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AUTONOMIC MODULATION OF LEFT VENTRICULAR DIASTOLIC FUNCTION IN HEALTHY ADULTS

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Relevance. The autonomic nervous system (ANS) plays a central role in maintaining cardiovascular homeostasis. While its effects on systolic function are well documented, left ventricular (LV) diastolic function is also energy-dependent and may be influenced by autonomic tone. Altered sympathetic-parasympathetic balance is a recognized feature of cardiovascular disorders, including heart failure with a preserved ejection fraction (HFpEF). Understanding how the ANS acutely influences diastolic indices in healthy individuals may help define normal physiological variability and improve the distinction between functional autonomic influences and structural myocardial diseases.

Aim: to investigate the acute effects of autonomic modulation on LV diastolic filling indices in healthy young adults using echocardiography with tissue Doppler imaging.

Materials and methods. A prospective study was conducted on 20 healthy adults (age 20–40 years; 10 men and 10 women). The protocol included three stages: (1) baseline rest, (2) exercise-induced autonomic activation using treadmill exercise at 70% of maximal heart rate, and (3) parasympathetic-promoting stimulation using guided deep breathing at 6 breaths/min. The autonomic state was assessed using heart rate variability indices, including the root mean square of successive differences (RMSSD) and high-frequency (HF) power. Diastolic assessment included the ratio of early to late mitral inflow velocity (E/A ratio), deceleration time (DT), and early diastolic mitral annular velocity (E′).

Results and discussion. At baseline, the participants demonstrated normal diastolic indices (E/A ratio 1.5 ± 0.1, DT 198 ± 12.4 ms, e′ 12.2 ± 0.8 cm/s). During exercise-induced autonomic activation, the E/A ratio decreased to 1.1 ± 0.2, DT increased to 234 ± 15.2 ms, and E′ decreased to 9.1 ± 0.7 cm/s, whereas guided slow breathing was associated with preservation or improvement of these indices (E/A ratio 1.6 ± 0.2, DT 180 ± 10.3 ms, e′ 13.7 ± 0.9 cm/s). However, during tachycardia, fusion of the E and A waves may reduce the reliability of the E/A ratio and DT measurements. In addition, because a breathing frequency of 0.10 Hz falls below the conventional HF band, the HF power and RMSSD may not fully reflect parasympathetic reactivity under this condition. Therefore, the observed changes should be interpreted as alterations in the diastolic filling dynamics rather than direct measures of LV stiffness.

Conclusion. This study suggests that acute changes in the autonomic state are associated with measurable changes in LV diastolic filling patterns in healthy adults. Exercise-induced autonomic activation was associated with less favorable filling indices, whereas guided slow breathing was associated with more favorable diastolic dynamics. These results support further investigation of autonomic modulation as a physiological influence on diastolic function and as a potential target for future non-pharmacological interventions.