The Phenomenon of Early Repolarization
A False Alarm?

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Early repolarization, ST-segment elevation in the absence of conduction abnormalities, or chest pain has been considered as a normal state for more than half a century. Because this ECG pattern predominates among young and fit individuals with slow heart rates, it has been generally viewed as a marker of good health. Most recommendations for standardization and interpretation of the ECG include a statement that the term early repolarization is used to describe a normal QRS-T variant with ST-segment elevation, and most clinicians have for years been considering early repolarization as nonspecific ST elevation, especially in the left precordial leads. After some case reports pointing to an arrhythmogenic potential of early repolarization, a series of case-control studies in 2008 unexpectedly described an apparent over-representation of J waves (ie, terminal QRS notch and slurring) in inferolateral leads in patients with idiopathic ventricular fibrillation.1,2 These findings challenged physicians to think again about the belief that this pattern was simply a normal variant and lead to confusion among both professionals and patients. Thereafter, inferolateral QRS notch and slurring, referred to as early repolarization ECG pattern, have also been demonstrated to possess an increased risk of sudden cardiac death and mortality in general population,3–5 and its association with malignant arrhythmias during ischemia seems substantial.6–8 However, the first issue to keep in mind with articles concerning this phenomenon of early repolarization is the fact that idiopathic ventricular fibrillation and the so-called early repolarization syndrome associated with it are rare conditions, and these should not be confused with plain early repolarization ECG pattern, which is a common finding from childhood to middle age.3–5,9 Furthermore, it cannot be overemphasized that practically all of the articles with any association between early repolarization pattern and adverse outcomes have put their focus on J waves and terminal QRS slurring or notchting instead of the classical definition of ST elevation. The amount of research articles concerning this phenomenon has exploded during the past couple of years, but the clinical implications of J waves in apparently healthy individuals have remained unclear given that this pattern is remarkably common, yet primary electric disease associated with sudden death is rare. The ongoing investigation of this ECG pattern has begun to clarify this apparent paradox, and with time it will hopefully lead to a more practical approach of how to live with this potentially deadly ECG pattern.

In this issue of Circulation: Arrhythmia and Electrophysiology, Ilkhanof et al10 present a benign natural history of early repolarization in young adults followed to middle age. A total of 5039 individuals were followed for >23 years, with several 12-lead electrocardiograms recorded during the follow-up period. As in previous studies, those with early repolarization were more likely to be men, black, smokers, and have greater fitness, lower heart rate and body mass index, and longer PR, QRS, and QT intervals. After adjustments, no statistically significant associations with total or cardiovascular mortality were found at any point of the follow-up. The vast majority of early repolarization patterns regressed with time: the pattern was observed in one fifth of the population at baseline, and the prevalence diminished over time down to 6%. The maintenance, loss, or gain of the pattern during the follow-up did not influence the outcomes. These findings were rather expected after observations from previous studies, such as the influence of testosterone level to the presence of early repolarization pattern and the decline of the pattern with aging, as well as the benign prognosis and high prevalence of ST elevation especially in the lateral leads.9,11,12

Two major points from this study must be emphasized. First, as the authors write themselves, they have used a significantly differing definition for early repolarization compared with recently published articles. The pattern of early repolarization in this study has comprised mainly of the classical ST elevation in left precordial leads, whereas practically every other article describing any association between early repolarization pattern and sudden cardiac death has focused on terminal QRS changes and found especially inferior manifestations and J waves without any ST elevation to carry a remarkable risk. Thus, these results are not related to the recent fear of J waves but are further confirming the benign nature of the classical form of early repolarization in left precordials.11,13 One should note that these fundamental differences in the definition of the pattern are not weaknesses of the study but describe the current lack and urgent need for some standardization for the term early repolarization14 Second, as the authors again debate themselves, their follow-up is limited to middle age, and the participants are not yet exposed to triggering events, such as myocardial ischemia, at rates that would possibly lead to statistically significant associations. This is an important notion per se, because there are emerging data supporting

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the concept that early repolarization pattern would only act as an underlying electrophysiological substrate but require a trigger to turn bad. This is the so-called 2-hit hypothesis, as presented by Dr Viskin elsewhere.\textsuperscript{13,14} It is speculated that individuals with early repolarization might have an increased risk of ventricular fibrillation during events such as those present in myocardial ischemia, which further shorten the action potential and increase the repolarization dispersion. The risk of arrhythmias might also be increased in situations in which early repolarization and a fixed arrhythmogenic substrate are present, such as myocardial scarring in older ages or other pathological conditions. All of these speculations quickly arise the question whether the so-called early repolarization pattern represents accelerated repolarization or whether it is actually a manifestation of a conduction defect, but thus far no one knows. Overall, the results presented by Ilkhanof et al\textsuperscript{10} fit the current knowledge of early repolarization well, but clinicians are encouraged to familiarize themselves with the previous articles on inferolateral J waves.

The used terminology surrounding the terms J waves and early repolarization can be misleading in many ways, and therefore some consensus concerning the definitions with different patterns is requested. At the end of the day, with the current knowledge it seems that the classical form of early repolarization with high take-off ST elevations in left precordials, as familiar to most clinicians, should not be interpreted as a marker of a high risk for sudden cardiac death without any other cause suggestive of cardiac disease. When the rare patients with idiopathic ventricular fibrillation and early repolarization syndrome are excluded, overall most of the other phenotypes of early repolarization and J waves, in general, also likely possess minimal risk of sudden cardiac death, although in the presence of additional and transient conditions, the threshold for severe arrhythmias might be reduced. The early repolarization syndrome in patients with cardiac arrest is good to acknowledge, but it is likely that in the vast majority of apparently healthy individuals, inferolateral J waves in an ECG will not turn into a clinical issue without the development of other arrhythmic triggers.

Disclosures
None.

References

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