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Commentary

Tissue Doppler Imaging in Cardiology: Its Roles and Clinical Applications

Cheuk Wang*

Department of Medicine and Therapeutics, Chinese University of Hong Kong, Ma Liu Shui, Hong Kong

DESCRIPTION

An effective echocardiographic method for assessing the quantitative systolic and diastolic function of the Left Ventricle (LV) is Tissue Doppler Imaging (TDI). Recent research has examined how TDI-derived parameters can help predict the prognosis of serious cardiac conditions such heart failure, acute myocardial infarction, and hypertension. Myocardial mitral annular or basal Segmental (Sm) systolic and early diastolic velocities have been demonstrated to predict cardiovascular events or mortality in these circumstances. The sensitive, noninvasive echocardiographic technique known as "Tissue Doppler Imaging" (TDI) makes use of the Doppler Effect to gauge the speed of tissue migration within the myocardium. It aids in the quantitative evaluation of the myocardium's global and local functions. This method aids in the early identification of risk variables as well as the detection of preclinical and clinical Left Ventricular (LV) systolic and Diastolic Dysfunction (DD) [1].

While strain imaging is a more accurate method for determining regional myocardial deformation, TDI detects myocardial velocity and velocity gradient, which are indirect indicators of myocardial deformation. Strain imaging enables for the early diagnosis of several subclinical cardiac illnesses, such as idiopathic dilated cardiopathy, in addition to being a more sensitive approach and angle independent. However, TDI is a quicker technique, has clinical applications that are specific and relevant, and has a higher temporal resolution than strain imaging. These clinical applications include assessing diastolic dysfunction, LV and RV systolic function, ventricular dyssynchrony, and constriction versus restriction. Additionally, TDI has other applications in modern echocardiography, such as the analysis of left atrial mechanics and the prediction of myocardial viability, even if these sophisticated methods are not widely used.

Doppler echocardiography depends on the ability to detect changes in the frequency of ultrasound waves reflected from moving objects. According to this theory, traditional Doppler techniques measure high-frequency, low-amplitude signals from tiny, quickly moving blood cells to determine the blood flow velocity. To quantify the higher-amplitude, lower-velocity signals of cardiac tissue motion in TDI, the same Doppler methods are applied. TDI can be carried out in both colour and pulsed-wave modalities. Because the longitudinally oriented endocardial fibres are most parallel to the ultrasound beam in the apical views, pulsed-wave TDI is particularly well suited to the measurement of long-axis ventricular motion. Mitral annular motion is a good substitute indicator of total longitudinal Left Ventricular (LV) contraction and relaxation because the apex is generally stationary during the cardiac cycle [2,3].

Applications of tissue doppler imaging

The most recent recommendations for studying diastolic function put a lot of emphasis on TDI for diastolic dysfunction diagnosis and grading. These recommendations state that TDI is a requirement for evaluating diastolic function; three of the five measures used to diagnose diastolic dysfunction are TDI parameters. It should be emphasized that spectral TDI makes it possible to get E' even with a weak sonographic signal and with relatively high significance. Given that TDI is an angle-dependent approach, a good alignment is a prerequisite in order to prevent an underestimation of E' value. Daily echocardiogram routinely includes the TDI test to evaluate diastolic function; nonetheless, it is crucial for patients with heart failure with intact ejection fraction and for the assessment of LV filling pressure [4].

A measurement of longitudinal systolic function, systolic myocardial velocity (Sa) at the lateral mitral annulus correlates with peak dP/dt and LV ejection fraction measures. Within 15 seconds of the beginning of ischemia, a decrease in Sa velocity can be seen, and regional decreases in Sa are associated with localised abnormalities in wall motion. Peak Sa velocity typically rises with dobutamine infusion and and falls with ischemia, hence that TDI measurements of systolic function be incorporated into exercise testing to evaluate for ischemia, viability, and contractile reserve.

A sensitive assessment of all synchronisation parameters is possible using TDI due to its great temporal resolution, regardless

Correspondence to: Cheuk Wang, Department of Medicine and Therapeutics, Chinese University of Hong Kong, Ma Liu Shui, Hong Kong, E-mail: wangcheuk@cu.hk

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of whether the motion is at the intraventricular or interventricular level. An important point to note is that colour TDI is a qualitative method that enables the visual evaluation of synchrony by employing various coded colours that can be translated into curves representing the earliest and later segment contraction. Additionally, spectral TDI is helpful for studies on tissue synchronisation, and the metrics "time to onset" (from the start of the QRS to the commencement of systolic motion on the spectral curve) and "time to peak" are frequently utilized (from onset to peak of motion on spectral curve) [5].

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