The spell of ventricular systolic function

Kazuhiro Yamamoto

© The Japan Society of Ultrasonics in Medicine 2012

Doppler echocardiography provides much observational information about hemodynamics and cardiac function and structure in clinical practice and research. To obtain insight into the pathophysiology of cardiovascular diseases, reliable results and appropriate interpretation of results are required.

Heart failure with preserved ejection fraction (HFPEF) was previously referred to as diastolic heart failure. This phenotype is not associated with left ventricular dilatation or reduced ejection fraction, and stroke volume is not decreased. Symptoms are principally derived from elevated left atrial pressure, and thus diastolic dysfunction was considered to play a crucial role in this phenotype of heart failure. However, the term “diastolic heart failure” has resulted in a conflict. There have been many reports showing alteration of “indices of systolic function” in HFPEF, and these results have been interpreted as meaning that this phenotype of heart failure is due to systolic dysfunction. Is this conclusion right?

Firstly, many studies have compared HFPEF patients and normal subjects. There are several steps between the normal condition and HFPEF. There are many asymptomatic patients with cardiac dysfunction, and which factors play a key role in the transition from an asymptomatic stage to a symptomatic HFPEF stage has not been adequately discussed. Observed phenomena at the heart failure stage are not necessarily responsible for the pathogenesis

of this type of heart failure. They may be a result of the onset of heart failure or be only associated with heart failure without any effects on its pathogenesis. Secondly, what is a reliable index for ventricular systolic function? The ejection fraction is widely used as a simple index for systolic function. Although the ejection fraction is affected by many other factors and has several limitations as an index for systolic function, it is preserved in HFPEF. The slope of the end-systolic pressure–volume relation has been considered to be a load-independent, sensitive, and reliable index for systolic function, and is increased in HFPEF. An increase in the slope is interpreted as enhanced systolic function in subjects with reduced ejection fraction, but not in those with preserved ejection fraction. This difference in the interpretation of slope data is not based on scientific reasons. On the contrary, changes in Doppler echocardiographic indices obtained during the ventricular systolic phase in HFPEF are taken precedence over observation with such established indices for systolic function, and have led to the conclusion that systolic dysfunction plays a crucial role in HFPEF. Here, we have to recognize that such Doppler echocardiographic indices are only obtainable during the systolic phase, and it remains controversial whether those Doppler echocardiographic indices are superior to the previously established indices in the assessment of systolic function.

The confusion about the concept of HFPEF is principally attributed to a wrong impression that heart failure should be derived from systolic dysfunction. Patients with low cardiac output do not make up the majority of heart failure patients, regardless of their ejection fraction. Many patients show symptoms and signs of pulmonary congestion that is attributed to diastolic dysfunction. Even if systolic dysfunction is present, it does not necessarily mean that systolic dysfunction plays a crucial role in the

K. Yamamoto (✉)
Division of Cardiovascular Medicine,
Endocrinology and Metabolism,
Department of Molecular Medicine and Therapeutics,
Faculty of Medicine, Tottori University, 86, Nishi-cho,
Yonago 683-8503, Japan
e-mail: ykazuhiro@med.tottori-u.ac.jp

development of heart failure. We have to break free from the spell of ventricular systolic function and throw away the stereotypical concept that ventricular systolic function is overwhelmingly important in maintaining systemic circulation. This spell may mistakenly lead doctors into drawing inappropriate conclusions from clinical findings. If the ejection fraction does not differ but another Doppler echocardiographic index obtained during the systolic phase differs between normal subjects and patients with heart failure/cardiovascular diseases, some investigators make a simplistic conclusion that the latter index is more sensitive to systolic dysfunction without considering the possibility that the latter index is inaccurate for the assessment of systolic function.

The starting point of the cardiac cycle is usually set at end-diastole, because ventricular contraction is thought of as a principal and energy-consuming role. When is the heart most relaxed? The relaxed phase should require less energy. Have you ever seen the ventricle at end-diastole at autopsy? The ventricle is usually at end-systole at autopsy. This phenomenon is the same as rigor mortis and is caused by depletion of the energy source, ATP. Thus, the end-systolic phase, not the end-diastolic phase, is the stage where the least energy is required.

Belief is not necessarily truth!!