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Breijo's Electrocardiographic Model

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Abstract

Breijo's electrocardiographic model is becoming better known to cardiologists every day. The decrease in the PR interval, together with the decrease of the QTc interval in the same individual, is the main and only feature of the same individual. It can often go unnoticed, but many problems could be avoided if it was previously diagnosed, including sudden death.

Keywords

Cardiac Arrhythmias, Breijo Pattern, Sudden Cardiac Death, Palpitations, Tachycardia

1. Introduction

The decrease of the cardiac electrical systole—short PR and QTc intervals in the same electrocardiogram, also known as "Electrocardiographic Breijo Pattern"—is increasingly studied by several authors. The vast majority of the time it can be overlooked in an electrocardiogram tracing.

More than 127 cases have been studied and cross-checked by our research team so far.

Its diagnosis is indispensable in eluding of the most heartbreaking consequence: avoidable death.

Despite the fact that for many authors, the cardiac electrical systole comprises only from the beginning of the Q wave to the end of the T wave—that is, depolarization and repolarization of the ventricles—, the atria are also part of it.

Consequently, the P wave, as well as the PR segment, must be a part of the electrical cardiac systole.

When there is a shortening of the PR interval along with a shortening of the QT interval, we should talk about: *Decrease of cardiac electrical systole.*

This peculiar electrocardiographic pattern is denominating the Breijo Pattern: "*A PR interval less than* 0.120 *seconds along with a QTc interval less than*

0.360 *seconds*."

It is typical in this type of patients, carriers of the Breijo pattern, some common peculiarities in all of them:

1) Unspecific symptoms that are considered mild, such as:

- Palpitations, usually nocturnal, which awaken the patient from the natural sleep. Profuse nocturnal sweating.
- Light-headedness feelings misinterpreted.

2) A perception of chest pain very unspecified, not irradiated and whose electrocardiographic study is regarded, in the vast majority of cases, as untypical or normal, since coronary alterations are not observed.

3) A personal background, in childhood, of seizures treated with anti-epileptic drugs without the presence of any brain disorder on the electroencephalogram.

4) Low levels of lithemia. (This is a typical and constant feature on all patients).

5) A preference for young age (up to 40) and male sex.

2. Main Document

In 2008, Breijo-Marquez *et al.* [1] [2] [3] presented an electrocardiographic pattern, in which both the PR and QT intervals were shorter in milliseconds than what is regarded as acceptable limits.

They called this phenomenon as "*Decrease of electrical cardiac systole*" [1] [2] [3] since both, depolarization and repolarization, atrial and ventricular, are lower in their standard lengths. (PR interval and QT interval).

It is well known that, in an electrocardiogram, there are different waves, intervals, and segments.

These are the follows:

1) Waves. - P, Q, R, S, T. (U-wave in some occasions)

2) Intervals: PR (for other PQ authors). QRS. QT. RR.

3) Segments: ST fundamentally.

In spite of the repeated repetition of the image, we put it below in an attempt to gain a better understanding (**Figure 1**).

The P-wave reflects atrial depolarization (contraction).

The PR-interval corresponds to the delay between the end of atrial depolarization (contraction) and the beginning of ventricular depolarization (contraction); its length must be between 0.120 seconds and 0.200 seconds.

The Q wave is a negative deflection in the ECG resulting at the beginning of ventricular depolarization (first wave in QRS complex).

The T wave is a reflection of ventricular repolarization.

The QT interval includes a complete ventricular depolarization and repolarization (full ventricular cycle); its length must be between 0.400 and 0.450 seconds [4] [5] (depending on authors and their conveniences ,since some authors have studied and published in different journals what the correct length of the QTc interval should be. [6] [7] [8] [9] Even they have not agreed with their

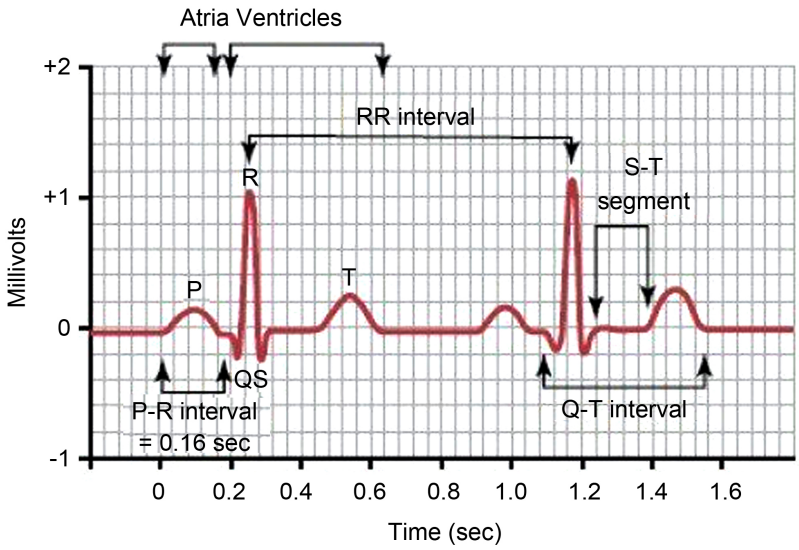

Figure 1. Normal electrocardiogram tracing: Waves, intervals and segments.

different conclusions [8] [9].

We agree to Gollop, these values may vary; for us and with a broader context, the standard QTc values are between 0.400 and 0.450 seconds in length).

There are many formulas to measure the amount of these ranges; the most used are *Bazett and Fridericia* yet. [4] [5]

Like the R-R interval, the QT interval is dependent on the heart rate in an obvious way (the faster the heart rate, the shorter the R-R Interval and QT interval) and may be adjusted to improve the detection of patients at increased risk of ventricular arrhythmia.

The length of the PR interval, of the QRS complex, of the ST segment and the corrected QT interval, are very all-important and must be valued in all cases.

The PR interval must be greater than 120 milliseconds and lower than 200 milliseconds.

Otherwise, we would find a "short PR" if this is fewer than 120 milliseconds).

If greater than 200 milliseconds would be the denominated like an *Auricle-ventricular block in any of its variants.*

The QRS complex should have a maximum length of 0.10 seconds. If it were longer lasting, we would be in front of a branch block in its different modalities (complete or incomplete).

Several formulas are used to correct the QT interval (QTc). The most used are those of *Bazett and Fridericia* [4] [5].

However, for these authors, typical values would be between 0.40 and 0.44 seconds, regardless of the person's age and sex.

The discrepancies among the different authors about the typical values of corrected QT are immense. The great controversy that persists to this date is about which should be considered as an average length of the QT interval since it is related to the heart rate; that is, the QT value is frequency-dependent. These controversies are producing an authentic catastrophe when it comes to cata-

loging when it is or not a short QTC. [4] [5] [6] [7] [8].

For us, —according to Gollop [10]—any QT value corrected interval less than 0.360 seconds must be considered as "short QT".

The most commonly used formulas are as follows (**Table 1**):

When the lengths of the different waves, intervals, and segments are greater or lesser than the values considered as normal, the heart is much more vulnerable to deadly arrhythmias (any of these may be truly lethal, and accesses to ventricular fibrillation may develop).

As we have already written, Breijo *et al.* published a new electrocardiographic pattern consisting of a short PR and QT intervals in the same electrocardiogram tracing.

People who had this kind of electrocardiographic pattern had also suffered from a wide variety of symptoms. Nocturnal tachycardias, dizziness, seizures, and unexplained syncopal accesses were the main symptoms common to all patients.

Absolutely all them were diagnosed as people with epilepsy and treated with specific drugs for epilepsy all patients; however, the electroencephalographic registers did not provide any visualization for epileptic focus in any of assessed patients [1]. Of course, the results with such treatment were null.

The patient age ranged from 16 to 40 years. The male gender was predominant. All previous electrocardiographic studies were considered within average ranges (the shortening of either the PQ interval and corrected QT interval went unnoticed).

As we have previously written, the typical features of the Breijo pattern are:

1) A PR interval of fewer than 120 milliseconds (short PR).

2) A QTc interval fewer than 360 millisecond.

Both on the same electrocardiographic tracing.

We agree with Gollop *et al.* [10] on when the QTc interval duration ought to be considered as "short". Gollob and al. have written over 61 cases of Short QT Syndrome. Their cohort of 61 cases was predominantly male (75.4%) and had a mean QTc value of 0.306 seconds with values ranging from 0.248 to 0.381 seconds in symptomatic cases. For Gollob *et al.*, the overall median age at clinical presentation was 21 years [(IQR: 17 to 31.8 years) with a value of 20 years (IQR: 17 to 29 years) in males and 30 years (IQR: 19 to 44 years) in females].

Table 1. QT heart rate correction formulas.

QT Heart Rate Correction Formulas	
Exponential	**Formula**
Bazett	QT/RR1/2
Fridericia	QT/RR1/3
Linear	**Formula**
Framingham	QT + 0.154 (1-RR)
Hodges	QT + 1.75 (HR-60)

These authors developed, about the ECG characteristics of the general population, and in consideration of clinical presentation, family history and genetic findings, a highly sensitive diagnostic using a scoring system. This "scoring system" includes (Table 2):

We have seen cases of a short QT interval (QTc ≤ 0.350 seconds) in asymptomatic patients and without a positive family history thereto for congenital (and non-genetic) character.

We also think is worthy to be mentioned an interesting paradoxical ECG phenomenon called *deceleration-dependent shortening of QT interval* (shortening of QT interval associated with a decrease in heart rate) should also be considered in a differential diagnosis [1] [2] [3].

In order to know precisely if the corrected QT value—by the different existing formulas—is in ranges, we use the Boston diagram, which we present below (Figure 2):

Of all the current layouts, this is the one we consider as the most reliable and the most accurate.

3. The Electrocardiographic "Breijo Model"

As we have written in earlier pages, the first case of Breijo Pattern was published

Table 2. Gollop's score. Patients are deemed high-probability (≥ to 4 points), intermediate probability (3 points) or low probability (≤2 points).

QTc in milliseconds	
<370	1
<350	2
<330	3
J point-T peak interval	
<120	1
Clinical History	
Sudden cardiac arrest	2
Polymorphic VT or VF	2
Unexplained syncope	1
Atrial fibrillation	1
Family History	
1s or 2nd degree relative to SQTS	2
1st or 2nd degree relative to sudden death	1
Sudden infant death syndrome	1
Genotype	
Genotype positive	2
Mutation of undetermined significance in a culprit gene	1

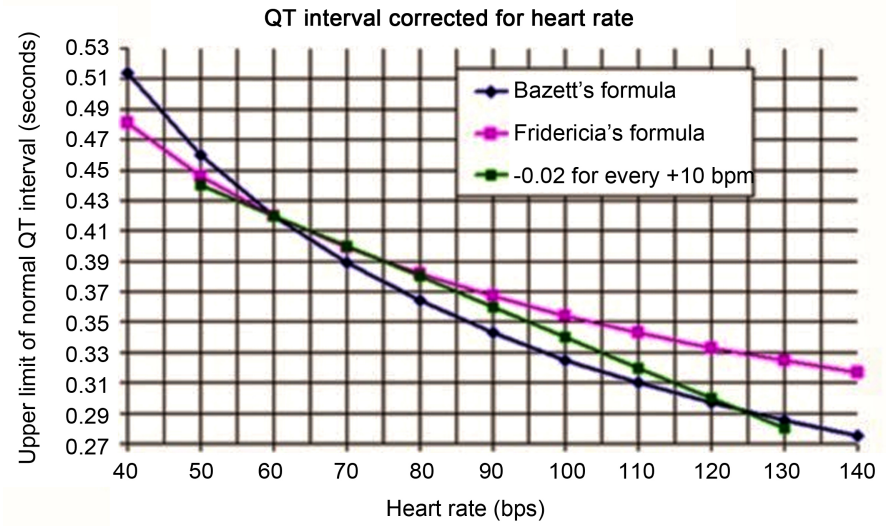

Figure 2. Boston diagram. Heart rate in bpm (coordinates) and length of QT interval (in abscissa) are perfectly exposed.

in the International Journal of Cardiology in 2008 [1].

The patient was a 37-year-old male, born in Mexico, D.F.

Since his childhood, he had suffered from tonic-clonic seizures and was treated with antiepileptic drugs (concretely with valproic acid) but without any epileptogenic focus showing up on his electroencephalogram.

Since then, the patient has referred multiple accesses of nocturnal palpitations, accompanied by intense sweating. Unstable gait sensation. He liked to play sports, but at the minimum effort, he was impressed anew severe palpitations that impede him to continue with it.

The patient was very worried about his heart. and visited numerous specialists in the field. He underwent a lot of diagnostic tests, and all of them were considered as in average range. The doctors believed him to be a patient with intense anxiety and hypochondriasis.

The patient had reported about two attacks of total loss of consciousness without loss of sphincters. This was regarded as a vase-vagal etiology.

A thorough compilation of patients with this kind of symptoms such as childish convulsions without an adequate response to conventional treatment for epilepsy, bouts of nocturnal tachycardia with sudden character, and syncopal events related to the effort.

An exhaustive study of personal antecedents and of his current clinical situation was made. An exhaustive measurement of intervals, segments, and electrocardiographic waves also was made.

By way of example, we will expose the electrocardiogram tracing of this patient: A 37-year-old man with much nocturnal tachycardia crisis (since childhood) and three syncopal events observed and related to physical stress. In his family background, two sudden deaths were found: father died at age 55 years of sudden cardiac, and a brother died at 22 months by sudden infant death.

He was diagnosed in his Reference Hospital (where he was transferred by emergency services) with supraventricular tachycardia to 195 - 200 beats per minute, with narrow QRS complexes. Severe diaphoresis, with the paleness of skin and mucous. A severe arterial hypotension to 90/50 mm. Hg. Cardiac auscultation was in normal ranges but with a rapid rhythm. Tachypnea to 20 cycles/minute. A grade Stuporous (Glasgow 15/15). The neurological examination was within normal ranges without focalizations. Central and peripheral pulses were palpable, symmetric and synchronous. The patient was diagnosed with nonspecific supraventricular tachycardia (**Figure 3**).

An ECG with supraventricular tachycardia can be seen at approximately 150 - 170 bpm (From V1 to V5; V6 lead could not be loaded).

This supraventricular tachycardia disappeared using the administration of two doses of Adenosine iv. in bolus, with six mgrs. each one in 1 minute (**Figure 4**). A Hospital discharge was made after full stabilizing of acute process and patient was derived from your cardiologist outpatient, with the following diagnosis. A paroxysmal supraventricular tachycardia and Crisis of anxiety: The patient was

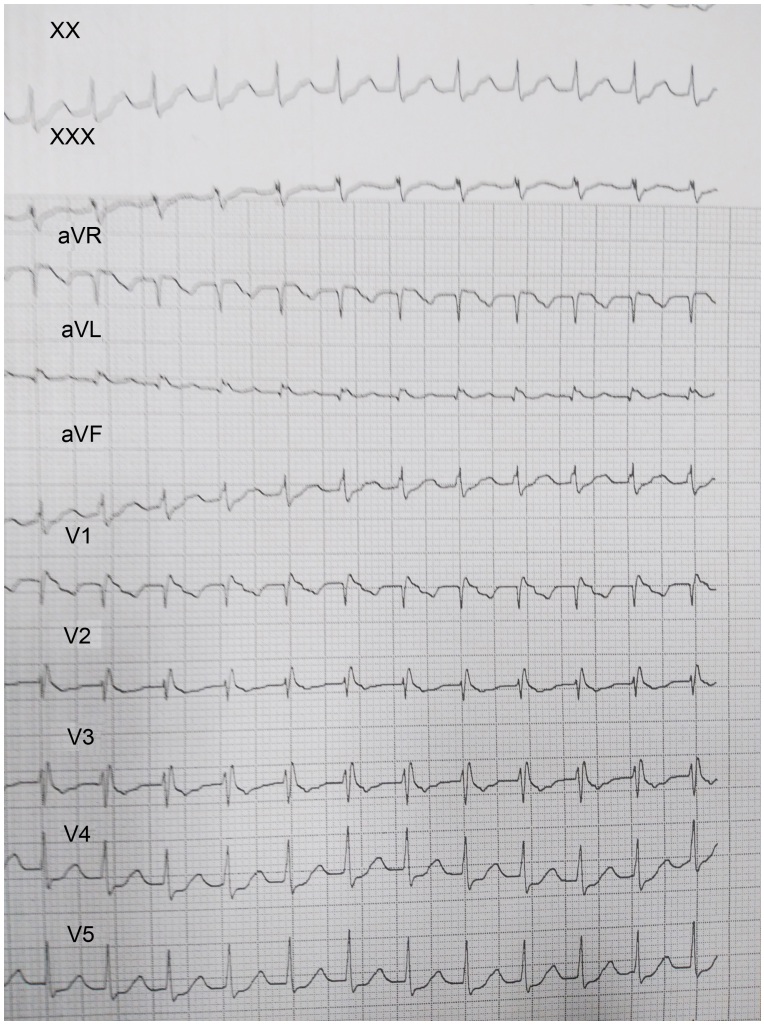

Figure 3. Supraventricular tachycardia.

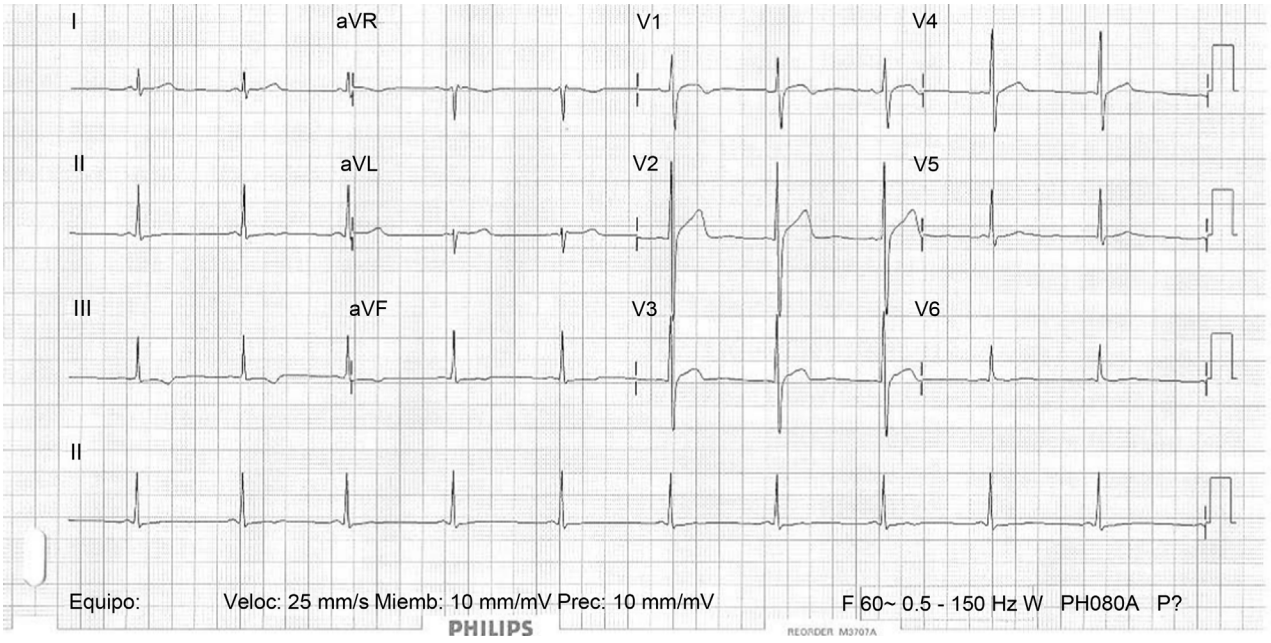

Figure 4. Electrocardiographic tracing after administering Adenosine. The full basal electrocardiogram tracing.

transferred to our Hospital because he had a similar event as the exposed, after the first visit with his outpatient cardiologist. There, the patient was adequately assessed with electrocardiogram, echocardiogram, blood levels of ions and cardiac markers as well as electrophysiological study (EEF) (**Figure 4**). He was negative for high levels of Troponin (I-T), CK, CPK-MB and however he was positive for low levels of lithium-ion (<0.1 mEq/L).

Nevertheless, in an in-depth and careful study of his basal electrocardiogram, we were able to assess the existence of a short PR and QTc interval.

Below, we present the first electrocardiogram (**Figure 5**) of the patient that we were able to assess.

(Despite the fact that we practice a full series of tests on the patient, the most significant in this exposure is the electrocardiography and the Holter studies (**Figure 6**)).

To 60 bpm can be seen the short PR-interval (<0.120 seconds) together to the short QT-interval (<0.350 seconds.). Chiefly in inferior and precordial leads.

On the Boston Diagram, it would be 350 milliseconds (red marked).

Same features than **Figure 1**. PQ-interval: 0.100 - 0.110 seconds = Short PQ-interval. QTc (Bazzet) 0.339 - 0.340 seconds (<0.350 seconds) = Short QT-interval. QTc (Fridericia) 0.332 seconds (<0.350 seconds) = Short QT-interval.

4. Differential Diagnosis

A Differential diagnosis is imperative to do it so with any electrocardiographic entity that has a shortened PR interval.

These are, fundamentally (**Table 3**)

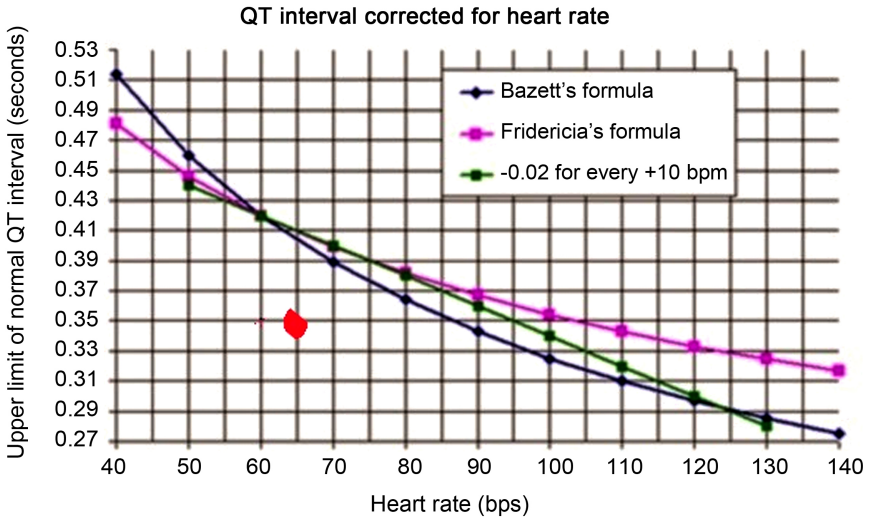

Figure 5. QT interval corrected for heart rate.

Figure 6. Holter study.

Table 3. Differential diagnosis, based on the characteristics of the different intervals and complex.

ENTITY.	PR-interval.	QRS complex.	QTc
WPW	Short.	Wide (δ-wave)	Normal.
L.G.L	Short.	Normal.	Normal.
Breijo Pattern	Short.	Normal.	Short.
Mahaim	Normal or Short.	Normal or wide	Normal

1) Wolff-Parkinson-White (W. P. W.).

2) Low-Ganong-Levine (L. G. L.).

3) Mahaim.

This "Breijo Pattern" we have assessed both in isolation and associated with other kinds of cardiac pathologies. Such as "*Wellens Pattern*", *Wolf-Parkinson-White* syndrome and in "*Takotsubo's Disease*". As it can be seen in the images below (**Figure 7**).

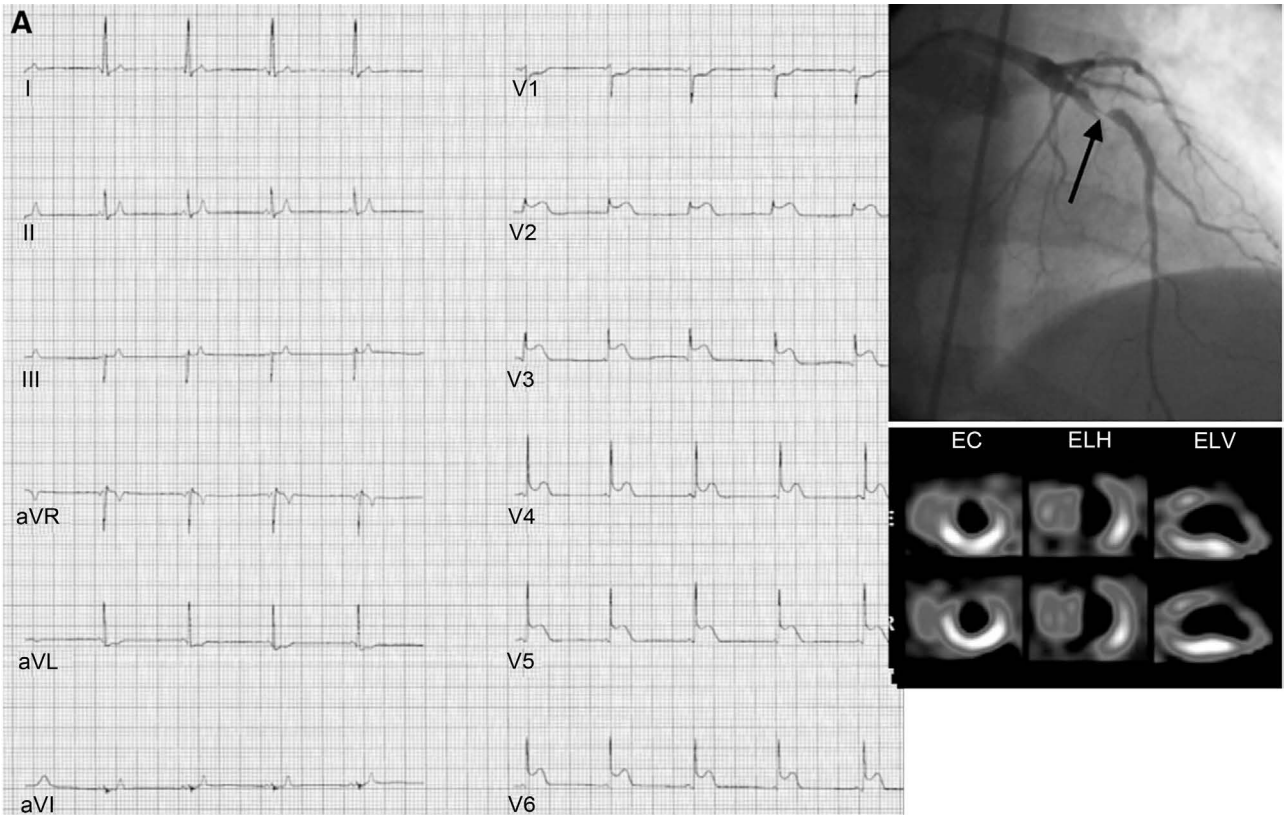

Figure 7. A Breijo Pattern along with a *Wellens Pattern* can be valued in the image [11] [12].

The "*Broken heart syndrome*" (Takotsubo) and the Breijo Pattern are correctly appreciated in the following image (**Figure 8**) [13] [14].

We have also known the existence of a *Wolf-Parkinson-White syndrome* associated with an electrocardiographic Breijo pattern, as can be seen below (**Figure 9**).

5. Some Significant Images, Typical of the Breijo Pattern

A typical image of a Breijo Pattern in precordial left leads (**Figure 10**).

Measured PR interval: 0.988 seconds (**Table 4**).

Calculated QTc interval: (**Figure 11**).

In the Boston Diagram at 68 bpm.

The last electrocardiogram (**Figure 12**) performed with a Breijo Pattern, in a male person who unfortunately died due to not being able to be recovered from a sudden death.

The electrocardiographic tracing was considered as within acceptable limits and his doctors decided to send him home.

In a nutshell, we can say about the Breijo Pattern the following conclusions.

1) Although relatively little known so far, it is increasingly being discovered in ECG tracings that at first glance may appear normal.

2) The accurate reading of the ECG tracing must be of mandatory compliance. Despite the fact that symptoms referred by patients may be slight.

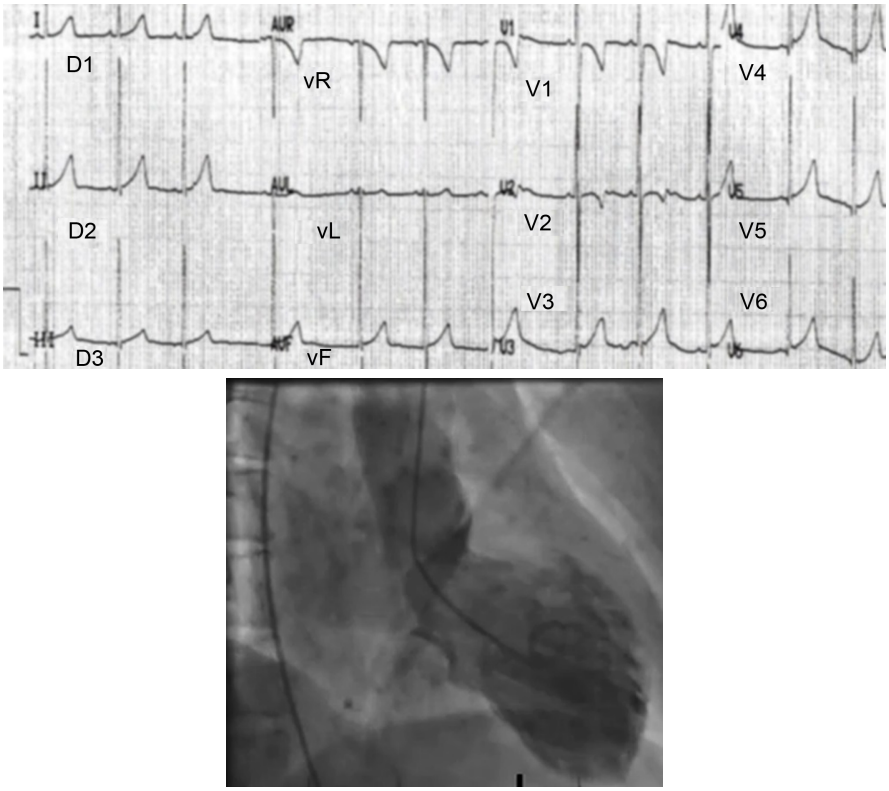

Figure 8. A Takotsubo disease alongside a Breijo Pattern.

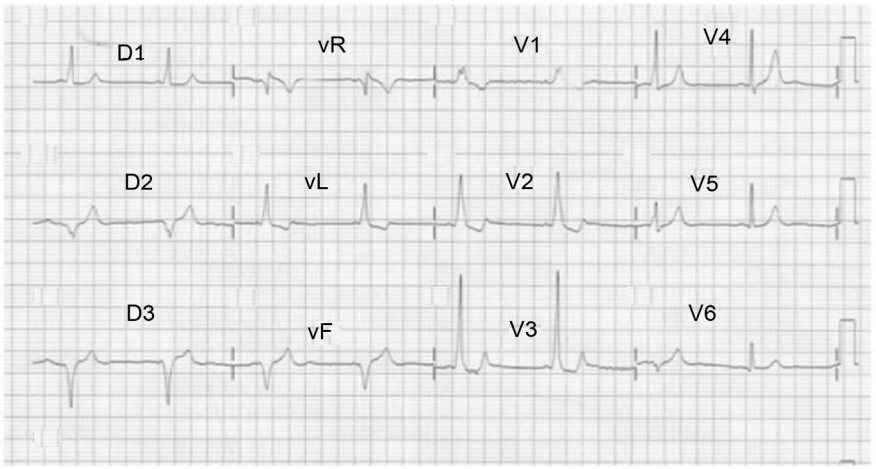

Figure 9. A *WPW* alongside a Breijo Pattern can be perfectly seen in the image [15] [16].

3) It is usually characteristic the fact that most of the patients with a Breijo Pattern have suffered in their childhood seizure crisis without being observed any focus of epilepsy in the all the assessed electroencephalography studies.

4) The most harmful consequence of the Breijo Pattern is the sudden cardiac death, which, although fortunately not often occurring, can happen.

6. Summarizing

- It is imperative to always take into account each and every one of the symptoms

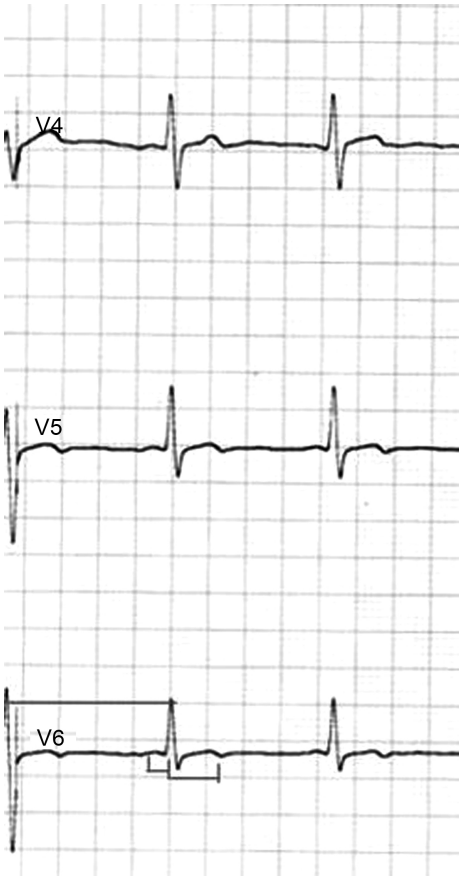

Figure 10. Detail in precordial left leads.

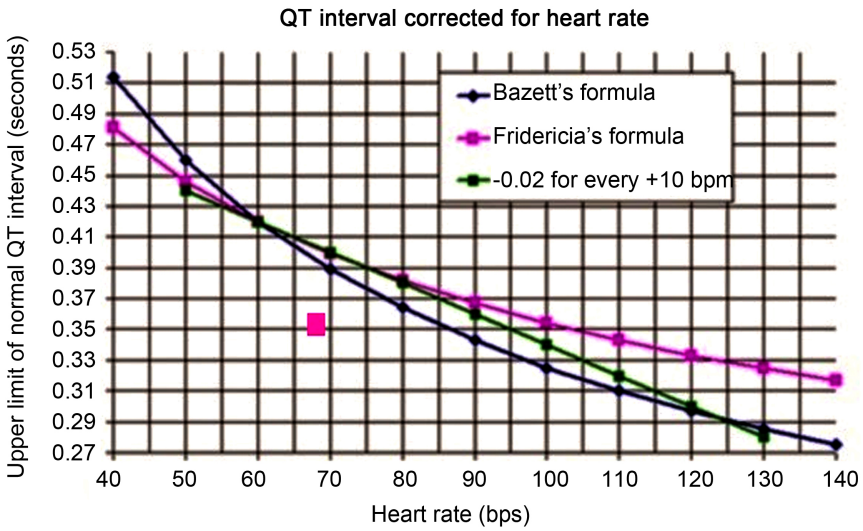

Figure 11. **Square in red.

that a patient refers, however slight they may seem to us. Especially if they are repetitive.

- Any patient who comes to our hospital with symptoms of nocturnal palpitations (which causes him/her to wake up from normal sleep), especially if they

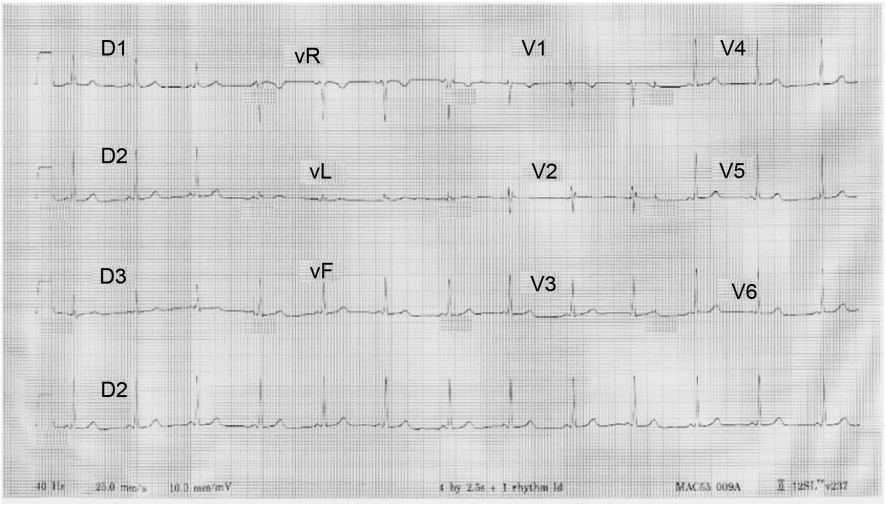

Figure 12. PR interval value: 0.89 seconds (very short) Measured QTc value: Between 0.356 and 0.334 seconds very short).

Table 4. QTc values according to the diverse formulas.

RR	0.882352941176	seg
QTc (Rautaharju)	390	mseg
QTc (Bazett)	347	mseg
QTc (Framingham)	326	mseg
QTc (Friderica)	339	mseg
QTc (Call)	342	mseg

are accompanied by profuse sweating, nausea or throwing up, atypical thoracic discomfort as well as symptoms considered as mild or psychosomatic, especially if they are repetitive, should be evaluated in depth, without leaving any diagnostic elements ignored.

- Any patient with such characteristics must have a thorough examination of his or her background. Especially focused on the existence of syncopes or lost consciousness, as if the patient has suffered from convulsions in childhood, treated with antiepileptics and without focus electroencephalographic epileptogenic that can justify it.
- Carrying out an electrocardiographic study is imperative.

Assessing each and every one of its parameters. Making special emphasis on the lengths of the waves, intervals, and segments.

- The presence of a Breijo electrocardiographic pattern makes the heart much more vulnerable to severe arrhythmias and even sudden cardiac death.
- Whenever we find ourselves on an electrocardiogram with a short PR and QTc interval, we must be very alert and careful with the patient.
- Lithium levels in blood must be obligatorily assessed, since all patients with Pattern Breijo have low or very low levels.

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