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Research Article

ELECTROCARDIOGRAPHIC MARKERS OF SUDDEN CARDIAC DEATH: THE ROLE OF UNRECOGNIZED PATTERNS

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Abstract

Electrocardiographic (ECG) interpretation relies on established reference ranges for key cardiac intervals, particularly the PR interval (0.120–0.200 ms) and the corrected QT (QTc) interval (0.360–0.450 ms in healthy adults, with up to 0.460 ms considered normal in women). The QT interval is commonly corrected using heart rate–dependent calculations derived from the RR interval preceding it, ensuring more accurate assessment of ventricular repolarization. Deviations from these normative values are clinically significant, as disturbances in cardiac electrical conduction may predispose individuals to electrical instability, malignant arrhythmias, and potentially sudden cardiac death.

This paper highlights a critical and often under-recognized electrocardiographic pattern characterized by simultaneous shortening of both the PR and QT intervals. Such combined shortening may indicate heightened myocardial electrical vulnerability, increasing the risk of severe rhythm disturbances. Despite this, affected individuals may present with ECG findings that are interpreted as within normal limits, particularly when assessed in asymptomatic or baseline clinical conditions. This creates a diagnostic challenge, as the subtle dual-interval reduction may be overlooked, leading to underdiagnosis of a potentially life-threatening condition.

Clinically, this pattern is frequently observed in young adult females, particularly in the third decade of life, who present repeatedly to emergency services with non-specific symptoms such as nocturnal palpitations, diaphoresis, agitation, and occasional syncope. These symptoms often resolve upon hospital arrival, and routine vital signs and laboratory investigations typically remain within normal ranges, except in some cases where subtherapeutic lithium levels are noted. Importantly, nocturnal symptom onset, including palpitations that disrupt sleep and episodes of true syncope, are recurrent features. While patients may appear clinically stable, the risk of progression to malignant arrhythmias, cardiac arrest, or sudden cardiac death remains significant.

The findings underscore the importance of careful ECG interpretation beyond standard reference ranges, particularly in patients with recurrent unexplained symptoms. Recognition of concurrent PR and QT interval shortening may provide an important diagnostic clue for identifying individuals at elevated risk of sudden cardiac events. Enhanced clinical awareness and more refined diagnostic criteria are therefore essential to improve early detection and prevent fatal outcomes associated with this underappreciated electrocardiographic pattern.

Keywords: Electrocardiogram; PR Interval; QT Interval; Sudden Cardiac Death; Cardiac Arrhythmia

INTRODUCTION

Consequently, the standard values for us -and for most authors- are: **PR interval:** From 0.120 milliseconds to 0.200 milliseconds **Corrected QT interval:** 0.360 milliseconds to 0.450 milliseconds (in healthy women up to 0.460 milliseconds is considered normal) **[3].**

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We speak of a corrected QT interval because a calculation must be made between the value of the QT interval obtained and the value of the RR interval measured prior to the QT interval obtained. Whenever there is a disturbance in the heart's electrical system - in this case, in the duration of the different intervals of the ECG tracing - the heart becomes much more vulnerable and electrical instability manifests itself, leading to numerous serious types of cardiac arrhythmias, some of which could be fatal (as we have written above).

In this case, a shortening of the PR interval together with a shortening of the QT interval in the same individual, the vulnerability discussed above and electrical instability could be much greater and even highly lethal.

But, in addition, when the patient suffering from this type of alterations is in baseline and asymptomatic conditions, the electrocardiographic tracing can be considered as "within normality", and go unnoticed and, therefore, misdiagnosed, when in reality both intervals are short and, therefore, the patient is highly susceptible to severe alterations of the cardiac electrical system, including sudden cardiac death.

The typical patient with this electrocardiographic pattern is a woman in the third decade of her life, with multiple visits to the emergency services, with mild symptoms of palpitations, profuse sweating (which usually disappears on arrival at the hospital), somewhat agitated, with vital signs within average values, and with laboratory values also within the norm, except for blood lithium values which are always below the thresholds. The symptoms reported by the patient are mostly nocturnal, waking the patient up. Nocturnal palpitations that awaken from natural sleep, true syncope, are the most frequent symptoms, but cardiac arrest -although she may recover- and sudden death should never be ruled out.

As most of the time physicians consider the ECG tracing to be normal, patients are discharged from the hospital with the prescription of benzodiazepines and with a request for psychiatric evaluation considering them as a cardiac neurosis.

If we examine these patients in depth, we can find that more than 90% of them presented seizures in childhood without any electroencephalographic substrate and empirically treated with different types of anticonvulsants.

The referred symptoms are repetitive, and the attendance to the emergency department is constant, with the same hospital discharge result. The patients are regular visitors to the emergency department.

Until a moment may come when the patient no longer comes on her own, since the access has been very serious and she is either in cardiac arrest or has suffered sudden cardiac death due to an erroneous diagnosis.

To conclude, we can state that not all patients with this type of symptomatology have a psychosomatic basis, but that their cardiac electrical system has an altered substrate and, therefore, their heart is much more prone to malignant arrhythmias than that of healthy people.

Therefore, the study of each of the parameters to be assessed must be meticulous. In this way, we can avoid much greater evils, such as cardiac arrest and even sudden cardiac death.

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As "closure" we can state that the electrocardiographic pattern with short PR and QTc intervals exists, that it can produce high cardiac electrical instabilities and that, therefore, it should always be evaluated in detail in every electrocardiographic tracing and never be discharged from the hospital without being sure of its presence.

Of note, the author and his team have seen and diagnosed this variety of arrhythmia both in isolation and as part of other cardiac disorders such as Wellens Pattern **[7] (Figure 3)**, WolfParkinson-White **[8] (Figure 4)** and others **[9]**.

As a graphic example of this cardiac electrical abnormality, we can see below the image of a baseline ECG in a patient suffering from PR and short QTc interval.

The PR interval is 0.100 milliseconds: Short.

The QTc interval was evaluated according to the most commonly used formulas; in no case did it exceed 0.350 milliseconds.

Figure nº 1: This figure was the first electrocardiographic tracing studied by the author and corresponded to a 36-year-old male with the symptoms mentioned in the text. **[1]**

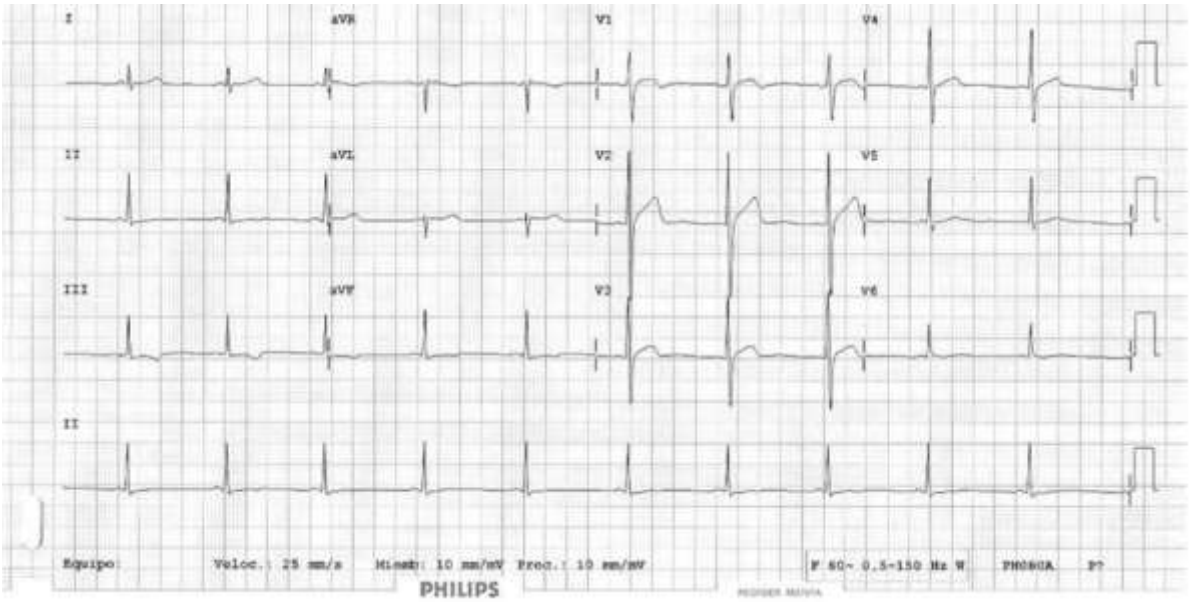

Figure 2: Values obtained using the most commonly used formulas relating the measured value of the QT interval and the RR interval (heart rate).

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RR	0.9523809523809523	seg
QTc (Rautaharju)	402	mseg
QTc (Bazett)	341	mseg
QTc (Framingham)	333	mseg
QTc (Friderica)	338	mseg
QTC (Call)	339	mseg

Figure No. 3: A typical association of the Breijo model and the Wellens pattern. **[7]**

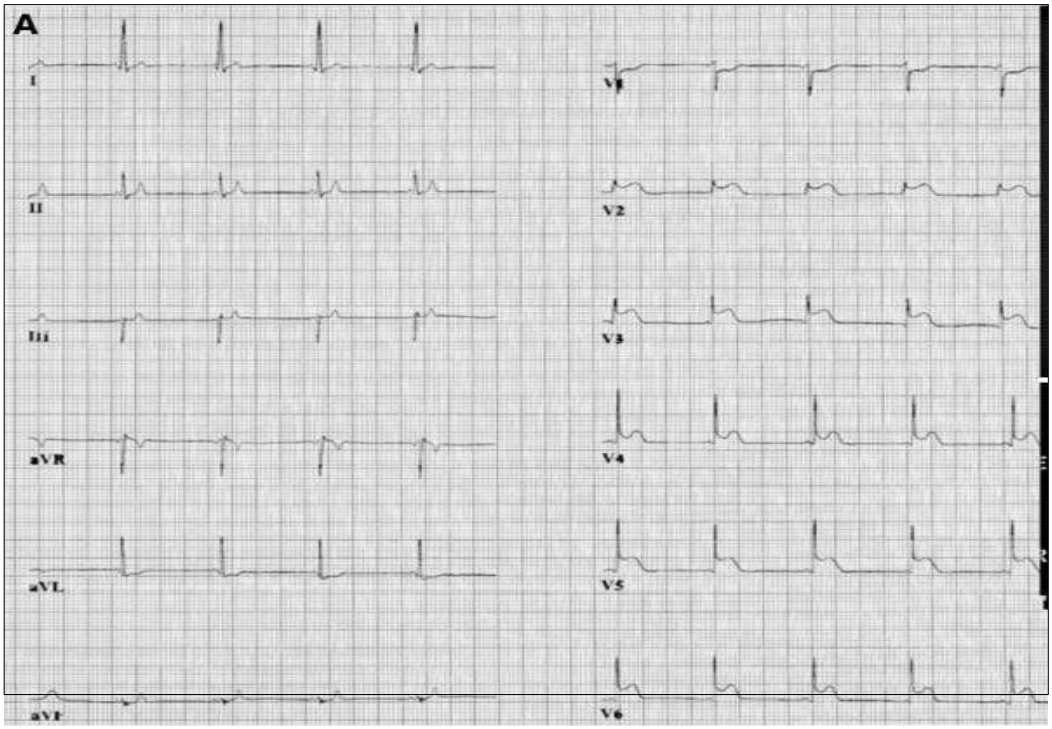

Figure No. 4: A WPW and a Breijo model together on the same ECG tracing. **[8]**

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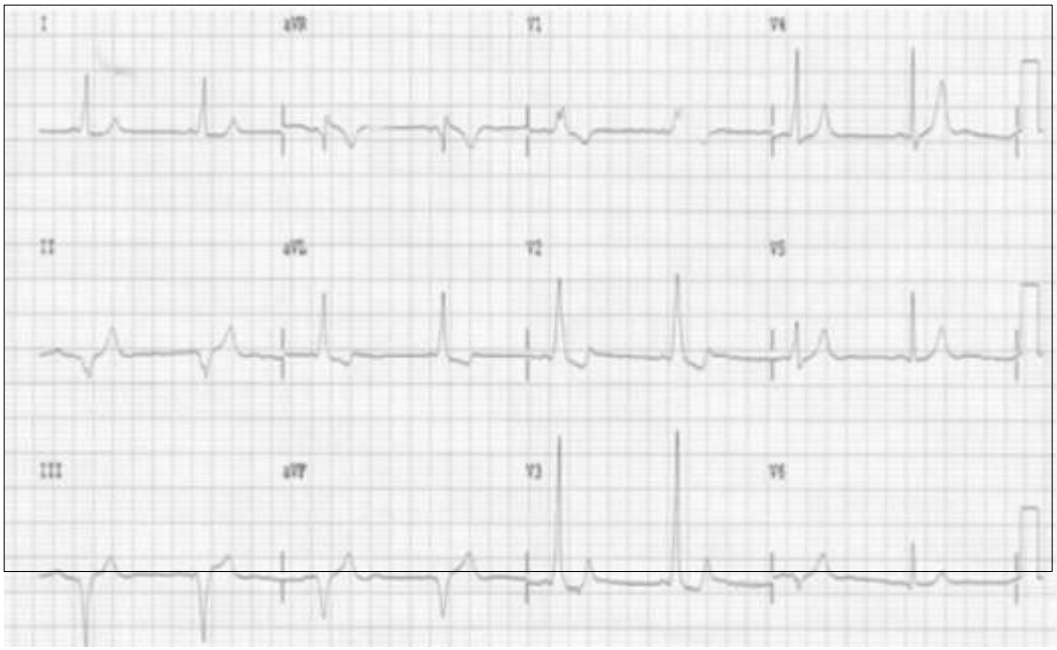

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