Short Communication

Interventional Cardiology

Ventilatory efficiency is affected by left ventricular diastolic dysfunction without left ventricular ejection fraction

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About the study

In the past, the cause of heart failure was considered left ventricular systolic dysfunction, however, left ventricular diastolic dysfunction has also attracted attention of the causes of heart failure [1]. Left ventricular diastolic dysfunction is usually assessed in patients with Heart Failure with Preserved Ejection Fraction (HFpEF). HFpEF has been shown a similar mortality rate, compared to Heart Failure with Reduced Ejection Fraction (HFrEF) [2]. It is important to understand both the pathophysiology and the treatment of HFpEF. HFpEF also shows high rates of underlying diseases including hypertension, diabetes mellitus, and Chronic Obstructive Pulmonary Disease (COPD) and non-cardiovascular death [3]. The mechanism of left ventricular diastolic dysfunction is suggested multiple complicated factors. The cardiomyopathy by amyloidosis, hemochromatosis, and sarcoidosis deposits protein or otherwise in the myocardium and stiffens heart and cause left ventricular diastolic dysfunction. COPD occurs lung hyperinflation, increasing pulmonary vascular resistance, increasing right ventricular pressure, mechanical interaction to left ventricle, and causes left ventricular diastolic dysfunction [4]. Calcium handling, fibrosis, inflammation, nitric oxide, and oxidative stress are also considered the cause of left ventricular diastolic dysfunction.

Ventilatory inefficiency predicts prognosis in heart failure [5]. Ventilatory inefficiency is also detected the patients with hypertension without heart failure and is at risk of developing future heart failure [6]. Ventilatory efficiency depends on lung diffusing capacity [7], caused by alveolar-capillary membrane conductance [8], lung fluid and vascular stiffness [9], pulmonary capillary hydrostatic pressure, and left arterial pressure [10]. Left ventricular diastolic dysfunction increases cardiac filling pressure and limits cardiac output [11]. It is considered that left ventricular diastolic dysfunction occurs ventilatory inefficiency.

Cardiopulmonary Exercise Test (CPET) is a stress examination with using expiratory gas analysis and detects anaerobic threshold, exercise tolerance, cardiac function, and lung function in clinical setting [12,13]. CPET detects ventilatory volume including tidal volume, respiratory rate, Ventilatory Equivalents (VE) and ventilatory efficiency including VE/Oxygen uptake (VE/VO_2), VE/Carbon Dioxide output (VE/VCO_2), end-tidal oxygen, and end-tidal carbon dioxide. Lung function is important for understanding the pathophysiology of heart failure. During CPET, some patients with heart failure increase ventilatory equivalents due to high ventilation/perfusion mismatching [14]. HFpEF has been reported the impairment of ventilatory efficiency during exercise [15].

Left ventricular diastolic dysfunction exists HFrEF, in addition to HFpEF [16]. The study about ventilatory inefficiency in patients with left ventricular diastolic dysfunction during CPET, regardless of Left Ventricular Ejection Fraction (LVEF),

was reported [17]. In this study, 294 cardiovascular disease patients were divided into Grade I and Grade II/III left ventricular diastolic dysfunction groups by a national consensus and the groups adjusted age, gender, body mass index, smoking, and LVEF by propensity score matching. High left ventricular diastolic dysfunction group showed significantly high VE/VO_2 and VE/VCO_2 during all periods. High VE/VO_2 and VE/VCO_2 indicate impairment of ventilatory efficiency, because it suggests that more ventilation requires for oxygen uptake or carbon dioxide output. The report showed that left ventricular diastolic dysfunction, regardless of LVEF, impairs ventilatory efficiency during CPET. Although, high left ventricular diastolic dysfunction group did not show significant differences in the markers of ventilatory volume including tidal volume, respiratory rate, and VE, it might be affected lower rate of COPD.

Conclusion

HFpEF has been shown the impairment of ventilatory efficiency. Left ventricular diastolic dysfunction, regardless of LVEF, also showed impairment of ventilatory efficiency during CPET. The pathophysiology of heart failure without LVEF would also be important for understanding patient's pathological condition and prognosis.

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