Detection of subclinical LV dysfunction by tissue Doppler imaging

Frank Weidemann* and Joerg M. Strotmann

Department of Internal Medicine I, Center of Cardiovascular Disease, University of Wuerzburg, Germany

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This editorial refers to 'Tissue Doppler imaging predicts left ventricular dysfunction and mortality in a murine model of cardiac injury'1 by T.G. Neilan et al., on page 1868

Echocardiography is a well-established clinical tool for the assessment of myocardial function. However, in subclinical diseases, the routinely used echocardiographic parameters such as left ventricular (LV) ejection fraction (EF) and fractional shortening are not sensitive enough to detect myocardial dysfunction. We have learned over the past years that other echocardiographic techniques such as tissue Doppler imaging might be able to describe changes in myocardial performance that go beyond the limitations of ‘simple’ measurements of EF or myocardial motion.1 The technology of tissue Doppler imaging has been technically implemented since almost a decade, and within the last years, numerous studies have shown the additional value in describing changes in LV function both in systemic and regional myocardial diseases.2,3 By post-processing, tissue Doppler data strain rate can be calculated, which is a regional deformation parameter independent of overall heart motion and tethering effects. This parameter has been validated and is mainly related to the intrinsic contractility of the underlying myocardium and relatively independent of heart rate.4 A variety of cardiac diseases causing subtle impairment of LV contractility have been evaluated by these techniques, including cardiomyopathies, hypertensive heart disease, and myocardial storage disorders.2,5,6 In addition, it could be shown that specific treatment in different diseases can change regional myocardial function, which was documented by tissue Doppler and strain rate imaging.5,7 Using echocardiography, only those new tissue Doppler based parameters could detect these subtle changes in myocardial function in contrast to conventional measurements.5,7

In this respect, the study by Neilan et al.8 deserves our attention for different reasons. Their experimental study in a murine model of LV dysfunction suggests that abnormal tissue Doppler and strain rate indices may predict late cardiac dysfunction and death, at a time when conventional echocardiographic parameters are still normal. In this context, the study eludes the next step whether those new technologies may predict clinical endpoints such as heart failure and cardiac death, which is a crucial information for the clinical relevance of new technologies currently invading cardiology.

To confirm the toxic impact of doxorubicin on the investigated myocardium, invasive haemodynamic measurements and also histological studies on cardiac apoptosis were taken as the gold standard of cardiac assessment. Tissue Doppler data were related to those haemodynamic and histological abnormalities and even of more importance to clinical outcome. This supports the concept to use tissue Doppler imaging for monitoring cardiac effects of new therapeutic strategies to prove cardiac efficacy or side effects.

Another important aspect of this study is the fact that tissue Doppler imaging was used in a small animal model (mice). Currently, murine models of cardiac diseases play an increasingly important role in the understanding of the disease process and the evaluation of different therapies. In this respect, it is interesting to see that tissue Doppler imaging is also applicable in the experimental environment even in the presence of heart rates up to 500/min.9 Although the original recordings of Doppler traces which were presented in this paper look reliable, the spatial resolution in mice hearts remains a matter of discussion, especially when endocardial velocities are given and transmural myocardial strain rates are calculated. In clinical application, we currently try to compensate for false measurements by tracking the region of interest throughout the cardiac cycle. It remains unclear how to do this technically in mice with high heart rates and thin LV walls. Maybe automated algorithms based on raw data measurements with speckle tracking facilities will solve this problem in the future. First, applications have been presented and are under evaluation.10

The study by Neilan et al. is important in the way that it sets path for further applications of tissue Doppler imaging in the clinical evaluation of subclinical states of myocardial dysfunction and confirms the results of a number of tissue Doppler studies dealing with the assessment of this subtle LV dysfunction in patients. However, larger multicentre trials are needed to confirm the clinical value and the accuracy of tissue Doppler parameters to predict the clinical
outcome and to define its role in the cardiac assessment of patients at risk.

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References