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Editorial

Value of measurement of QRS-T angle from a standard 12-lead electrocardiogram☆

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The frontal QRS-T angle is defined as the angle between frontal-plane 2-dimensional directions of ventricular depolarization and repolarization measured from 12-lead standard electrocardiogram (ECG). A wide QRS-T angle has been proposed to reflect either structural cardiac abnormality or changes in ionic channels altering the sequence of repolarization. A wide QRS-T angle has also been shown to predict mortality in various populations [1,2]. In a seminal paper by Zabel et al. 3-dimensional angle between depolarization and repolarization waveforms, calculated by the integrative TCRT approach, was a strong predictor of mortality in post-infarction patients [3]. Many subsequent studies have confirmed this observation. A more precise 3-dimensional evaluation of depolarization and repolarization process can be obtained by vectorcardiography or by orthogonal representation of a standard 12-lead ECG. This more complex methodology, however, is not easily available for diagnostic purposes and it is not usually implemented in automated ECG analysis. In contrast, frontal plane QRS-axis and T-axis are readily available from standard 12-lead ECG and are usually included in the automated reports of ECG machines. Despite its apparent computational simplicity, measurement of and utility of the frontal QRS-T angle in diagnostics is not familiar to most clinicians.

In a large multi-center study, Strebel at al. have assessed the diagnostic utility of QRS-T angle in the diagnosis of non-ST elevation myocardial infarction as well as its prognostic significance [4]. The authors conclude that frontal QRS-T angle measured from standard 12-lead ECG provides incremental diagnostic accuracy for the diagnosis of non-ST-elevation myocardial infarction on top of standard ECG criteria, and independently predicts all-cause mortality during 2 years of follow-up. This is a well-conducted study with relevant results. The authors have to be commended to have pulled the parameter out and to test it with high accuracy. The strength of this paper is to include 2705 patients and to show statistically incremental diagnostic efficacy independence from age, ECG confounders, and troponin levels.

It would be interesting to see, if 3-dimensional analysis would have provided even stronger diagnostic and prognostic accuracy. Different computational possibilities of the 3-dimensional QRS-T angle analysis have previously been used in different studies. Comparing some of these, it has recently been shown that 3-dimensional integrative TCRT approach to the calculation provides stronger predictor of mortality than other spatial QRS-T angle expressions, and that there are no strong correlations between the results of the different computations [5]. It has been proposed that this is mainly because the QRS complex does not have a universal direction and, particularly in diseased hearts, exhibits complex directional fluctuations. Such fluctuations are, by definition, lost in the frontal-plane assessment. Hence, a true 3-dimensional analysis of depolarization and repolarization heterogeneity is perhaps to be expected to improve the assessment of electrophysiologic abnormalities and thus a stronger prognostic accuracy.

Strebel et al. have not analyzed separately the directions and deviations of T-wave and QRS axis. In a general population sample, the prognostic significance of wide QRS-T angle was mainly due to abnormal T-wave axis, suggesting that analysis of only T-wave axis might be enough for prognostic purposes [2]. It can be assumed that acute ischemia also causes more abnormalities in T-wave than overall QRS axis directions if the 3-dimensional details are excluded. If so, this could further simplify the ECG diagnostics without the analysis the angle itself. In addition, the threshold for distinguishing between normal and abnormal QRS-T-angle has varied in different studies, and the optimal cut-off values can also differ between sexes, in addition to heart rate dependency [6]. The study of Strebel et al. does not provide a definite cutoff value of the QRS-T angle for diagnostic or for prognostic purposes.

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One statistical point of the study by Strebel et al. deserves a comment. Any new diagnostic or risk marker should be ideally tested by using c-statistics and reclassification analyses to give more insight how much the novel index improves the diagnostic accuracy on the top of all known clinical markers (and ECG findings in the study of Strebel at al.). The ROC curve comparison does not give enough information for this purpose. C-statistics gives some relevant information, but categorical reclassification index would provide even more powerful clinical information, such as the number or percent of patients who can be correctly diagnosed when a novel index is added to established model, including all well-known diagnostic markers, such as other ECG criteria of ischemia, symptoms, age, gender, coronary risk markers etc. in this context. Analyses of this kind would have given more information on the clinical utility of the measurement of QRS-T angle in the diagnosis of non-ST elevation myocardial infarction and on its prognostic value. Anyway, the present study by Strebel at el. suggests that the measurement of dimensional directions of depolarization and repolarization and their relation to each other could provide useful information in various clinical settings.

Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

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