Prevalence of Atrial Fibrillation and Antithrombotic Prophylaxis in Emergency Department Patients

Phillip A. Scott, MD; Arthur M. Pancioli, MD; Lisa A. Davis, RN, MSN, CCRC; Shirley M. Frederiksen, MS, RN, CCRC; John Eckman, BS

Background and Purpose—The emergency department (ED), as the point of first medical contact for many complaints referable to atrial fibrillation (AF) and a common source of primary care, occupies a unique position to identify AF patients at risk of stroke. This study evaluates that potential by determining the prevalence of AF in an ED population and assessing antithrombotic use in those patients with recurrent AF.

Methods—This was a multicenter, retrospective, cross-sectional study of consecutive records of ED patients with AF identified by ECG between January and June 1998. American Heart Association and modified Stroke Prevention in Atrial Fibrillation criteria established high-risk patients and contraindications to anticoagulation, respectively.

Results—We identified 866 records with ECG-proven AF in 78,787 patient visits for an estimated prevalence of 1.10% (95% CI, 1.03 to 1.17). We found that 556 records had a prior history of AF; of these, 221 (40%) used warfarin alone, 155 (28%) had antiplatelet therapy alone, 28 (5%) used both, and 152 (27%) had no antithrombotic therapy identified. Sixty-eight patients (12%; 95% CI, 0.10 to 0.15) were warfarin eligible and without antithrombotic therapy. An additional 64 (12%; 95% CI, 0.09 to 0.14) had antiplatelet therapy alone. In warfarin-eligible patients, no differences were identified between the anticoagulated and nonanticoagulated groups on the basis of age, sex, or race. Of patients on warfarin with a measured international normalized ratio, 61% (95% CI, 0.55 to 0.67) were outside the AHA-recommended range of 2.0 to 3.0.

Conclusions—AF is a common finding in an ED population. Many are warfarin eligible and untreated or undertreated. Methods to increase anticoagulant use in this at-risk population warrant further investigation. (Stroke. 2002;33:2664-2669.)

Key Words: anticoagulants ■ atrial fibrillation ■ stroke prevention
New-onset AF was defined as any patient without a prior history of stroke and contraindications to anticoagulation to evaluate treatment also separated by the presence of a high-risk variable for ischemic antithrombotic use in patients with recurrent AF. These records were separated by the presence of a high-risk variable for ischemic antithrombotic use in patients with recurrent AF. These records were recorded as separate incidences if obtained on different visit dates, Patients with multiple ECG tracings over the study period were identified from each database with subsequent rhythm confirmation. Patients with AF were identified from each database with subsequent rhythm confirmation. Using available medical records, a study physician or clinical nurse coordinator completed a 40-item data form for each patient visit. Information sought included patient demographics; past medical history; contraindications to antithrombotic therapy; medications at ED presentation with specific evaluation for warfarin, aspirin, ticlopidine, and/or clopidogrel use; treatment in the ED; international normalized ratio (INR), if measured; and disposition at discharge. Patients with multiple ECG tracings over the study period were recorded as separate incidences if obtained on different visit dates, each representing a separate opportunity for identifying antithrombotic therapy need. The total number of adult patient visits during the study period formed the denominator for determination of the prevalence of AF. Effective anticoagulation was defined as an INR ≥2.0 and ≤3.0. Patient with new-onset AF or those with a history of hyperthyroidism or a prosthetic cardiac valve were excluded to evaluate antithrombotic use in patients with recurrent AF. These records were also separated by the presence of a high-risk variable for ischemic stroke and contraindications to anticoagulation to evaluate treatment in the groups defined as warfarin-eligible and warfarin-ineligible. New-onset AF was defined as any patient without a prior history of AF, as documented by the treating physician, or prior documented AF in the ECG database. Patients were considered at high risk for stroke on the basis of recommendations published by the American Heart Association. High risk was defined as the presence of any of the following variables in the medical record at the time of ED presentation: prior diagnosis of hypertension, previous stroke or transient ischemic attack, diabetes mellitus, congestive heart failure, or age >65 years.

We adapted the Stroke Prevention in Atrial Fibrillation (SPAF) trial exclusion criteria for determining contraindications to anticoagulant therapy in a method similar to that of Sudlow et al.9 These were defined as the following: (1) any current gastrointestinal or genitourinary bleeding or any prior gastrointestinal or genitourinary hemorrhage requiring hospitalization, transfusion, surgery, or emergent endoscopy; (2) inability to monitor patient, including identification as homeless within the medical record, lack of a registration home address, or as determined by the chart reviewer; (3) the presence of liver disease as determined by documented history or clinical suspicion of regular daily intake of large amounts of alcohol, regular heavy drinking of alcohol limited to weekends, periods of sobriety punctuated by binges lasting weeks to months, or known cirrhosis of any cause; (4) any central nervous system hemorrhage, hemarthrosis, or bleeding complication requiring hospitalization; (5) history of ≥3 falls in the preceding year, patients with known ataxia or vertigo, and patients requiring crutches, cane, walker, or assistance to ambulate or judged unstable by chart reviewer; (6) the presence of uncontrolled hypertension defined as systolic pressure >180 mm Hg or diastolic pressure >100 mm Hg; or (7) daily use of nonsteroidal anti-inflammatory drugs.

**Materials and Methods**

**Design and Study Population**

A retrospective, cross-sectional study of consecutive ED patients with nonvalvular AF diagnosed by ECG between January 1 and June 30, 1998, at the University of Michigan (Ann Arbor), St Joseph Mercy Hospital (Ann Arbor), and the University of Cincinnati (Ohio). These EDs are associated with residency training programs and are regional trauma centers representing a mixture of both urban and suburban tertiary care facilities. The combined regional population served by these EDs have age, sex, and race profiles similar to those of the overall US population, except for a lower proportion of patients of Hispanic origin. The Institutional Review Boards of the University of Michigan and University of Cincinnati approved the study for conduct under institutional consent forms.

All adult patients evaluated in the ED and undergoing ECG analysis during the study period were eligible for inclusion. Each department used dedicated ECG equipment with computer rhythm interpretation stored in a searchable database. Patients with AF were identified from each database with subsequent rhythm confirmation. Using available medical records, a study physician or clinical nurse coordinator completed a 40-item data form for each patient visit. Information sought included patient demographics; past medical history; contraindications to antithrombotic therapy; medications at ED presentation with specific evaluation for warfarin, aspirin, ticlopidine, and/or clopidogrel use; treatment in the ED; international normalized ratio (INR), if measured; and disposition at discharge. Patients with multiple ECG tracings over the study period were recorded as separate incidences if obtained on different visit dates, each representing a separate opportunity for identifying antithrombotic therapy need. The total number of adult patient visits during the study period formed the denominator for determination of the prevalence of AF. Effective anticoagulation was defined as an INR ≥2.0 and ≤3.0. Patient with new-onset AF or those with a history of hyperthyroidism or a prosthetic cardiac valve were excluded to evaluate antithrombotic use in patients with recurrent AF. These records were also separated by the presence of a high-risk variable for ischemic stroke and contraindications to anticoagulation to evaluate treatment in the groups defined as warfarin-eligible and warfarin-ineligible. New-onset AF was defined as any patient without a prior history of AF, as documented by the treating physician, or prior documented AF in the ECG database. Patients were considered at high risk for stroke on the basis of recommendations published by the American Heart Association. High risk was defined as the presence of any of the following variables in the medical record at the time of ED presentation: prior diagnosis of hypertension, previous stroke or transient ischemic attack, diabetes mellitus, congestive heart failure, or age >65 years.

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**Statistical Analysis**

Continuous variables are presented as mean±SD; categorical variables are given as proportions with 95% CIs. Period prevalence of untreated AF is presented as a proportion with 95% CIs. Qualitative data were compared by use of a χ² test, with P≤0.05 considered significant. No comparison of data between hospitals was conducted because 2 (University of Michigan and St Joseph Mercy Hospital) share a common service area with the potential of confounding.
In the study population, the mean ± SD age was 74.5 ± 12.9 years (median, 77.4). Baseline characteristics are identified in Table 1. The presence of a high-risk variable for stroke was identified in 94% of records, with age >65 years being most frequently identified. Patients with multiple risks were common: 33% of all records had 2 high-risk variables, 28% had 3, and 14% had ≥4. A contraindication to warfarin use was identified in 240 records, with 74% having a single contraindication, 21% with 2 contraindications, and 5% with ≥3 contraindications noted. The most frequent contraindication noted was history of falling or unstable gait (n=128).

Antithrombotic Use
The prevalence of antithrombotic use in ED patients with recurrent, nonvalvular AF is presented in Figure 1. Two hundred forty-nine records identified warfarin use. Two hundred twenty-one used warfarin alone, whereas 27 patients combined warfarin and aspirin therapy and 1 patient combined warfarin and ticlopidine. No use of clopidogrel was identified. Of the 249, 216 (87%) documented an INR value. Forty-four percent (95% CI, 0.38 to 0.51) were subtherapeutic, 37% (95% CI, 0.30 to 0.43) were within the recommended range, and 19% (95% CI, 0.14 to 0.24) had values >3.0.

In the 307 records without warfarin prophylaxis, the absence of antiplatelet therapy was as common as its use. In those patients on antiplatelet therapy alone, aspirin was again the dominant choice, with only 7 patients using ticlopidine. No instance of combining antiplatelet agents was found.

Contraindications to anticoagulation were common; the frequency by group is listed in Figure 1. Of the 249 warfarin-treated patients, 81 had modified SPAF exclusion criteria. Of the 307 nonanticoagulated patients, a contraindication was found in 159. The frequencies of individual modified SPAF contraindications to anticoagulation in each group are presented in Table 2. Nonanticoagulated patients were more likely to have a contraindication compared with patients on warfarin (P<0.05).

“Warfarin eligible” was defined as the presence of recurrent AF, no identified SPAF contraindication to warfarin use, and an accompanying high-risk variable for ischemic stroke. Prevalence of antithrombotic use in this group is presented in Figure 2. Of the 291 warfarin-eligible patients, 159 (55%) had warfarin (or warfarin plus antiplatelet) therapy identified, 64 (22%; 95% CI, 0.17 to 0.27) noted antiplatelet use alone, and 68 (23%; 95% CI, 0.19 to 0.28) lacked evidence of any stroke prevention therapy.

### Table 1. Baseline Characteristics of ED Patients With Recurrent AF

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (±SD), y</td>
<td>74.5 (±12.9)</td>
<td></td>
</tr>
<tr>
<td>Age group, n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤55 y</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>55–64 y</td>
<td>67</td>
<td>12</td>
</tr>
<tr>
<td>65–74 y</td>
<td>133</td>
<td>24</td>
</tr>
<tr>
<td>75–84 y</td>
<td>211</td>
<td>38</td>
</tr>
<tr>
<td>≥85 y</td>
<td>100</td>
<td>18</td>
</tr>
<tr>
<td>Male/female, n</td>
<td>240/316</td>
<td>43/57</td>
</tr>
<tr>
<td>Ethnic background</td>
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<td></td>
</tr>
<tr>
<td>White</td>
<td>474</td>
<td>85</td>
</tr>
<tr>
<td>Black</td>
<td>63</td>
<td>11</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Other</td>
<td>18</td>
<td>3.2</td>
</tr>
<tr>
<td>High-risk stroke variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &gt;65 y</td>
<td>441</td>
<td>79</td>
</tr>
<tr>
<td>Hypertension</td>
<td>329</td>
<td>59</td>
</tr>
<tr>
<td>CHF</td>
<td>245</td>
<td>44</td>
</tr>
<tr>
<td>Diabetes</td>
<td>129</td>
<td>23</td>
</tr>
<tr>
<td>Prior stroke or TIA</td>
<td>125</td>
<td>23</td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>230</td>
<td>41</td>
</tr>
<tr>
<td>ED disposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital admission</td>
<td>422</td>
<td>76</td>
</tr>
<tr>
<td>Discharged from ED</td>
<td>134</td>
<td>24</td>
</tr>
</tbody>
</table>

CHF indicates congestive heart failure; TIA, transient ischemic attack.

### Table 2. Frequency of Modified SPAF Contraindication to Anticoagulation

<table>
<thead>
<tr>
<th></th>
<th>Patients on Warfarin (n=249)</th>
<th>Patients not on Warfarin (n=307)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Falling/unstable gait</td>
<td>35</td>
<td>14</td>
</tr>
<tr>
<td>Inability to monitor</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>Chronic NSAID use</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Prior GI/GU hemorrhage</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Alcohol abuse/liver disease</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Other hemorrhage on warfarin</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Total patients*</td>
<td>81</td>
<td>159</td>
</tr>
</tbody>
</table>

NSAID indicates nonsteroidal anti-inflammatory drug; GI, gastrointestinal; and GU, genitourinary.

*Multiple risks in some patients.

Results
During the study period, 78,787 emergency patient visits occurred. A total of 15,238 ECGs were obtained (Figure 1): 871 identified AF in patients ≥18 years of age. Of these records, 866 were available for review (University of Michigan, 219; St Joseph Mercy Hospital, 495; University of Cincinnati, 152). The estimated prevalence of AF in the overall ED population was 1.10% (95% CI, 1.03 to 1.17). Among patients undergoing ECG evaluation, the prevalence of AF was 5.68% (95% CI, 5.32 to 6.05).

Of the 866 reviewed records, 310 were excluded from further analysis by a history of new-onset AF, hyperthyroidism, or valvular heart disease, leaving 556 records in the study population with recurrent AF. These 556 records represented 478 individual patients because 63 patients had multiple visits during the study period. All data forms had complete demographic information.

Patient Characteristics
In the study population, the mean ± SD age was 74.5 ± 12.9 years (median, 77.4). Baseline characteristics are identified in Table 1. The presence of a high-risk variable for stroke was identified in 94% of records, with age >65 years being most frequently identified. Patients with multiple risks were common: 33% of all records had 2 high-risk variables, 28% had 3, and 14% had ≥4. A contraindication to warfarin use was identified in 240 records, with 74% having a single contraindication, 21% with 2 contraindications, and 5% with ≥3 contraindications noted. The most frequent contraindication noted was history of falling or unstable gait (n=128).
Figure 2. Antithrombotic use in warfarin-eligible and -ineligible populations. AP indicates antiplatelet therapy (aspirin or ticlopidine). * indicates 95% CIs calculated with Fisher’s exact test.

Discussion

Overview
The US population with AF is expected to rise from the current estimate of 2.2 million individuals to 5.6 million by 2050. Given an approximate 3% to 5% per year rate of ischemic stroke in unselected patients with nonvalvular AF, it is clear that the burden of stroke caused by AF will increase if prevention efforts are not successful. The effectiveness of anticoagulation in this role is well established, and numerous guidelines advocate its use. Nevertheless, substantial underuse occurs in both the inpatient and community settings, and numerous authors have called for coordinated efforts to improve treatment.

Efforts to improve anticoagulant use have focused on professional and public education, governmental monitoring, and reducing barriers to treatment. These efforts, however, may be limited by the number of physicians requiring educational contact, patient access to primary care, prevalence of AF in a given practice population, and the effectiveness of patient and physician interventions to increase antithrombotic use. Additional approaches are needed to increase treatment and monitor therapy.

The literature on improving medical treatment supports a “multilevel” approach to decreasing morbidity and mortality from cardiovascular disease and stroke. These strategies focus on improving patient, provider, and health system behaviors to increase compliance. The ED occupies a logical position to implement such strategies in the context of improving anticoagulation in AF because it continuously interfaces with all 3 elements. Additionally, it may offer unique advantages in that it is often the point of first medical contact for patients with complaints referable to AF, including chest pain, palpitations, and shortness of breath. This may represent a “teachable moment” when patients and/or referring physicians are most receptive to behavioral and medical intervention for stroke prevention or health maintenance.

Additionally, EDs serve as the primary healthcare resource to many of the 43 million uninsured in the United States and see a disproportionate percentage of low-income families and minorities.

Our study represents a first step in evaluating the potential impact of including the ED in stroke prevention efforts in AF. In addition to determining the prevalence of AF in this setting, the results extend previous findings of anticoagulation underuse to ED patients in a tertiary setting and indicate a serious lack of effective anticoagulation in those already on warfarin therapy.

Prevalence of AF in the ED
The prevalence of AF in the overall ED population (1.10%; 95% CI, 1.03 to 1.17) was significantly higher than the 0.95%
(95% CI, 0.94 to 0.96) reported in a study of 1.98 million members of a health maintenance organization. It is also larger than the 0.89% reported for the overall US population.1 This likely reflects an increased frequency of cardiovascular disease in patients presenting for emergency care. Importantly, our methodology identified cases only in those undergoing routine ECG analysis and likely represents a conservative estimate of the true prevalence of AF in the entire ED population.

The 5.7% (95% CI, 5.3 to 6.0) prevalence of AF in the population of patients undergoing ECG testing (n=15,238) matches the upper range of the 4.7% to 6.0% prevalence reported for populations ≥65 years of age.1,9,26 This finding is not unexpected because 80% of records reviewed identified patients ≥65 years of age, again reflecting the frequency of ED evaluation of cardiovascular and pulmonary complaints in the elderly.

**Warfarin Use**

In our study population, warfarin was underused in eligible patients. Of the 291 records identified as warfarin-eligible patients, 132 indicated no anticoagulant use. Of these, half noted antiplatelet use alone, and the remainder had no antithrombotic therapy of any kind. The size of the treatment effect from placing these patients on warfarin can be estimated with previously published data.4 Anticoagulation of the 68 warfarin-eligible patients on no antithrombotic therapy would have prevented 2.5 primary ischemic strokes per year, assuming a relative risk reduction of 60%. Anticoagulation of the 64 warfarin-eligible patients on aspirin would have prevented 1.5 primary ischemic strokes per year, assuming a relative risk reduction of 40%.4 Thus, over the 6-month study period, an effective intervention to increase anticoagulant use in at-risk patients could potentially have prevented 4 strokes per year (number needed to treat to prevent 1 stroke; 33). To achieve similar results with intravenous recombinant tissue plasminogen activator (Activase or alteplase) after an acute stroke would require treatment of 36 patients within 3 hours to achieve similar results with intravenous recombinant tissue plasminogen activator (Activase or alteplase) after an acute stroke would require treatment of 36 patients within 3 hours of symptom onset (number needed to treat to achieve a National Institutes of Health Stroke Scale score of 0 to 1, 9). This number exceeds the annual thrombolytic treatment expected to prevent 1.5 primary ischemic strokes per year, assuming a relative risk reduction of 40%.4

Additional increases in the total proportion of patients eligible for anticoagulation on the basis of SPAF-defined inclusion/exclusion criteria alone.

We also identified numerous cases in which warfarin was used in ineligible patients. In the 265 cases ineligible for warfarin because of a lack of a high-risk stroke variable or the presence of a modified SPAF contraindication, 90 (16%; 95% CI, 0.13 to 0.19) were anticoagulated. This may represent inappropriate treatment or treatment of patients with reversible contraindications to anticoagulation. Of the specific contraindications in these 90 patients found 14 on chronic nonsteroidal anti-inflammatory drug therapy and 7 with hypertension, both modifiable conditions.

In our study population, effective anticoagulation (INR between 2.0 and 3.0) to prevent stroke in AF was the exception in patients already on warfarin therapy. Only one third of patients tested were within recommended guidelines, a finding identical to previous reports on INR values at admission in hospitalized patients with AF.6 This may reflect an alteration in a previously therapeutic INR because of the underlying condition requiring the patient to seek hospital-based care or a broader failure in monitoring and maintaining effective anticoagulation. In either case, the risk-to-benefit ratio of warfarin therapy is negatively affected, and increased INR testing in the ED is recommended.

Limitations of this study include those associated with its retrospective design. We relied on identifying patients only through ECG tracings with documented AF. This may have excluded patients with AF who did not undergo ECG analysis. We were dependent on the accuracy and availability of hospital medical records for the quality of the variables studied. No attempt was made to obtain information directly from the patient or the primary care physician to supplement the available information. Patient refusal of offered anticoagulation therapy was not evaluated, nor was compliance with a recommended treatment program.

In conclusion, a substantial percentage of untreated patients with recurrent AF who are eligible for anticoagulation can potentially be identified in the ED setting. Routine assessment of INR of anticoagulated AF patients is recommended because subtherapeutic and supratherapeutic INR results are common. These findings support further evaluation of the use of EDs in stroke prevention efforts for patients with AF. Methods to prospectively identify, refer, and/or treat AF patients with high-risk variables for ischemic stroke should undergo further exploration in the ED setting.

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