# Review of: "Using QRS loop descriptors to characterize the risk of sudden cardiac death in patients with structurally normal hearts"

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**Commentary on: Using QRS loop descriptors to characterize the risk of sudden cardiac death in patients with structurally normal hearts**

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Sudden cardiac death (SCD) is worldwide a prominent cause of both morbidity and mortality and is mainly caused by cardiac arrhythmias, particularly ventricular tachyarrhythmias [1,2]. Prior reports demonstrated that between 5% and 10% of SCD patients have a ‘normal’(structural and functional) heart [3]. However, the exact mechanism of SCD in patients with a structurally normal heart is still unknown [3,4] and patients at risk cannot be identified due to a lack of accurate

diagnostic criteria. In this paper, Cheng-I Wu et al. focused on the ventricular arrhythmogenic substrate using the characteristics of the QRS loop. Electrocardiographic (12-lead ECG) and echocardiographic examination revealed no electrical or structural abnormalities.

However, spatial information hidden in the 12-lead ECG is not easily distinguishable by visual inspection. Therefore, Cheng-I Wu et al. projected 12-dimensional ECG data into three orthogonal vectors, which contain 90% of the overall amount of variance explained by all principal components. In this way, the heart's 2D and 3D dynamic structure from an electrical activity point of view are represented by the vectorcardiograms without including the time information.

In the vectorcardiogram, the cardiac trajectory is represented by loops employed to characterize the spatiotemporal electrical activity of the heart. Therefore, the surface of the QRS loop is a feasible indicator of abnormalities in electrical activity. The authors showed that the percentage of the loop area in SCD is lower than in the control group. This phenomenon is due to the poor electrical conduction along the x- or y-direction, which reduces the surface of the QRS loop [5].

Although in this paper, the authors introduced a useful method to detect SCD in patients with a history of aborted SCD, there still are some issues that needs to be taken into account in future studies.

The authors showed that the loop area in the SCD group is lower than in the control group. However, this finding does not apply solely to SCD; in other cardiac diseases, such as atrial fibrillation (AF) [6] and myocardial infarction(MI) [5], the surface of the QRS loop is lower than in a control population in respectively the x-direction and z-direction. Therefore, in order to detect SCD, specific criteria applicable only to SCD are mandatory. Moreover, the amplitude of the electrical activity is influenced by the body mass index (BMI) which also has an impact on the QRS loop area. Therefore, we recommend to take also the BMI into account. The authors mentioned that they divided the QRS surface into 4900 pixels. However, the QRS surface should be discretized due to the ADC's (analog-to-digital converter) resolution. In other words, ADC resolution is effective in the accuracy of loop dispersion (LD).Furthermore, Cheng-I Wu et al. reported the results from a population including 59 SCD patients and 103 patients from the control group using one-way ANOVA. In one-way ANOVA, however, an unbalanced dataset has an impact on the robustness of the equal variance assumption. Finally, the AUC values in the ROC analysis represent that themodel needs improvement to be capable in distinguishing between classes. This is also confirmed in Fig.4 that events overlap a lot, and enhancements in the features are required.

Despite these issues, from the clinical point of view, the method proposed by Cheng-I Wu et al. is relativelystraightforward and applicable in daily clinical practice. Unfortunately, the first clinical demonstration of VA is usually SCD [7]. However, a small percentage of people who died of SCD had wearable ECG electrodes. Therefore, using wearables, particular multi-lead ECG devices may lead to early recognition of individuals at risk for SCD and hence to timely treatment and reducing health expenses.

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