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REVIEW TOPIC OF THE WEEK

A Test in Context

E/A and E/e′ to Assess Diastolic Dysfunction and LV Filling Pressure

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JACC JOURNAL CME

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CME Objective for This Article: Upon completion of this activity, the learner should be able to: 1) explain the physical and physiological underpinnings of the Doppler and tissue Doppler parameters of diastolic function; 2) delineate the stepwise echocardiographic assessment of diastolic function in order to accurately diagnose individuals with diastolic dysfunction and elevated left ventricular filling pressure; and 3) describe the pathophysiology underlying the pearls and pitfalls of mitral inflow and tissue Doppler imaging in special scenarios such as constrictive pericarditis and pulmonary arterial hypertension.

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Medium of Participation: Print (article only); online (article and quiz).

CME Term of Approval

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A Test in Context

E/A and E/e′ to Assess Diastolic Dysfunction and LV Filling Pressure

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ABSTRACT

Diastolic dysfunction represents a combination of impaired left ventricular (LV) relaxation, restoration forces, myocyte lengthening load, and atrial function, culminating in increased LV filling pressures. Current Doppler echocardiography guidelines recommend using early to late diastolic transmitral flow velocity (E/A) to assess diastolic function, and E to early diastolic mitral annular tissue velocity (E/e') to estimate LV filling pressures. Although both parameters have important diagnostic and prognostic implications, they should be interpreted in the context of a patient's age and the rest of the echocardiogram to describe diastolic function and guide patient management. This review discusses: 1) the physiological basis for the E/A and E/e′ ratios; 2) their roles in diagnosing diastolic dysfunction; 3) prognostic implications of abnormalities in E/A and E/e′; 4) special scenarios of the E/A and E/e′ ratios that are either useful or challenging when evaluating diastolic function clinically; and 5) their usefulness in guiding therapeutic decision making.
(J Am Coll Cardiol 2017;69:1451–64)

Diastolic function is a catch-all term referring to several different physiological processes that allow the left ventricle (LV) to fill with sufficient blood for the body's current needs at a low enough pressure to prevent pulmonary congestion. *Diastole* (Table 1) actually begins in systole, as energy stored in titin within the myocyte and as torsion in the interstitial fibers of the myocardium. As systole ends, an abrupt untwisting occurs, which lowers pressure in the LV until the mitral valve (MV) opens, and blood flows along a negative pressure gradient (suction) toward the apex until the pressure equilibrates between the left atrium (LA) and the LV, resulting in diastasis until the final component of ventricular filling occurs with atrial contraction. Derangement of any of these components may produce the pathophysiological entity of *diastolic dysfunction* (Table 1), a leading cause of the important and growing clinical syndrome of heart failure with preserved ejection fraction (HFpEF), which now accounts for ≥50% of all heart failure cases (1).

TABLE 1 Components of Healthy Diastole and Disorders That May Affect Them

Diastolic Component	Potential Disruptors
Storage of energy in systole	Systolic dysfunction
Rapid untwisting and relaxation	LV hypertrophy, ischemia, dyssynchrony
Highly compliant fully-relaxed LV and compliant pericardium	LV hypertrophy, infiltration, scarring; constrictive pericarditis; RV overload with extrinsic compression of the LV
Effective atrial contraction	Atrial fibrillation, atrial systolic failure

LV = left ventricle; RV = right ventricle.

Herein we present a comprehensive review of the echocardiographic early to late diastolic transmitral flow velocity (E/A) ratio and the E to early diastolic mitral annular tissue velocity (E/e′) ratio, placing each of these tests in clinical context for the practicing clinician. We discuss: 1) the physiological basis for the E/A and E/e′ ratios; 2) the role of these parameters in diagnosing diastolic dysfunction; 3) prognostic implications of abnormalities in E/A and E/e′; 4) special scenarios of the E/A and E/e′ ratios that are useful when evaluating diastolic function clinically; and 5) the usefulness of these indexes in guiding therapeutic decision making.

THE PHYSIOLOGICAL BASIS FOR ECHOCARDIOGRAPHIC ASSESSMENT OF DIASTOLIC FUNCTION

Definitive assessment of diastolic function requires intraventricular pressure measurements (to measure the relaxation time constant, tau [τ], left ventricular end-diastolic pressure [LVEDP] before and after atrial contraction, and ventricular stiffness [which requires additional simultaneous ventricular volume measurement]) (2). Because these measurements are impractical for daily clinical practice, attention has been directed toward noninvasive methods,