Serial Electrocardiographic Assessments Significantly Improve Detection of Atrial Fibrillation 2.6-Fold in Patients With Acute Stroke

Andre G. Douen, MD, PhD, FRCPC; Nicole Pageau, RN, BSc; Sejla Medic, RN

**Background and Purpose**—Previous studies have reported a low, \( \approx 1\% \) to 3\%, rate of detection of occult atrial fibrillation (AF) with Holter monitor in patients with acute stroke. Furthermore, at least one study has reported that Holter monitoring could not always corroborate initial electrocardiographic (ECG) detection of AF suggesting underestimation of AF by Holter. We compare the detection of new-onset AF by serial ECG assessments and Holter after acute ischemic stroke.

**Methods**—One hundred forty-four patients with ischemic stroke admitted to a stroke unit were studied. The number of ECGs conducted within the first 3 days up to the detection of AF as well as the time interval for Holter “hookup” and subsequent reporting of AF was documented.

**Results**—ECGs were performed in 143 patients with a baseline of 10 (7\%) patients having a history of AF. Serial ECGs detected 15 new AF cases in 2 days of admission, thereby increasing the total number of known AF cases to 25 (17.5\%), a 2.6-fold increased realization of AF \((P=0.011)\). Holter was also completed in 12 of 15 new cases of AF but surprisingly identified AF in only 50\% (6 of 12). Holter monitoring was performed in 126 cases and in this subgroup, there was no statistically significant difference in the rate of AF detection with ECG or Holter.

**Conclusions**—Serial ECG assessments within the first 72 hours of an acute stroke significantly improve detection of AF. The discordance regarding the corroboration of AF by Holter in ECG-positive patients with AF supports previous observations and suggests a high incidence of paroxysmal AF as a cause of ischemic stroke. \((Stroke. 2008;39:480-482.)\)

**Key Words:** arrhythmia ■ ECG ■ Holter ■ stroke ■ TIA

Identification of atrial fibrillation (AF) and treatment with anticoagulants in elderly patients, > 75 years old, or those with concomitant cardiovascular risk factors have been a major advance in cardioembolic prophylaxis and stroke prevention.\(^1\)\(^-\)\(^2\) Consequently, patients with cerebral ischemia are usually investigated with at least an electrocardiogram (ECG) and in many cases will be submitted to some form of cardiac monitoring in an effort to capture chronic or occult AF. However, there is a relative dearth of information regarding the benefit of continuous ECG monitoring for detection of AF in acute stroke.\(^3\)\(^-\)\(^6\) Limited reports suggest a low yield of \( \approx 2\% \) to 3\% for detection of new-onset AF by Holter in acute stroke and at least one study suggests that routine Holter monitoring in not recommended in stroke inpatients.\(^4\) In addition, we also recently failed to detect any significant difference between Holter and ECG in AF detection in patients with stroke/transient ischemic attack assessed in an outpatient stroke clinic.\(^7\) Furthermore, Shafqat et al observed that Holter does not always detect AF in patients AF-positive on ECG,\(^6\) suggesting some inadequacy of Holter in the detection of AF and potential for underestimation of AF in this setting.

The present study was undertaken to determine the rate of detection of AF by repeat (serial) ECG assessments in the first 72 hours of admission and to compare this with the routine use of Holter monitor on an inpatient stroke unit.

**Methods**

We conducted a chart review from the Trillium Health Centre stroke database of 150 consecutive patients admitted to the stroke unit over an 8.5-month period in 2005. Based on a preset decision to exclude patients with intracerebral hemorrhage, 6 charts were then excluded. We focused on the detection of new-onset AF by ECG and Holter monitor. The latter forms part of the admitting order set for inpatient stroke admissions. The length of time taken for Holter monitor “hookup” and for reporting of AF was documented. Similarly, the number of ECGs conducted within the first 3 days up to the detection of AF was also recorded.

Fisher exact test was used to analyze the ECG data set among the 143 patients with ECG, whereas the McNemar (binomial test) was conducted in a homogenous group of 126 patients who received both ECG and Holter studies.
Table 1. ECG Detection of New AF and Comparison With Holter Monitoring*

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Cerebral Event</th>
<th>AF No.</th>
<th>Day</th>
<th>AF</th>
<th>Hookup</th>
<th>Report</th>
<th>Change in Antithrombotic Therapy</th>
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<tr>
<td>1</td>
<td>L-Hem-S</td>
<td>(+)</td>
<td>0</td>
<td>ND</td>
<td>...</td>
<td>...</td>
<td>Antiplt→Anticoag</td>
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<tr>
<td>2</td>
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<td>2</td>
<td>(+)</td>
<td>3</td>
<td>4</td>
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</tr>
<tr>
<td>3</td>
<td>R-Hem-S</td>
<td>(+)</td>
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<td>(-)</td>
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<td>3</td>
<td>Nil→Anticoag</td>
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<tr>
<td>4</td>
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<td>(+)</td>
<td>2</td>
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<td>3</td>
<td>Antiplt→Anticoag</td>
</tr>
<tr>
<td>5</td>
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<td>1</td>
<td>(-)</td>
<td>5</td>
<td>6</td>
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<tr>
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<td>(+)</td>
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<td>(+)</td>
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<td>6</td>
<td>Antiplt→Anticoag</td>
</tr>
<tr>
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<td>2</td>
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<tr>
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<td>(+)</td>
<td>3</td>
<td>(+)</td>
<td>3</td>
<td>6</td>
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<tr>
<td>9</td>
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<td>(+)</td>
<td>2</td>
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<td>ND</td>
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<td>Died</td>
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<td>ND</td>
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<tr>
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<td>3</td>
<td>3</td>
<td>(-)</td>
<td>4</td>
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<tr>
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<td>5</td>
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<tr>
<td>15</td>
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<td>3</td>
<td>3</td>
<td>(+)</td>
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<td>3</td>
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<td>Average</td>
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<td>1.2</td>
<td>3.7</td>
<td>4.75</td>
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</table>

*ECG detected 15 new cases of AF. Holter monitor was not done in 3 cases. Holter was negative for AF. (-) in 6 patients with newly diagnosed AF.

L-Hem-S indicates left hemisphere stroke; R-Hem-S, right hemisphere stroke; (+), AF detected; (-), AF not detected; Antiplt, antiplatelet; Anticoag, anticoagulant; ND, not done.

**Results**

Table 1 shows ECG detection of AF and concomitant use and outcome of Holter monitor in these patients. AF was detected in 24 (16.8%) cases of 143 studies performed, 9 (6.3%) of whom had a baseline history of AF. Hence, ECG detected 15 new cases of AF with an overall 2.6-fold (16.8%/6.3%) increase ($P=0.001$) in the appearance of AF compared with the baseline. ECG obtained at admission was considered zero time. Seven new cases of previously unknown AF were detected with admission ECG, and 8 more cases were detected by ECGs conducted over the next 72 hours. It took $\approx2$ ECGs and $\approx1$ day postadmission to detect AF. Of these 15 new ECG-positive cases, Holter monitoring was not done in 3 patients but was completed in 12 cases. Surprisingly, Holter was only able to detect AF in 50% (6 of 12) of ECG-positive AF cases with an average Holter reporting date of 4.75 days.

We conducted the converse analysis for ECG/Holter comparison by first identifying the number of new AF cases detected by Holter and comparing this with ECG data (Table 2). Holter monitor detected AF in 12 of 126 cases performed; 3 of these had a history of AF. Holter detected 9 new cases with an average reporting time of 5.25 days. ECG was able to detect AF in 6 (67%) of these new cases with an average of $\approx2.4$ ECG studies and 1.75 days for detection of AF. Although Table 2 shows only those cases in which Holter was positive, it should be pointed out that within the group of 126 patients in whom Holter monitoring was performed, 6 patients had new-onset AF detected by ECG but were Holter-negative for AF. Consequently, within this subgroup of 126 patients, there were 15 new cases of AF detected, 12 by ECG and 9 by Holter. However, statistical analysis showed no significant difference ($P=0.25$) between ECG and Holter findings.

The overall combined use of ECG and Holter detected 18 new cases of AF in 144 patients. Combined with an additional 10 patients with a premorbid history of AF, the total number of AF cases in this study group was 28 (19.4%), comparable to previous reports. Note that AF could not be detected by either ECG or Holter in one of the 10 patients with a reported premorbid history of AF. Detection of AF by either ECG or Holter brought about a shift in treatment paradigm from antplatelet to anticoagulant (Tables 1 and 2).

**Discussion**

Previous reports suggest only modest, $\approx3\%$, detection of occult AF with continuous cardiac monitoring in the first 48 hour poststroke, whereas use of 24-hour Holter in stroke inpatients detects new-onset AF in $<2.5\%$ of patients. In the present study, we observed $\approx7\%$ detection in new-onset AF with 24-hour Holter. However, if the ECG-positive AF cases are excluded, the detection rate was only 2.3% (3 of 126), consistent with previous observations. Interestingly, the data do not show superiority of Holter over ECG, but show instead that serial ECGs within the first 3 days of admission significantly improves detection of AF. Furthermore, in patients in whom ECG detected new AF, Holter monitoring was only positive in 50% of these cases (Table 1). This discrepancy is similar to previous observations by Shafqat et al who observed that Holter did not corroborate...
detection of AF in 3 of 14 (21%) patients with ECG-positive AF.6 Taken together, these data show (1) the potential for underestimation of AF by Holter and (2) suggest a high incidence of paroxysmal AF as an underlying cause of stroke. Indeed, the overall incidence of AF, new-onset plus known, was 19.4%.

The combined use of Holter and ECG gave the best rate of new AF detection 13.5% (18 of 133); serial ECG alone detected 11.3% (15 of 133) new cases within 72 hours of admission, demonstrating the importance and timeliness of serial ECG assessments in the immediate poststroke period.

In summary, AF is a major modifiable stroke risk factor, which increases steadily with age.1,2 Underrecognition and treatment of AF in patients with stroke/transient ischemic attack increases the risk of stroke recurrence. In this regard, although 24-hour Holter improves detection of AF after acute stroke (Table 2),4–6 there appears to be considerable underestimation of AF by Holter as compared with serial ECG assessments. Conversely, although serial ECG improved AF detection, there were some patients in whom Holter detected new AF and serial ECGs were negative for AF (Table 2). Hence, given the clinical importance of AF detection in patients with stroke, it is unlikely that ECGs would entirely supplant 24-hour Holter monitoring, but the study suggests that serial ECGs (=3 studies/72 hours) is an effective means of AF detection; 24-hour Holter can be used if initial ECGs assessments are negative for AF. This strategy may be particularly useful in centers where cardiac telemetry or Holter are not readily available and could also eliminate the need for more costly telemetry/Holter in those patients without specific medical reason for telemetry in whom early ECG detects AF.

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Disclosures
None.

References
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