Holter monitoring — a necessity for the evaluation of palpitations

T. H. DIAMOND, R. SMITH, D. P. MYBURGH

Summary

Eighty-five patients complaining of palpitations were evaluated by means of 24-hour dynamic electrocardiography. A sensitivity of 0,69 and a specificity of 0,90 were calculated. This illustrates the value of Holter monitoring in the assessment of patients complaining of palpitations.

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Holter monitoring has been increasingly used for detecting cardiac arrhythmias over the past 20 years. This increase has largely been due to the major limitations of the standard office ECGs in detecting transient cardiac arrhythmias, which may manifest at any time of day. Dynamic electrocardiography may thus reveal the diagnosis in the form of a disturbance in either cardiac rhythm, rate or conduction in patients presenting with either cardiovascular complaints[1,2] (palpitations, chest pain or dyspnoea) or transient neurological disturbances[3-5] (dizziness or syncope). A retrospective study was therefore undertaken to evaluate the benefit of Holter monitoring in establishing the cause of palpitations in a group of patients referred to the Institute for Aviation Medicine, Verwoerdburg, Tvl, during the past year.

Patients and methods

Patients

Eighty-five patients were referred over a 12-month period. Their ages ranged from 18 to 67 years (mean 37,9 years). All complained of palpitations, either as a chronic problem or a single episode requiring hospital admission. In addition, no conclusive diagnosis had been reached on the evidence of a resting ECG. The only patients excluded were those who had previously suffered a myocardial infarction or who were on digoxin therapy. The selected group were all clinically evaluated in terms of their cardiovascular status, resting and stress ECG and the results of Holter monitoring. A positive palpitation response was considered if a patient experienced symptoms of palpitation during the period monitored.

Dynamic electrocardiography

All patients were monitored for a 24-hour period with 2-channel Oxford Medilog portable tape recorders. In order to ensure technically optimal recordings, the usual strict precautions were taken.[6] Electrodes were placed in the conventional manner utilizing the V3 and V5 reference points. The patients were instructed to indicate their symptoms (palpitations) by marking the tape with the 'event button'.

The completed tapes were scanned by an Oxford Medilog analysis system and analysed by 3 doctors experienced in Holter monitoring techniques. The recordings were then arbitrarily classified in order to differentiate significant arrhythmias from coincidental beats (Table I). A positive Holter response was recorded if the recording revealed more than 30 ectopic beats per hour (atrial, nodal or ventricular) or any rhythm or conduction disturbance. The history of palpitations experienced during the monitored period was then correlated with the arrhythmias recorded on the Holter monitor. This correlation was performed by means of the ROC (receiver operating characteristic) analysis.[7] In order to establish an understanding of this analysis the following terms must be listed: true positive (TP) — a positive Holter response with a positive palpitation response; false positive (FP) — a positive Holter response with a negative palpitation response; true negative (TN) — a negative Holter response with a negative palpitation response; false negative (FN) — a negative Holter response with a positive palpitation response.

From these criteria the following can be deduced:

$$\text{Sensitivity} = \text{TP fraction} = \frac{\text{No. of TPs}}{\text{Total No. pos. palpitation responses}}$$

$$\text{FN fraction} = \frac{\text{No. of FNs}}{\text{Total No. pos. palpitation responses}}$$

$$\text{Specificity} = \text{TN fraction} = \frac{\text{No. of TNs}}{\text{Total No. neg. palpitation responses}}$$

$$\text{FP fraction} = \frac{\text{No. of FPs}}{\text{Total No. neg. palpitation responses}}$$

$$\text{TPF} + \text{FNF} = 1$$

$$\text{Pos. predictive value} = \frac{\text{No. of TPs}}{\text{Total No. pos. Holter responses}}$$

$$\text{Neg. predictive value} = \frac{\text{No. of TNs}}{\text{Total No. neg. Holter responses}}$$

Results

Of the 85 patients investigated, 68 (80%) were male and 17 (20%) female. On clinical and standard electrocardiographic examination 58 patients (68,2%) had normal cardiovascular findings, 13 (15,3%) had ischaemic heart disease, 7 (8,2%) showed a Wolff-Parkinson-White (WPW) pattern, 6 (7%) had mitral valve prolapse and 1 (1,2%) had a coronary artery bypass graft. No definitive diagnosis of the cause of the palpitations was obtainable from either the resting or stress ECGs. Only 10 patients (11,8%) were already on specific anti-arrhythmic therapy, comprising ß-adrenergic receptor blocking agents, calcium antagonists and disopyramide. These 10 patients were not analysed separately since all experienced palpitations during the monitoring period.

Arrhythmias detected during the Holter monitoring period are listed in Table II. Supraventricular ectopic beats were the commonest arrhythmia noted, but these occurred in inadequate

Institute for Aviation Medicine, Verwoerdburg, Tvl
T. H. DIAMOND, M.B. B.CH.
R. SMITH, M.B. B.CH.
D. P. MYBURGH, *SM.*, M.B. CH.B., F.A.C.C.

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TABLE I. CRITERIA FOR A POSITIVE HOLTER RESPONSE

- **Atrial**
  - **Atrial ectopic beats > 30/h**
  - **Atrial bigeminy**
  - **Paroxysmal atrial tachycardia**
  - **Atrial flutter or fibrillation**
- **Ventricular**
  - **Ventricular ectopic beats > 30/h**
  - **Ventricular bigeminy**
  - **Ventricular tachycardia**
- **Nodal**
  - **Nodal ectopic beats > 30/h**
  - **Nodal bigeminy**
- **Other**
  - **Wolff-Parkinson-White pattern associated with atrial tachyarrhythmias**
  - **Tachycardia-bradycardia syndrome**

TABLE II. CARDIAC ARRHYTHMIAS DETECTED DURING HOLTER MONITORING IN 40 PATIENTS

Arrhythmia	Patients	
	No.	%
Supraventricular ectopy	**16**	**38,1**
AEBs/NEBs > 30/h	**3**	
Atrial bigeminy	**0**	
PAT	**10**	
Atrial fibrillation	**5**	
Atrial flutter	**4**	
Ventricular ectopy	**22**	**52,4**
VEBs > 30/h	**15**	
Bigeminy	**7**	
Ventricular tachycardia	**4**	
Pre-excitation syndromes with atrial tachycardias	**3**	**7,1**
WPW plus atrial fibrillation	**1**	
WPW plus PAT	**1**	
Lown-Ganong-Levine pattern with PAT	**1**	
Bradycardia-tachycardia syndrome	**1**	**2,4**

AEBs = atrial ectopic beats; NEBs = nodal ectopic beats; PAT = paroxysmal atrial tachycardia; VEBs = ventricular ectopic beats; WPW = Wolff-Parkinson-White pattern associated with atrial tachyarrhythmias.

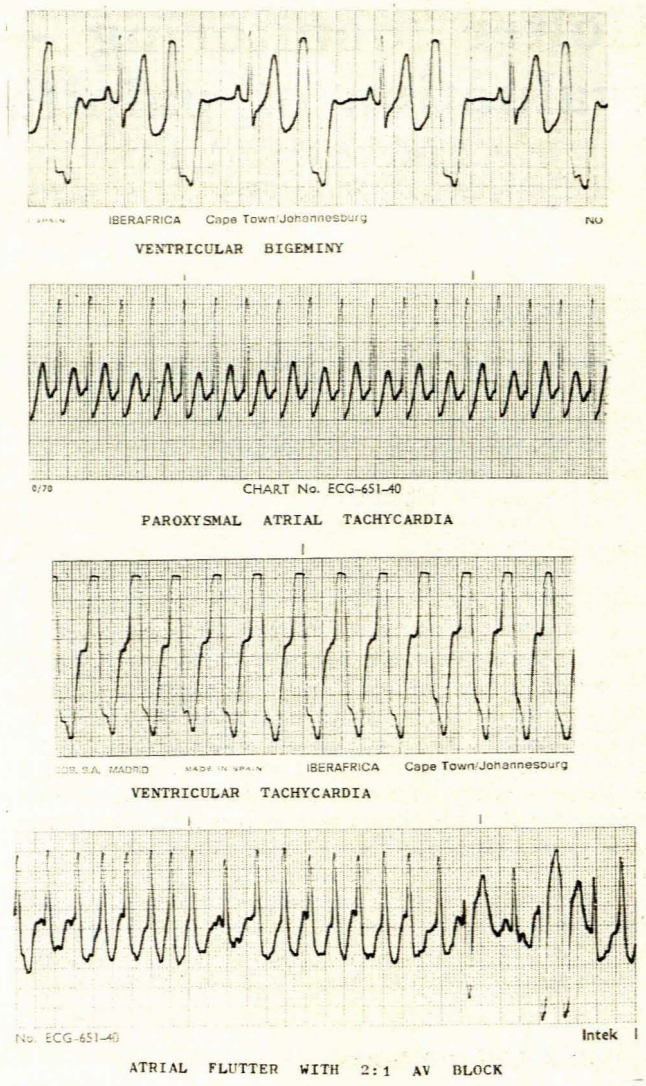

Fig. 1. Four examples of arrhythmias detected on the Holter recordings.

TABLE III. ROC ANALYSIS TO SHOW CORRELATION BETWEEN HOLTER MONITORING AND PALPITATIONS

		Palpitations +	Palpitations −	Total
Holter findings	+	**37 (TP) (FN)**	**3 (FP) (TN)**	**40**
	−	**17**	**28**	**45**
Total		**54**	**31**	**85**

$\chi^2 = 25{,}06$; $P < 0{,}001$.

TP = true positive; FP = false positive; FN = false negative; TN = true negative.

numbers and were therefore regarded as being coincidental. The most significant arrhythmias detected were ventricular ectopy and paroxysmal atrial tachycardia, occurring in 15 and 10 patients respectively. It must be noted, however, that more than 1 type of arrhythmia occurred on a few of the analysed recordings. Fig. 1 displays four examples of arrhythmias detected on the Holter recordings.

Only 54 patients (63,5%) experienced palpitations during the 24-hour period and were labelled as having a positive palpitation response. Using the classification outlined in Table I, this group was further shown to contain 37 patients (43,5%) with positive Holter findings. Hence, by using this arbitrary arrhythmia classification, a positive correlation between Holter monitoring and palpitations was found in 65 patients ($P < 0{,}001$). Of these 37 patients were in the true-positive group and 28 in the true-negative group. The remaining 20 patients were grouped as false negative (17 patients) or false positive (3 patients). Sensitivity was therefore 0,69 and specificity 0,90, with an efficiency of 76,5% (Table III).

Discussion

The technology for and clinical use of dynamic ambulatory (Holter) electrocardiographic recordings has expanded rapidly during

the past 20 years. This has led to the development of small (500 g) portable tape recorders, capable of storing 24 hours of electrocardiographic data, i.e. more than 100 000 beats. This can be contrasted with routine ECGs, which would consume almost a mile of ECG paper over a similar period.[8]

The popularity of the Holter ECG therefore stems from its value in evaluating symptoms,[1-5] i.e. cardiac and neurological symptoms, and asymptomatic conditions by the detection of arrhythmias and ST-segment changes in the evaluation of cardiac disease.[9] In addition, it may also be used for assessing the therapeutic efficiency of anti-arrhythmic agents and for evaluating the safety and efficiency of a cardiac rehabilitation programme. Finally, it may be the only means of evaluating pacemaker malfunction.[10,11]

Numerous studies have therefore been undertaken of Holter monitoring in the evaluation of symptoms. Lipski *et al.*[1] evaluated 55 patients with symptoms of syncope, dizziness and palpitations and found a 55% incidence of cardiac arrhythmias. Tabatznik[12] showed a 60% incidence of cardiac arrhythmias in his group of patients with a history of syncopal attacks. Similarly, this study has shown a 68,5% incidence of cardiac arrhythmias in a group of 54 patients experiencing palpitations.

The results obtained in most studies are similar, even though there are significant variables. The period of Holter monitoring influences the detection of cardiac arrhythmias. Lown and Wolff[13] have stated that a period of more than 10 hours is necessary for the detection of serious arrhythmias. This study was standardized by performing 24-hour Holter monitoring as suggested by Lown and Wolff.[13]

The arrhythmia classification for labelling a Holter response as positive is important in determining relevant sensitivity and specificity of the test. Numerous arrhythmia classifications have been suggested, and this study is based on a classification advocated by several authors.[13-15] The arrhythmia findings in this study revealed a high incidence of incidental supraventricular ectopic beats (< 30/h). The commonest significant Holter finding was of ventricular arrhythmias (52,4%). A strict classification was thus imperative in determining the validity of the recorded arrhythmias. The clinical acumen and awareness of the referring physician also play an important role in influencing the percentage yield of Holter monitoring. Since a Holter monitoring system is expensive and is usually owned and interpreted by a cardiological unit, patients presenting with common complaints such as palpitations and dizziness must be referred to these units. This group of 85 patients were all referred from an internal medicine department. Only patients with previously suspected acute arrhythmias or chronic repetitive palpitations were referred.

Palpitations are mainly cardiac in origin and may be evoked under certain circumstances when circulating serum catecholamine levels are elevated.[16] These circumstances are usually transient and may include anxiety, effort, smoking, alcohol abuse and sexual excitement. Since many of these are sporadic, it is obvious that symptom duplication in a physician's office is almost impossible. In order to determine a positive time correlation between palpitations and cardiac arrhythmias, an 'event button' is used to mark the tape recording at the time at which the palpitations are experienced. Patient diaries, although not requested in this study, are useful from a therapeutic point of view in order to correlate the activity with the symptoms.

This study clearly illustrates the strong correlation between the demonstration of arrhythmias on 24-hour Holter monitoring and the presence of palpitations ($P < 0{,}001$), and stresses the need for this test in diagnosing the cause of palpitations. Its accuracy can be seen by its specificity of 0,90 and its efficiency of 76,5%.

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