Myocardial strain imaging and malignant ventricular arrhythmia risk

Early repolarization syndrome (ERS) refers to sudden cardiac death or documented ventricular tachycardia/ventricular fibrillation in individuals with an early repolarization pattern (ERP). Although ERP is associated with higher risk for arrhythmia death, the absolute increase in risk is low (1). ERP has never been shown to consistently increase arrhythmic risk in the absence of additional pro-arrhythmic triggers.

A large inter-segmental variability in contraction duration (mechanical dispersion) may cause dyssynchrony and reflects local electromechanical heterogeneity of myocardial tissue. Mechanical dispersion and global longitudinal strain (GLS) assessed with speckle-tracking echocardiography (STE) seem to be markers of high risk of ventricular arrhythmia in patients with cardiomyopathies (2).

In ERP, malignant ventricular arrhythmias are consequence of abnormal electrical substrate (not structural). However, even patients with channelopathy such as congenital short QT syndrome seem to have a significant dispersion of myocardial contraction, a consequence of subclinical systolic dysfunction (3).

Strain imaging produced with STE is an excellent tool for assessing regional and global systolic and diastolic left ventricle (LV) function. Longitudinal LV mechanics, which are predominantly governed by the subendocardial layer, are the most vulnerable and most sensitive to presence of myocardial disease. Subendocardial fibers determine primarily the longitudinal strain, whereas mid-myocardial and subepicardial fibers determine predominantly the circumferential and radial strain and rotation. There is also a base-to-apex gradient, with higher velocities recorded at LV base than near apex. Most cardiac pathologies involve subendocardial layers first; longitudinal strain is usually the earliest to be compromised and is more robust than radial strain. Radial and circumferential strains remain preserved, or may even be accentuated, during early stages to compensate for loss of longitudinal function. Impairment of radial and circumferential strain is a relatively late phenomenon and tends to reflect more extensive myocardial damage. If unaffected, mid-myocardial and epicardial function may result in normal or nearly normal circumferential and twist mechanics with relatively preserved LV pump function and ejection fraction. Compromised early diastolic longitudinal mechanics and reduced and/or delayed LV untwisting may elevate LV filling pressures and result in diastolic dysfunction.

Gülel et al. (4) studied myocardial deformation parameters (strain, strain rate, rotation, and twist) of LV obtained using STE in subjects with ERP. They concluded that LV myocardial deformation evaluated with STE is normal, with a few regional exceptions, and that STE does not provide much information about risk stratification in subjects with ERP. Gülel et al. (4) found some changes in circumferential and radial early diastolic parameters, known to be related to arrhythmia risk. Proving significant dispersion in certain myocardial segments in ERP would be of great value to identify patients at high risk. Patients with type 3 ERS, which involves ERPs with inferior, lateral, and right precordial leads abnormalities, have the highest level of risk for malignant arrhythmias; however, they were not present in the study of Gülel et al. (4).

Although some form of standardization seems to be mandatory (5), STE might be promising in arrhythmia risk stratification.

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Accepted Date: 24.06.2016

DOI:10.14744/AnatolJCardiol.2016.00016