Which oracle to use for tracking a desynchronized heart? A matter of predictability in contemporary medicine

"One theory is scientific to the extent that can be disproved."
Karl Popper

In diseased hearts, an electrical dyssynchrony caused by an altered velocity and uniformity of electrical propagation may result in areas of activation delay (1); when the delay has a certain pattern, it is also observed on the surface 12-lead ECG as a lengthening of the QRS complex. The functional consequence of this delay may be a mechanical dyssynchrony. As indicated by Kass (2), cardiac dyssynchrony should be distinguished from dyssynergy, which refers to a difference in function and not timing. We can distinguish at least three types of mechanical dyssynchrony: atrio-ventricular, inter-ventricular, and intra-ventricular. Because mechanical dyssynchrony can manifest without QRS elongation (3), particularly in an infarcted myocardium, all these types of mechanical dyssynchrony can be accurately identified using a combination of echocardiographic techniques including simple M-mode pulsed/continuous Doppler, pulsed tissue Doppler (up to specific applications and usually offline), color tissue velocity imaging, strain rate imaging, real-time three-dimensional reconstruction (4), and speckle-tracking echocardiography (STE) (5), even if the agreement between these approaches is variable (6).

It is well established that a defective electromechanical coupling may depress the ejection fraction of the left ventricle (7) and cause cardiac pathological remodeling that occurs with dilation of the left ventricle and further deterioration of the ventricular function over time, according to a known vicious circle, which also depends on the factor that caused heart failure (HF). The solution to the problem consists in starting a process of reverse remodeling by optimizing medical therapy with drugs of proven efficacy such as angiotensin-converting enzyme inhibitors (ACEi) and beta-blockers. In this context the process of fibrosis in atria (8) and in ventricles is both pathological marker and therapeutic target because it has been demonstrated in arterial hypertension with some classes of drugs acting on the renin–angiotensin-aldosterone system (9). More recently, a new therapeutic option in HF has gained ground with the introduction of cardiac resynchronization therapy or CRT. This approach was previously tested in the atrioventricular dyssynchrony in 1990 (10) using bicameral pacemakers and subsequently extended to ventricular dyssynchrony by adding a pacing lead in the left ventricle to the existing standard pacemakers or defibrillators with usually only a right ventricular lead (11). Thus far, CRT is tailored for patients with QRS>120 ms and LVEF≤35%, and at least, moderate symptoms of chronic HF. One of the main problems is that at least 30%-50% of patients undergoing CRT fail to respond adequately, or in some cases, HF worsens (12), and QRS duration does not accurately distinguish responders to CRT (13); furthermore, the LVEF 35% criterion, as suggested by a post-hoc analysis of the PROSPECT study (14), has proved to be not always appropriate. In the complex interplay between diagnostic and therapeutic tools, the situation appears to be confusing (6, 15) and this problem is part of a more recent question that results from the application of probabilistic data to medical choices: can the mathematical-statistical models support clinical decision making? These models, indeed, are imperfect representations of the reality because they are built on relatively limited groups of studied subjects, and therefore, their predictability is limited. In recent years when clinical decisions are forced by the practical guidelines, which are the operational consequence of this probabilistic approach, recover of only an individual patient appears impossible. For all those of us who believe in a medicine tailored to each patient, the question on which oracle you must consult to track a desynchronized heart remains unavoidable.

In the current issue of Anatol J Cardiol published "Apical transverse motion is associated with speckle-tracking radial dyssynchrony in patients with non-ischemic dilated cardiomyopathy." entitled by Gürel et al. (16), a preliminary experience of assessing apical transverse motion (ATM) as a surrogate parameter to assess regional temporal and functional left ventricular inhomogeneities has been reported and compared with STE (17), a parameter that was tested in the Speckle-Tracking and Resynchronization trial (5). Even with some limitations, including the number of studied subjects and lack of a follow-up on the few CRT patients, the study confirm that ATM is associated with radial dyssynchrony assessed by STE supporting the concept of a certain overlap between the techniques to assess mechanical dyssynchrony, with peculiar pros and cons of each of the aforementioned approaches.

In search of more reliable criteria to overcome the puzzle of how to define and track a desynchronized heart (6), STE requires high quality images, including a high frame rate and second

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harmonic tool; defining the ROI, as in any other echocardiographic gray scale analysis (18), is almost user dependent and the endocardial-epicardial borders are manually traced. Nevertheless, STE has been validated by accurate sonomicrometry and tagged MRI and demonstrated to overcome one of the main limitations of tissue Doppler technology that requires the parallel orientation between the ultrasonic beam and wall motion direction (19). In this context, because a golden standard is not yet available, we must rely on multiparametric echocardiographic score.

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