Outcomes for Emergency Department Patients With Recent-Onset Atrial Fibrillation and Flutter Treated in Canadian Hospitals

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Study objective: Recent-onset atrial fibrillation and flutter are the most common arrhythmias managed in the emergency department (ED). We evaluate the management and 30-day outcomes for recent-onset atrial fibrillation and flutter patients in Canadian EDs, where cardioversion is commonly practiced.

Methods: We conducted a prospective cohort study in 6 academic hospital EDs and enrolled patients who had atrial fibrillation and flutter onset within 48 hours. Patients were followed for 30 days by health records review and telephone. Adverse events included death, stroke, acute coronary syndrome, heart failure, subsequent admission, or ED electrocardioversion.

Results: We enrolled 1,091 patients with mean age 63.9 years, atrial fibrillation 84.7%, atrial flutter 15.3%, hospital admission 9.0%, and converted to sinus rhythm 80.1%. Although 10.5% of recent-onset atrial fibrillation and flutter patients had adverse events within 30 days, there were no related deaths and 1 stroke (0.1%). Adjusted odds ratios for factors associated with adverse event were hours from onset (1.03/hour; 95% confidence interval [CI] 1.01 to 1.05), history of stroke or transient ischemic attack (2.09; 95% CI 1.01 to 4.36), and pulmonary congestion on chest radiograph (7.37; 95% CI 2.40 to 22.64). Patients who left the ED in sinus rhythm were much less likely to experience an adverse event ($P<.001$).

Conclusion: Although most recent-onset atrial fibrillation and flutter patients were treated aggressively in the ED, there were few 30-day serious outcomes. Physicians underprescribed oral anticoagulants. Potential risk factors for adverse events include longer duration from arrhythmia onset, previous stroke or transient ischemic attack, pulmonary congestion on chest radiograph, and not being in sinus rhythm at discharge. An ED strategy of sinus rhythm restoration and discharge in most patients is effective and safe. [Ann Emerg Med. 2017;69:562-571.]

Please see page 563 for the Editor's Capsule Summary of this article.

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INTRODUCTION

Background

Atrial fibrillation is characterized by disorganized atrial electrical depolarization leading to an irregular and rapid pulse rate. In the emergency department (ED), physicians often manage patients with either recent-onset or permanent (chronic) atrial fibrillation.[1] In the case of permanent atrial fibrillation, cardioversion has previously failed or clinical judgment has led to a decision not to pursue cardioversion, with ED care focusing on rate control.[2] When atrial fibrillation terminates spontaneously within 7 days of recognized onset, it is designated paroxysmal; when sustained beyond 7 days, atrial fibrillation is designated persistent. Atrial flutter is an arrhythmia with similar pathophysiology that is characterized by rapid, regular atrial depolarizations at a characteristic rate of approximately 300 beats/min and presents with various degrees of atrioventricular block. Atrial flutter is less common than atrial fibrillation but has similar management issues in the ED, and most patients with atrial flutter also have episodes of atrial fibrillation. Our focus is on symptomatic patients with recent-onset atrial fibrillation and flutter, ie, those with episodes of atrial fibrillation or atrial flutter (first detected, recurrent

Editor's Capsule Summary

What is already known on this topic

Recent-onset atrial fibrillation and flutter are commonly treated in the emergency department (ED).

What question this study addressed

What happens to patients with these 2 rhythms in a setting in which ED cardioversion attempts (electrical and pharmacologic) are common?

What this study adds to our knowledge

In a 1,091-subject cohort from 6 Canadian EDs, 80.1% converted to sinus rhythm. Adverse effects in the next 30 days included only 1 stroke and no deaths.

How this is relevant to clinical practice

ED cardioversion of these patients often succeeds without harm, buttressing the argument for embracing this practice.

paroxysmal, or recurrent persistent) in which the onset is less than 48 hours and cardioversion is an option. Recent-onset atrial fibrillation and flutter are the most common acute arrhythmia cases requiring care in the ED.[3-5]

Importance

Variation in practice within EDs has been well described and reflects a lack of high-quality evidence to guide the acute management of recent-onset atrial fibrillation and flutter.[6-8] Standard textbooks and guidelines fail to offer clear evidence-based direction for physicians treating recent-onset atrial fibrillation and flutter.[9-12] Particularly controversial is the issue of using rhythm control or rate control.[13-16] The large Atrial Fibrillation Follow-up Investigation of Rhythm Management and AF-CHF trials compared rate and rhythm control for patients with mostly recurrent, persistent atrial fibrillation but did not explore the optimal management for ED recent-onset atrial fibrillation and flutter patients presenting within 48 hours of onset.[17,18] In the United States, patients are often admitted to the hospital under the cardiology service or discharged home after rate control only.[19] In Canada, emergency physicians are much more likely to follow an aggressive antiarrhythmia treatment approach using pharmacologic cardioversion or electrocardioversion.[6,8,20] They perceive that this strategy has significant benefits for patients: immediate return to normal activities without the need for hospital admission or need for treatment with rate control and oral anticoagulant drugs. Two sites have described several cohorts of patients successfully treated with rhythm control, with good results.[4,21-23] Other ED studies of rhythm control for recent-onset atrial fibrillation and flutter have been small or did not include both pharmacologic and electrocardioversion as an option.[19,24-27]

Goals of This Investigation

We are not aware of previous studies that prospectively followed recent-onset atrial fibrillation and flutter patients after ED disposition. We sought to fill this knowledge gap about the outcomes and adverse events that might occur in such patients after a sentinel ED visit, regardless of initial management or disposition. In particular, our goal was to describe ED management and then follow patients prospectively for 30 days to determine clinical outcomes, use of health care resources, use of oral anticoagulants, and adverse events. Finally, we wished to evaluate potential risk factors for these adverse events to better understand how to prevent them.

MATERIALS AND METHODS

Study Design and Setting

We conducted a prospective cohort study in 6 Canadian academic hospital EDs.

Selection of Participants

We attempted to enroll consecutive patients presenting with an episode of recent-onset atrial fibrillation and flutter, in which symptoms required urgent management and in which pharmacologic or electrocardioversion was an option. Specifically, we included patients with a clear history of onset within 48 hours, or a clear history of onset within 7 days and who had received adequate anticoagulation, or a clear history of onset within 7 days and no left atrial thrombus on transesophageal echocardiography. We did not exclude patients who required admission or who converted spontaneously to sinus rhythm before treatment.

We excluded patients who had been previously enrolled, with permanent or persistent atrial fibrillation, or whose primary presentation was for another condition such as (1) acute coronary syndrome presenting with chest pain and acute ischemic changes on ECG; (2) congestive heart failure with severe shortness of breath requiring immediate intravenous diuretic, nitrates, or bilevel positive airway pressure; (3) pneumonia with temperature greater than 38.5°C (101.3°F), respiratory symptoms, and receiving antibiotics in the ED; (4) pulmonary embolism presenting with chest pain or shortness of breath; and (5) sepsis with infection and 2 or more systemic inflammatory response syndrome criteria.

Patients were identified prospectively in the ED and then followed by telephone interviews.

Patients gave consent to participate in the study, as approved by the respective hospital research ethics boards.

Methods of Measurement and Data Collection and Processing

The sources of data were the ED health record (including nursing and physician notes), hospital electronic records (clinical, laboratory, and imaging), ED enrollment form, clinic records, self-administered patient questionnaire, follow-up telephone interviews, and provincial coroners' records. We collected extensive demographic and clinical patient data, details of ED treatment, outcomes, and disposition. The chest radiography interpretations were those of certified radiologists who had no knowledge of the study protocol. We then followed patients for 30 days to determine subsequent ED and physician visits, investigations and prescriptions, and need for cardioversion or admission. Site study staff were individually trained and monitored by a central study coordinator who reviewed source documents for the accuracy of the data submitted.

Outcome Measures

We were particularly interested in the occurrence of serious adverse events and their relationship with atrial fibrillation or atrial flutter. We created a composite outcome, serious event, that included the following within 30 days: death, stroke, acute coronary syndrome, heart failure, subsequent hospital admission related to atrial fibrillation or atrial flutter, and subsequent need for ED electrocardioversion.

Primary Data Analysis

Management, ED clinical outcomes, 30-day outcomes, and health care resource use were presented descriptively as appropriate for continuous, ordinal, and categorical outcomes. We classified the following as adverse events: death, stroke, acute coronary syndrome, acute heart failure, subsequent hospital admission related to atrial fibrillation or atrial flutter, and subsequent need for ED electrocardioversion. We evaluated the univariate association of 20 clinical and demographic factors with adverse events, using *t* tests, Mann-Whitney *U* tests, and χ^2 tests for continuous, ordinal, and categorical variables, respectively. We then conducted multivariate logistic regression analyses to identify independent predictors associated with adverse events. Model building proceeded with backward elimination selection $P<0.1$. The following independent variables were tested in the multivariate models: age, CHADS2 score, previous stroke, atrial fibrillation versus atrial flutter, hours since onset of atrial fibrillation and flutter, ischemia on ECG, congestion on chest radiograph, pulse rate at disposition from ED, and rhythm at disposition with mode of conversion (spontaneous, pharmacologic, or electrical). We estimated that approximately 1,000 patients would yield at least 100 adverse events, allowing us to evaluate at least 10 predictor variables in the multivariate modeling.

RESULTS

Characteristics of Study Subjects

We enrolled 1,091 of 1,120 eligible patients between June 2010 and May 2012 at 6 hospital sites (Figure). Twenty-nine patients were missed, usually after hours, but we could detect no bias in patient selection. By review of electronic health and coroners' records, we were able to ascertain the outcomes of all patients.

These recent-onset atrial fibrillation and flutter patients were younger than typical permanent atrial fibrillation patients, with a mean age of 63.9 years (Table 1), although 17.2% were aged 80 years or older. On arrival to the ED, 84.7% of patients were in atrial fibrillation and 15.3% in atrial flutter, the mean duration of symptoms was 7.7 hours, and 65.0% had previous episodes of recent-onset atrial fibrillation and flutter. Of 630 patients (57.8%) with a CHADS2 score of 1 or more, only 202 (32.1%) were receiving warfarin. Although 73.6% of patients had troponin levels and 29.9% had thyroid-stimulating hormone levels measured, only 3 underwent transesophageal echocardiography while in the ED.

Main Results

Patients were most likely to be primarily treated with electrocardioversion or pharmacologic cardioversion (72.8%), with intravenous procainamide being by far the most common drug used (Table 2). Electrocardioversion (97.9%) and sedation (98.3%) were almost always provided by the emergency physician. Heparin was rarely administered

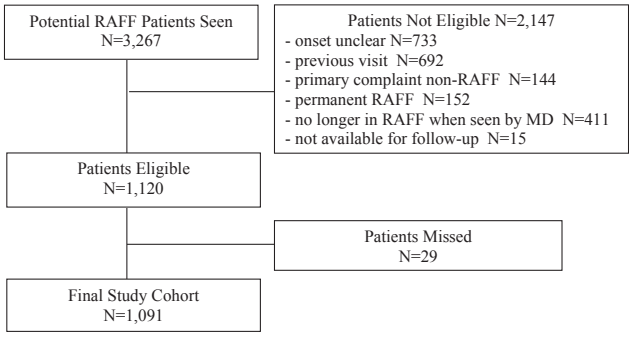

Figure. Study flow of recent-onset atrial fibrillation and flutter patients. *RAFF*, Recent-onset atrial fibrillation and flutter.

Table 1. Baseline characteristics for 1,091 recent-onset atrial fibrillation and flutter patients.

Characteristic	Patients
Age, mean (SD), y	63.9 (15.2)
Range	19–103
Men (%)	649 (59.5)
Hospital (%)	
Kingston General Hospital, Kingston, ON	152 (13.9)
Ottawa Hospital–Civic Campus, Ottawa, ON	296 (27.1)
Ottawa Hospital–General Campus, Ottawa, ON	182 (16.7)
University of Alberta Hospital, Edmonton, AB	132 (12.1)
Foothills Medical Centre, Calgary, AB	261 (23.9)
Mount Sinai Hospital, Toronto, ON	68 (6.2)
Initial rhythm (%)	
Atrial fibrillation	924 (84.7)
Atrial flutter	167 (15.3)
Duration of arrhythmia, mean (SD)	
Hours (less than 48 h), N=1,052	7.7 (9.6)
Range	1.0–48
Days (between 3 and 7 days), N=39*	4.0 (1.8)
Range	2–7
Main presenting symptom (%)	
Palpitations	852 (78.1)
Chest pain	127 (11.6)
Shortness of breath	44 (4.0)
Dizziness	37 (3.4)
Weakness	11 (1.0)
Syncope	12 (1.1)
Other	8 (0.7)
Initial vital signs, mean (SD)	
Pulse rate	120 (29)
Systolic blood pressure	131 (23)
Oxygen saturation %	98 (2)
Canadian Triage and Acuity Scale Level, median (IQR)†	2 (0)
Previous atrial fibrillation (%)	709 (65.0)
Electrocardioversion	351 (32.2)
Pharmacologic cardioversion	201 (18.4)
Ablation	89 (8.2)
CHADS2 criteria (%)	
>75 y	301 (27.6)
Stroke/transient ischemic attack	76 (7.0)
Hypertension	465 (42.6)
Diabetes mellitus	98 (9.0)
Congestive heart failure	50 (4.6)
CHADS2 score, median (IQR)‡	1 (2)
Score >1	630 (57.8)
Receiving warfarin, N=630	202 (32.1)
Other medical history (%)	
Coronary artery disease	194 (17.8)
Valvular heart disease	92 (8.4)
Pacemaker/ICD	39 (3.6)
COPD/asthma	104 (9.5)
Current medications (%)	
β-Blockers	432 (39.6)
Acetylsalicylic acid	390 (35.8)
Warfarin	278 (25.5)
Calcium-channel blocker	199 (18.2)
Sotalol	50 (4.6)
Clopidogrel	46 (4.2)
Amiodarone	45 (4.1)
Propafenone	40 (3.7)
Digoxin	33 (3.0)
Procainamide	1 (0.1)
Investigations	
ECG shows ischemic changes (%)	26 (2.4)
Initial ECG-calculated pulse rate, median, range	125 (45–213)
Chest radiograph shows CHF (%)	24 (2.2)
International normalized ratio (%)	853 (78.2)
Level, mean, N=853	1.4
Troponin level (%)	803 (73.6)
Above 99th percentile (%), N=803	680 (84.7)
TSH (%)	327 (30.0)
Below reference value (%), N=326	9 (2.8)
C-reactive protein (%)	4 (0.4)
Level, mean, mg/L	1.6
Echocardiography (%)	
Transesophageal	3 (0.3)
Transthoracic	4 (0.4)
Left atrial clot	0
Significant valvulopathy	1 (0.1)
Other conditions identified in ED (%)	
Congestive heart failure	19 (1.7)
Acute coronary syndrome	12 (1.1)

ICD, Implantable cardioverter defibrillator; *COPD*, chronic obstructive pulmonary disease; *TSH*, thyroid-stimulating hormone.
*Patients fully anticoagulated or negative transesophageal echocardiogram result.
†Canadian Triage and Acuity Scale ranges from 1 (critical) to 5 (not urgent).
‡The CHADS2 score ranges from 0 to 6.

in the ED (4.6%). Adverse events with cardioversion were uncommon and usually transient (Table 3).

Only 9.0% of patients were admitted and only 19.9% were not in sinus rhythm at discharge (Table 4). Although physician follow-up was routinely recommended, rarely was an outpatient echocardiogram ordered (8.2%) or oral anticoagulants prescribed (4.8%).

We successfully followed patients for 30 days and noted that 27.9% returned to the ED and 15.4% returned for an issue directly related to atrial fibrillation or atrial flutter (Table 5). By 30 days, 50.7% of patients had consulted a physician and only small numbers of patients had received prescriptions for warfarin (4.5%) or novel oral anticoagulants (4.1%). We estimate that by 30 days, only 49.3% of patients with CHADS2 score of 1 or more were receiving oral anticoagulants.

Overall, 10.5% of patients had experienced an adverse event, but there were no deaths related to atrial fibrillation or atrial flutter and there was 1 stroke (ischemic) (Table 6). Four patients died because of renal and heart failure, cancer (2), and respiratory failure. The patient who had a stroke was an 81-year-old woman who was receiving warfarin with international normalized ratio 2.3 and who spontaneously converted to normal sinus rhythm while in the ED 23 days before. Within 30 days, 6.5% of patients required electrocardioversion in the ED (versus 0.9% in a clinic) and 3.2% of patients had returned and required admission for atrial fibrillation or atrial flutter. There was variation among

Table 2. Proportions of recent-onset atrial fibrillation and flutter patients receiving treatments in the ED.

Treatment	Patients (N=1,091)
First attempted treatment (%)	
Observe only	102 (9.4)
Rate control only	194 (17.8)
Rhythm drug first	368 (33.7)
Electrocardioversion first	427 (39.1)
Second attempted treatment (%), N=167	
Rhythm drug	23 (13.8)
Electrocardioversion	144 (86.2)
IV rate control drugs in ED (%)	438 (40.2)
Metoprolol	285 (65.1)
Total dose administered, mean, mg	9
Pulse rate 1 h post, mean	102
Diltiazem	141 (32.2)
Total dose administered, mean, mg	21
Pulse rate 1 h post, mean	97
Other medications (%)	12 (2.7)
Digoxin	4 (0.9)
Bisoprolol	2 (0.5)
Sotalol	2 (0.5)
Atenolol	1 (0.2)
Carvedilol	1 (0.2)
Labetalol	1 (0.2)
Esmolol	1 (0.2)
IV adenosine administered (%)	34 (3.1)
Rhythm control drugs in ED (%)	391 (35.8)
Procainamide IV	332 (84.9)
Amiodarone IV	37 (9.5)
Propafenone PO	11 (2.8)
Vernakalant IV	4 (1.0)
Other medications	9 (2.3)
Flecainide PO	3 (0.8)
Dronedarone PO	2 (0.5)
Ibutilide IV	1 (0.3)
Successful conversion	204 (52.2)
Electrocardioversion attempted (%)	571 (52.3)
Successful conversion	514 (90.0)
Max energy, mean, Joules	148.0
No. of shocks administered, mean	1.4
Pad position, N=56	
Anterolateral	4 (7.1)
Anteroposterior	52 (92.9)
Physician performing cardioversion, N=571	
Emergency physician	559 (97.9)
Cardiology	12 (2.1)
Sedation given by, N=571	
Emergency physician	561 (98.3)
Anesthesia	9 (1.6)
Sedation used, N=571	
Propofol	549 (96.1)
Fentanyl	316 (55.3)
Midazolam	23 (4.0)
Other	34 (6.0)
Second electrocardioversion required after recurrence	11 (1.9)
Consultations in ED (%)	
Cardiology	216 (19.8)
Internal medicine	21 (1.9)
Anesthesia	5 (0.5)
Antithrombotic therapy given in ED (%)	
Heparin	50 (4.6)
IV unfractionated	15 (1.4)
SC low molecular weight	35 (3.3)
Warfarin*	40 (3.7)
Acetylsalicylic acid	95 (8.7)
Clopidogrel	8 (0.7)

*No novel oral anticoagulants were used in the ED during the study period.

sites in treatment strategies and outcomes (Table E1, available online at http://www.annemergmed.com).

We found many variables strongly associated with adverse events on univariate analysis (Table 7). Further analysis by multivariate techniques revealed 3 patient-related variables and 1 management-related variable that were independently associated with adverse events (Figure E1 and Table E2, available online at http://www.annemergmed.com). Increasing risk for adverse event were hours from onset of atrial fibrillation and flutter (odds ratio 1.03/hour; 95% confidence interval [CI] 1.01 to 1.05), history of stroke or transient ischemic attack (TIA) (2.09; 95% CI 1.01 to 4.36), and pulmonary congestion on chest radiograph as reported by radiologists (7.37; 95% CI 2.40 to 22.64). In regard to discharge rhythm, patients who left the ED in sinus rhythm were much less likely to experience an adverse event ($P<.001$), with those converted pharmacologically having the lowest odds ratio (0.23; 95% CI 0.08 to 0.64). For the overall model, Hosmer and Lemeshow goodness-of-fit P value was .84 and the c statistic was 0.680.

LIMITATIONS

We recognize that this observational cohort study had several limitations, including the fact that not all eligible patients were enrolled in the study. However, only 29 patients (2.6%) were missed and this low number is unlikely to contribute substantive patient selection bias. We acknowledge that we did not have follow-up ECG tracings for the majority of patients but are confident that patients with a recurrence of atrial fibrillation and flutter would have been identified by a return visit to the ED. We were able to ascertain survival status on all patients. We could not model correlates of death and stroke alone because of the rarity of these events. Consequently, we chose to define adverse events as a composite of clinically relevant outcomes. Strengths of the study include detailed prospective follow-up, a large cohort from multiple sites, and detailed data collection.

Table 3. Adverse events occurring before ED disposition for (N=1,091) recent-onset atrial fibrillation and flutter patients.

Adverse Events (%)	Patients
If rhythm control drugs administered, N=391	42 (10.7)*
Hypotension	24 (6.1)
Drug infusion stopped	15 (3.8)
Bradycardia	12 (3.1)
Other	6 (1.5)
Ventricular tachycardia	4 (1.0)
Atrial tachyarrhythmia	3 (0.8)
Heart block	0
Torsades de pointes	0
Syncope	0
Supraventricular tachycardia	0
If electrocardioversion attempted, N=571	19 (3.3)
Transient hypoxia	19 (3.3)
Aspiration	0
Stroke	0
Death	0

*Patients may have had more than 1 adverse event.

DISCUSSION

We believe this to be the largest multicenter prospective study to evaluate the outcomes of recent-onset atrial fibrillation and flutter patients managed in the ED. Our study found that such patients are younger than those reported as having permanent or persistent atrial fibrillation. In our Canadian sites, the majority of patients were safely treated with restoration of sinus rhythm by pharmacologic cardioversion with intravenous procainamide or electrocardioversion and sedation provided by the emergency physician. Adverse events with cardioversion were uncommon and most patients were discharged in sinus rhythm. Prescription of oral anticoagulants in the ED was surprisingly low, considering that more than 50% of patients had a CHADS2 score of 1 or more and only 25% were currently receiving warfarin. Approximately 10% of patients experienced an adverse event within 30 days of the ED visit, with no deaths related to atrial fibrillation or atrial flutter and 1 stroke. The key findings of this study are the identification of potential risk factors for subsequent adverse events. Patient-related risk factors are longer time from onset of arrhythmia, history of stroke or TIA, and pulmonary congestion on chest radiograph. We also identified an important treatment risk factor, with patients who left the ED in sinus rhythm being much less likely to experience an adverse event. The lowest odds ratio was for patients converted pharmacologically. These potential risk factors should be carefully considered by physicians managing recent-onset atrial fibrillation and flutter in the ED.

Table 4. ED disposition for 1,091 recent-onset atrial fibrillation and flutter patients.

Disposition Details (%)	Patients, N=1,091
Disposition	
Discharged home	993 (91.0)
Scheduled return to ED next day, N=993	21 (2.1)
Admitted	98 (9.0)
Converted to sinus rhythm before ED discharge, N=1,089*	(80.1)
Electrical	513 (47.1)
Drug	204 (18.7)
Spontaneous	155 (14.2)
Not converted	217 (19.9)
Pulse rate before discharge, mean, beats/min	76
ED length of stay, hours, median (IQR), h	5.0 (4)
Outpatient follow-up recommended N=993†	
Cardiology	630 (63.4)
Family physician	413 (41.6)
Internal medicine	29 (2.9)
Echocardiogram	81 (8.2)
New prescriptions at discharge, N=993	
Acetylsalicylic acid	115 (11.6)
Metoprolol	62 (6.2)
Warfarin‡	48 (4.8)
Other cardiac medication	41 (4.1)
Diltiazem	21 (2.1)
Low molecular weight heparin	12 (1.2)
Clopidogrel	1 (0.1)

*The mode of achieving discharge rhythm was unknown for 2 patients.
†Patients may have had more than 1.
‡No novel oral anticoagulants were used in ED during the study period.

We are aware of no prospective studies that were able to link specific ED management strategies with patient outcomes in a focused population of recent-onset atrial fibrillation and flutter patients. We identified 13 studies of ED recent-onset atrial fibrillation and flutter management involving restoration of sinus rhythm by drugs or electrocardioversion. These studies used a variety of methodologies (health records review,[4,21,22,27,28] prospective cohort,[29-32] and randomized trial[19,24,25,33]) and only 2 prospectively followed patients outside the hospital. Decker et al[19] followed 153 US patients for up to 6 months and found relatively few adverse events. Bellone et al[33] followed 247 Italian patients but reported rhythm only at 60 days. Scheuermeyer et al[22,23] conducted several retrospective Canadian health records reviews to evaluate outcomes of recent-onset atrial fibrillation and flutter patients at 30 days and 1 year and also found relatively few adverse events. They also identified underuse of oral anticoagulants by emergency physicians.[34] In another retrospective study, Atzema et al[35] noted the low physician follow-up rate within 7 days of an ED visit. None of these studies attempted to identify risk factors for adverse events. Atzema et al[36] identified a number of factors associated with mortality in a large database study of nonspecific atrial fibrillation patients with a very low ED cardioversion rate (15%).

Table 5. Clinical outcomes of 1,091 recent-onset atrial fibrillation and flutter patients after 30 days.

Outcome	Patients (N=1,091)
Return ED visit (%)	304 (27.9)
Related to AF/AFL	168 (15.4)
No. of visits, mean, N=168	1.5
Days post ED, mean (SD), N=168	10.7 (8.3)
Outpatient visits (%)	
Cardiology follow-up	278 (25.5)
No. of visits, mean	1.2
Days post ED, mean (SD)	14.9 (9.0)
Internal medicine	55 (5.0)
No. of visits, mean	1.4
Days post ED, mean (SD)	9.8 (7.8)
Family physician	269 (24.7)
No. of visits, mean, N=264	1.5
Days post ED, mean (SD), N=269	9.2 (8.0)
Hospital admission (%)	42 (3.9)
Related to atrial-fibrillation/flutter	35 (3.2)
Days post ED, mean (SD), N=42	11.6 (8.0)
Length of stay, mean days (SD), N=39	6.9 (9.9)
Electrocardioversion (%)	71 (6.5)
Days post ED, mean (SD)	12.5 (8.6)
In ED	61 (5.6)
In clinic	10 (0.9)
Successfully cardioverted (%), N=71	62 (87.3)
Electrocardiography (%)	401 (36.8)
Days post ED, mean (SD)	15.1 (9.0)
Rhythm, N=374	
Normal sinus	296 (79.1)
Atrial fibrillation	66 (17.7)
Atrial flutter	12 (3.2)
Pulse rate, mean, N=338	73.2
Other arrhythmia, N=1,091	
AV block	1 (0.1)
Ventricular tachycardia	2 (0.2)
Supraventricular tachycardia	3 (0.3)
Echocardiography (%)	324 (29.7)
Transthoracic	280 (86.4)
Transesophageal echocardiography	20 (6.2)
Results of echocardiography, N=265	
Left atrial clot	0
Significant valvulopathy	48 (18.1)
Left atrial enlargement	76 (28.7)
Left ventricular hypertrophy	14 (5.3)
New medications prescribed (%)*	265 (24.3)
β-Blocker	89 (8.2)
Calcium-channel blocker	31 (2.8)
Antiarrhythmic	86 (7.9)
Digoxin	18 (1.6)
Warfarin	49 (4.5)
Novel oral anticoagulant	45 (4.1)
Acetylsalicylic acid	30 (2.8)
Clopidogrel	6 (0.6)

AF, Atrial fibrillation; *AFL*, atrial flutter.
*Some patients were prescribed more than 1 drug.

Table 6. Adverse events occurring within 30 days for 1,091 recent-onset atrial fibrillation and flutter patients.

Adverse Events, N	Patients, N=1,091
Total adverse events*	117 (10.7)
Death related to AF/AFL	0
Deaths not related to AF/AFL	4
Stroke	1 (0.1)
Days post ED	23
Acute coronary syndrome	6 (0.6)
Days post ED, mean (SD)	12.5 (11.6)
Acute heart failure	11 (1.0)
Days post ED, mean (SD)	12.9 (9.1)
Subsequent electrocardioversion in ED	71 (6.5)
Days post ED, mean (SD)	13.8 (8.6)
Subsequent hospital admission for AF/AFL	36 (3.3)
Days post ED, mean (SD)	11.6 (8.0)

*Patients may have had more than 1 adverse event.

Barrett et al[37] created a predictive model aid for adverse events, but the findings are not applicable to the Canadian setting in that 85% of patients were admitted and there were no data on ED management strategies.

There are few data on the incidence of stroke after an ED visit for atrial fibrillation.[38] Airaksinen et al[39] reported a 7-year review of patients who were successfully cardioverted from atrial fibrillation with onset less than 48 hours, in a cardiology clinic, and who had neither long-term oral anticoagulation nor periprocedural heparin therapy.[20] Of 5,116 successful cardioversions in 2,481 patients, 0.7% of patients developed thromboembolic events within 30 days (median 2 days). Noted risk factors were similar to those from the CHADS2 score.

This study reveals some variation in management among sites but confirms the safety and effectiveness of an aggressive pharmacologic or electrocardioversion strategy in the ED, with few patients requiring admission. We encourage physicians to seriously consider rhythm control rather than rate control in the ED because this strategy immediately returns patients to their normal state and daily activities and avoids the burden of hospitalization.

Although patient outcomes were very good, we were concerned about the infrequent prescription of oral anticoagulants by emergency physicians for the many patients with a CHADS2 score of 1 or more. This is contrary to recommendations of the Canadian Cardiovascular Society.[40,41] The main purpose of anticoagulation for at-risk recent-onset atrial fibrillation and flutter patients is to reduce their long-term risk of stroke, not just in the immediate postcardioversion period. The current recommendations include prescription of oral anticoagulants (warfarin or novel oral anticoagulants) to recent-onset atrial fibrillation and flutter patients who are aged 65 or older or have 1 or more CHADS2 risk factors. Less than half of patients with a CHADS2 score of 1 or more were receiving oral anticoagulants 30 days after the

Table 7. Comparison of characteristics and ED management for patients with and without adverse events within 30 days (N=1,091).

Characteristic	Adverse Event, N=117	No Adverse Event, N=974
Age, mean (SD), y	66.2 (14.6)	63.7 (15.3)
>80	26 (22.2)	162 (16.6)
Men (%)	73 (62.4)	576 (59.1)
Initial rhythm (%)		
Atrial fibrillation	89 (76.1)	835 (85.7)
Atrial flutter	28 (23.9)	139 (14.3)
Duration of arrhythmia		
Hours, mean (SD) (less than 48 h), N=111:941	10.9 (12.9)	7.3 (9.1)
Range	1.0–48.0	1.0–48.0
Days, mean (SD) (between 3 and 7 days), N=6:33	5.0 (2.1)	3.9 (1.7)
Range	2.0–7.0	2.0–7.0
Time from onset (%), h		
<12	83 (70.9)	781 (80.2)
>12	34 (29.1)	193 (19.8)
>24	18 (15.4)	86 (8.8)
>36	9 (7.7)	27 (2.8)
CTAS level, mean	2.16	2.20
Previous atrial fibrillation (%)	86 (73.5)	623 (64.0)
Electrocardioversion	56 (65.1)	295 (47.4)
Pharmacologic cardioversion	21 (24.4)	180 (28.9)
CHADS2 score, mean	1	1
>1	77 (65.8)	553 (56.8)
Troponin level >99th percentile (N=82:721)	61 (74.4)	619 (85.9)
Chest radiograph shows pulmonary congestion (%)(N=57:330)	10 (8.6)	14 (1.4)
IV rate control drugs in ED (%)	49 (41.9)	389 (39.9)
Rhythm control drugs in ED (%)	25 (21.4)	366 (37.6)
Electrocardioversion attempted (%)	70 (59.8)	501 (51.4)
Antithrombosis therapy in ED (%)	19 (16.2)	146 (15.0)
Disposition: discharged home (%)	99 (84.6)	894 (91.8)
Mode of conversion before disposition (%)		
Electrical	63 (53.8)	450 (46.3)
Spontaneous	14 (12.0)	141 (14.5)
Not converted	33 (28.2)	184 (18.9)
Drug	7 (6.0)	197 (20.3)
First attempted treatment		
Rate control only	28 (23.9)	166 (17.0)
Observe only	10 (8.6)	92 (9.5)
Pharmacologic cardioversion first	23 (19.7)	345 (35.4)
Electrocardioversion first	56 (47.9)	371 (38.1)
Second attempted treatment, N=16:151		
Pharmacologic cardioversion	2 (12.5)	21 (13.9)
Electrocardioversion	14 (87.5)	130 (86.1)
Pulse rate before discharge, mean (SD), beats/min	80 (23.7)	75 (17.8)

CTAS, Canadian Triage and Acuity Scale.

sentinel ED visit. We believe that this therapy should be initiated in the ED because many patients have trouble accessing early follow-up care and because many primary care physicians may not be familiar with these recent guidelines.[42] Clearly, all recent-onset atrial fibrillation and flutter patients must have their CHADS2 factors and bleeding risk evaluated in the ED.

Our findings provide additional tools to physicians who manage recent-onset atrial fibrillation and flutter and who should recognize additional risk of adverse events for patients whose presentation is delayed, have had previous stroke or TIA, or have evidence of active heart failure. We suggest early follow-up for these patients. Our findings suggest that patients fare better when they leave the ED in sinus rhythm, and this should provide further evidence for physicians who have been reluctant to cardiovert. We recognize that our recommendations are not the result of a randomized trial comparing rate versus rhythm control for recent-onset atrial fibrillation and flutter. Cardioversion is now so widely used in Canadian EDs that it would be difficult, if not impossible, to enroll a large enough sample size to test for superiority with clinical outcomes.

Much research is still required to determine the safest and most effective management strategies for recent-onset

atrial fibrillation and flutter patients. For example, there is clinical equipoise in Canada about whether rhythm control in the ED should commence with pharmacologic or electrocardioversion. We recommend further evaluation of the effect of recent-onset atrial fibrillation and flutter risk-stratification and cardioversion for all patients in the ED.

This multicenter prospective study found that although most recent-onset atrial fibrillation and flutter patients were treated aggressively in the ED, there were few serious outcomes within 30 days. Physicians underprescribed oral anticoagulants. We identified potential patient-specific risk factors for adverse events, including longer duration from onset of arrhythmia, previous stroke or TIA, and congestion on chest radiograph. We also identified that patients who left the ED in sinus rhythm were much less likely to experience an adverse event, with the lowest risk being for those converted pharmacologically. We encourage consideration of these risk factors and use of cardioversion for most recent-onset atrial fibrillation and flutter patients in the ED.

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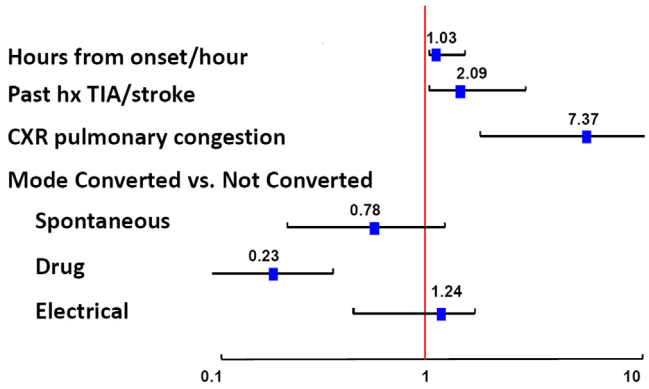

Figure E1. Adjusted odds ratios with 95% CIs for factors associated with 30-day adverse events. Hosmer and Lemeshow goodness-of-fit *P* value .84; *c* statistic=0.680.

Table E1. Comparison of treatments and outcomes by hospital.

Characteristic	Total N	Kingston General Hospital, N=152	Ottawa Hospital–Civic Campus, N=296	Ottawa Hospital–General Campus, N=182	University of Alberta Hospital, N=132	Foothills Medical Centre, N=261	Mount Sinai Hospital, N=68
First attempted treatment, %							
Rate only	194	27.0	8.5	16.5	19.7	23.0	17.7
Observe only	102	12.5	7.4	5.5	15.9	9.6	7.4
Rhythm drug first	368	44.1	47.6	50.0	7.6	10.7	45.6
Electrical first	427	16.5	36.5	28.0	56.8	56.7	29.4
Second attempted treatment, %							
Rhythm drug	23	0.0	5.8	10.0	70.0	36.8	12.5
Electrical	144	100.0	94.2	90.0	30.0	63.2	87.5
Mode of conversion, N=1,089, %							
Electrical	513	29.6	53.6	42.9	52.3	53.5	35.3
Drug	204	24.3	24.4	27.5	6.1	6.9	27.9
Spontaneous	155	19.7	8.5	17.0	18.9	13.9	11.8
Not converted	217	26.3	13.6	12.6	22.7	25.8	25.0
Admitted, %	1,091	9.9	3.7	4.4	11.4	11.5	27.9
Adverse event, %	117	7.2	10.1	7.1	15.2	13.0	13.2

Table E2. Independent predictors of serious adverse events as determined by stepwise logistic regression analysis for 1,091 recent-onset atrial fibrillation and flutter patients.

Variable	β	*P* Value	Odds Ratio	95% CI
Duration since onset of arrhythmia per hour	.03	.006	1.03	1.01–1.05
History of stroke or transient ischemic attack	.74	.048	2.09	1.01–4.36
Chest radiograph shows congestion	2.00	<.001	7.37	2.40–22.64
Converted to sinus rhythm		.004		
Spontaneous	–.24	.55	0.78	0.35–1.74
Drug	–1.49	.005	0.23	0.08–0.64
Electrical	.21	.47	1.24	0.69–2.23