

Original Article

Utility of Ambulatory Cardiac Loop Event Electrocardiographic Recorders for the Diagnosis of Palpitations

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ABSTRACT

Objectives: The aim of study is to quantify the diagnostic yield of event ECG recorders over Holter 24-hour ECG monitoring in the evaluation of patients with palpitations.

Design: Cohort study conducted between January 2000 and June 2002.

Methods: Over 18 months we studied 95 patients but the results of 80 patients were included in the study. All patients with palpitations were referred from the outpatient clinic of the Farwaniya Hospital. Echocardiography and Holter ECG monitor for 24 hours were done for all subjects. All patients underwent event recorder for three weeks. The patients were classified into two groups: group I included 35 patients with heart disease and group II included 45 patients without heart disease.

Results: When considering age and gender there was no

significant difference between both groups of study ($P = NS$). The diagnostic yield of the event recorder was 50% in all patients studied: 65.7% in the patients with heart disease and 37.8% in the patients without heart disease. There was a significant increased percentage of diagnosis in the third week of the study than in the first and second weeks ($p < 0.01$). There was a significant increased percentage of diagnosed patients with event recorder than those with Holter monitor ($p < 0.01$). There was a significant increased percentage of successful recording with event ECG recorder in male and young patients than female and old patients respectively, ($P < 0.05$).

Conclusion: By capturing cardiac rhythms when there are no typical symptoms, event ECG recording may eventually become the standard diagnostic test in patients with recurrent palpitations.

KEY WORDS: event recorder, Holter monitor, loop recorder, palpitations

INTRODUCTION

There are many etiologies for palpitation. Establishing a definitive diagnosis of palpitation is important because this symptom may be benign or may herald an ominous prognosis. The usual evaluation, including a history, physical examination and electrocardiogram suggests a cause for symptoms in approximately 50% of patients^[1,2].

In many patients, the 24-hour Holter recording is unable to document the cause of the patients' symptoms. Long term monitoring is necessary in such cases. This could be effected by simply repeating many 24-hour Holter recordings until symptoms occur but is costly and inefficient^[3].

Event recorders are small ECG recording devices used for various periods of time. The patient can save the recording by manually triggering the device, which stores the rhythm for later playback. Some devices allow the capture of both retrospective and prospective recordings^[4]. The cardiac loop ECG recorder is a new recording

device that can be worn for months at a time. It has a memory loop that can store the previous one to four minutes of cardiac rhythm when activated by the patient whenever symptoms occur^[5]. Linzer *et al*^[6] have reported their phase technology assessment of this new device in a retrospective evaluation of a separate series of patients who underwent loop monitoring for clinical indications.

The aim of this study is to quantify the diagnosis yield of event ECG recorders over Holter 24-hour ECG monitoring in the evaluation of patients with palpitations.

PATIENTS AND METHODS**Study patients:**

Ninety five patients were included in the study. All patients with palpitations were referred by their physicians to the Non-Invasive Cardiac Laboratory, Cardiology Department, Farwaniya Hospital between January 2000 and June 2002. All patients were evaluated clinically, by history, physical examination, 12-leads ECG, routine

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laboratory investigations and echocardiography and Doppler study.

There were two groups:

Group I: 35 patients with heart disease [20 patients had ischemic heart disease (eight patients with anterior myocardial infarction, six patients with inferior myocardial infarction and six patients with stable angina pectoris), four patients presented with mitral valve prolapse, eight patients were hypertensive with left ventricular hypertrophy and three patients were referred with mitral regurgitation].

Group II: 45 patients without heart disease (22 patients were diabetics, eight patients were thyrotoxic and 10 patients were anaemics).

Definition:

- Inappropriate sinus tachycardia is a sinus tachycardia with a rate of >120 beats/minute unassociated with exertion or emotional stress.
- Young patients were those who were under 45 years old.
- Middle age patients were those between 45 and 65 years of age.
- Old patients were those who were over 65 years old.

Twenty- four hour Holter monitor:

All subjects and patients of the study underwent continuous ambulatory 3-channel Holter monitoring for 24 hours. Indeterminate Holter recording was absence of symptoms with absence of arrhythmias.

Event ECG Recording:

This new monitoring device evolved from real time event recorders called "King of Hearts Express" spacelabs and it has a maximal capacity of storing five minutes of rhythm. This device has digital memory (freeing the patient from the necessity of immediate access to a telephone) as well as a "leading edge" memory loop that continuously stores several minutes of ECG in digital form. The monitor is activated by the patient pushing a record button during the prodrome of an event or upon arousal. The device then stores the previous one to four minutes of cardiac rhythm in memory as well as the subsequent 30 to 60 seconds of rhythm. The "King of Heart Express" is 5.5 x 3.0 inches and weighs 150 gm. It uses two 'AA' batteries which are changed every week. The event recorder required the use of two standard Holter monitoring electrodes, which is changed every two days by the patient.

Study design:

All patients were provided with a loop event ECG recorder for three weeks' use. A test ECG strip was transmitted by the patient before leaving the non-invasive cardiac laboratory to ascertain the ability to use the device correctly.

Patients were contacted weekly by the study data cardiologist to discuss any difficulties in machine use, to replace batteries, to transmit the rhythm strips and also to observe if the arrhythmia was detected. If a strip was of poor quality or if the patient was not certain that the button had been depressed in close proximity to the event, then monitoring was continued for the remaining weeks of the study or earlier, should a diagnostic recording be obtained.

The primary outcome measure of the study was the number of patients for whom a clear recording of cardiac rhythm was obtained during palpitation. Patients with these outcomes were considered to have a diagnostic recording period. The diagnostic yield was calculated as the number of diagnostic event ECG recorder studies divided by the total number of studies performed.

Statistical analysis:

Continuous variables are summarized as mean \pm standard deviation (SD). Comparison between two groups was performed with t-test for continuous variables and chi-square test for categorical variables. A P-value of < 0.05 was considered statistically significant and P-value of < 0.01 was considered statistically highly significant.

RESULTS

Over the 18-months' duration of the study, 480 patients underwent Holter monitor and 95 patients underwent both Holter monitor and event recorder monitoring. There was an increasing number of patients referred for event ECG recording. There were only two patients who underwent event recorder on January 2001 but there were 12 patients who underwent event recorder on May 2002. Therefore, 95 patients were included in the study but results of 80 patients only were included in the statistics of the study.

No patients reported symptoms of presyncope or syncope. No sustained or non-sustained ventricular tachycardia were reported. Over the duration of this study, only four patients successfully transmitted the event ECG recordings transtelephonically by direct telephone line connection to our computer analysis system. It was reviewed by an experienced cardiologist but the data were scanty and not enough to study the utility and validity of trans-telephonic event ECG recorders in the diagnosis of palpitations.

There was no significant difference between patients with heart disease and patients without heart disease when considering age and gender ($P = \text{NS}$), but there was a significant increase in percentage of patients with recorded symptom and arrhythmia detected. There was a significant decreased percentage of patients with recorded symptom and arrhythmia not detected than subjects of group II ($P < 0.05$), table 1.

Diagnostic yield:

Forty patients of the total of 80 (50%) had recorded symptoms and detected arrhythmias during the three weeks of the event recording study. Twenty three patients of the 35 with heart disease (65.7%) had recorded symptoms and detected arrhythmias compared to 17 patients of the 45 patients without heart disease (37.8%), table 1. There were a significant increased percentage of loop event ECG tracing recorded during the third week of the study as compared to the first and second weeks of the study (50% versus 15% and 26%, respectively, $P < 0.01$), Fig. 1.

Event recorder versus Holter monitor:

There was a significant increased percentage of unrecorded ECG tracing with Holter monitor than event recorder but there was a significant increased percentage of atrial ectopics and ventricular arrhythmias (frequent ventricular ectopics, ventricular bigeminy and ventricular couplets) recorded with event recorder than those recorded with Holter monitor ($P < 0.05$). No malignant ventricular arrhythmia (non-sustained or sustained ventricular tachycardia) was recorded either by event ECG recorder or Holter 24-hour ECG monitoring. No significant difference was noted between the two methods in sinus tachycardia, table 2. There was a significant increased percentage of diagnosed patients with event recorder than Holter monitor ($P < 0.01$), Fig. 2.

There were 55 young, 25 old and 10 middle-aged patients. There was a significant increased percentage of successful recordings with loop event recorder in males than females (80% versus 41% respectively, $P < 0.05$) Fig. 3. There was also a significant increased percentage of successful ECG recordings in the young than the old patients (84% versus 36% respectively, $P < 0.05$), Fig. 4.

Compliance and difficulty using the recorders:

Fifteen patients refused to continue the study after their first week of the study due to inadequate cardiac event recording. The causes of this difficulty are summarized in table 3.

DISCUSSION

Table 1
Patients' characteristics, clinical and event ECG recordings

	Overall	Heart Disease	No heart disease	P-value
Patients:	80	35 (43.7)	45 (56.3)	NS
Male n (%)	50 (62.5)	25 (71.4)	28 (62.2)	NS
Female n (%)	30 (37.5)	10 (28.6)	17 (37.8)	NS
Age (years): mean \pm SD	48.6 \pm 7.8	49.1 \pm 4.6	46.2 \pm 6.9	NS
Results:				
S+A+ n (%)	40 (50)	23 (65.7%)	17 (37.8%)	< 0.05
S+A- n (%)	13 (16.2%)	2 (5.7%)	11 (24.4%)	< 0.05
S-A- n (%)	27 (33.8%)	10 (28.6%)	17 (37.8%)	NS

S+ = symptoms recorded, A+ = arrhythmia detected, A- = no arrhythmia detected, S- = no symptoms recorded.

Table 2
Percentage of unrecorded and recorded arrhythmias with Holter versus event ECG recorders.

	Holter REC %	Event REC %	P-value
Unrecorded tracing	86	50	< 0.05
Inap. Sinus tachycardia	5	8	NS
Atrial ectopics	6	22	< 0.05
Ventricular arrhythmias	3	20	< 0.01

Inap. = inappropriate, REC= recording

Table 3
Causes of inadequate recording in 15 patients

Difficulty	No.
Poor electrode contact	2
Patient did not push record button during event	5
Patient not wearing monitor during event	2
Faulty electrode wire connection with device	2
Event captured but erased before transmission	4

Guidelines for the use of ambulatory electrocardiography (ECG) continue to evolve with advances in technology of the monitoring devices as well as other medical devices, and clinical research. An ACC/ AHAtask force issued updated guidelines for the use of this technology in 1999^[7], a decade after its first guidelines in 1989^[8]. Particularly, important progress was made during this period including solid-state digital technology that facilitates trans-telephonic transmission of ECG data, technical advances in long-term event recorders and improved signal quality and interpretation. A class I indication of ACC/AHA task force is the use of ambulatory ECG in patients with recurrent palpitations. This test is considered useful in this setting because the frequency of recurrence of palpitations makes it more likely that ECG data will be captured during episodes of palpitations^[7].

Using a new non-invasive commercially available monitoring device, the cardiac loop ECG

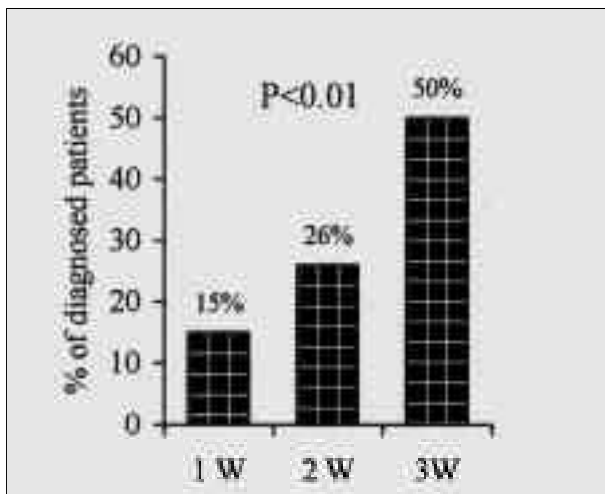


Fig. 1: Increasing percentage of diagnosed patients with increasing duration of Event ECG recording. W= week

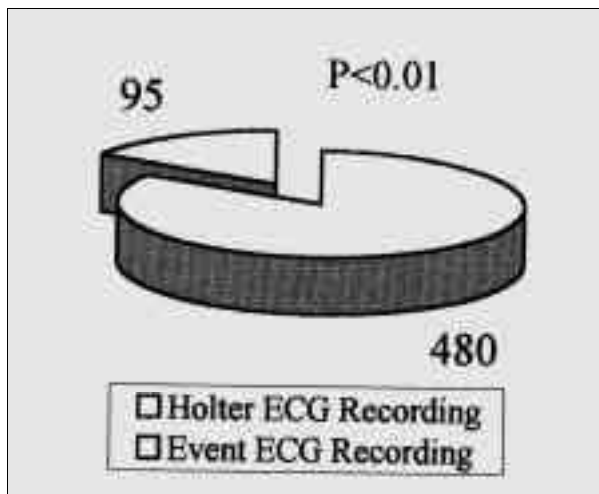


Fig. 2: Number of patients referred for Holter and Event ECG recording within 18 months

event recorder; we were able to determine arrhythmias in 50% of patients with recurrent palpitations, and to ascertain whether the arrhythmia was responsible for their symptoms. Cardiac loop ECG event recorders are able to diagnose an important proportion of patients with recurrent symptoms, and help reassure other patients and physicians that serious arrhythmias were not the cause of symptoms^[9,10,11].

Cardiac event ECG recorders hold numerous advantages over Holter monitors. Firstly, they can be worn for extended periods of time. Secondly, they capture only the rhythm of interest, that is the rhythm occurring during symptoms. Thirdly, event ECG recorders are relatively inexpensive^[6].

The diagnostic yield of event recorder was 50% in our study and this is in agreement with the studies of Linzer *et al*^[6]. Fechter *et al*^[3] however, evaluated 72% of patients with palpitations and his diagnostic yield was 39%. This was substantially less than ours; and this may be related to their relatively short monitoring period which was of two weeks' duration and to the use of post-symptom devices only.

Overall, 95 event recorders were used but only 80 patients were included and the diagnostic utility was 50%. 50% of our patients successfully recorded the events. Forty percent of them has a correlated transmitted events with their presenting symptoms and 16.2% of them were transmitting normal sinus rhythm during one of their typical spells. However, the breakdown of clinical utility was not uniform and was largely determined by the nature of the presenting symptoms and the presence or absence of heart disease, age of the patients and gender. This is in agreement with the results of Fogel *et al*^[12] and Pratt *et al*^[13]. The event recorders were not of much benefit in the elderly compared to the younger patients. Many elderly patients were

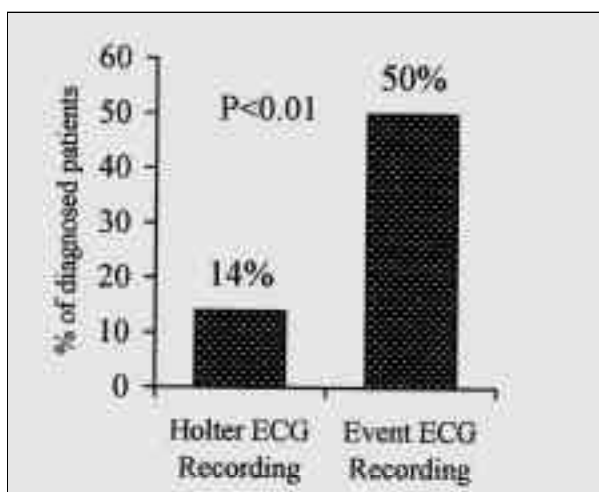


Fig. 3: Percentage of diagnosed patients with Holter and Event ECG recordings

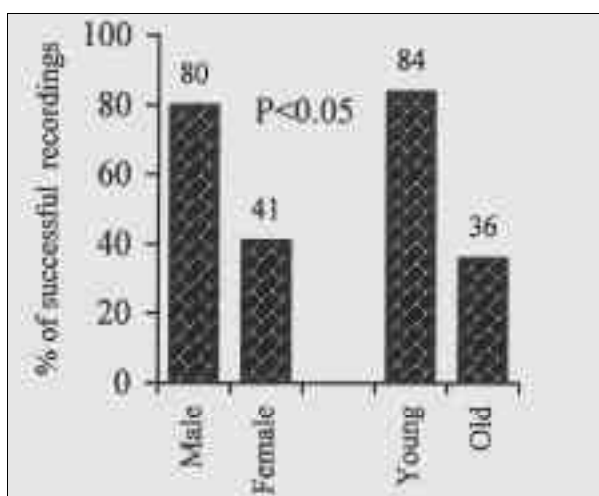


Fig. 4: Percentage of successful recording with event ECG recorders in male versus female and young versus old patients.

intimidated by the devices. Despite the assistance of family members, a large number of older patients, especially those with cognitive impairment, seemed unable to tolerate the daily

use the recorders^[14,15,16]. The elderly were not the only patients who had difficulty using the monitors. Some younger patients could not tolerate the device. Patients with short prodrome and prolonged loss of consciousness were unable to activate the device^[17].

Older devices had a sequence of recording, transmitting, erasing and restarting the monitor that was too complicated for several patients to master, despite their being trained in the use of the monitor by the investigation team^[14,18]. Our device is a new generation of recorders, with easier instructions for use and programming for arrhythmia detection and this improved the patient's use of the devices.

There are strengths and limitations in the current study. It was prospective and all patients underwent a standardized evaluation. Limitations include the relatively small sample of studied patients and the potential lack of normal distribution of the patients' sample due to the presence of frequent episodes of palpitations. In addition, there is no gold standard with which to compare event ECG recording.

CONCLUSION

By capturing cardiac rhythms when there are no typical symptoms, event ECG recording may eventually become the standard diagnostic test in patients with recurrent palpitations.

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