Missed Opportunities for Appropriate Anticoagulation Among Emergency Department Patients With Uncomplicated Atrial Fibrillation or Flutter

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Study objective: Emergency department (ED) patients with atrial fibrillation or flutter are at risk of stroke, and guidelines recommend anticoagulation for patients with increased cardiovascular risk. Emergency physicians have a unique opportunity to provide appropriate anticoagulation for such patients, and we wished to investigate whether this was accomplished.

Methods: This retrospective cohort study used a database from 2 urban EDs to identify consecutive patients with an ED discharge diagnosis of atrial fibrillation or flutter from April 1, 2006, to March 31, 2010, who were managed solely by the emergency physician. Comorbidities, rhythms, and management were obtained by chart review, and complicated patients (those with an acute underlying medical condition) were excluded by predefined criteria. Patient medications on ED presentations were obtained through the provincial Pharmanet database. Patients were stratified into CHADS 2 (congestive heart failure, hypertension, age > 75, diabetes, stroke/transient ischemic attack) scores, and the primary outcome was the proportion of higher-risk (CHADS 2 score >0) patients who were discharged home with the incorrect anticoagulation by the emergency physician. The secondary outcome was the number of lower-risk (CHADS 2=0) patients who began receiving warfarin by the emergency physician orders. The regional ED database was interrogated to ascertain the number of patients who had a stroke at 30 days.

Results: Consecutive patients (1,090) were enrolled and 732 were discharged home with no cardiology consultation (657 fibrillation and 75 flutter). Of 151 higher-risk (CHADS 2 score >0) patients who should have been anticoagulated, 80 (53.0%; 95% confidence interval 44.7% to 61.0%) were discharged home from the ED without appropriate anticoagulation. In this group, 1 patient had an ischemic stroke at 24 days. Among 300 lower-risk patients (CHADS 2 score=0), 25 (8.3%; 95% confidence interval 5.6% to 12.2%) had warfarin initiated.

Conclusion: In this cohort of ED patients with uncomplicated atrial fibrillation or flutter who were discharged without cardiology involvement, many were not appropriately anticoagulated before ED arrival, and more than half of such patients did not appear to have corrective measures initiated by the emergency physician. This may represent a potential opportunity to improve patient care and outcomes. [Ann Emerg Med. 2013;xx:xxx.]

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INTRODUCTION

Background

Atrial fibrillation and flutter are commonly encountered dysrhythmias, with more than half a million emergency department (ED) visits in the United States, where more than 60% of patients are admitted to the hospital.[1] The most dreaded complication of atrial fibrillation or flutter is stroke, which may occur during the early period after ED management. All relevant guidelines state that patients at higher risk should receive some form of oral anticoagulation.[2-8]

It is unclear how many patients with atrial fibrillation or flutter are correctly anticoagulated in the community; however, their ED visit represents an opportunity for emergency physicians to ensure appropriate anticoagulation. Work by Lang et al[9] suggests that many ED patients are discharged without appropriate anticoagulation; however, the reasons for this behavior were not described. Because guidelines[2-8] rely on large cohorts of patients admitted to the hospital or followed by cardiologists, the role of emergency physicians in providing anticoagulation remains unclear.

Furthermore, the long-term outcomes of such patients have not been described, to our knowledge. Our objective was to describe the proportion of patients who had incorrect

Editor's Capsule Summary

What is already known on this topic

Patients with atrial fibrillation and flutter are at progressively increased risk of stroke according to their CHADS2 score.

What question this study addressed

A retrospective cohort study of 732 patients was performed to determine how often emergency patients with primary new or recurrent atrial fibrillation or flutter were discharged with appropriate guideline-based anticoagulation.

What this study adds to our knowledge

When new anticoagulation is indicated, emergency atrial fibrillation and flutter patients are discharged without appropriate anticoagulation 53% of the time. For patients already receiving anticoagulation, nontherapeutic international normalized ratio values are corrected 78% to 100% of the time.

How this is relevant to clinical practice

Emergency physicians need to improve procedures for addressing appropriate anticoagulation for atrial fibrillation and flutter patients at elevated risk for stroke.

anticoagulation on ED discharge and link it to 30-day and 1-year stroke outcomes. We also sought to explore the complexity of ED patients with atrial fibrillation or flutter (for example, those with malignancy or renal failure) and explore the rationale for emergency physician decisionmaking about anticoagulation.

MATERIALS AND METHODS

Study Design and Setting

This was a retrospective cohort study at 2 Canadian university-affiliated EDs that share an ED database.[10-12] St. Paul's Hospital is an inner-city referral center with 65,000 annual ED visits during the study period. It has comprehensive cardiology services with a coronary care unit and interventional and electrophysiology services. Mount St. Joseph's Hospital is a community center with 25,000 yearly visits and a general internal medicine service. More than 200 medical students and residents are trained at both sites annually; education rounds are held every 2 weeks for the benefit of both trainees and staff. This study was a secondary analysis of a 1-year outcome review of patients with atrial fibrillation[10] and flutter[11] and was approved by the ethics review board of Providence Health Care and the University of British Columbia.

Interventions

Emergency physicians managed fibrillation and flutter patients at their discretion, including decision to rate or rhythm control and which method and agents to use, decision to refer the patient to the inpatient cardiology service, and decision to anticoagulate. Physicians were not aware of this study.

Selection of Participants

From April 1, 2006, to March 31, 2010, consecutive patients residing in the health region and with an ED diagnosis of atrial fibrillation (*International Classification of Diseases, 10th Revision* [*ICD-10*] code I48.0) or flutter (*ICD-10* code I48.1) were identified in the ED database. (Physicians could list up to 10 discharge diagnoses.) Board-certified cardiologists verified each ECG within 24 hours, and each patient required ECG confirmation of the diagnosis. Because patients were followed for 1 year after their index visit, ED encounters occurring more than 365 days after the initial visit were considered second index events, and patients could be analyzed more than once during the study period.

We sought to enroll uncomplicated atrial fibrillation or flutter patients who were managed by the emergency physician only; therefore, patients who had pacemaker implantation, ablation procedures, coronary artery bypass grafting, or percutaneous coronary intervention within 7 days before the ED visit were excluded because management decisions typically involve the surgeon or cardiologist. In addition, patients who were referred to cardiologists, either as inpatients or for follow-up, or admitted to the hospital were excluded because consultants managed anticoagulation. Patients who attended the ED only to monitor their anticoagulation were excluded. Finally, patients with the following acute medical conditions were excluded because they require hospitalization or specific therapy unrelated to atrial dysrhythmias: sepsis, shock, pneumonia, acute coronary syndrome, acute decompensated congestive heart failure, pulmonary embolism, chronic obstructive pulmonary disease, thyrotoxicosis, hypertensive emergency, drug overdose, acute valvular disease, or hypothermia. Rather than relying on emergency physician or hospital discharge coding, we followed the prespecified criteria outlined in Appendix E1 (available online at http://www.annemergmed.com). A second trained, blinded reviewer assessed all charts of patients with such underlying illnesses to ensure that such exclusions were appropriate. A κ value was obtained for eligibility decisions, and a board-certified cardiologist reviewed controversial cases.

The sites share an electronic database, which records patient demographics, arrival time, triage complaint,[13] acuity level,[14] and discharge times. The database also contains all patient records at both hospitals to 1999, including outpatient clinic visits; laboratory, ECG, and imaging results; inpatient progress notes; nursing notes; and discharge summaries for all ED and hospital visits. Furthermore, the database is linked to the provincial Pharmanet database, which tracks all dispensed prescription medications. The sites also share a computerized physician order entry system that captures all ED investigations, medications, and consultations. For each patient encounter, emergency physicians complete an electronic discharge

summary—also available on the database—which records discharge diagnoses, as well as investigations, medications, procedures, and discharge prescriptions. In addition, all changes to existing medications (including increasing or decreasing anticoagulation) and follow-up (for example, recommending a visit to with the primary care physician or having the international normalized ratio rechecked within a certain time) are recorded in a free-text discharge summary box.

We adhered to the criteria for medical record review described by Gilbert et al[15] and Worster et al.[16] Four reviewers (2 staff emergency physicians and 2 final-year medical students with previous graduate degrees) who were blinded to study hypothesis and to patient outcomes independently abstracted charts onto standardized electronic spreadsheets to document vital signs, comorbidities, and ED treatments. Reviewers were trained on the first 10 charts and could contact the primary investigator at any time to discuss unclear data. Blocks of charts were submitted every few weeks and the data were assessed by the primary investigator for obvious problems, such as patients older than 75 years who had a CHADS score of zero. The patient's electronic chart was reviewed as far back as 1999 to clarify missing or unclear information. A second abstractor reviewed a random 10% of all charts.

Because the CHADS 2 score[17] (subsequently referred to as the CHADS score) was the variable of interest, a second staff physician who was blinded to study hypothesis and outcomes calculated the score for a random 50% of all patients in the following manner: (1) age was abstracted directly from the patient chart; (2) hypertension was ascertained from ED records, clinic visits, and previous hospital admissions, along with ancillary information such as left ventricular hypertrophy on ECG, or a Pharmanet record from the ED visit denoting an antihypertensive medication; (3) heart failure was ascertained from ED records, clinic visits, previous hospital admissions, and objective tests such as brain natriuretic peptide, or echocardiograms, cardiac catheterization ventriculograms, provocative nuclear medicine testing, and cardiac magnetic resonance imaging (MRI), all of which provide left ventricular ejection fraction; if this was less than 40%, the patient was considered to have heart failure; (4) diabetes was ascertained from ED records, clinic visits, and hospital admission, or a Pharmanet record denoting a diabetic medication; and (5) previous stroke or transient ischemic attack was ascertained from ED records, clinic visits, admission, and previous computed tomography, angiography, or MRI. Conflicting information (for example, the ED nursing notes recorded hypertension and the physician did not) resulted in a further chart review to 1999 examining all the above information. A κ value was then calculated for each component of the CHADS score; a weighted κ value[18] was calculated for the score itself.

Outcome Measures

During the study period, the 2004 Canadian Cardiovascular Society guidelines[2] recommended the following anticoagulation strategies for both atrial fibrillation and atrial flutter: (a) for CHADS score 0, aspirin; (b) for CHADS score 1, aspirin or warfarin; (c) for CHADS score greater than 0, warfarin only. For CHADS score 0 patients who received an ablation, warfarin was recommended for at least 6 months postprocedure. (The standards changed in late 2010, after the study period,[4,5] to ensure that CHADS score 1 patients received warfarin only.) For the purpose of the study, CHADS score 0 patients were considered lower risk and CHADS score greater than 0, higher risk because a patient with a CHADS score greater than 0 needed an emergency physician to perform an action (initiating anticoagulation) that required weighing risk and benefits. We determined the number of patients who presented to the ED with incorrect anticoagulation and also the proportion of those patients for whom the emergency physician corrected this error.

However, we recognized that some complex patients might have increased bleeding risk from warfarin, especially patients with frequent falls, renal or hepatic failure, alcoholism, active cancer, or recent (within 1 year) gastrointestinal or intracerebral bleeding. We reviewed all patients with CHADS score greater than 0 who were not receiving acetylsalicylic acid (for CHADS score 1 only) or warfarin when they presented in the ED and who did not have acetylsalicylic acid (for CHADS score 1 only) or warfarin initiated in the ED. As long as the emergency physician defended the decision not to initiate acetylsalicylic acid or warfarin—for example, the chart or discharge summary recorded that the patient had a contraindication to anticoagulation—this was not counted as an error. Furthermore, if emergency physicians did not initiate anticoagulation or provide a reason but advised patients to discuss their anticoagulation with an outpatient primary care physician, this was considered appropriate management. All CHADS score 0 patients who were discharged with a new warfarin prescription by the emergency physician also had their charts examined for justification such as previous rheumatic disease, a new murmur, concurrent thromboembolic disease, or planned outpatient cardioversion.

The primary outcome was the proportion of at-risk patients with CHADS score greater than 0 who did not begin receiving warfarin (or aspirin for CHADS score 1) by the emergency physician, no justification was provided for this decision, and patients were not advised to discuss anticoagulation with a primary care physician. The secondary outcome was the proportion of patients with CHADS score 0 and not previously receiving warfarin who began receiving warfarin by emergency physician order with no justification. Unclear cases were referred to 2 independent assessors (a board-certified cardiologist and a double board-certified emergency physician/hematologist) who were blinded to stroke outcomes. If there was disagreement, the principal author provided final adjudication.

Because they would not be receiving anticoagulation in the community, patients with new atrial dysrhythmias were considered separately as follows: (1) for CHADS score 0, any patient discharged with a warfarin prescription and no justification was considered incorrectly anticoagulated; (2) for

CHADS score greater than 0, any patient who was not discharged with either aspirin (CHADS score 1 only) or warfarin (CHADS score greater than 0) with no reason was considered incorrectly anticoagulated.

Finally, the proportion of patients who were receiving warfarin and who had their international normalized ratio checked by the emergency physician was obtained. We also recorded the number of nontherapeutic international normalized ratios and emergency physician actions in response to nontherapeutic international normalized ratios.

For longer-term outcomes, the patient's unique provincial health number was cross-referenced with the regional ED database to monitor regional follow-up visits and ascertain potential ED visits for stroke. (See Appendix E2, available online at http://www.annemergmed.com, for details.) Patients with ischemic or hemorrhagic stroke were included because anticoagulation can lead to the latter.[19]

Primary Data Analysis

Microsoft Excel 2008 (Microsoft, Redmond, WA) was used for data entry and analysis. Discrete variables were reported as percentages. Continuous variables were presented as means with SDs (if normally distributed) or medians with interquartile ranges (if non-normally distributed).

RESULTS

During the 4-year study period, 1,538 patients received an ED diagnosis of atrial fibrillation; 263, atrial flutter (Figure). Overall, 711 were excluded, with 227 having an acute underlying medical condition; the interrater reliability for exclusion was 0.71 (95% confidence interval [CI] 0.61 to 0.80); 21 patients required adjudication. A further 358 were referred to cardiologists, leaving 732 eligible patients managed only by emergency physicians. κ Scores for cardiovascular risk factors were as follows: age 1.0 (95% CI 0.96 to 1.0); hypertension 0.89 (95% CI 0.84 to 0.93), diabetes 0.87 (95% CI 0.82 to 0.91), heart failure 0.83 (95% CI 0.75 to 0.91), stroke or transient ischemic attack 0.80 (95% CI 0.70 to 0.91). The weighted interrater agreement for the CHADS score was 0.54 (95% CI 0.51 to 0.57). Fourteen cases required adjudication to determine whether anticoagulation was appropriate; the reviewers agreed on 13 of them.

Table 1 demonstrates the baseline characteristics and medication profiles of the 360 CHADS scores greater than 0 and 372 CHADS score 0 patients.

Table 2*A* summarizes the proportion of study patients with CHADS score greater than 0 who were correctly anticoagulated before and after their ED encounter. There were 289 patients with previous atrial dysrhythmias; of these, 197 (68.2%) were correctly anticoagulated at their ED visit. There were 71 patients with new-onset atrial dysrhythmias, none of whom were receiving warfarin. (However, 12 new CHADS score 1 patients were receiving aspirin.) In total, there was an opportunity to provide appropriate anticoagulation in 151

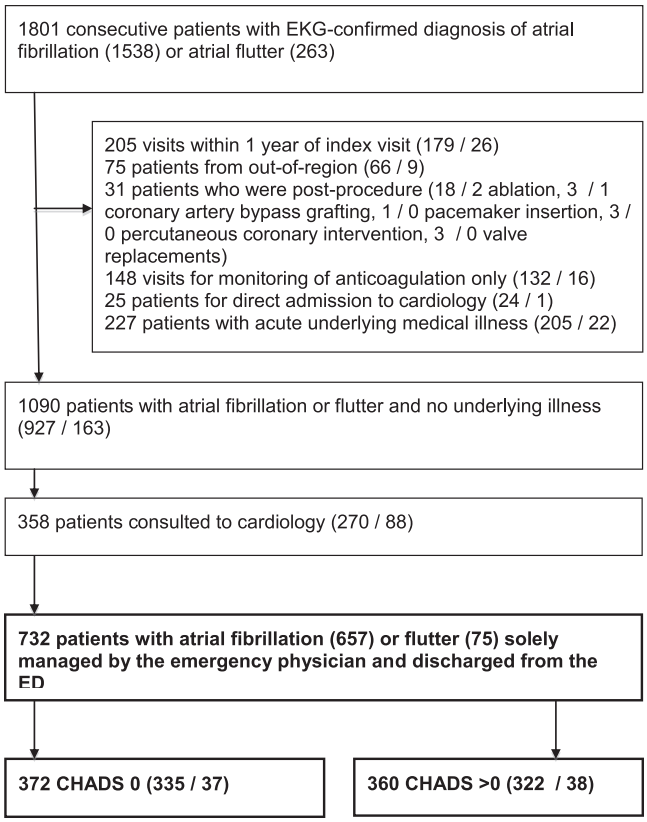

Figure. Study flow diagram.

patients. Emergency physicians initiated anticoagulation in 41 (6 aspirin [for CHADS score 1] and 35 warfarin) patients (27.2%; 95% CI 20.4% to 35.1%) and gave reasons for not anticoagulating 21 more (13.9%; 95% CI 9.0% to 20.7%). Reasons included end-stage renal failure on hemodialysis (n=3), chronic alcohol use (5), cancer (3), recurrent falls (3), previous bleeding episodes (4), previous adverse reaction (1), and patient refusal (2). A further 9 patients (6.0%; 95% CI 2.9% to 11.4%) were advised to discuss anticoagulation with their primary care physician. Overall, 80 of 151 patients (53.0%; 95% CI 44.7% to 61.1%) were discharged home with no anticoagulation, no justification, and no instructions to discuss anticoagulation in the outpatient setting. In the subset of 71 new-onset patients, 59 (83.0%) were discharged home without starting anticoagulation.

Table 2*B* shows there were 328 CHADS score 0 patients—of whom 72 (22.0%) were receiving warfarin—and 44 CHADS score 0 patients with new-onset dysrhythmias, for a total of 372 CHADS score 0 patients. Overall, 300 patients were not receiving warfarin, but emergency physicians began administering warfarin to 25 (8.3%; 95% CI 5.6% to 12.2%), none with a reason provided. Nine of 44 (20.5%) patients with new-onset illness were discharged home with a warfarin prescription.

Table 3 shows that more than 80% of the patients receiving warfarin had their international normalized ratio checked, and

Table 1. Baseline characteristics, stratified by CHADS score, (CHADS score 0 and CHADS scores 1 to 6 calculated separately) for patients managed solely by the emergency physician, n=732.

CHADS	0	1	2	3	4	5	6	Total 1–6
Total number of patients	372	205	117	25	13	0	0	360
Demographics								
Age, median (IQR), y	59 (53,64)	65 (58,73)	77 (69,85)	81 (75,86)	82 (78,87)			62 (55,71)
Male	269 (72.3)	120 (58.5)	62 (53.0)	13 (52.0)	7 (53.8)			202 (56.1)
EMS arrival	58 (15.6)	51 (24.9)	47 (40.2)	10 (40.0)	9 (69.2)			117 (32.5)
Arrhythmia history, No. (%)								
Atrial arrhythmias	329 (88.4)	151 (73.6)	104 (88.9)	20 (80.0)	13 (100.0)			288 (80.0)
DC cardioversion	71 (19.1)	25 (12.2)	12 (10.3)	0	0			37 (10.3)
Ablation	50 (13.4)	18 (8.8)	4 (3.4)	0	0			22 (6.1)
Risk factors, No. (%)								
Hypertension	0	142 (69.3)	95 (81.2)	22 (88.0)	13 (100.0)			272 (75.6)
Coronary artery disease	0	40 (19.5)	30 (25.6)	9 (36.0)	6 (46.1)			85 (23.6)
Valvular disease	18 (4.8)	12 (5.9)	5 (4.3)	1 (4.0)	1 (7.7)			19 (5.3)
Diabetes	0	15 (7.3)	12 (10.3)	7 (28.0)	6 (46.2)			30 (8.3)
Congestive heart failure	0	0	8 (6.8)	8 (32.0)	7 (53.8)			23 (6.4)
Previous stroke or TIA	0	0	1 (0.9)	5 (20.0)	4 (30.8)			10 (2.8)
Medications, No. (%)								
ASA	68 (18.3)	50 (24.4)	60 (51.2)	19 (76.0)	9 (69.2)			138 (38.3)
Clopidogrel	0	0	2 (1.7)	3 (12.0)	2 (15.4)			7 (1.9)
Warfarin	72 (19.4)	83 (40.4)	58 (49.6)	14 (56.0)	10 (76.9)			165 (45.8)

CHADS, CHADS 2 score; *EMS,* emergency medical services; *TIA,* transient ischemic attack; *ASA,* acetylsalicylic acid.

this was consistent across CHADS scores. For 164 of 193 patients (84.9%), the international normalized ratio was within the target range of 2.0 to 3.0. For 22 of 24 cases in which the international normalized ratio was subtherapeutic, warfarin or low-molecular-weight heparins were administered in the ED, or the patient was advised to increase the warfarin dose during the next few days. Similarly, in 4 of 5 cases in which the international normalized ratio exceeded 3.0, patients were advised to stop receiving warfarin.

The 30-day and 1-year stroke outcomes were as follows: A 66-year-old hypertensive woman (CHADS score 1) who did not begin receiving warfarin or aspirin before or after her ED visit (no justification provided) had a large right middle cerebral artery stroke at 24 days. Three additional patients had a stroke between 1 month and 1 year, but in each of these cases, the emergency physician provided justification for not starting anticoagulation, and none of the following 3 cases was counted as inappropriate anticoagulation. An 81-year-old woman with atrial fibrillation (CHADS score 3) who had a previous "warfarin allergy" was instructed to continue acetylsalicylic acid for stroke prophylaxis and experienced an extensive left middle cerebral artery stroke at 2 months. A 63-year-old man (CHADS score 2) refused anticoagulation and experienced a left middle cerebral artery stroke at 3 months. An 87-year-old man with diabetes, hypertension, and bladder cancer (CHADS score 3) who did not begin receiving warfarin because of bleeding risk from his cancer experienced a thalamic stroke at 9 months. All 4 patients had long hospital stays.

LIMITATIONS

Several features limit the generalizability of these data. This is a retrospective review in 2 urban Canadian EDs in which many patients were not referred to cardiologists, and this may not be typical in all environments. Comorbidities and CHADS scores were derived from chart reviews and we may have estimated some scores incorrectly. The Canadian Cardiovascular Society guidelines changed in late 2010 after this study was completed, recommending that all patients with a CHADS score greater than 0 receive warfarin anticoagulation.[5] Although the CCS guidelines may not be universally accepted, the study finding that physicians frequently do not take the opportunity to optimize anticoagulation strategies for patients at risk is almost certainly true in diverse settings. Newer non–ED-based risk-stratification systems,[20,21] such as CHADS-VASC[22] scores were not used in this analysis because they were only developed after the study period. The latter score may be a more accurate stratification of stroke risk—to illustrate, a recent analysis of stable atrial fibrillation outpatients enrolled in 2 large clinical trials emphasized the safety of aspirin therapy in CHADS score 1 patients with a CHADS-VASC score of 1.[23,24]

The low stroke rate may be attributable to the uncomplicated group of patients we selected. In our ED population, unmeasured comorbidity and intrinsic thrombotic risk may be lower than reported in studies from admitted cardiology populations—a form of spectrum bias that limits the generalizability of data from one type of study setting to another. Emergency physicians may have verbally informed patients about changes to anticoagulation strategies but not recorded this on the discharge summary or chart. However, in a medicolegal sense, failure to document instructions is generally viewed as failure to provide instructions. This was only a 2-center study, and emergency physicians and consultants might be more diligent in recording their discharge strategies in other environments. It is possible we missed outcome events for

Table 2. Appropriate and inappropriate anticoagulation by emergency physicians, stratified by CHADS score (CHADS score 0 and CHADS scores 1 to 6 calculated separately).

A, CHADS scores 1 to 6 for atrial fibrillation and flutter (360 patients); there were no atrial fibrillation CHADS 5 or 6 patients and no atrial flutter CHADS 3 to 6 patients.

	CHADS Score						
	Fibrillation				Flutter		
CHADS Scores 1–6 Patients	**1**	**2**	**3**	**4**	**1**	**2**	**Total**
Number of patients	178	106	25	13	27	11	360
Previous atrial dysrhythmia, No. (%)	138 (77.5)	81 (76.4)	23 (92.0)	12 (92.3)	24 (88.9)	11 (100.0)	289 (80.2)
Previous atrial dysrhythmia and receiving appropriate anticoagulation before ED visit, No. (%)*	99 (71.7)	53 (65.4)	14 (60.9)	10 (83.3)	16 (66.7)	5 (45.4)	197 (68.2)
Previous atrial dysrhythmia and not receiving appropriate anticoagulation before ED visit, No. (%)*	39 (28.3)	28 (34.6)	9 (39.1)	2 (16.7)	8 (33.3)	6 (54.5)	92 (31.8)
New atrial dysrhythmia, No. (%)	40† (22.5)	25 (23.6)	2 (8.0)	1 (7.7)	3 (11.1)	0	71 (19.7)
Patients with opportunity for correcting anticoagulation by emergency physician, No. (%)	67 (37.6)	53 (50.0)	11 (44.0)	3 (23.1)	11 (37.2)	6 (54.5)	151 (41.9)
For patients with the opportunity to correct anticoagulation, No. (%)							
Aspirin started by emergency physician	6 (9.0)	Not applicable	Not applicable	Not applicable	0	Not applicable	6 (4.0)
Warfarin started by emergency physician	13 (19.4)	15 (28.3)	4 (36.3)	1 (33.3)	1 (9.1)	1 (16.7)	35 (23.5)
Total anticoagulation started by emergency physician	19 (28.4)	15 (28.3)	4 (36.3)	1 (33.3)	1 (9.1)	1 (16.7)	41 (27.2)
Anticoagulation not started by emergency physician but reason given‡	9 (13.4)	10 (18.9)	1 (9.1)	1 (33.3)	0	0	21 (13.9)
Advised to follow up with primary care	5 (7.5)	4 (7.5)	0	0	0	0	9 (6.0)
No anticoagulation started by emergency physician and no reason given	34 (50.7)	24 (45.3)	6 (54.5)	1 (33.3)	10 (90.9)	5 (83.3)	80 (53.0; 95% CI 44.7–61.0)

*According to Canadian Cardiovascular Society guidelines from 2004–2010, patients with CHADS score 1 should be receiving warfarin or aspirin (several patients were receiving both) and patients with CHADS 2 or greater should be receiving warfarin. This was calculated as a proportion of previous atrial dysrhythmias.
†Twelve patients were already receiving aspirin, presumably for coronary artery disease. Therefore, 28 patients had an opportunity for correct anticoagulation by the emergency physician.
‡A "reason" included documented justification for not initiating anticoagulation; this could include fall risk, active malignancy, renal failure, recent gastrointestinal or intracerebral bleed, etc.

B, CHADS score 0 for atrial fibrillation and flutter (385 patients).

CHADS Score 0 Patients	**Atrial Fibrillation**	**Atrial Flutter**	**Total**
Number of patients	335	37	372
Previous atrial dysrhythmia and not receiving warfarin before ED visit, No. (%)	233 (69.6)	23 (62.2)	256 (68.8)
Previous atrial dysrhythmia and receiving warfarin before the ED visit, No. (%)*	60 (17.9)	12 (32.4)	72 (19.4)
New atrial dysrhythmia (and not receiving warfarin before ED visit), No. (%)	42 (12.5)	2 (5.4)	44 (11.8)
Patients discharged with new warfarin prescription and reason given, No. (%)	0	0	0
Patient discharged with new warfarin prescription and no reason given, No. (%)	19 (6.9)	6 (24.0)	25 (8.3; 95% CI 5.6–12.2)

*According to the Canadian Cardiovascular Society guidelines from 2006 to 2010, for CHADS score 0 patients, aspirin was the recommended form of anticoagulation. (But patients with nonvalvular atrial fibrillation or flutter were not required to be anticoagulated.) Patients with CHADS score 0 often received warfarin for 6 months postablation, but that time frame could be extended at the discretion of the electrophysiologist.

patients who moved away during the study period because the annual migration rate from our health region is around 1.6%.[25]

DISCUSSION

This series of 732 consecutive patients with uncomplicated atrial fibrillation or flutter who were discharged from the ED without a cardiology consultation included 372 CHADS score 0 patients and 360 CHADS score greater than 0 patients. In the latter high-risk group, of the patients who were not correctly anticoagulated before their ED visit, more than half had no anticoagulation started in the ED, no justification provided for this decision, and no advice to discuss the matter with a primary care physician. For at-risk CHADS score greater than 0 patients with new-onset atrial arrhythmias, more than 80% did not start receiving anticoagulation. As CHADS scores increase, the benefit from anticoagulation also increases,[18] and emergency physicians should consider this when making important treatment decisions. Of the CHADS score 0 patients,

Table 3. International normalized ratio measurements and corrective action undertaken by physicians, stratified by CHADS score.

CHADS	0	1	2	3	4	5	6	Total
Number of patients managed by emergency physician only	372	205	117	25	13	0	0	732
Patients receiving warfarin	72 (19.4)	83 (40.4)	58 (49.6)	14 (56.0)	10 (76.9)			237 (32.4)
Appropriate INR/corrective measures, No. (%)								
INR checked	57 (79.2)	69 (83.1)	48 (82.7)	11 (78.5)	8 (80.0)			193 (81.4)
If INR checked, was therapeutic (2.0–3.0)	48 (84.2)	57 (82.6)	43 (89.6)	8 (72.7)	8 (100.0)			164 (84.9)
INR subtherapeutic (<2.0)	9 (18.8)	9 (15.3)	4 (9.3)	2 (18.2)	0			24 (14.6)
If subtherapeutic, did emergency physician correct?	8 (88.9)	9 (100.0)	3 (75.0)	2 (100.0)	0			22 (91.6)
INR supratherapeutic (>3.0)	0	3 (5.1)	1 (2.3)	1 (9.1)	0			5 (3.0)
If supratherapeutic, did emergency physician correct?	0	2 (66.7)	1 (100.0)	1 (100.0)	0			4 (80.0)
Total nontherapeutic INR	9 (18.8)	12 (20.3)	5 (11.6)	3 (27.2)	0			29 (15.1)
If nontherapeutic, did emergency physician correct?	8 (87.5)	11 (78.5)	4 (80.0)	3 (100.0)	0			26 (89.6)

INR, International normalized ratio; a subtherapeutic INR was considered corrected if warfarin or low-molecular-weight heparin was administered in the ED or the patient was advised to increase warfarin dose for a period of time. A supratherapeutic INR was considered corrected if the patient was advised to decrease the warfarin dose or hold it for a few days.

approximately 8% began receiving warfarin—contrary to guidelines—with no reason provided. In comparisons of new-onset patients, a greater proportion of CHADS score 0 patients began receiving anticoagulation than higher-risk CHADS score greater than 0 patients. This demonstrates that despite evidence-based guidelines for risk stratification and anticoagulation of patients with atrial fibrillation and flutter, many patients still arrive in the ED with inappropriate anticoagulation, and most do not have these errors corrected by an emergency physician.

This supports findings by Lang et al,[9] who determined that only 18% of inadequately anticoagulated CHADS score greater than 2 patients began receiving warfarin according to the emergency physician; many patients with low-risk CHADS scores began receiving warfarin. However, reasons for prescribing (or not prescribing) anticoagulation were not provided, and long-term outcomes were not ascertained.

Approximately 80% of our patients who were receiving warfarin had their international normalized ratio checked during the ED encounter. Although the American College of Cardiology/American Heart Association or Canadian Cardiovascular Society guidelines do not require it,[3-6] it seems logical to ensure that patients at risk are actually anticoagulated. In the majority of cases of incorrect international normalized ratio levels, emergency physicians undertook appropriate corrective action.

The majority of ED-based research in this area has focused on rate versus rhythm control, in which there is evidence that both treatments appear to be safe. Little ED-based research has addressed the decision to anticoagulate—arguably a much more important issue because stroke is the most dreaded complication of atrial dysrhythmias and there is strong evidence that correct anticoagulation improves patient outcomes. Our data and those of the study by Lang et al[9] suggest that many at-risk patients are not appropriately anticoagulated in the community and that they do not have this evidence-based therapy initiated when they present to EDs.

Many patients in this study had significant comorbidities such as fall risk, renal failure, and active cancer. Generally, patients with such conditions have been excluded from clinical trials[26-31]; hence, guidelines for their management are sparse. A study of 1,245 patients with atrial fibrillation and a high fall risk showed a 3-fold increase in intracranial hemorrhage in this group but also a 13-fold increase in ischemic stroke.[32] Therefore, fall risk, although frequently cited by clinicians as a reason to avoid anticoagulation,[33,34] should not be considered an absolute contraindication to initiating warfarin. With respect to chronic renal failure, opinion is divided, with some authors recommending anticoagulation of patients with atrial fibrillation[35-37] and others advising otherwise.[38-40] Recent studies, published after our data collection, show that patients with active malignancy, previous major hemorrhage, abnormal renal function, liver disease, or excessive alcohol use have a substantially increased bleeding risk.[41,42] However, many atrial fibrillation strokes are fatal or neurologically devastating, whereas major bleeding is less often debilitating.[8] Consequently, recent guidelines emphasize anticoagulation with close monitoring in higher-risk patients, with informed patient choice being paramount in deciding whether to anticoagulate such patients.[7,8] For emergency physicians, discussing these issues in complex patients in a busy environment may be difficult, but discharging patients and asking them to follow up with a primary care provider with respect to anticoagulation concerns may be suboptimal care.

In this cohort of ED patients with uncomplicated atrial fibrillation or flutter who were discharged without cardiology involvement, many were not appropriately anticoagulated before ED arrival and more than half of such patients did not appear to have corrective measures initiated by the emergency physician. This may represent a potential opportunity to improve patient care and outcomes.

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APPENDIX E1.

Exclusion criteria for acute underlying medical causes of atrial fibrillation or flutter.

The purpose was to exclude patients in whom it was apparent to the emergency physician that atrial fibrillation was confounded by another serious acute medical condition. Note that all physical examination findings, laboratory, ECG, or radiologic investigations must have been available in the ED. (The exceptions were blood, urine, or sputum cultures because these take 24 to 48 hours to return. However, if the treating emergency physician is ordering such tests, an infectious process was most likely considered in the ED already.) All physical examination information would be located on the emergency physician's chart or the consulting physician admission note. (At our institution, the admission note is dictated while the patient is still in the ED.) Results of any tests must have been available during the patient's ED stay. For example, a patient admitted with "weakness" and no objective physical examination, laboratory, ECG, or imaging criteria, who developed a fever of 39.5°C and a new right lower lobe infiltrate, along with a new elevated WBC count on postadmission day 4, would not be excluded under these guidelines.

1. Acute coronary syndrome: ECG findings of new left bundle-branch block; ST-segment elevation of 2 mm in precordial or 1 mm in limb leads; coronary artery revascularization by percutaneous coronary intervention or bypass grafting; admission and treatment for acute coronary syndrome.[1]
2. Acute heart failure: documented findings on physical examination (S3 gallop, lung crackles, jugular vein distention, positive abdominojugular test result) or documented new findings on chest radiography (cardiomegaly or pulmonary edema) or brain natriuretic peptic levels greater than 400 pg/mL; or diuretic use in the ED; or admission and treatment for heart failure.[2,3]
3. Hypothermia: Documented body temperature less than 32°C in the ED.
4. Sepsis: Meeting at least 2 of SIRS criteria (T <34°C or >38°C; WBC count <4,000 or >12,000/mL; pulse rate >90 beats/min; respiratory rate >20 breaths/min, or PCO_2 <32 mm Hg) with evidence of new infection (new infiltrate on chest radiograph; positive blood, urine, or wound culture results; WBCs in the cerebrospinal fluid).[4]
5. Exacerbation of chronic obstructive pulmonary disease: documented increase in cough, dyspnea, and sputum production, or documented improvement in respiratory function after administration of bronchodilators, or admission and treatment for chronic obstructive pulmonary disease.[5]
5. Thyrotoxicosis: TSH <0.02 ng/mL or admission and treatment for thyrotoxicosis.
6. Overdose of medicinal agents: documented overdose of medicinal agents and treatment for overdose of medicinal agents.
7. Pulmonary embolism: proven on CT or pulmonary angiography.
8. Acute valve disease: echocardiographic evidence of acute valve injury.
9. Hypertensive emergency: blood pressure >220/100 mm Hg with evidence of new end-organ injury (acutely altered vision with documented grade III/IV papilledema, documented acute aortic dissection, documented new neurologic deficit, acute renal failure, or blood smear result demonstrating microangiopathic hemolytic anemia).[5]
10. Stroke or transient ischemic attack: acute neurologic deficit, whether reversible or not.

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APPENDIX E2.

Follow-up ED visits.

The 2 study sites are part of the 6-hospital Vancouver Coastal Health (VCH) region. Each resident of British Columbia has a Provincial Health Number (PHN), a unique 10-digit identifier. Residents of the VCH area can be identified by their postal codes. VCH maintains a real-time database, which links each ED and permits tracking of patients through their PHN. (This database is separate from both the SPH/MSJ ED administrative database and the provincial vital statistics database.) For each patient encounter, it lists ED triage times and complaints, as well as discharge diagnoses, times of discharge, and patient disposition. The 5 possible disposition outcomes are discharged home, left against medical advice, transferred to other facility, admitted to the hospital, and died.

After identification of the index ED visit, patients were tracked for 1 year with the PHN, and all subsequent regional ED visits were identified. The majority of revisiting patients (≈95%) during that time frame attended the index hospital for second and subsequent ED visits. All visits to other regional EDs were obtained from the regional ED database. All VCH EDs use the Canadian Emergency Department Information System presenting complaint list (CEDIS), a standardized list of 161 triage complaints. (1) Subsequent regional ED visits with triage complaints of (a) cardiac arrest—nontraumatic, (b) chest pain, (c) palpitations/irregular heartbeat, (d) syncope/presyncope, (e) cool pulseless limb, (f) altered level of consciousness, (g) confusion, (h) dizziness/vertigo, (i) gait disturbance/ataxia, (j) extremity weakness/symptoms of cerebrovascular accident, (k) sensory loss/paresthesias, (l) shortness of breath, and (m) respiratory arrest were identified.

Patients who met the triage criteria were investigated as follows: For SPH/MSJ patients (95%), the ED chart of the follow-up visit was investigated, and patients were divided into 3 categories: (a) patients who had visits obviously related to atrial dysrhythmias (discharge diagnosis atrial fibrillation, stroke, etc) were counted; (b) patients who had visits that were obviously unrelated (ankle sprain, laceration, mechanical back pain, etc.) were not counted; and (c) patients with possibly related visits (discharge diagnoses of nonspecific weakness, nonspecific chest pain, etc.) were counted if they had an ECG showing atrial fibrillation and the treating physician provided some sort of treatment related to the atrial fibrillation, including administering fluids or diuresis). The latter group erred toward an increased number of visits. For example, patients with pneumonia and atrial fibrillation were counted as being "related to atrial fibrillation" because it is probable that the atrial dysrhythmias worsened the pneumonia.

For patients who presented to other regional hospitals (≈5%), the triage codes were investigated and the patients counted if they had any of the above codes, which may have overestimated the number of visits. There was no access to formal chart review or ECG from the other hospitals, only triage diagnosis, ED diagnosis, and hospital admission diagnosis. Any patients who were admitted at the other hospitals had their admitting diagnosis scrutinized and were included unless there was an obvious non-atrial dysrhythmias diagnosis. For example, medical conditions such as renal failure, sepsis, or weakness were included because it is probable that atrial dysrhythmias worsened these conditions; conditions such as "back pain" were not included because it is doubtful that atrial dysrhythmias worsened these conditions.

For both situations (SPH/MSJ revisit or regional revisit), recording of visits was up to the individual data abstractor and there was no review by a second physician, although abstractors were encouraged to review dubious cases at regularly scheduled meetings. This approach probably overestimated the number of visits related to atrial dysrhythmias.

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