Role of Transtelephonic Electrocardiographic Monitoring in Detecting Short-Term Arrhythmia Recurrences After Radiofrequency Ablation in Patients With Atrial Fibrillation

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OBJECTIVES
The aim of our study was to determine the incidence of asymptomatic recurrences of atrial fibrillation (AF) by daily transtelephonic (TT) electrocardiographic (ECG) monitoring, as compared with standard ECG and 24-h Holter recording, in patients who underwent radiofrequency catheter ablation (RCA) of AF.

BACKGROUND
The efficacy of RCA of AF is usually evaluated by means of patients’ symptoms.

METHODS
Seventy-two patients with paroxysmal (n = 37) or persistent (n = 35) drug-refractory AF underwent circumferential RCA of the pulmonary vein (PV) ostia. Left isthmus ablation was performed in 57 patients, and cavotricuspid isthmus ablation was done in 69 patients. Patients were scheduled to obtain an ECG and Holter recordings one and four months after ablation, as well as a daily TT ECG, from 30 to 120 days after ablation or in the event of symptoms.

RESULTS
A total of 5,585 TT ECGs were obtained (mean 77.5 per patient). In 20 patients (27.8%), AF recurrences were recorded during TT ECG, whereas ECG and Holter monitoring revealed AF recurrences in 10 patients (13.9%, p = 0.001). Ten patients had at least one asymptomatic AF recurrence, and eight were completely asymptomatic. The ECG recorded in the event of symptoms always showed AF.

CONCLUSIONS
Transtelephonic ECG is better than standard ECG and 24-h Holter recordings in evaluating AF relapses after RCA, thus decreasing the short-term success of ablation from 86% to 72%.

The absence of symptoms should not be interpreted as absence of AF, as 50% of patients were asymptomatic during at least one AF episode. (J Am Coll Cardiol 2005;45:873–6) © 2005 by the American College of Cardiology Foundation

Atrial fibrillation (AF) is the most common sustained arrhythmia and is associated with substantial morbidity that is primarily related to symptoms, heart failure, and thromboembolic events (1). Radiofrequency catheter ablation (RCA) has recently been proposed as an alternative treatment for drug-refractory paroxysmal and persistent AF. The success rate of catheter ablation has been mainly based on patients’ symptoms or routine electrocardiograms (ECGs) or 24-h Holter recordings. However, asymptomatic recurrences of AF may remain undetected. When routine transtelephonic (TT) ECG recordings are performed, the incidence of asymptomatic AF may be as high as 20% (2,3), and treatment of AF with drug therapy may contribute to this incidence by providing rate control during recurrence or by shortening the duration of the recurrence (4). The aim of our study was to determine the incidence of asymptomatic AF recurrences, using daily TT ECG monitoring, in the short-term follow-up of patients with paroxysmal or persistent AF undergoing catheter ablation.

METHODS
Patient population. Seventy-two of 97 consecutive patients who underwent catheter ablation of AF met the inclusion criteria and were willing to give consent, and thus were enrolled. Inclusion criteria included: 1) symptomatic drug-refractory AF (at least two anti-arrhythmic drugs attempted); 2) paroxysmal AF with documented monthly sustained episodes; and 3) persistent AF in patients who had already undergone three or more electrical cardioversions.

Study protocol. All patients gave informed, written consent to be enrolled in the study. A detailed clinical examination, thyroid function tests, ECG, chest radiography, Holter monitoring, and transthoracic and transesophageal echocardiography were routinely performed. All patients were treated with oral anticoagulation using warfarin sodium to achieve an international normalized ratio of 2 to 3 for three weeks before catheter ablation. All patients underwent ablation while receiving the best anti-arrhythmic treatment. After ablation, cardiac rhythm was monitored by telemetry for at least 4 h and 12-lead ECG was performed at 12, 24, and 36 h after ablation. Clinical examination and 12-lead ECG were scheduled after hospital discharge, at one week, and at 14, 30, and 120 days. Thirty days after ablation, patients received a TT ECG recorder (CG2206 Sorin Life Watch, Milan, Italy) and were instructed to

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Manuscript received September 26, 2004; revised manuscript received November 16, 2004, accepted November 22, 2004.
obtain a daily 30-s TT ECG for the next 90 days and a further TT ECG record in case of symptomatic palpitations. A 24-h Holter recording and transthoracic echocardiogram were scheduled 30 and 120 days after ablation, whereas transesophageal echocardiography was usually performed three to four months after ablation to assess the occurrence of pulmonary vein (PV) stenosis. After ablation, patients were discharged on oral anticoagulation and anti-arrhythmic therapy for at least four months.

**Mapping and ablation procedure.** The mapping and ablation strategy has been already described (5). Briefly, the left atrium and PVs were explored using a transeptal approach. Real-time three-dimensional left atrial maps were reconstructed using a nonfluoroscopic navigation system (CARTO, Biosense Webster, Los Angeles, California), acquiring a minimum of 60 points. The ostium of the PVs was identified by fluoroscopic visualization of the catheter tip entering cardiac silhouette, during withdrawal of the catheter from the PV, with a simultaneous impedance decrease and appearance of atrial potential. In patients in sinus rhythm at the beginning of the procedure, maps were acquired during pacing from the coronary sinus. In patients in AF, maps were acquired to assess the amplitude of the local atrial electrograms. Radiofrequency pulses were delivered using a 3.5-mm (with a temperature setting up to 45°C and radiofrequency energy up to 50 W) cooled-tip catheter. Radiofrequency energy was delivered for 60 to 120 s until the local electrogram amplitude was reduced ≥80%. The ablation lines consisted of a contiguous focal lesion deployed at a distance ≥5 mm from the ostia of the PVs, creating a circumferential line of conduction block around each PV. The remap process was performed in all patients in sinus rhythm, utilizing the pre-ablation anatomic map for the acquisition of new points. A minimum of 5 points per each circumferential line was sampled. The end point of the ablation procedure was low peak–to–peak bipolar potentials (<0.1 mV) inside the lesion, as determined by local electrographic analysis and voltage maps. Adjunctive ablation lines were created in the right or left atrium: along the cavotricuspid isthmus (with electrophysiologic assessment of transisthmic block), and along the isthmus between the mitral annulus and left inferior PV (without electrophysiologic assessment of transisthmic block). At the end of the procedure, electrical cardioversion was performed if sinus rhythm was not obtained during ablation.

**Statistical analysis.** Continuous variables are expressed as the mean value ± SD and were compared using the two-tailed Student t test for paired and unpaired data. A value of p < 0.05 was considered statistically significant. For the analysis of atrial arrhythmia recurrence, we considered the period from one to four months after ablation, during which the patients had the TT ECG recorder. Atrial fibrillation–free survival data, using standard ECG and Holter recording or TT ECG recordings, were analyzed by Kaplan–Meier analysis, and the difference in survival between groups was examined with the log-rank test.

**RESULTS**

**Clinical characteristics.** Among the 72 patients enrolled, 43 were male, with a mean age of 62 ± 9.1 years (range 36 to 78 years); 37 patients (51%) had paroxysmal AF; and 35 patients (49%) had persistent AF. Their arrhythmic history lasted a median of four years (range 0.5 to 20 years), and they had tried a mean of 3.2 ± 0.8 anti-arrhythmic drugs (range 2 to 5 years). Structural heart disease was present in 50 patients (69%): hypertension in 42 patients, ischemic heart disease in 5 patients, and valvular disease in 3 patients. The mean anteroposterior left atrial diameter was 42.4 ± 3.9 mm (range 37 to 55 years), and the mean left ventricular ejection fraction was 58.7 ± 7.6% (range 48% to 75%). Amiodarone was prescribed in 49 patients, and flecainide in 23 patients.

**Mapping and ablation procedure.** The mean number of separate PV ostia mapped per patient was 4.0 ± 0.5 (range 2 to 6), whereas the mean number of separate PV ostia encircled per patient was 3.8 ± 0.7 (range 2 to 6). The mean procedure duration was 183.7 ± 64.1 min (range 75 to 295 min), and the mean fluoroscopic exposure was 26.3 ± 8.8 min (range 13 to 59 min). The mean duration of radiofrequency applications per patient was 56.4 ± 16.2 min (range 24 to 97 min), and the mean duration of radiofrequency applications per isolated PV ostium was 15.4 ± 5.9 min (range 6 to 41 min). Documentation of successful ablation of all the targeted PVs was obtained in 65 patients (90%). Left inferior PV-mitral annulus isthmus ablation was performed in 57 patients (79%), and cavotricuspid isthmus ablation was done in 69 patients (96%). One patient had transient phrenic paralysis, and one patient had pericardial effusion, which did not require pericardiocentesis.

**Clinical outcome.** We obtained 288 standard ECGs, 144 24-h Holter recordings (4 ECGs and 2 Holter recordings per patient) and 5,585 TT ECG recordings (mean 77.5 TT ECGs per patient). By means of standard ECG and Holter recording, 10 patients (13.9%) had an atrial arrhythmia recurrence documented. During TT ECG recordings, 20 patients (27.8%) had atrial arrhythmia recurrences (p = 0.001) (Fig. 1); of them, 10 had at least one asymptomatic episode and eight were completely asymptomatic. Twelve patients acquired a TT ECG during palpitation (27 episodes), and the rhythm was always AF. No differences in any clinical characteristics or anti-arrhythmic drug therapy were observed between patients with symptomatic and asymptomatic AF recurrences.
obtain a TT ECG once monthly until follow-up ended at 12 months, whereas our patients had a daily TT ECG for three months. Recently, Oral et al. (13) evaluated the incidence of asymptomatic AF in 60 patients who reported no symptoms of recurrent AF at ≥6 months after ablation. The patients were provided with a patient-activated TT event recorder for 30 days, a mean of 6.45 ± 195 days after the ablation procedure, and were asked to record and transmit the ECG on a daily basis and whenever they felt palpitations. Seven patients felt palpitations, and each of them had an AF episode documented by the event monitor. Among the 53 asymptomatic patients, an episode of AF was captured in one patient (2%) during the study period. The lower incidence of asymptomatic AF recurrence, as compared with our series, might reflect the shorter period of follow-up evaluated (one versus three months) and the choice of Oral et al. (13) of scanning 30 days of the long-term follow-up rather than 90 days of the short-term follow-up, in which the incidence of AF recurrence is higher (14,15).

Clinical implications for anticoagulation. Our data seem to suggest that the true success rate of AF catheter ablation, using standard ECG and 24-h Holter monitoring, is strongly overestimated. Their most important clinical implication is in the management of patients undergoing AF ablation and is related to the need for anticoagulation in patients with AF (16,17). Physicians usually consider AF as cured if sinus rhythm is documented on routine ECG or 24-h Holter monitoring, and they often stop anticoagulation. However, short-lasting episodes of atrial arrhythmia, which often are asymptomatic, identify patients who are more than twice as likely to die or have a stroke (18). According to these findings, we share the view of Kaufman and Waldo (1), who suppose that the only patients who do not need life-long oral anticoagulation are those without associated risk factors for stroke.

Patient symptoms. In our study, we tried to correlate symptoms with arrhythmia recurrence. Significantly, 12 patients acquired a TT ECG during palpitation, and the rhythm was always AF. Similar data have been recently reported by Oral et al. (13); in their series, seven patients felt palpitations during the study, and each of them had an episode of AF documented by the event monitor during symptoms. These data suggest that the population of patients who undergo catheter ablation for drug-refractory AF has a high capacity to recognize the nature of their symptoms.

Study limitations. The study has two major limitations. 1) The TT ECG lasted only 30 s; so far, we might have lost some asymptomatic AF episodes. However, all patients had sustained and usually long-lasting episodes of AF before ablation, and after ablation, we observed a higher incidence of persistent AF recurrences instead of paroxysmal recurrences, even in asymptomatic patients. 2) In our study, all patients were taking anti-arrhythmic drug therapy during the three-month follow-up period. Drug therapy may in-
crease the incidence of asymptomatic AF recurrences by providing rate control during recurrence or by shortening the duration of the recurrence.

**Conclusions.** Transtelephonic ECG is better than standard ECG and 24-h Holter recordings in evaluating AF relapses after RCA, thus decreasing the short-term success of the ablation from 86% to 72%. The absence of symptoms should not be interpreted as absence of AF, as 50% of patients with recurrences were asymptomatic during at least one AF episode.

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