

# Patient-initiated transtelephone transmission of electrocardiographic signals in the diagnosis of arrhythmias

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Thirty-one patients who had complained of recurrent palpitations were given transtelephone transmitters of electrocardiographic signals and instructed to use the transmitters while they were having symptoms. From the transcribed electrocardiograms sinus tachycardia was documented in 12 patients, paroxysmal atrial tachycardia in 7, atrial fibrillation in 4, atrial flutter in 3, frequent ventricular premature beats in 4 and ventricular tachycardia in 1. Patient-initiated transtelephone transmission of electrocardiographic signals was found to be an effective means of documenting the nature of symptomatic paroxysmal tachycardia.

Trente-et-un patients qui s'étaient plaints de palpitations récidivantes ont reçu un émetteur électrocardiographique téléphonique et ont reçu l'instruction de l'utiliser au moment où ils éprouvaient des symptômes. A partir des électrocardiogrammes (ECG) transmis, une tachycardie sinusale a été vérifiée chez 12 patients, une tachycardie auriculaire paroxystique chez 7, une fibrillation auriculaire chez 4, un flutter auriculaire chez 3, des extrasystoles ventriculaires fréquentes chez 4 et une tachycardie ventriculaire chez 1. La transmission de l'ECG par téléphone s'est avéré un moyen efficace de mettre en évidence la nature d'une tachycardie paroxystique symptomatique.

The successful treatment of a recurrent arrhythmia requires an accurate diagnosis of the nature of the arrhythmia. Most reliable in this regard is an electrocardiogram (ECG) taken during a spontaneous episode. All too often, however, the arrhythmia has ended spontaneously by the time the person reaches a medical facility. For these patients a number of alternatives are available. Treadmill or bicycle stress testing<sup>1</sup> and atrial pacing or programmed atrial stimulation<sup>2</sup> can be used to induce an arrhythmia, but it is often difficult to relate with certainty the artificially induced ar-

rhythmia to the patient's spontaneous arrhythmia. The likelihood of detecting an arrhythmia with 24-hour electrocardiographic taping<sup>3</sup> increases with the frequency of occurrence of the arrhythmia. Often, however, the individual remains free of symptoms as long as the monitor is attached.

The use of patient-activated transtelephone transmitters of electrocar-

diographic signals, which were developed for follow-up pacemaker surveillance,<sup>4,5</sup> has increased to the point where commercially available units are very small, relatively inexpensive and convenient to use. The resulting ECG is free of artefact and sufficiently detailed for arrhythmia analysis. Thus, application of this tool to arrhythmia detection was a logical



FIG. 1—Transtelephone transmitter of electrocardiographic signals placed against upper part of chest; mouthpiece of telephone receiver placed against transmitter.

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step.<sup>6,7</sup> This paper summarizes our recent experience with these transmitters in the diagnosis of paroxysmal arrhythmias.

## Methods

For the transmitter to be useful the tachycardia must produce symptoms that are recognizable to the patient, yet not too disabling. When symptoms occur, the patient dials a number indicated on the transmitter, states his or her name, places the transmitter against the chest, and then places the telephone mouthpiece against the transmitter (Fig. 1). When the transmitter is demonstrated to the patient, he or she transmits a tracing of the normal rhythm, which provides a useful guide for later interpretation of tracings from signals transmitted when the patient is symptomatic.

At our pacemaker registry there is a dedicated telephone line for receiving these transmissions. The telephone is "hard-wired" to an automatically activated tape recorder (Sony TC-860, Tokyo). Thus, the system is available for transmission 24 hours a day. Each day the tape is played back through a transcriber (Cardiotrak model 2100 receiver, Cardiac Pacemakers Inc., St. Paul, Minnesota) that produces a standard-format ECG strip that is usually free of artefact and sufficiently clear in its detail to allow interpretation using standard diagnostic criteria for arrhythmias<sup>8</sup> (Fig. 2). I reviewed all transmissions from patients with arrhythmias.

## Results

Detailed documentation was available for 31 patients with arrhythmias who had been given transmitters since January 1976. The 10 men and 21 women ranged in age from 16 to 84 (mean 50.6) years. A definite diagnosis was established in all 31 within 2 months of receipt of their transmitter (Table I). In four patients the first transmission while symptoms were occurring produced an ECG containing too much artefact for accurate interpretation; a diagnosis was

Table I—Arrhythmias detected by transtelephone transmission of electrocardiographic signals

Arrhythmia	Total no. of patients	Men		Women	
		No.	Age (yr)	No.	Age (yr)
Sinus tachycardia	12	3	47*	9	43*
Paroxysmal atrial tachycardia	7	0	—	7	44*
Atrial fibrillation	4	2	45, 71	2	64, 84
Atrial flutter	3	1	83	2	56, 61
Ventricular premature beats	4	3	48, 55, 57	1	66
Ventricular tachycardia	1	1	47	0	—

\*Mean; actual ages listed in Tables II and III.

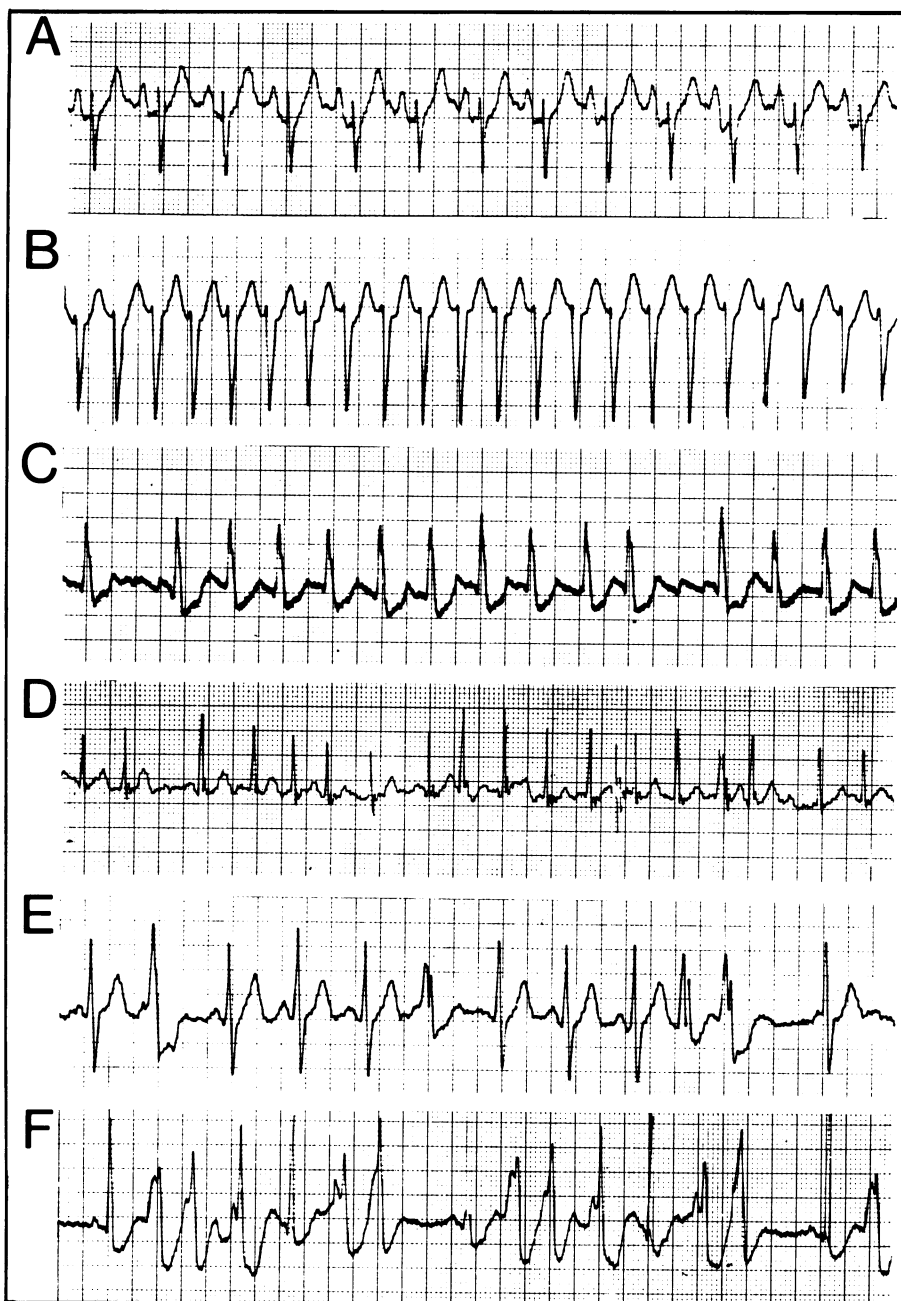


FIG. 2—Sample electrocardiographic records from telephone transmissions from patients in this study: A, sinus tachycardia, heart rate 120 beats/min; B, paroxysmal atrial tachycardia, heart rate 190 beats/min; C, atrial flutter, primarily 2:1 conduction, flutter waves clear at times of spontaneously increased atrioventricular block; D, atrial fibrillation; E, ventricular premature beats, single and paired; F, ventricular tachycardia, atrioventricular dissociation, "capture beats" (beats 5 and 12).

readily made from the second ECG for each patient.

Transmitters were given to 26 patients to document unknown arrhythmias. Before the transmitters were supplied, stress electrocardiography and 24-hour ECG taping had been done in 12 and 9 of these patients respectively, without detection of arrhythmia.

In two patients arrhythmias noted by other means were shown not to be the cause of the palpitations. One patient had only occasional ventricular premature beats demonstrated by 24-hour taping; subsequent telephone transmission showed atrial flutter to be responsible for the symptoms. In the second instance several atrial and ventricular premature beats were demonstrated on an ECG obtained with the patient at rest; the transmitted arrhythmia was atrial fibrillation. In two patients with frequent ventricular premature beats (demonstrated by 24-hour taping in one and stress electrocardiography in the other) telephone transmission established that the patients' symptoms were related to increased frequency of the premature beats rather than to a more malignant arrhythmia. In one patient who was receiving digoxin for atrial flutter documented by 24-hour taping, subjectively different palpitations developed; transmission permitted documentation of paroxysmal atrial fibrillation (panel D of Fig. 2).

The most common arrhythmia detected was sinus tachycardia (Tables I and II); the heart rates varied from 120 to 160 beats/min. These patients could not be distinguished by history from patients proven to have paroxysmal atrial tachycardia (Table III). Mitral valve prolapse was present in approximately one third of the patients in each of these groups. All had normal thyroid function. No other etiologic factors could be identified except in one patient (Table III, no. 7), in whom a standard ECG obtained with the patient at rest showed a short PR interval (Lown-Ganong-Levine syndrome).

One of the patients with frequent ventricular premature beats had undergone aortocoronary bypass graft-

ing previously, and one of his three grafts was occluded. A second patient with ventricular premature beats had angiographically proven coronary artery disease. Thus, ischemia may have been the basis of the arrhythmia in these two patients. The patient with recurrent ventricular tachycardia (panel F of Fig. 2) had angiographically normal coronary arteries.

## Discussion

Patient-activated transtelephone ECG transmitters appear to provide the best means of documenting a paroxysmal recurrent arrhythmia, provided the arrhythmia is of sufficient duration, yet not too disabling. Although a person other than the patient can perform the transmission, the need to place a telephone receiver close to the transmitter makes this approach generally unsatisfactory for the patient with disabling symptoms. By activating the transmitter at the time of symptoms, the patient ensures that the arrhythmia detected is the abnormality producing his or her

symptoms. Thus, one does not have to rely on the chance occurrence of an arrhythmia during a particular period or on the variety of available techniques that may artificially induce an arrhythmia. The transmitter is conveniently carried about and can easily be used any time an arrhythmia occurs. Transmission is limited only by the availability of a telephone; hence, distance is not a factor. We have even received a number of excellent transmissions by long distance and from public telephone booths.

Telephone transmitters have been used for arrhythmia detection in our hospital since 1970. However, since their use is limited to outpatients, detailed documentation was not readily available for the earlier years. Thus, I limited this study to the past 2 years.

Sinus tachycardia was the most common arrhythmia detected. The 12 patients complained of sudden paroxysms of regular palpitations and were all clinically thought to have paroxysmal atrial tachycardia. The distinction between these conditions is therapeutically important, for eight of the patients were helped by reassurance alone; three were treated with minor tranquilizers and only one required propranolol. Some of these patients appear to be similar in many respects to those considered to have DaCosta's syndrome or equivalent disorders that may also be related to mitral valve prolapse.<sup>9</sup>

Since the object of stress electrocardiography is to increase the sinus rate, the diagnosis of sinus tachycardia cannot be made by this technique. Similarly, sinus tachycardia demonstrated by 24-hour electrocardiographic taping is usually not recognized as an abnormality even if temporally related to the patient's symptoms.

At more rapid heart rates the electrocardiographic distinction of sinus tachycardia from paroxysmal atrial tachycardia can be difficult. The availability of a test ECG strip showing normal sinus rhythm was an important aid in this respect. During sinus tachycardia the P wave was identical to that during normal sinus

Table II—Age and sex of the 12 patients with sinus tachycardia

Patient no.	Age (yr)	Sex
1	53	F
2	67	F
3	46	F
4	45	F
5	58	M
6	22	F
7	41	F
8	37	M
9	28	F
10	56	F
11	46	M
12	28	F

Table III—Age and sex of the seven patients with paroxysmal atrial tachycardia

Patient no.	Age (yr)	Sex
1	16	F
2	47	F
3	43	F
4	42	F
5*	55	F
6	66	F
7	38	F

\*Standard electrocardiogram obtained with the patient at rest showed a short PR interval.

rhythm and the PR interval was the same or shorter.

Not all arrhythmias can be readily diagnosed from an ECG alone. Thus, it may still be necessary in selected cases to perform intracardiac electrocardiography and arrhythmia induction before a definitive diagnosis can be made.<sup>10</sup> However, once one has seen the morphologic characteristics of the arrhythmia on the ECG obtained by telephone transmission, it is possible to relate with more certainty an arrhythmia produced artificially in the laboratory with that occurring spontaneously.

Patient-activated transmitters are only useful in symptomatic arrhythmias. In some situations — for example, after myocardial infarction — it may be important to detect asymptomatic arrhythmias while the patient is ambulatory.<sup>3,11</sup> At present, 24-hour electrocardiographic taping offers our only approach to this type of arrhythmia. Taping is also the best means presently available for assessing

symptoms that would not permit transmission, such as syncope.

Thus, the patient-activated trans-telephone ECG transmitter provides us with a very efficient tool for the diagnosis of recurrent symptomatic paroxysmal arrhythmias.

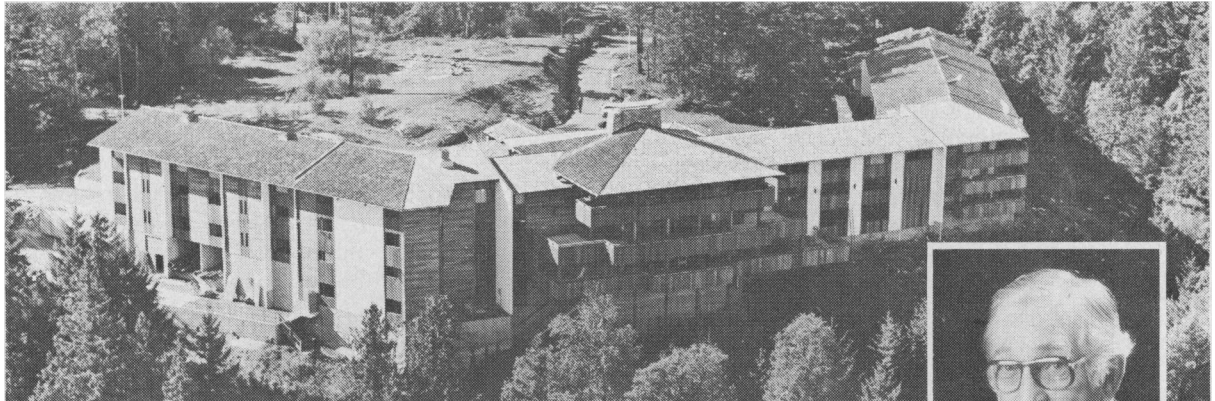
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