

## ARRHYTHMIAS

# Utility of cardiac event recorders in diagnosing arrhythmic etiology of palpitations in patients without structural heart disease

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**Objective.** To determine the diagnostic yield of transtelephonic event monitors for identifying the reason for palpitations in patients with no structural heart disease.

**Patients and method.** For 20 months we enrolled all patients reporting palpitations in whom heart disease had been ruled out by medical history, physical examination, ECG and transthoracic echocardiography. All patients underwent 24 h Holter monitoring, which did not provide diagnostic information. Later, a Cardiotest 4DM<sup>®</sup> transtelephonic event monitor was provided to each patient for a mean of 15±3 days. We used SPSS V 10 for statistical analysis.

**Results.** Two hundred twenty-seven consecutive patients were enrolled. Mean age was 45±3 years (range 12-85); 167 were females (74%). Two hundred twelve of the 227 patients (93.3%) experienced palpitations while wearing the device, and 210 (92.5%) used the monitor correctly, recording the cardiac rhythm during palpitations. Fifteen patients (6.6%) had no palpitations during the days of study. In 125 (55%) the Cardiotest 4DM<sup>®</sup> correctly recorded and transmitted arrhythmia that justified the patients' reference to palpitations. In 35 (15.4%) significant arrhythmia was detected: paroxysmal supraventricular tachycardia in 21, atrial fibrillation in 9, atrial flutter in 5, runs of ventricular extrasystoles in 4 and right outflow tract ventricular tachycardia in 1. Sinus rhythm was recorded during palpitations in 85 patients (37%), and arrhythmia as the cause could be ruled out.

**Conclusions.** Cardiotest 4DM<sup>®</sup> identifies arrhythmia in a very high proportion of patients with palpitations and no structural heart disease.

**Key words:** *Palpitations. Diagnosis.*

## Utilidad de un grabador de acontecimientos en el diagnóstico de la etiología arrítmica de las palpitaciones en pacientes sin cardiopatía estructural

**Objetivo.** El objetivo del presente trabajo es determinar cuál es el rendimiento de la utilización del grabador de acontecimientos en el diagnóstico de la etiología de las palpitaciones como síntoma en pacientes sin cardiopatía estructural.

**Pacientes y método.** Durante 20 meses se han incluido en el estudio a todos los pacientes que consultaban por palpitaciones y en los que se descartaba mediante historia clínica, exploración, ECG y ecocardiografía la existencia de cardiopatía estructural. A todos se les realizó un Holter de 24 h que no resultó diagnóstico. Posteriormente se les proporcionó un registrador de acontecimientos Cardiotest 4DM<sup>®</sup> durante una media de 15 ± 3 días. Utilizamos el paquete estadístico SPSS V.10.

**Resultados.** Se incluyeron en el estudio 227 pacientes consecutivos. La edad media fue de 45 ± 3 años (rango, 12-85 años) y 167 eran mujeres (74%). Un total de 212 de los 227 pacientes incluidos (93,3%) tuvieron palpitaciones durante los 15 días que dispusieron del monitor, y 210 (92,5%) utilizaron correctamente el monitor, grabando el ritmo cardíaco coexistente con dichas palpitaciones. Quince pacientes (6,6%) no tuvieron palpitaciones durante los días de estudio. En 125 (55%) el Cardiotest 4DM<sup>®</sup> grabó y transmitió por vía transtelefónica correctamente arritmias que justificaban las palpitaciones referidas por los pacientes. En 35 pacientes (15,4%) se detectaron arritmias significativas: 21 taquicardias paroxísticas supraventriculares, 9 fibrilaciones auriculares, 5 aleteos auriculares, 4 tripletes de extrasístoles ventriculares y una taquicardia ventricular de tracto de salida de ventrículo derecho. En 85 pacientes (37%), durante las palpitaciones no se detectó arritmia alguna que las justificara, excluyendo así las arritmias como etiología de la misma.

**Conclusiones.** El Cardiotest 4DM<sup>®</sup> permite identificar arritmias en una proporción muy elevada de pacientes con palpitaciones y sin cardiopatía estructural conocida.

**Palabras clave:** *Palpitaciones. Diagnóstico.*

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## INTRODUCTION

Palpitations are a frequent symptom and the motive of many visits to emergency services and cardiology clinics. On many occasions, palpitations are produced by arrhythmias. It can be difficult to establish the cause of palpitations, as much because of the medical history as the scant percentage of diagnoses usually reached with conventional studies. Among patients who refer palpitations, abundant information is available about patients with structural heart disease, but not about patients with palpitations and a healthy heart.

The aim of the present study is to determine the performance of event recorders in reaching a diagnosis of the cause of palpitations as a symptom in patients without structural heart disease.

## PATIENTS AND METHOD

### Patient selection

This study included all patients seen for palpitations in the emergency services and outpatient clinics of the Servicio de Cardiología of Hospital Virgen del Rocío, Sevilla, in a period of 20 consecutive months, without detecting structural heart disease.

### Inclusion and exclusion criteria

The patients selected to form part of the study were seen because they had suffered palpitations at least once in the previous 15 days, but structural heart disease (including left ventricular hypertrophy) had been excluded and no significant arrhythmias (symptomatic supraventricular or ventricular extrasystoles, sustained or unsustained symptomatic tachycardia) were detected in a 24-h Holter. All patients with structural heart disease and pathological ECG who duly underwent electrophysiological study (according to SEC recommendations) of their arrhythmia, or had a documented history of arrhythmia, were excluded. It was not the aim of this study to analyze patients with structural heart disease, so their data were not collected.

### Standardized evaluation of all patients

Before providing patients with transtelephonic electrocardiography equipment (TTE), they underwent a standardized evaluation that included a complete medical history, physical examination, 12-lead electrocardiogram, Doppler-color echocardiogram, and a 24-h Holter recording. In no patient did the Holter recording yield a diagnosis, so all patients were provided

with a TTE monitor (Cardiotest 4DM<sup>®</sup>, Cardiplus Telemedicina S.L.) after the standardized evaluation.

### Transtelephonic electrocardiogram

The Cardiotest 4DM<sup>®</sup> monitor is a pocket monitor capable of acquiring and recording the external signal of the heart rhythm with an electrocardiographic lead connected to the monitor by 4 electrodes located on the back of the device. The electrode is placed in contact with the skin at a site next to the sternum and at the fourth rib (a site equivalent to lead V2). The monitor can also receive a signal through a cable connected to 3 conventional strip electrodes. The patients were instructed to use it when palpitations appeared. To keep the patient trained and to correct errors, they were instructed to tape and transmit transtelephonically for a 2-min period every day. After training each patient, they were provided a monitor for 15 days, a period that was extended 15 days longer if the patient's palpitations did not reappear. Once the patient had recorded the daily follow-up or the events he or she suffered, they were transmitted telephonically to the data-receiver center 24 hours a day.

### Definitions

#### *Palpitations*

Symptom referred by patients who describe a subjective sensation of a disturbance in heart rhythm in the form of increased frequency, intensity, or a change in rhythm.

#### *Arrhythmias*

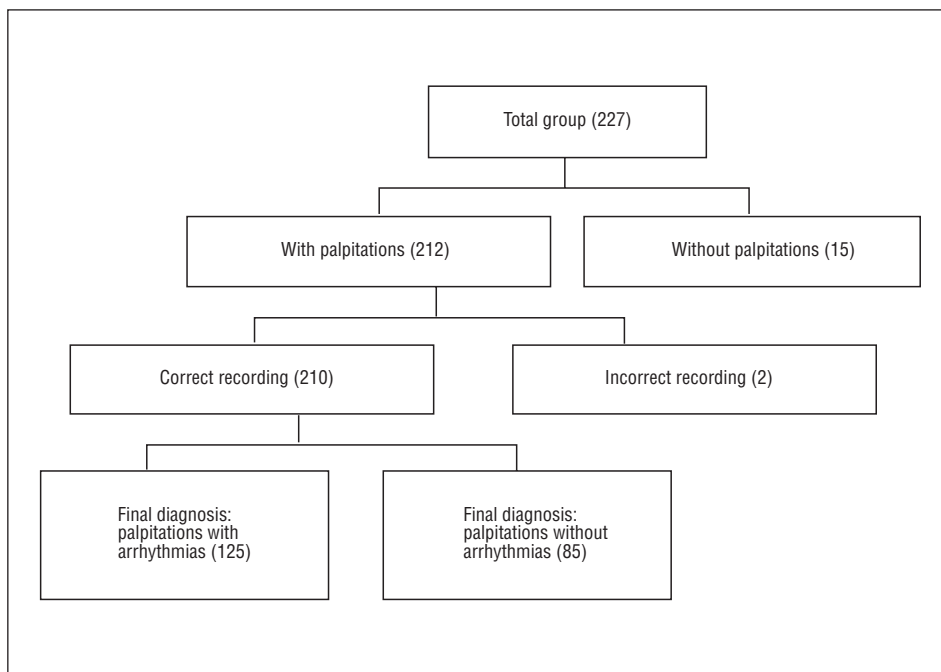
Disturbances in the ECG transmitted by patients that constitute known pathological rhythms (frequently sinus tachycardia over 100 beats/min, supraventricular paroxysmal tachycardia, nonsustained ventricular tachycardia, sustained ventricular tachycardia, supraventricular extrasystoles, and ventricular extrasystoles).

#### *Palpitations without arrhythmia*

Palpitations during which the monitor recorded sinus rhythm; in these cases the patient was asked to record another episode of palpitations.

#### *Objective*

The aim of the study was to record the cardiac rhythm while the patient was experiencing symptoms in order to diagnose the arrhythmic or non-arrhythmic



**Fig. 1.** Flow chart of the patients included in the study of palpitations with Cardiotest 4DM®.

cause of patient’s symptoms. The diagnosis was considered correct when a complete 2-min recording was obtained while the patient described his or her symptoms (changes in the rhythm, intensity, or frequency of the heartbeat).

**Statistical analysis**

The qualitative variables are expressed as percentages and the quantitative variables as mean±SD. Diagnosed and undiagnosed patients were compared using the  $\chi^2$  test. The Student t test was used to compare means. The SPSS V. 10.0. statistical package was used.

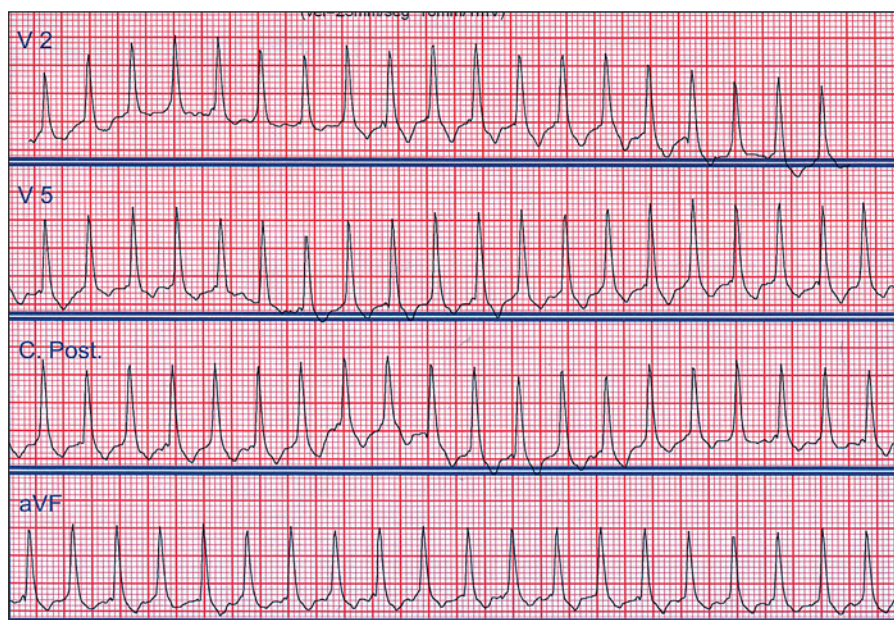
**RESULTS**

From February 1998 to December 2000, we included 227 patients in the study, including 167 women (74%). The mean age of patients was 45±3 years (range, 12-85 years). Ten patients were less than 20 years old, 103 were 21 to 45 years old, 94 patients were 46 to 70 years old, and 20 were over 71 years old. Two (0.6%) patients had a history of arterial hypertension and were under treatment with ramipril and quinapril. No patient was receiving antiarrhythmic treatment. Only 12% of patients referred dyspnea in addition to palpitations. The time since onset of the palpitations was 7±5 months (range, 1-36 months). Their duration was not quantified.

The mean number of days that the patients kept the monitor was 15±3 days. A total of 212 of the 227 patients included (93.3%) had palpitations in the 15 days that they had the monitor, and 210 (92.5%) used the monitor correctly to record the cardiac rhythm that coincided with these palpitations (Figure 1). In all the cases the patients reported self-limited palpitations. Fifteen patients (6.6%), 11 of them women, did not have palpitations on the study days. In 125 (55%), the Cardiotest 4DM® correctly recorded and transmitted by telephone the arrhythmias responsible for the palpitations described by the patients. In 85 patients (37%), no arrhythmia was detected during palpitations that could have explained them, thus ex-

**TABLE 1. Electrocardiographic findings during palpitations**

|                                 | Total |
|---------------------------------|-------|
| Supraventricular arrhythmias    | 87    |
| Extrasystoles                   | 41    |
| Paroxysmal tachycardia          | 16    |
| Atrial fibrillation             | 9     |
| Atrial flutter                  | 5     |
| Sinus tachycardia               | 16    |
| Ventricular arrhythmias         | 38    |
| Isolated extrasystoles          | 33    |
| Pairs and runs of extrasystoles | 4     |
| Ventricular tachycardia         | 1     |
| Absence of arrhythmias          | 85    |



**Fig. 2.** Paroxysmal supraventricular tachycardia at 190 beats/min recorded in a 37 year-old patient with palpitations.

cluding arrhythmia as the cause of palpitations and establishing the diagnosis of palpitations without arrhythmia. Two patients (0.8%) did not know to use the monitor, a 63 year-old patient and an 81 year-old patient with Parkinson's disease. The electrocardiographic findings obtained in symptomatic patients are presented in Table 1. No statistically significant differences were observed by sex ( $\chi^2 = 3.5$ ;  $P = .17$ ). There was no relation between time since onset of symptoms and the presence of arterial hypertension ( $P = \text{NS}$ ), arrhythmias ( $P = \text{NS}$ ), or the type of arrhythmia found ( $P = \text{NS}$ ). The same percentage of diagnoses was reached in patients with dyspnea as in those without dyspnea (56% versus 55%;  $P = \text{NS}$ ).

In 35 of the 227 patients (15.4%), significant self-limited arrhythmias were detected: 21 paroxysmal supraventricular tachycardia (Figure 2), 9 atrial fibrillation, 5 atrial flutter, 4 triplets of ventricular extrasystoles, and 1 ventricular tachycardia of the right ventricular outflow tract. Pharmacological or electrophysiological treatment was correctly established for the arrhythmias in all patients.

## DISCUSSION

Referring to a subjective symptom as «palpitations» does not establish a firm relation with the presence of demonstrable changes in cardiac rhythm or frequency. Ambulatory 24-h Holter recordings in patients with heart disease and healthy volunteers has demonstrated that the relation between palpitations and cardiac irregularities is weak, many patients with palpitations do

not have arrhythmias, and many patients with arrhythmias do not report symptoms. In addition, it has been established that the experience of the physician influences his or her understanding of what each patient described as palpitations (OR=1.8 [1.03-3.2]; 95% CI), even after adjusting for the clinical and demographic characteristics of patients. This aspect, together with the association between the presence of structural heart disease and arrhythmias, and, finally, the limited health care resources available in the Spanish national health care system are the three main conditionants of the diagnostic approach to patients seen for palpitations in which structural heart disease is excluded. Our study did not attempt to compare the value of the medical history for predicting the type of arrhythmia that the patient has based on monitor findings, so this point is not contemplated and must be examined in future studies.

Frequently, the diagnostic study of patients with palpitations concludes when a 24-h Holter recording has been made (which is usually normal), which is why its capacity for diagnosing transitory and infrequent events has been questioned. Many attempts have been made to extend its range beyond 24 h, generally by using event recorders, which often are equipped for transtelephonic transmission. These recorders are activated by the patients and increase the number of diagnoses reached in patients who have palpitations. Since Furman et al. reported the use of transtelephonic electrocardiography for the at-home follow-up of patients with permanent pacemakers,<sup>10</sup> other authors have reported their experience with the use of event recorders

in diagnosis, the assessment of the effectiveness of antiarrhythmic drugs, and even routine ECG.

Two previous studies that used event recorders to study palpitations have found pathological rhythms and sinus rhythm in 67%-35% and 46%-20% of patients, including patients with and without structural heart disease. In pediatric patients with palpitations, the use of event recorders has achieved a sensitivity of 100% and a specificity of 62% in relating symptoms with arrhythmias. In pediatric patients with healthy hearts and normal findings with conventional Holter, arrhythmias have been diagnosed in 27% of cases. Our study is the first to analyze prospectively the usefulness of this device in the diagnosis of patients without structural heart disease who report palpitations but are not diagnosed by routine methods (all patients had an ECG, chest radiograph, laboratory tests, echocardiography, and Holter). In our series, although all the patients had a normal Holter recording, Cardiotest 4DM<sup>®</sup> diagnosed an arrhythmia in 55% of them that was responsible for their palpitations.

Using a commercially available external device for 15±3 days, we were able to diagnose arrhythmias that caused palpitations in 55% of the patients, and to exclude arrhythmias as a cause of palpitations in 37%. In a brief period of time, this monitor provided valuable information for 92% of our patients without structural heart disease who experienced palpitations. The diagnoses reached in 30 patients with significant supraventricular arrhythmia (21 paroxysmal tachycardia, 9 atrial fibrillation, and 5 atrial flutter) and in 5 patients with ventricular arrhythmia should be emphasized. With conventional methods, these 35 patients with «complex» arrhythmias had not been diagnosed. The fact that these patients did not have structural heart disease may suggest that in many cases there are no arrhythmias underlying the palpitations described. However, but a prompt and accurate diagnosis can change the natural history of arrhythmias like atrial fibrillation, thus avoiding possible embologenic complications or syncope and their dramatic consequences in patients without heart disease. In patients with syncope, whether or not structural heart disease exists, a new device known as the implantable Holter has demonstrated its diagnostic utility. Future studies with this device should increase our understanding of palpitations in patients without structural heart disease.

### Limitations

Only patients with palpitations and no other symptoms were included, and the profile of the risk of ischemic heart disease was not considered in these pa-

tients since was not the object of the study. However, its possible presence, particularly in older patients, cannot be overlooked.

### CONCLUSIONS

Cardiotest 4DM<sup>®</sup> allows the identification of arrhythmias in a very high proportion of patients with palpitations and no known structural heart disease.

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