EDITORIAL
DOI 10.4070/kcj.2011.41.3.122

Print ISSN 1738-5520 / On-line ISSN 1738-5555

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Interpretation of Annular Tissue Doppler Imaging

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Diastolic dysfunction has become a more predominant form of heart failure (HF) than systolic dysfunction in the community. However, diastolic dysfunction is not always related to HF. Diastolic HF is defined as HF with preserved left ventricular (LV) systolic function, usually a LV ejection fraction (EF) of more than 50%, in the absence of valvular heart disease. The clinical importance of diastolic dysfunction has increased because its prevalence has increased with worsening morbidity and mortality, especially in the elderly and women. The standard criteria for LV diastolic dysfunction is characterized by impairment of LV relaxation during the isovolumic relaxation time (Tau) in cardiac catheterization. However, routine invasive cardiac catheterization is not always feasible, and therefore, we need simple noninvasive modalities to replace catheterization.[1)2)] The initial approach to assess diastolic function was the pulsed-wave Doppler of mitral inflow, based on the early filling (E) and atrial contraction (A) ratio and E-deceleration time. However, there were some limitations, first being its dependency on loading conditions and difficulty in differentiation between the normal and pseudonormal pattern. To overcome these limitations, mitral annular tissue Doppler imaging (TDI), with primary measurements of systolic (s'), early diastolic (e') and late diastolic velocity (a') has been widely used. TDI-derived velocities also have some limitations. The e' velocity can change with increase in age and it may not be useful in conditions of heavy mitral annular calcification, septal or lateral wall infarction, constrictive pericarditis, and severe mitral regurgitation. Despite these limitations, TDI is a sensitive and load-independent measure of LV relaxation, and has been a part of the most widely used and important echocardiographic parameter. A recent study by Baek et al.[3)] identified that when interpreting diastolic function in elderly subjects, different cut-off values should be considered according to TDI modality, annulus site, and gender. Study results have shown that spectral TDI has a somewhat higher e' than that of color-coded TDI, and the e' value in both these methods of tissue Doppler is lower in women as compared with men.

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• The author has no financial conflicts of interest.

Spectral Tissue Doppler Versus Color-Coded Tissue Doppler

Spectral TD images are acquired from the medial or lateral portion of mitral annulus using 2 mm sample volume and it detects the frequency shift between the emitted and returning ultrasound signal that is subjected to Fast Fourier analysis and the method provides peak velocity at a given myocardial location.[4)] However, spectral TDI can produce a random noise. Color-coded TDI appreciates Doppler shift analysis with autocorrelation technique and this is achieved by smoothing of the Doppler signal by temporal filtering, and it provides the relative mean myocardial velocity for a given segment. And therefore theoretically, color-coded TDI value should be lower than spectral TDI value and may underestimate the true value. The diagnostic accuracy in assessing diastolic dysfunction by using two tissue Doppler methods has not been studied systemically.

As Baek et al.[3)] reported that spectral TDI showed higher e' than color-coded TDI, which as expected was consistent with the previous studies. The diagnostic accuracy of these two methods for detecting diastolic dysfunction is not statistically different either on septal or lateral tissue Doppler.

Gender Difference on Tissue Doppler

In general, TDI has shown that men have a significantly higher s' compared with women. Because strain and strain rate values are not significantly different between genders, LV length appears to explain the difference in s' between genders. However, the results of e' between genders are not always consistent. Unlike this issue, another study by Holland et al.[5] reported that e' is not different between genders. The main difference between the two studies was the subjects' age. In the elderly group, women might have a more stiff LV chamber during LV diastole than men, which resulted in a lower e' in this case.

In conclusion, when we measure annular TDI we have to consider the methodology of TDI measurements, patient's age and gender, although the differences are not so large. However, this conclusion can only apply to those patients who had hypertension and who are ≥70 years of age and should not be extrapolated to all age groups or all patients with HF.

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