Detection of Atrial Fibrillation With Concurrent Holter Monitoring and Continuous Cardiac Telemetry Following Ischemic Stroke and Transient Ischemic Attack

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Atrial fibrillation (AF) is a major risk factor for recurrent ischemic stroke. We aimed to compare the detection rate of AF using continuous cardiac telemetry (CCT) versus Holter monitoring in hospitalized patients with ischemic stroke or transient ischemic attack (TIA). Between June 2007 and December 2008, 133 patients were admitted to an academic institution for ischemic stroke or TIA and underwent concurrent inpatient CCT and Holter monitoring. Rates of AF detection by CCT and Holter monitoring were compared using the McNemar paired proportion test. Among the 133 patients, 8 (6.0%) were diagnosed with new-onset AF. On average, Holter monitoring was performed for 29.8 hours, and CCT was performed for 73.6 hours. The overall rate of AF detection was higher for Holter monitoring compared with CCT (6.0%; 95% confidence interval [CI], 2.9-11.6 vs 0; 95% CI, 0-3.4; $P = .008$). Holter detection of AF was even higher in specific subgroups (those with an embolic infarct pattern, those age >65 years, and those with coronary artery disease). Holter monitoring detected AF in 6% of hospitalized ischemic stroke and TIA patients, with higher proportions in high-risk subgroups. Compared with CCT, Holter monitoring is significantly more likely to detect arrhythmias. **Key Words:** Cardiac monitoring—cardioembolic stroke.

Atrial fibrillation (AF) has been considered the most important single cause of ischemic stroke in elderly persons and is responsible for about 10% of all ischemic strokes.[1] The prevalence of AF in the general population varies with age, nearly doubling every decade after age 50, from approximately 0.5% at age 50-59 years to 8.8% at age 80-89 years,[2] with an associated annual stroke risk of up to 18.2% in the highest-risk groups.[3] Compared with antiplatelet therapy, warfarin provides an additional 40% reduction in the risk of recurrent stroke in patients with AF.[4-6] Standard diagnostic evaluation of patients admitted for ischemic stroke or transient ischemic attack (TIA) commonly does not reveal an etiology, however, with up to 40% of ischemic strokes classified as cryptogenic.[7] Paroxysmal AF is difficult to diagnose and may be underdiagnosed in patients with cryptogenic stroke. Recent studies found that up to 23% of patients with cryptogenic stroke had paroxysmal AF with long-term outpatient cardiac monitoring.[8,9] Given the impact on management in patients with AF and ischemic stroke or TIA, diagnostic tests that achieve the highest diagnostic yield are critical. We sought to compare the rates of detection of AF by 2 commonly used modalities, Holter monitoring and continuous cardiac telemetry (CCT), in patients with ischemic stroke and TIA.

Methods

We reviewed a prospective stroke registry of 456 consecutive patients admitted to our institution for acute ischemic stroke or TIA between June 2007 and December 2008 (Fig 1). During the study period, both Holter and

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Received March 12, 2010; accepted May 21, 2010.

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1052-3057/$ - see front matter

doi:10.1016/j.jstrokecerebrovasdis.2010.05.006

CCT monitoring were ordered for evaluation of patients admitted for ischemic stroke or TIA as standard clinical protocol at our institution. To be included in this analysis, patients had to have a diagnosis of ischemic stroke or definite/probable TIA and to have undergone cardiac rhythm evaluation with Holter and CCT concurrently during hospitalization. Exclusion criteria were a history of chronic or paroxysmal AF and a possible TIA diagnosis with an equally likely competing diagnosis. Of the 456 patients with ischemic stroke and TIA, 171 (37.5%) received concurrent CCT and Holter monitoring during hospitalization. There were no significant differences in terms of age (P = .620), sex (P = .464), hypertension (P = .547), diabetes (P = .354), heart disease (P = .446), or Trial of ORG 10172 in Acute Stroke Treatment (TOAST) subtype (P = .855) between these 171 patients and the 285 patients who did not have both Holter monitoring and CCT. Of these 171 patients, 28 patients with a known history of chronic or paroxysmal AF and 10 patients with possible TIA and an alternate competing diagnosis (ie, migraine, syncope, or seizure) were excluded. We compared the detection rates of AF using Holter monitoring and CCT in the remaining 133 patients. The Rush University Medical Center's Institutional Review Board approved the study design.

Baseline sociodemographic (age, sex, and race), clinical (stroke risk factors, symptomatology, National Institutes of Health Stroke Scale score on admission, and medication use, including antithrombotic therapy), radiographic (computed tomography, magnetic resonance imaging, carotid ultrasound, and echocardiography), and outcome data (discharge disposition and medications) were retrieved from the prospective stroke registry. Electrocardiography (ECG), Holter monitoring, and CCT interpretations were abstracted from medical charts without retrospective adjudication or reinterpretation to ensure a "real life" comparison.

Each patient underwent admission ECG; those with AF detected by admission ECG were excluded from this study. CCT was performed throughout the period of hospitalization. Telemetry leads were placed on admission, and rhythm strips were printed and reviewed by nursing staff every 8 hours for rate, rhythm, and routine interval measurement. Alarms for abnormal rhythm or rate >120 beats/minute were reviewed by nursing staff, and physicians were notified for further review at the discretion of the nurses. At least 24 hours of Holter monitoring was performed in all patients but 3, who had 22 hours, 16 hours, and 7 hours of monitoring. A cardiologist (K.K.) interpreted each Holter study. Specific arrhythmias were noted, including AF and nonsustained ventricular tachycardia (NSVT). For this study, AF was defined following convention as a supraventricular tachyarrhythmia characterized by uncoordinated atrial activation with fibrillatory waves varying in amplitude, shape, and timing, replacing consistent P waves and with a duration >30 seconds.[4] NSVT was defined as 3 or more consecutive beats arising below the atrioventricular node with a rate of >100 beats/minute and lasting <30 seconds.

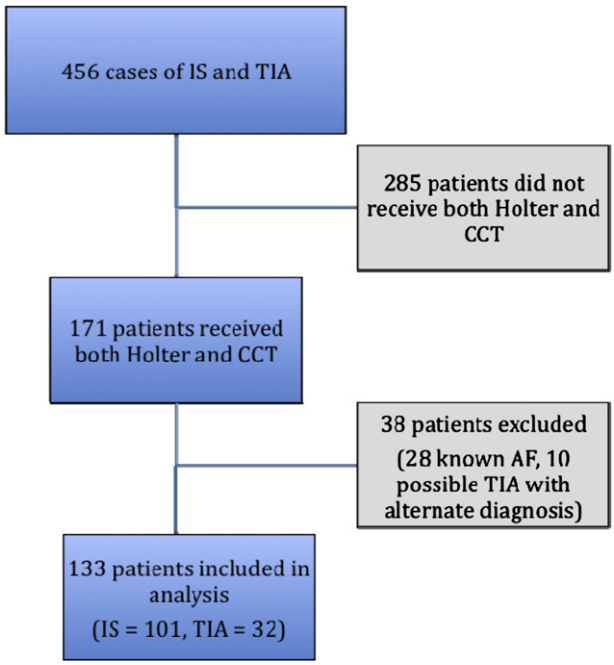

Figure 1. *Patient selection.*

Statistical analyses were performed using SPSS version 14.0 (SPSS Inc, Chicago, IL). The modified Wald approach was used to determine 95% confidence intervals (CIs) for rates of detection of AF and NSVT by each modality. The McNemar test was used to compare paired proportions. A P value <.05 was considered significant in all analyses.

Results

Baseline characteristics of the cohort are summarized in Table 1. Mean patient age was 63.1 years, and 49.6% of the cohort was male. A past medical history of coronary artery disease was present in 25 patients (18.8%), and warfarin use on admission was reported in 7 patients (5.3%; none to treat AF). A total of 101 patients (75.9%) had sustained ischemic stroke, and 32 patients (24.1%) were diagnosed with TIA. On average, Holter monitoring was performed for 29.8 hours, and CCT was performed for 73.6 hours (Fig 2). Holter monitoring began a median of 27.5 hours after initiation of CCT.

The overall AF detection rate was higher by Holter monitoring than by CCT (6.0%; 95% CI, 2.9-11.6 vs 0%; 95% CI, 0-3.4; P = .008). Initially, 53 of the cases of ischemic stroke (52.5%) were considered cryptogenic, but AF was newly diagnosed by Holter monitoring in 5 of these cases (9.4%). Three patients had AF of duration between 0.3% (4.4 minutes) and 3.0% (29 minutes) of the entire Holter recording time, and 3 patients had AF for <0.1%