

DYNAMIC ELECTROCARDIOGRAPHY—REVIEW OF 100 CASES

Kazuhiko KIKAWA, M.D.* and Milford C. MALONEY, M.D. FACP**

*Department of Medicine,
Mercy Hospital, Buffalo, New York*

Accepted for Publication on May 11, 1978

Abstract

Review of 100 cases of dynamic electrocardiogram (24-hour Holter monitoring ECG) reveals that the routine ECG which usually provides less than 1 minute of actual recording time was inadequate for the detection of arrhythmia in 59 of the 91 symptomatic patients.

Syncope alone was the most frequent symptom noted in approximately one-third of the patients.

In the group with demonstrated arrhythmia or significant changes in arrhythmia on 24-hour Holter recording the incidence of supraventricular arrhythmia was 30%, ventricular arrhythmia 38% and for sinus abnormalities and A-V block it was 32%.

The most frequent arrhythmia in the ventricular arrhythmia group was uniform PVC (premature ventricular contraction) of more than 6 per minute (39%). None of PVC demonstrated R on T phenomenon nor subsequent ventricular fibrillation. Only 1 patient displayed a short run of ventricular tachycardia.

Holter monitoring is a practical, noninvasive tool with demonstrated potential for increasing the accuracy of diagnosis in selected cardiovascular problems but it also possesses certain limitations as demonstrated by the fact that it failed to offer explanation for the symptoms in 14 of our patients.

INTRODUCTION

24-hour Holter monitoring (Dynamic electrocardiography) is of proven clinical value and it is now being widely utilized¹⁻³.

Footnotes:

Presented at the 10th Annual Research Symposium in Mercy Hospital, June 1976.

* Present address: Division of Cardiology, Department of Medicine, Kawasaki Medical School, Kurashiki 701-01, Japan.

** Chairman, Department of Medicine, Mercy Hospital, Buffalo, New York. Associate Clinical Professor of Medicine, State University of New York at Buffalo.

木川和彦

It is a method of continuous recording of the electrocardiogram on magnetic tape whereby there is capability to record over 100,000 cardiac cycles which occur during a 24-hour period in contrast to the approximate 50 to 100 cycles which are recorded on a routine electrocardiogram.⁴⁻⁶⁾ It offers an important diagnostic approach and perhaps the earliest practical method for the detection of high risk "normals" who may or may not have premonitory symptoms but who are nonetheless most prone to develop arrhythmia or ischemic attack.⁷⁻¹⁰⁾ Since approximately 60% of the 600,000 deaths due to coronary artery disease in the U. S. annually occur suddenly outside the hospital,^{11,12)} it is suggested that increased utilization of dynamic electrocardiography may serve to decrease these disquieting statistics which have remained unchanged over the past years.¹³⁾

MATERIALS AND METHODS

24-hour¹⁴⁾ Holter recording was performed on 100 patients at Mercy Hospital, Buffalo, New York, from September, 1974 through March, 1976 for evaluation of various symptoms such as syncope, dizziness and palpitation wherein routine electrocardiograms failed to demonstrate any diagnostic abnormalities. When routine electrocardiograms did display rhythm disturbance or ischemic change, Holter monitoring was subsequently done for the purpose of demonstrating a chronological relationship between the reported symptoms and the electrocardiographic changes.

There were 100 cases which comprised 55 males and 45 females and of this number 56 were in-patients and 44 were out-patients.

The age distribution was from 12 to 85 years. 25% of the total number of patients studied were found to be in the 6th decade.

The electrocardiocorder (Avionics Model 400) is a portable battery operated instrument which is enclosed in a leather case designed to be carried over the shoulder like a camera. In this series two leads¹⁵⁾ were recorded in the Holter ECG. Each patient was directed to maintain a diary or log in which he recorded his symptoms and the time of occurrence, and noted their relation to the state of physical activity or to emotional stimuli.

This information was later correlated and analysed in chronological manner on the continuous ECG recording with the data being reproduced by a playback unit or cardioscanner (Avionics Model 650 Composite Electrocardioscanner), which permits rapid scanning of the recorded tape for detection of documented electrocardiographic changes.

RESULTS

Table 1 demonstrates patients' symptoms and reasons for Holter monitoring. Syncope alone was the most frequent symptom noted in approximately one-third of the patients.

TABLE 1.
Symptomatic indications for Holter monitoring

Symptoms	Number of patient
Syncope	30
Dizziness	10
Palpitation	16
Chest pain	4
Others	21
Combination of above	18
Unknown	1
	<u>100</u>

The routine ECG revealed arrhythmia in 32 cases but failed to demonstrate any arrhythmia or conduction disturbance in 59 cases. The routine resting ECG was not available for patients who were referred from outside the hospital.

In 59 cases where no arrhythmia appeared on the routine ECG, 33 patients (56%) displayed arrhythmia whereas the remaining 26 cases (44%) failed to demonstrate arrhythmia during the 24-hour Holter recording period.

In 32 patients with arrhythmia on routine ECG there were 24 patients (75%) who displayed a significant change in the arrhythmia on Holter recording. No significant changes in the arrhythmia was noted in the remaining 8 (25%) patients (Table 2). A total of 57 (63%) patients displayed a significant arrhythmia on 24-hour Holter recording.

TABLE 2.
Comparison of Routine and Holter ECG

Routine ECG	Holter ECG
No arrhythmia 59	[26 (44%)—no arrhythmia 33 (56%)—arrhythmia
Arrhythmia 32	[8 (25%)—no significant changes 24 (75%)—significant changes of arrhythmia
Unknown 9	—
<u>100</u>	<u>91</u>

In the group with demonstrated arrhythmia and significant changes in arrhythmia, the incidence of supraventricular arrhythmia was 30%, ventricular arrhythmia 38% and for sinus abnormalities and A-V block it was 32%. Several patients displayed a combination of two or more arrhythmias such as PAC and PVC in a single Holter recording.

The most frequent arrhythmia in the group with supraventricular arrhythmia was noted to be PAC occurring at a frequency of less than 6 per minute (Table 3). Of interest was one patient who displayed an episode of paroxysmal atrial fibrillation, which corresponded with an attack of severe dizziness during the recording period and in whom the diagnosis of asymmetric septal hypertrophy had previously been established on the basis of positive family history, physical exam. and echocardiogram. Figure (1) displays the patient's resting ECG which shows sinus rhythm. Figure (2) demonstrates her Holter ECG tracing which displays a change from sinus rhythm to frequent PAC and then atrial fibrillation. (Figure 3)

TABLE 3.
Incidence and type of various arrhythmias

Supra ventricular arrhythmia 25(30%)	Atrial		
	Premature beats <6/min	10	
	Premature beats >6/min	5	
	Tachycardia	3	
	Fibrillation	2	
	Junctional		
	Junctional rhythm	2	
	Premature beats <6/min	2	
	Premature beats >6/min	1	
	Tachycardia	1	
	Escape beats	1	
	Ventricular arrhythmia 31(38%)	Uniform premature beats <6/min	12
		Uniform premature beats >6/min	10
Multiform PVC <6/min		3	
Multiform PVC >6/min		4	
Paired PVC		1	
Tachycardia		1	
Sinus abnormalities and A-V block 26(32%)	Sinus tachycardia	14	
	Sinus bradycardia	4	
	Sinus arrest, pause & SA block	4	
	2° A-V block	3	
	3° A-V block	1	
	Tachycardia - bradycardia	1	

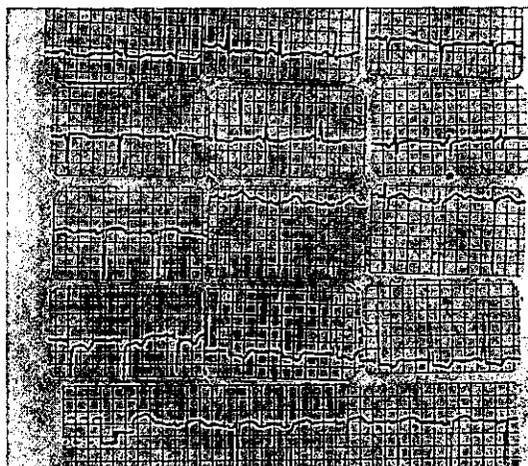


Fig. 1. Resting ECG—Sinus rhythm

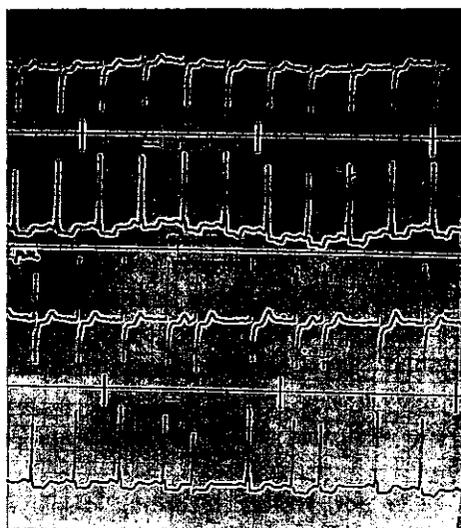


Fig. 2. Holter monitoring ECG—Sinus rhythm with frequent PACs

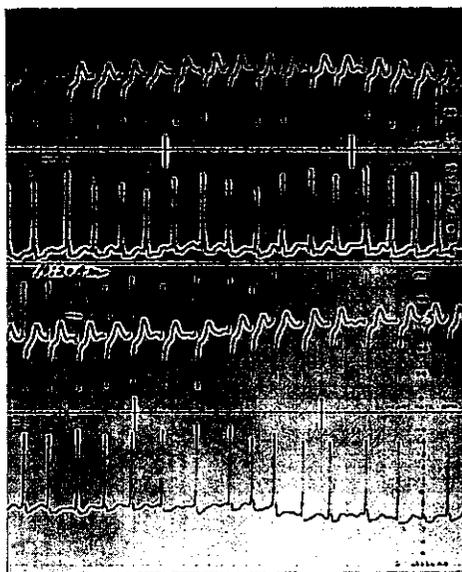


Fig. 3. Holter monitoring ECG—Atrial fibrillation

The most frequent arrhythmia in the group with ventricular arrhythmia was unifocal or uniform PVC of more than 6 per minute with unifocal PVC of less than 6 per minute occurring as the second most frequent ventricular arrhythmia. None of these PVC demonstrated R on T phenomenon nor subsequent ventricular fibrillation. Only 1 patient displayed a short run of ventricular tachycardia and this patient's routine ECG displayed atrial fibrillation with right bundle branch block. Following the Holter recording a permanent demand pacemaker was inserted.

In the group with sinus abnormalities and A-V block, sinus tachycardia was the most frequent occurrence followed closely by sinus bradycardia. One patient who demonstrated sinus bradycardia (55 per minute) on his resting ECG was noted to display a sick sinus syndrome manifested by an episode of tachycardia which was followed by a period of marked sinus bradycardia on his Holter recording.

Neither routine ECG nor Holter recording displayed any abnormalities which might account for symptoms in 26 of the 91 patients (29%). The etiologic diagnoses which were established for these symptoms are recorded on Table 4. Cerebrovascular insufficiency was the diagnosis for 6 patients but it is to be noted that there was no apparent explanation for the symptoms offered by 14 of the 26 patients.

TABLE 4.
Etiology of symptom in 26 patients without arrhythmia

Diagnosis	Number of patients
Cerebrovascular insufficiency	6
Carotid sinus syndrome	1
Vesodepressor syncope	1
Anxiety reaction	1
Hysterical reaction	1
Mitral valve prolapse	1
Pre-excitation syndrome	1
Unknown	<u>14</u>
	26

DISCUSSION

Review of this series of cases at the Buffalo Mercy Hospital reveals that the routine ECG which usually provides less than 1 minute of actual recording time was inadequate for the detection of arrhythmia in 59 of the 91 symptomatic patients. Many activities such as anxiety, effort, digestion and smoking can provoke transient arrhythmia which may escape detection on routine ECG in the hospital or the physician's office. The detection of arrhythmias which are associated with physical activity is particularly relevant in the symptomatic patient with or without heart disease.¹²⁾

Utilizing the Holter recording technique, Hinkle noted no increased incidence of coronary artery disease or subsequent myocardial infarction in middle-aged men who had displayed only supraventricular arrhythmia.¹⁶⁾ However, supraventricular tachyarrhythmias are of importance when rapid cardiac rate may provide the mechanism responsible for diminished cardiac output with consequent cerebrovascular insufficiency.^{17,18)} In our series, the case of asymmetric septal hypertrophy with atrial fibrillation demonstrates the important role which Holter recording can play in the diagnosis and treatment of supraventricular arrhythmias. In Ingham's study of 27 patients with asymmetric septal hypertrophy who had Holter monitoring, there was 70% incidence of supraventricular tachycardia, including atrial fibrillation.¹⁹⁾

Although premature ventricular beats are frequently encountered in healthy young adults and considered as benign when there is no overt evidence of heart disease they may on occasion be the first manifestation of latent coronary artery disease in symptomatic individuals.^{20,21)} According to Alexander's study²²⁾ ventricular premature beats have particular significance when they occur in patients who have hypertension, angina pectoris, or a previous myocardial

infarction^{23,24)} since they are associated with a considerably increased incidence of subsequent myocardial infarction and sudden death. Hinkel's data demonstrated in his study of 301 cases that 15 of 17 patients (88%) who subsequently died of coronary artery disease had displayed ventricular premature beats on the initial Holter recording, yet only 18% of these patients displayed ventricular premature beats on the routine resting electrocardiogram. 16 of the 17 coronary deaths in his study were sudden.¹⁶⁾ In view of these findings it would appear that a follow-up on the patients who displayed ventricular premature beats in our series would be warranted.

Although transient third degree A-V block was detected in only 1 case in this study, Holter recording has been particularly useful in predicting the probability of A-V block before it becomes complete.^{25,26)} Similarly, the foregoing data would suggest the advisability for Holter monitoring on patients with symptoms which suggest intermittent cerebrovascular insufficiency as well as on those asymptomatic patients who display trifascicular block on routine electrocardiogram.^{17,27)}

In this study, 5 patients with permanent pacemaker had Holter recordings but none of them demonstrated a malfunction of the pacemaker. Holter monitoring represents another practical method for determining intermittent pacemaker failure or pacemaker induced arrhythmias which escape detection on the routine electrocardiogram. In Bleifer's study of 48 patients for pacemaker malfunction it was demonstrated that 9 of these patients (18%) displayed malfunction when routine electrocardiograms and pacemaker evaluation clinics were unable to detect such pacemaker disturbance.¹²⁾

Holter recording has been recommended for the evaluation of transient non-specific ST segment and T wave changes which occur in patients with known or suspected coronary artery disease.²⁸⁻³¹⁾ In our study, Holter recording was done on only 3 patients who were noted to complain of chest pain with documented normal resting electrocardiograms and negative treadmill exercise test. One of these patients displayed ischemic ST-T changes several times during the recording interval but there was poor correlation with symptoms as recorded in her diary. Stern's study revealed that 37 of 80 patients who presented precordial symptoms with a normal routine electrocardiogram and a negative Master two-step test were noted to demonstrate ischemic ST changes on Holter recording during various intervals of the day. 6 to 12 months follow-up on these 37 patients revealed that 1 patient had sustained an acute myocardial infarction, 7 had developed pathological changes in the routine electrocardiogram and 16 had displayed progression in the severity of their precordial symptoms.³²⁾

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