Is there any relationship between cardiopulmonary capacity and cardiovascular mechanics in coronary artery disease?

Cardiopulmonary exercise testing (CPET) is traditionally used for the identification of the pathophysiological causes of dyspnea; determination of the heart failure severity and patient prognosis; evaluation of therapy efficacy; estimation of timing for heart transplantation; and prescription of intensity of exercise training programs. Despite the increasing number of studies and evidence that functional capacity is associated with all-cause and cardiac mortality in patients with heart failure and coronary artery disease (CAD) (1–3), the data regarding the relationship between cardiovascular function and functional capacity are scarce.

Aslanger et al. (4) in this issue of the journal entitled "Association between baseline cardiovascular mechanics and exercise capacity in patients with coronary artery disease" hypothesized that baseline cardiovascular mechanics may play a role in predicting the exercise capacity in patients with CAD. The authors included 25 CAD patients with reduced left ventricular ejection fraction [(LVEF) <55%] and the same number of CAD patients with normal LVEF (>55%). The investigators reported that all systolic cardiovascular mechanics parameters decreased in patients with reduced LVEF, whereas diastolic and arterial parameters did not differ between the observed groups. What is more interesting is that ventriculoarterial coupling showed a moderate correlation with peak oxygen consumption (VO_2) in patients with reduced LVEF (4). Only the left ventricular volume at 15 mm Hg (V_{15}), among diastolic parameters, and arterial compliance, among arterial parameters, appeared as significant factors that correlate with peak VO_2 in patients with normal LVEF. Conversely, in patients with reduced LVEF, none of the systolic, diastolic, or arterial parameters were correlated with peak VO_2 (4). However, ventriculoarterial coupling showed a moderate correlation with peak VO_2 in subjects with reduced LVEF. After adjustment for baseline differences, only ventriculoarterial coupling and V_{15} remained significantly correlated with peak VO_2.

The major limitation of this study is the limited number of included subjects. However, significantly larger investigations are still debating about the relationship between cardiovascular mechanics and functional capacity. The Aldo-DHF trial showed that the ventricular–vascular coupling correlated with peak VO_2 in patients with heart failure with preserved LVEF (5). Hasselberg et al. (6) showed that left ventricular (LV) systolic and diastolic parameters correlated with peak VO_2 in patients with preserved LVEF as well as in the entire group of patients with heart failure. The authors revealed that LVEF and E/A ratio correlated with peak VO_2 only in the entire population, but not in patients with the preserved LVEF, which is in line with the findings of Aslanger et al. (4). On the other hand, peak early diastolic filling velocity (E), deceleration time, and E/e′ ratio correlated with peak VO_2 in total study population and subpopulation with preserved LVEF (6), which was not confirmed by Aslanger et al. (4). Interestingly, Hasselberg et al. (6) indicated that LV global longitudinal strain significantly correlated with peak VO_2 in the total study population and subpopulation with preserved LVEF, and it was shown that LV longitudinal strain had significantly better ability to detect reduced peak VO_2 (<20 mL/kg/min) compared with EF and E/e′. In both the mentioned investigations, CAD was the main cause of heart failure (5, 6).

The latest study demonstrated that the oxygen uptake efficiency slope and minute ventilation/carbon dioxide production slope are independent predictors for all-cause and cardiovascular mortality in patients with CAD, irrespective of a maximal effort during CPET (7). Aslanger et al. (4) unfortunately did not study these associations, which would otherwise have been helpful for the population of heart failure patients who frequently stop CPET prematurely.

Despite the strong scientific evidence, which supports the usage of CPET, it should be underlined that CPET is still underutilized in everyday clinical practice because of cost, time, lack of equipment, and lack of competent specialists.

Marijana Tadic, Cesare Cuspidi[1]
University Clinical Hospital Centre "Dr. Dragisa Misovic - Dedinje", School of Medicine, University of Belgrade; Belgrade-*Serbia*
[1]University of Milan-Bicocca and Instituto Auxologico Italiano, Clinical Research Unit; Meda-*Italy*

References

1. Tenenbaum A, Motro M, Fisman EZ, Leor J, Boyko V, Mandelzweig L, et al.Functional capacity impairment in patients with coronary artery disease: prevalence, risk factors and prognosis. Cardiology 2003; 100: 207-15.
2. Arena R, Guazzi M, Myers J, Chase P, Bensimhon D, Cahalin LP, et al. The prognostic utility of cardiopulmonary exercise testing stands the test of time in patients with heart failure. J Cardiopulm Rehabil Prev 2012; 32: 198-202.

Address for correspondence: Marijana Tadic, MD, PhD, University Clinical Hospital Center "Dr. Dragisa Misovic - Dedinje", School of Medicine, University of Belgrade, Heroja Milana Tepica 1, 11000 Belgrade-*Serbia*
E-mail: marijana_tadic@hotmail.com
Accepted Date: 16.03.2016 **Available Online Date:** 25.04.2016

DOI:10.14744/AnatolJCardiol.2016.19711

3. Ingle L, Witte KK, Cleland JG, Clark AL. Combining the ventilatory response to exercise and peak oxygen consumption is no better than peak oxygen consumption alone in predicting mortality in chronic heart failure. Eur J Heart Fail 2008; 10: 85-8.
4. Aslanger E, Assous B, Bihry N, Beauvais F, Logeart D, Cohen-Solal A. Association between baseline cardiovascular mechanics and exercise capacity in patients with coronary artery disease. Anatol J Cardiol 2016; 16: 608-13.
5. Edelmann F, Gelbrich G, Duvinage A, Stahrenberg R, Behrens A, Prettin C, et al. Differential interaction of clinical characteristics with key functional parameters in heart failure with preserved ejection fraction-results of the Aldo-DHF trial. Int J Cardiol 2013; 169: 408-17.
6. Hasselberg NE, Haugaa KH, Sarvari SI, Gullestad L, Andreassen AK, Smiseth OA et al. Left ventricular global longitudinal strain is associated with exercise capacity in failing hearts with preserved and reduced ejection fraction. Eur Heart J Cardiovasc Imaging 2015; 16: 217-24
7. Coeckelberghs E, Buys R, Goetschalckx K, Cornelissen VA, Vanhees L. Prognostic value of the oxygen uptake efficiency slope and other exercise variables in patients with coronary artery disease. Eur J Prev Cardiol 2016; 23: 237-44.

Biochemist, MD. Meral Egüz's collections, İstanbul-Bosporus