Brazil*

Short Editorial related to the article: Impact of Isometric Exercise on Left Ventricular Mechanics Assessed by Global Longitudinal Strain and Myocardial Work in Healthy Adults

Assessment of left ventricular function by echocardiography has advanced remarkably in its ability to characterize aspects that extend beyond traditional measures of volume and ejection fraction (EF). Among these advances, the evaluation of contractility through two-dimensional strain analysis has gained particular prominence. Technological developments now allow this measure to be adjusted for afterload through myocardial work (MW), providing greater potential to identify subtle changes in ventricular function.[1]

Isometric exercise represents a strategy to increase afterload through handgrip, proving particularly useful in echocardiography because it enables the identification of functional changes in different clinical settings, including coronary artery disease, assessment of diastolic function, hypertension, athletes, and even atrial functional mitral regurgitation.[2-6]

The study presented adds important evidence by demonstrating how isometric handgrip stress can reveal subtle physiological adaptations in left ventricular mechanics among healthy adults. As reported by the authors, handgrip increased systolic blood pressure without changing left ventricular EF (64.8% vs. 64.4%), reinforcing the limitations of EF as an isolated marker of systolic performance, a finding that was expected.

The integration of global longitudinal strain (GLS) with blood pressure measurements, translated into MW, provided a more comprehensive understanding of changes in ventricular function when comparing data obtained at rest with those recorded during isometric exercise. The slight reduction in GLS observed during exercise was compensated for by the increased MW load imposed on the left ventricle, as evidenced by the increase in total and constructive MW. These findings support the greater myocardial oxygen consumption (VO_2) required under these conditions, as reflected by the observed values. Conversely, an increase in wasted MW and a consequent reduction in cardiac efficiency were also identified, illustrating the complexity of mechanical efficiency under pressure overload.

Another relevant aspect is that abnormalities in the basal segments of the left ventricle were primarily responsible for the reduction in GLS during exercise and also contributed to the greater increase in MW. These segments are known to be more susceptible to loading conditions and play a greater role in longitudinal deformation mechanics. In contrast, apical segments, despite containing a proportionally greater amount of longitudinal fibers, are less influenced by the load induced by handgrip because of their geometric arrangement. This type of regional characterization has important implications for populations with hypertension, early-stage cardiomyopathies, or exposure to cardiotoxic agents, scenarios in which the sensitivity of MW may provide a diagnostic advantage.

This study reinforces the use of isometric exercise as a feasible maneuver capable of clearly demonstrating physiological changes and expanding the understanding of cardiovascular phenomena when analyzed through MW. At a time when echocardiography seeks accessible methods to assess contractile reserve and detect subclinical dysfunction, handgrip emerges as a practical and physiologically informative alternative.

This opens a broad field of investigation regarding its application in different clinical settings aimed at the early recognition of abnormalities, a topic that has already been explored in prior research.[7,8] Nevertheless, this enthusiasm must still be supported by evidence demonstrating its clinical value, endorsed by guidelines, expert consensus documents, and, above all, its association with clinical outcomes.

In summary, this study represents a robust, necessary contribution to contemporary echocardiography. By integrating myocardial deformation findings, loading conditions, and mechanical efficiency, it establishes MW as a central component of advanced functional assessment, not only by refining the interpretation of systolic performance beyond EF but also by measurably expanding our ability to recognize subclinical dysfunction and guide clinical decision-making with greater precision. It therefore represents an important step toward a more comprehensive and integrated echocardiographic approach, one that is increasingly necessary in contemporary clinical practice.

Keywords

Global Longitudinal Strain; Stress Echocardiography

Mailing Address: Rodrigo B. M. Barretto •
Universidade de São Paulo, Instituto do Coração. Av. Eneas Carneiro Aquiar, 44. Postal Code: 05403-000. São Paulo, SP – Brazil
E-mail: barretto.rodrigo@terra.com.br

DOI: https://doi.org/10.36660/abcimg.20260073i

References

1. Helfant RH, De Villa MA, Meister SG. Effect of Sustained Isometric Handgrip Exercise on Left Ventricular Performance. Circulation. 1971;44(6):982-93. doi: 10.1161/01.cir.44.6.982.
2. Afridi I, Main ML, Parrish DL, Kizilbash A, Levine BD, Grayburn PA. Usefulness of Isometric Hand Grip Exercise in Detecting Coronary Artery Disease during Dobutamine Atropine Stress Echocardiography in Patients with Either Stable Angina Pectoris or Another Type of Positive Stress Test. Am J Cardiol. 1998;82(5):564-8. doi: 10.1016/s0002-9149(98)00398-1.
3. Cauwenberghs N, Cornelissen V, Christle JW, Hedman K, Myers J, Haddad F, et al. Impact of Age, Sex and Heart Rate Variability on the Acute Cardiovascular Response to Isometric Handgrip Exercise. J Hum Hypertens. 2021;35(1):55-64. doi: 10.1038/s41371-020-0311-y.
4. Freitas APTG, Massoni NM, Barretto RBM. Left Ventricular Longitudinal Strain Echocardiogram and Handgrip: A Useful Tool for Detecting Ischemia in the Emergency Room. Arq Bras Cardiol: Imagem Cardiovasc. 2021;34(4):eabc238. doi: 10.47593/2675-312X/20213404eabc238.
5. Samuel TJ, Beaudry R, Haykowsky MJ, Sarma S, Park S, Dombrowsky T, et al. Isometric Handgrip Echocardiography: A Noninvasive Stress Test to Assess Left Ventricular Diastolic Function. Clin Cardiol. 2017;40(12):1247-55. doi: 10.1002/clc.22818.
6. Spieker M, Sidabras J, Lagarden H, Christian L, Angendohr S, Zweck E, et al. Prevalence and Prognostic Impact of Dynamic Atrial Functional Mitral Regurgitation Assessed by Isometric Handgrip Exercise. Eur Heart J Cardiovasc Imaging. 2024;25(5):589-98. doi: 10.1093/ehjci/jead336.
7. Caminiti G, Volterrani M, Iellamo F, Marazzi G, D'Antoni V, Calandri C, et al. Acute Changes in Myocardial Work during Isometric Exercise in Hypertensive Patients with Ischemic Heart Disease: A Case-Control Study. J Clin Med. 2024;13(19):5955. doi: 10.3390/jcm13195955.
8. Cebrowska K, Mińczykowski A, Krauze T, Guzik P, Szczepanik A, Wykrętowicz A. The Pressure-Strain Work Indices in Response to Isometric Handgrip Exercise. Kardiol Pol. 2021;79(4):455-7. doi: 10.33963/KP.15912.