# Detection of Atrial Fibrillation with Intermittent Handheld Electrocardiogram in Patients with Ischemic Stroke and Transient Ischemic Attack

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*Background:* Atrial fibrillation is an important risk factor for recurrent ischemic stroke and transient ischemic attack. Despite routine investigation, some patients' atrial fibrillation remains undetected. Intermittent handheld electrocardiogram (ECG) is an option for extended ECG monitoring aiming at enhancing detection rates. This study aimed to explore the detection rate of atrial fibrillation in stroke and transient ischemic attack patients with intermittent handheld ECG in the clinical setting of Halland Hospital Halmstad. *Methods:* Patients discharged with a diagnosis of ischemic stroke or transient ischemic attack who underwent intermittent handheld ECG recording at Halland Hospital Halmstad from January 1, 2010, to March 31, 2014, were retrospectively studied; 370 patients in total. A positive investigation was defined as either atrial fibrillation for a minimum of 10 seconds or a short irregular supraventricular run. *Results:* We found an overall atrial fibrillation detection rate of 7.6% (95% CI 5.1%-10.1%). The detection rate in stroke patients (11.0%) was significantly higher than in transient ischemic attack patients (5.0%), $P = .032$. The detection rate in patients aged less than 65 years was 4.2%, increasing to 9.8% in patients aged 65 years or older, $P = .051$. *Conclusion:* This retrospective study shows an atrial fibrillation detection rate of 7.6% in a stroke and transient ischemic attack population using prolonged intermittent monitoring with handheld ECG recording. The compliance to the monitoring was excellent. **Key Words:** Atrial fibrillation—stroke—transient ischemic attack—arrhythmia detection—intermittent long-term ECG monitoring.


## Introduction

Atrial fibrillation (AF) is a major risk factor for ischemic stroke or transient ischemic attack (TIA) of cardioembolic origin.[1] For those who already have suffered from ischemic stroke or TIA, the presence of AF indicates high risk of a recurrent stroke event.[2] Treatment with oral anticoagulation (OAC) reduces the risk of stroke recurrence in these patients.[3,4] The standard antiplatelet therapy used as secondary prevention in stroke patients without known AF has, in comparison to OAC, a lower efficacy in preventing recurrent stroke if AF is present.[5]

Detecting AF in patients with stroke or TIA poses a challenge because AF in most patients is paroxysmal as well as asymptomatic. Single 12-lead electrocardiogram (ECG) recordings and 24-hour continuous ECG recording or inpatient ECG monitoring are at present the investigational recommendations from the European Stroke Organisation.[6] These ECG modalities are however hampered by disadvantages such as low yield, thereby leaving a proportion of patients with undiagnosed and thereby nonanticoagulated AF. A yield of 2%-5% has been reported from studies on 24-hour Holter recordings.[7,8] Studies on more extended ECG recordings with event recorders and

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implantable loop recorders have demonstrated a higher AF yield than 24-hour Holter recordings.[9,10]

The minimum duration of AF detected in poststroke screening needed to increase stroke risk is not very well defined. Data on AF duration and stroke risk are mostly derived from patients with a cardiac device.[11,12] Furthermore, the presence of supraventricular ectopic beats and short supraventricular runs is demonstrated to increase the risk of developing AF and the risk of stroke.[13]

Intermittent ECG recordings with a handheld device is a validated option for AF screening after stroke or TIA.[14,15] Some of the obstacles of long-term ECG recordings are overcome with this method because there is no need for adhesive electrode attachment, a factor known to affect tolerance and long-term signal quality. Previous reports have reported an AF yield of 6%-11% in stroke patients.[15,16] The purpose of this study was to report the diagnostic yield and compliance of handheld intermittent ECG recordings in clinical practice.

## Methods

We retrospectively studied all patients referred to handheld ECG investigation due to previous stroke or TIA in Halland Hospital Halmstad from January 1, 2010, to March 31, 2014. Eligible patients were informed via mail and offered to participate or to withdraw participation. Exclusion criteria were previously known AF, detected AF during the waiting time for investigation, or uncompleted registrations (defined as less than 4 recordings). The definition of stroke and TIA followed the definition or diagnosis set by the referring clinician.

The recordings with the handheld ECG recorder (www.zenicor.com) were made twice daily (mornings and evenings) for 14 days. During January 1, 2010, and January 27, 2011, the registrations were made for 10 seconds per recording, and for 20 seconds during January 28, 2011, and March 1, 2012, and from March 2, 2012, onwards, each recording was made for 30 seconds. The recordings were made by the patients' thumbs being applied on the sensors of the ECG device for 10-30 seconds, providing ECG lead 1. Each recording was instantaneously and automatically transmitted to a data server and available for interpretation via a web browser. The handheld ECG device has been validated in previous studies.[14,15]

A positive handheld ECG investigation was defined as either AF for a minimum of 10 seconds or a short supraventricular run. The minimum duration of 10 seconds was chosen on account of that the first year of recordings only permitted 10 seconds per registration.

The interpretation of the recordings was performed by cardiologists at the hospital. All positive recordings were reanalyzed by the study group.

Registrations with insufficient signal quality or with less than 15 recordings per patient were regarded as inconclusive and excluded from the result analysis.

Statistical analysis was done using IBM SPSS Statistics 20.0 (Armonk, NY: IBM Corp.). The Pearson's chi-square test was used for comparing the results between 2 groups.

The study was approved by the regional ethical review board in Lund.

## Results

Up to 370 patients were included in the study, see Figure 1. Baseline characteristics are shown in Table 1. The study group has a mean age of 66 years with a range from 22 to 90 years. TIA was more common than stroke among referred patients; 57% had TIA as index event compared to 43% diagnosed with stroke. Fifteen of the 164 TIA patients were diagnosed with amaurosis fugax.

Fourteen of the 370 included patients had inconclusive registrations (5 patients with less than 15 registrations and 9 with insufficient signal quality), leaving 356 patients for the outcome analysis. Twenty-seven patients (7.6%) had a positive investigation with a 95% CI between 5.1% and 10.1% (Table 2). Eighteen of these patients had AF for at least 10 seconds and 9 patients fulfilled the criteria of short irregular supraventricular runs. Ten patients out of the 18 with AF had several episodes of AF (defined as at least 2 nonsubsequent episodes). Five of the 9 patients with short supraventricular runs had multiple nonsubsequent supraventricular runs.

**Table 1.** *Baseline characteristics, n = 370*

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|---|---|
| Age, n = 370 | 66 ± 12 SD |
| Age (mean) of stroke patients, n = 163 | 66 ± 12 SD |
| Age (mean) of TIA* patients, n = 207 | 66 ± 13 SD |
| $CHA_2DS_2$-VASc score† (mean) | 4.2 ± 1.4 SD |
| $CHA_2DS_2$-VASc† (mean) of stroke patients, n = 163 | 4.2 ± 1.4 SD |
| $CHA_2DS_2$-VASc† (mean) of TIA* patients, n = 207 | 4.1 ± 1.5 SD |
| Gender male, n (%) | 195 (53%) |
| Gender female, n (%) | 175 (47%) |
| Index event stroke, n (%) | 163 (44%) |
| Index event TIA*, n (%) | 207 (56%) |
| Hypertension, n (%) | 232 (63%) |
| Diabetes mellitus, n (%) | 63 (17%) |
| Congestive heart failure, n (%) | 9 (2%) |
| Vascular disease‡, n (%) | 42 (11%) |

Abbreviation: SD, standard deviation; TIA, transient ischemic attack.

*TIA including 15 patients with amaurosis fugax.

†$CHA_2DS_2$-VASc counts 2 points each for stroke or TIA and age more than or equal to 75 years, and 1 point each for ages 65-74 years, heart failure, hypertension, diabetes, vascular disease, and female sex (as estimated after the stroke event).

‡History of myocardial infarction, peripheral vascular disease, or aortic atherosclerosis.