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Management and Disposition of Atrial Fibrillation in the Emergency Department: A Systematic Review

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Abstract

Introduction: Management of atrial fibrillation (AF) and atrial flutter (AFL) in the emergency department (ED) varies greatly, and there are currently no United States guidelines to guide management with regard to patient disposition after ED treatment. The aim of this systematic review was to evaluate the literature for decision aids to guide disposition of patients with AF/AFLin the ED, and assess potential outcomes associated with different management strategies in the ED.

Methods and Results: A systematic review was done using PubMed (MEDLINE), Cochrane Central Register of Controlled Trials (CENTRAL), and EMBASE, combining the search terms "Atrial Fibrillation", "Atrial Flutter", "Emergency Medicine", "Emergency Service", and "Emergency Treatment". After removal of duplicates, 754 articles were identified. After initial screening of titles and abstracts, 69full text articles were carefully reviewed and 34 articles were ultimately included in the study based on inclusion and exclusion criteria. The articles were grouped into four main categories: decision aids and outcome predictors, electrical cardioversion-based protocols, antiarrhythmic-based protocols, and general management protocols.

Conclusion: This systematic review is the first study to our knowledge to evaluate the optimal management of symptomatic AF/AFLin the ED with a direct impact on ED disposition. There are several viable management strategies that can result in safe discharge from the ED in the right patient population, and decision aids can be utilized to guide selection of appropriate patients for discharge.

Introduction

Atrial fibrillation (AF) is the most common dysrhythmia worldwide, with an estimated prevalence of 2.7 to 6.1 million in the United States (US) alone[1]. The risk for developing AF increases with advancing age, and the US prevalence is predicted to increase to as high as 12.1 million by the year 2030 as the elderly population continues to grow[2]. Along with the increased burden of disease, emergency department (ED) visits for symptomatic AF have continued to rise over the last 25 years, almost doubling from 1993 to 2004[3]. Despite a fairly stable relative rate of hospitalizations, the absolute number of hospitalizations for AF continues to climb as ED visits become more frequent[3]. National incremental healthcare costs of AF in the US are estimated to range from $6 to $26 billion, and a large portion of these expenses are related to inpatient hospitalization [4]. By preventing unnecessary hospital admissions for AF, it could be surmised that both healthcare costs and unwanted complications associated with hospitalization could be significantly reduced. The most recent American Heart Association/American College of Cardiology/Heart and Rhythm Society guidelines for management of AF do not specifically address management in the ED[5]. However, recent guidelines from the Canadian Cardiovascular Society do provide recommendations for ED management of AF, noting that there is increasing evidence that many patients with AF can be safely managed in the ED and discharged to home, without necessitating hospitalization[6]. The aim of our study was to search the existing literature for management strategies and decision aids for triaging ED patients with AF, specifically with a plan for selecting patients appropriate for outpatient management.

Key Words

Atrial Fibrillation, Atrial Flutter, Emergency Medicine, Emergency Service, Emergency Treatment

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Methods

Study Population

We performed a literature search on October 12, 2016 using PubMed (MEDLINE), Cochrane Central Register of Controlled Trials (CENTRAL), and EMBASE. The searches combined the terms "Atrial Fibrillation", "Atrial Flutter", "Emergency Medicine", "Emergency Service", and "Emergency Treatment". Additional relevant articles that were identified as references for the articles found during the primary search were also included in the review process. Articles published in English were accepted for this review, and non-English language articles were excluded at the title/abstract screening stage. Randomized controlled trials, non-randomized controlled trials, prospective and retrospective cohort studies, case-control studies, and case series were included. Cross-sectional studies, case reports, editorials, letters, comments, abstracts and poster presentations, guidelines, meta-analyses, and review articles were excluded.

Manuscripts selected for this review included: 1) ED management strategies for symptomatic AF or atrial flutter (AFL) directed toward

ED discharge, 2) a focus on the efficacy and/or safety of triaging or management protocols to assist with disposition of patients with AF/AFLin the ED, and 3) evaluation of short term outcomes (< 3 months) of patients with a primary diagnosis of AF/AFLwho were discharged from the ED. Articles that focused on the management of AF/AFL in the ED but without a direct impact on disposition were excluded. Articles that explored past predictors of hospital admission for AF/AFL without relating to patient outcomes were excluded. Articles that only evaluated outcomes more than 3 months after ED discharge were excluded, as we felt short term outcomes were more likely to be related to ED management and discharge. Additionally, articles that primarily focused on acute and long-term anticoagulationfor stroke prophylaxis were excluded.

After the initial database search and removal of duplicates, articles were screened and included or excluded based on title and abstract information. The articles that were included after this initial screening stage were then analyzed using full-text review, and included or excluded based on the previously mentioned inclusion/exclusion criteria. The entire screening process was performed by two independent reviewers (JV, MS)utilizing the Covidence web-based software platform, and conflicts were resolved by consensus with the assistance of a third independent reviewer (AG). The methodology for this systematic review is summarized in [Figure 1].

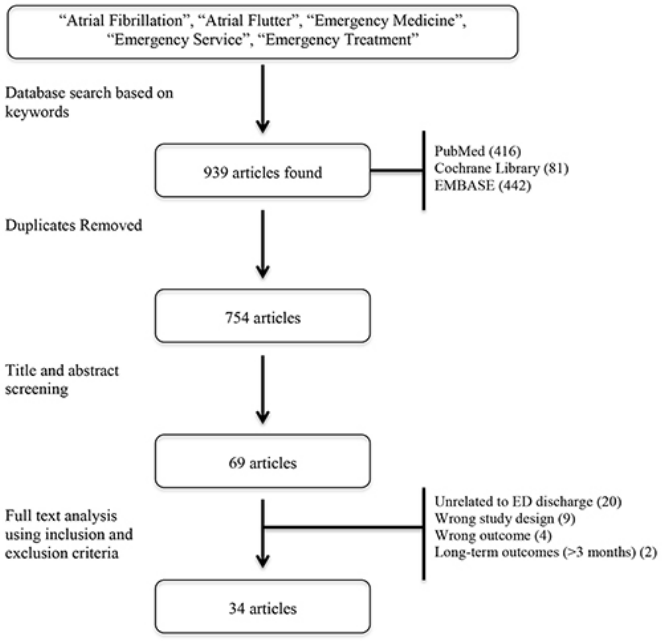

Figure 1: Systematic Review Process

Data extraction was performed individually by the two primary independent reviewers for the studies that were included after full text analysis. Relevant factors from each study were assessed for the final qualitative analysis, including study design, patient population, follow-up period, and interventions and outcomes.

Results

We identified a total of 939 articles (416 from PubMed, 81 from Cochrane Library, and 442 from EMBASE). Duplicates were excluded, resulting in 754 remaining articles. These articles were carefully screened based on information gathered from the titles and abstracts, leaving 69 articles to be analyzed by full text review. Twenty articles were excluded because although they discussed the management of AF/AFLin the ED, they did not specifically address patient disposition from the ED. Nine articles used one of the study designsthat we chose to exclude and 4 had irrelevant patient outcomes for our topic of interest. Finally, 2 articles were excluded because their primary focus was on long-term patient outcomes. This left 34 remaining studies to be included in our review. There were 4 randomized controlled trials, 10 prospective cohort studies, 12 retrospective cohort studies, 6 prospective case series, and 2 retrospective case series. Because our inclusion criteria allowed for some variety in the content of our articles, we grouped the articles into 4 separate categories: decision aids and outcome predictors, electrical cardioversion-based protocols, antiarrhythmic-based protocols, and general management protocols.

Decision Aids and Outcome Predictors

Seven of the articles focused specifically on how to determine which patients with AF/AFLcan be safely discharged from the ED by analyzing short term outcomes and creating novel prediction models and decision aids [Table 1][7-13]. The retrospective analysis done by Mulcahy et al reviewed the charts of all patients who presented to the ED with new-onset AF from 1987 to 1992, all of whom were subsequently admitted to the inpatient ward per hospital policy at that time[7]. Based on the overall hospital courses and interventions required while inpatient, they found that about one-third of these patients did not merit inpatient hospitalization, and 98% of those that did require inpatient care were easily identified while in the ED. RED-AF, a prediction model created by Barrett et al, assigned points for 12 clinical variables in ED patients with AF/AFL and predicted the risk of an adverse event at 30 days based on total points[8]. The initial model had modest predictive discrimination and was later prospectively validated with similar performance as the original cohort[11]. The biggest predictors of increased risk for short-term adverse events were increased age, inadequate ED rate control, dyspnea, smoking, and home beta-blocker use[8]. The AFFORD prediction model for 30-day adverse events was also created by Barrett et al, a few years after RED-AF, and assigned points to 17 different variables for risk stratification[12]. Atzema et al created both a complex as well as a pragmatic clinical decision instrument for risk-stratification, both of which performed well for predicting 30-day all cause mortality[13]. Compared with the complexity of the previous models, the pragmatic model (TrOPs-BAC) includes only 6 variables (positive troponin, other acute ED diagnosis, pulmonary disease, bleeding risk, age 75 years or older, and congestive heart failure) and can easily be memorized for quick reference. Atzema et al performed a large retrospective cohort study to look for factors associated with death within 90 days of an ED discharge after a visit for AF/AFL, and found that having no follow-up care was associated with the highest risk for short-term death (hazard ratio [HR] 2.27)[9]. This group also explored predictors for repeat ED visits for AF/AFL within 2 weeks of an ED discharge, and found that follow-up with a cardiologist or internist was associated with the lowest hazard for repeat visits (HR 0.61)[10].

Electrical Cardioversion-Based Protocols

Seven of the articles primarily analyzed the safety and efficiency

Table 1: Decision Aids

Author/Year	Study Design	No. of Patients	Inclusion Criteria	Intervention	Key Outcome Measures	Results
Mulcahy et al 1996[7]	Retrospective cohort study	229	ED patients with new diagnosis AF	Determination of medical justification of hospitalization for AF	Rate of medically justified admissions ED or hospital complications	1/3 of admitted AF patients did not merit hospitalization 98% of medically justified admissions could be identified in the ED
Barrett et al 2011[8]	Retrospective cohort study	832	ED patients with AF/AFL	Derivation and internal validation of RED-AF prediction model	30-day adverse events	RED-AF had modest predictive discrimination for the primary outcome (c-statistic of 0.67)
Atzema et al 2013 [9]	Retrospective cohort study	12,772	ED patients>65 years old with primary diagnosis AF/AFL	Discharge home from the ED	90-day all-cause mortality	3% death rate within 90-days Significantly increased hazard of death for patients with no outpatient follow-up
Atzema et al 2013 [10]	Retrospective cohort study	12,772	ED patients>65 years old with primary diagnosis AF/AFL	Discharge home from the ED	Return ED visit within 14 days	9% of patients had a return ED visit Patients with specialist outpatient follow-up less likely to return Patients with only family practice outpatient follow-up, high acuity triage score, and history of CHF more likely to return
Barrett et al 2015[11]	Prospective cohort study	497	ED patients with stable AF/AFL	Prospective validation of RED-AF prediction model	30-day adverse events	RED-AF performed similar to the original derivation cohort (c-statistic of 0.65) Clinically relevant threshold score had 96% sensitivity, 19% specificity, PPV 27%, NPV 93%
Barrett et al 2015[12]	Prospective cohort study	497	ED patients with stable AF/AFL	Derivation and internal validation of AFFORD clinical decision aid	30-day adverse events	AFFORD performed moderately well for predicting risk of short-term adverse outcomes (c-statistic of 0.7)
Atzema et al 2015[13]	REtrospective cohort study	3,510	ED patients with primary diagnosis AF	Derivation and validation of complex and pragmatic decision models for disposition of ED patients with AF	30-day all cause mortality	Both models were highly predictive of the outcome (c-statistic 0.87 and 0.81 for complex and pragmatic model, respectively)

AF = atrial fibrillation, AFL = atrial flutter, CHF = congestive heart failure, ED = emergency department, NPV = negative predictive value, PPV = positive predictive value

of direct-current cardioversion (DCCV) as a means to successfully discharge patients home from the ED [Table 2][14-20]. Conversion rates for DCCV were as high as 97% in the prospective cohort study by Jacoby et al, and no lower than 78%, which was the rate observed by Dankner et al[15,17]. In each of these studies, almost all of the patients who converted to normal sinus rhythm (NSR) were discharged home from the ED. Several of the studies noted a small number of minor ED complications with DCCV, primarily related to procedural sedation[14,16,18,19,20]. No major adverse events were observed within 3 months of discharge after ED DCCV in any of the included studies.

Table 2: Electrical cardioversion

Author/Year	Study Design	No. of Patients	Inclusion Criteria	Intervention	Key Outcome Measures	Results
Burton et al 2004[14]	Retrospective cohort study	388	ED patients with stable AF	Elective DCCV Elective CC Rate control only	ED disposition Conversion to NSR ED and 1-week adverse events	86% of all patients discharged home 86% conversation rate with DCCV 28 ED DCCV complications
Jacoby et al 2005[15]	Historically controlled prospective cohort study	60	ED patients with primary diagnosis stable AF/AFL AF duration <48 hours	Elective DCCV Historical controls with rate control only and hospital admission	ED disposition Conversion to NSR Post-discharge adverse events	80% of DCCV patients discharged home 97% conversion rate with DCCV No adverse events noted with telephone follow-up for DCCV patients
Lo et al 2006[16]	Prospective case series	33	ED patients with stable AF AF duration <48 hours	Elective DCCV	ED disposition Conversion to NSR ED and 3-month adverse events	79% of all patients discharged home 91% conversion rate with DCCV No major adverse events at 3 months
Dankner et al 2009[17]	Retrospective cohort study	374	ED patients with stable AF AF duration <48 hours or >48 hours with therapeutic INR	Elective DCCV Elective CC Rate control only	ED disposition Conversion to NSR 1 and 2-week adverse events	53% of DCCV patients discharged home 78% conversion rate with DCCV No definite treatment-related adverse events with DCCV
Scheuermeyer et al 2010[18]	Retrospective case series	400	ED patients with primary diagnosis stable AF/AFL AF/AFLduration <48 hours or >48 hours with therapeutic INR	Elective DCCV	ED disposition Conversion to NSR ED and 30-day adverse events	97% of patients discharged to home 97% conversion rate with DCCV No major 30-day adverse events 4.3% rate of minor procedural complications
Scheuermeyer et al 2011[19]	Retrospective cohort study	122	ED patients with primary diagnosis stable AFL	Elective DCCV Elective CC Spontaneous cardioversion Rate control only No rate or rhythm control	ED disposition Conversion to NSR ED adverse events	93% of DCCV patients discharged home 91% conversion rate with DCCV patients 2 DCCV patients had minor procedural complications
Cristoni et al 2011[20]	Prospective cohort study	322	ED patients with stable AF AF duration <48 hours	ED SOU management (DCCV vs. CC)	ED disposition Conversion to NSR Short-term adverse events	94% of patients discharged from ED in DCCV group vs. 56% in CC group 93% conversion rate in DCCV group vs. 51% in CC group No significant difference in short-term adverse events

AF = atrial fibrillation, AFL = atrial flutter, CC = chemical cardioversion, DCCV = direct current cardioversion, ED = emergency department, INR = international normalized ratio, NSR = normal sinus rhythm, SOU = short observation unit

Table 3: Medical Management

Author/Year	Study Design	No. of Patients	Inclusion Criteria	Intervention	Key Outcome Measures	Results
nnes et al 1997[21]	Randomized controlled trial	41	ED patients with stable AF, <75 years of age AF duration <48 hours	Sequential verapamil-quinidine Sequential digoxin-quinidine	ED disposition Conversion to NSR ED adverse events	63% of VER-Q and 27% of DIG-Q discharged home from ED 84% of VER-Q patients and 45% of DIG-Q patients successfully converted within 6 hours No significant adverse events
Ganau et al 1998[22]	Randomized controlled trial	156	ED patients with stable AF, <80 years of age AF duration <72 hours	IV propafenone IV saline placebo	ED disposition Conversion to NSR ED adverse events	65% of propafenone patients and 20% of placebo patients discharged home from ED 70% of propafenone patients and 17.3% of placebo patients converted within 2 hours 4 patients with minor, transient complications
Ergene et al 1998[23]	Prospective cohort study	50	ED patients with stable AF, <75 years of age AF duration <72 hours	PO propafenone	ED disposition Conversion to NSR Predictors for successful conversion ED adverse events	78% of patients discharged home from ED 78% conversion rate Higher response rate for symptom onset <24 hours 3 patients with severe hypotension responsive to IV fluids
Domanovits et al 2000[24]	Prospective case series	51	ED patients with stable AF/AFL AF duration <48 hours	IV ibutilide with DCCV for non-responders	ED disposition Conversion to NSR ED adverse events	92% of all patients discharged home from ED 75% conversion rate with ibutilide, 100% conversion rate with ibutilide +/- DCCV No major adverse effects
Mountantonakis et al 2006[25]	Prospective case series	36	ED patients with stable AF/AFL AF duration <72 hours	IV ibutilide	ED disposition Conversion to NSR ED adverse events	All patients who converted discharged home from ED 69% conversion rate No major adverse effects
Viktorsdottir et al 2006[26]	Retrospective cohort study	46	ED patients with stable AF/AFL AF duration <7 hours	IV ibutilide Rate control only	ED disposition Conversion to NSR ED adverse events	All patients who converted discharged home from ED 64% conversion rate in ibutilide group vs. 29% in rate control group No adverse effects in ibutilide group
Stiell et al 2007[27]	Retrospective case series	341	ED patients with primary diagnosis stable AF/AFL AF/AFLduration <48 hours	IV procainamide with DCCV for non-responders	ED disposition Conversion to NSR ED adverse events	94.4% discharged home from ED 50% conversion rate with procainamide alone, 91% with procainamide +/- DCCV 10% rate of adverse events, transient hypotension most common
Hirschl et al 2011[28]	Prospective cohort study	376	ED patients with stable AF AF/AFLduration <48 hours	IV flecainide IV ibutilide IV amiodarone IV magnesium IV digoxin IV diltiazem IV digoxin + diltiazem	ED disposition Conversion to NSR ED adverse events	All cardioverted and rate controlled patients discharged home from ED 45% overall conversion rate; flecainide (95%) and ibutilide (75%) had highest success rates 4% adverse event rate, lowest in digoxin and digoxin + diltiazem group
cheuermeyer et al 2013[29]	Retrospective cohort study	259	ED patients with primary diagnosis stable AF	BB CCB	ED disposition ED LOS ED and 30-day adverse events	No significant difference in ED LOS or discharge home from ED for BB vs. CCB (78% and 69%, respectively) No major ED adverse
White et al 2015[30]	Historically controlled prospective cohort study	104	ED patients with primary diagnosis stable AF/AFL AF/AFLduration <48 hours	IV procainamide with DCCV for non-responders Historical controls with standard care	ED disposition Conversion to NSR 30-day adverse events	93% of cohort discharged home from ED vs. 40% of historical controls 94% conversion rate for cohort vs. 56% of historical controls No major adverse events

AF = atrial fibrillation, AFL = atrial flutter, BB = beta blocker, CCB = calcium channel blocker, DCCV = direct current cardioversion, DIG-Q = digoxin plus quinidine, ED= emergency department, IV = intravenous, LOS = length of stay, NSR=normal sinus rhythm, PO = by mouth, VER-Q= verapamil plus quinidine

Notably, hemodynamic instability was an exclusion criterion for all of these studies, so DCCV was done purely on an elective basis. Additionally, 3 of the 7 studies required the onset of AF/AFL to be less than 48 hours prior to ED presentation for study inclusion[15,16,20]. The other 4 studies permitted an earlier onset of symptoms, but the large majority of patients still only had symptoms for 48 hours or less, no fewer than 68% of the cohort in the AFL study done by Scheuermeyer et al[14,17,18,19].

Antiarrhythmic-Based Protocols

Ten of the articles dealt with medical management of AF in the ED, either with chemical cardioversion or rate control alone [Table 3][21-30]. Chemical cardioversion had varying success rates depending on the pharmacologic agent that was chosen. The combinations of verapamil-quinidine and digoxin-quinidine used by Innes et al resulted in 84% and 45% conversion rates to NSR, respectively[21]. Intravenous (IV) and oral (PO) propafenone had 70% and 78% successful conversion rates, respectively[22,23].The use of IV ibutilide resulted in conversion rates ranging from 64% to 76%[24,25,26,28]. IV procainamide was used by Stiell et al and White et al with a 50% and 67% success rate, respectively [27,30]. Hirschl et al compared a variety of different medications, and found that flecainide (95%) and ibutilide (76%) had the highest rates of conversion to NSR [28]. Similar to the DCCV studies, all of these studies required a recent onset of AF/AFL for study inclusion.Only one of the articles in our study evaluated rate control alone with regard to ED discharge, comparing outcomes of those who received beta-blockers vs. calcium channel blockers, finding no significant differences in discharge rates or short-term adverse events[29].

General Management Protocols

NThe final category included ten articles, which either explored the efficacies of several different AF/AFL management strategies with the goal of ED discharge, or used specific protocols designed

to appropriately triage and disposition ED patients with AF/AFL [Table 4][31-40].Michael et al and Vinson et al compared several different ED management strategies, with DCCV being the most successful with regard to conversion to NSR[31,38]. However, 97% and 89% of all patients were discharged to home in Michael and Vinson's groups, respectively, including those who only underwent rate control or observation. Vinson et al observed a 29% rate of spontaneous cardioversion in the ED without any intervention; this rate improved

Table 4: General Management Protocols

Author/Year	Study Design	No. of Patients	Inclusion Criteria	Intervention	Key Outcome Measures	Results
Michael et al 1999[31]	Retrospective cohort study	289	ED patients with primary diagnosis stable AF	Elective DCCV Elective CC SC before or after treatment Rate control only	ED disposition Conversion to NSR ED and 1-week adverse events	97% of all patients discharged home 89% conversion rate for DCCV, 50% for CC, 15% spontaneously converted No adverse events with DCCV, 9% complication rate with CC
Koenig et al 2002[32]	Prospective case series	67	ED patients with stable AF AF duration <48 hours Failed ED cardioversion	EDOU management (rate control, CC, and/or DCCV)	ED disposition Conversion to NSR ED and 1-week adverse events	81% of patients discharged home from ED 82% overall conversion rate No major adverse events
Kim et al 2002[33]	Randomized controlled trial	18	ED patients with primary diagnosis new-onset, stable AF, <75 years old	Accelerated ED pathway Hospital admission	ED disposition ED/hospital LOS ED adverse events	100% conversion rate and discharge home from ED for accelerated pathway Mean LOS was 2.1 days for hospital admission vs. <1 day for accelerated pathway No major adverse events
Zimetbaum et al 2003[34]	Prospective cohort study	446	ED patients with primary diagnosis new-onset, stable AF	ED AF practice guideline Pre-intervention standard care	ED disposition 30-day return visits and adverse events	49% decrease in probability of hospital admission No difference in 30-day return visits or hospitalizations No 30-day strokes or death
Decker et al 2008[35]	Randomized controlled trial	153	ED patients with primary diagnosis stable AF AFduration, <48 hours	EDOU protocol Hospital admission	ED disposition Conversion to NSR or rate control ED, 30-day, and 6-month adverse events	85% of EDOU discharged home from ED 85% conversion rate in EDOU group vs. 73% in hospital admission group No significant difference in short term adverse effects
Stiell et al 2010[36]	Prospective case series	660	ED patients with primary diagnosis stable AF AF/AFL duration, <48 hours	Ottawa Aggressive Protocol	ED disposition Conversion to NSR ED and 1-week adverse events	97% of all patients discharged home from ED 92% successful conversion rate with IV procainamide +/- DCCV No major adverse events
Scheuermeyer et al 2012[37]	Retrospective cohort study	927	ED patients with primary diagnosis stable AF	Elective DCCV Elective CC SC Rate control only	ED disposition Conversion to NSR ED and 30-day adverse events	85% of patients discharged home 46% conversion rate to NSR 3% rate of adverse events in ED, 0.8% rate of stroke or death at 30 days
Vinson et al 2012[38]	Prospective cohort study	206	ED patients with primary diagnosis stable AFduration, <48 hours	Elective DCCV Elective CC SC Rate control only	ED disposition Conversion to NSR ED and 30-day adverse events	89% of patients discharged home 96% success rate for attempted cardioversion Rate of spontaneous conversion to NSR was 29% in ED, 69% within 48 hours of discharge home No major ED adverse events, 1% rate of stroke and no deaths at 30 days
Elmouchi et al 2014[39]	Prospective case series	100	AF clinic patients seen in follow-up after discharge home from ED visit for AF	Spectrum Health AF Protocol with AF clinic follow-up	90-day return ED visits or hospitalization 90-day mortality and TE events	10 AF-related return ED visits, 3 AF-related hospitalizations within 90 days No deaths or TE events at 90 days
Ptaszek et al 2016[40]	Prospective cohort study	359	ED patients with stable AF	AF treatment pathway Standard care	ED disposition Repeat visits or hospitalization	84% of AF pathway patients vs. 20% of controls discharged home from ED No significant difference in short-term readmissions

AF = atrial fibrillation, AFL = atrial flutter,CC = chemical cardioversion, DCCV = direct current cardioversion, ED= emergency department, EDOU = emergency department observation unit, IV = intravenous, LOS = length of stay, NSR = normal sinus rhythm, SC = spontaneous cardioversion, TE = thromboembolic

to 69% within 48 hours of discharge to home[38]. Scheuermeyer et al looked at outcomes of ED patients with symptomatic AF and no other underlying medical cause who received a similar variety of interventions, with 85% of patients discharged home from the ED and a 0.8% rate of stroke or death at 30 days[37]. Koenig et al observed an 81% discharge rate with no major adverse events after utilization of an ED observation unit for those who did not respond initially to ED management[32]. Stiell et al used a case series to evaluate the Ottawa Aggressive Protocol, which consisted of administration of IV procainamide followed by DCCV for those who did not convert to NSR initially, and showed that 97% of patients were discharged home from the ED without any major adverse events[36]. Kim et al and Decker et al both randomized patients to undergo protocols geared toward ED discharge vs. hospital admission, and found no significant difference in short-term adverse events[33,35]. Zimetbaum et al and Ptaszek et al compared their AF protocols to standard ED care, and found a 49% and 80% decreased probability of hospital admission, respectively, with no significant differences in short-term adverse events or hospitalizations[34,40]. Elmouchi et al created the Spectrum Health ED AF protocol, which had different treatment algorithms based on time of AF onset, and required close follow-up in an AF-specific clinic[39]. Out of 100 included patients, there were only 10 repeat ED visits and 3 hospitalizations for AF within 90 days, with no deaths or thromboembolic events.

Discussion

To our knowledge, this is the first systematic review to evaluate the optimal management of AF/AFL in the ED, specifically with regard

to appropriate triaging and disposition. Based on the results of the included articles, there are multiple, varying strategies to approach management as well as risk stratification. Moreover, our review suggests that by using these strategies, most patients can be safely discharged from the ED and managed successfully in the outpatient setting. Based on our review, we concluded three major findings: 1) decision aids and prediction models can be useful for determining ED disposition, 2) electrical cardioversion is more successful than medical management in converting to NSR, and 3) conversion to NSR is not required to allow for safe ED discharge.

Deciding which patients are safe to discharge from the ED and which require inpatient admission is not always straightforward, but one of our primary findings was that using prediction models can be helpful for stratifying patients. The RED-AF and AFFORD clinical tools both had modest predictive discrimination for their outcomes of interest, and the decision instruments created by Atzema et al were highly predictive of 30-day all cause mortality[8,11,12,13].Unlike many of the articles in this review, these decision aids did not exclude patients with other underlying acute medical conditions requiring hospitalization,which could broaden their applicability.Each of these studies was done at a single academic institution, and further validation in a variety of ED settings would strengthen the case for widespread use of these decision instruments. Regardless of risk stratification, transitions of care are an important aspect of acute AF/AFL management. Atzema et al demonstrated in 2 different articles that patients without adequate short-term follow-up had worse outcomes, reinforcing that close outpatient follow-up is important to ensure a safe ED discharge [9,10].

Electrical cardioversion was largely very successful in the articles we reviewed and helped with discharge from the ED. Several of the studies in the DCCV group directly compared electrical and chemical cardioversion, and found DCCV to have significantly higher successful conversion rates[14,17,19,20]. Although none of the studies in the antiarrhythmic group directly compared chemical cardioversion to DCCV, all of the pharmacologic agents had lower conversion rates than the results seen in the DCCV studies. A few of the chemical cardioversion studies used DCCV as an adjunct therapy for those who did not initially respond to the pharmacologic agents, with subsequent improvement of successful cardioversion[24,27,30]. In each study in the DCCV and antiarrhythmic groups, almost all patients who converted to NSR were discharged home from the ED. Importantly, with either DCCV or chemical cardioversion, it was critical to know the exact onset of the AF/AFL episode to ensure that the onset was less than 48 hours duration. In many cases this cannot be reliably determined and would thus warrant a transesophageal echocardiogram. This limits the utility of this strategy in many patients. In addition, in these patients with new onset AF/AFL, it is possible that many will spontaneously convert without an intervention in the ED, as a large proportion will likely have paroxysmal AF/AFL.

The final group of articles employed a combination of rate control, DCCV, chemical cardioversion, and observation alone, most by using implemented pathways and protocols with the aim of ED discharge when possible. These studies demonstrated a high success rate of ED discharge, regardless of the type of acute management that was chosen or rhythm status at time of discharge. It is interesting to note that the articles in the general management group demonstrated a similar rate of short-term adverse events to the articles in the DCCV and chemical cardioversion groups, many of which required patients to convert to NSR in order to be discharged[15,17-18,20,25-30]. While conversion to NSR seems desirable, particularly in patients with acute onset of AF/AFL, there is no particular reason that persistence of AF/AFL should preclude ED discharge, provided that rate control is adequate and the patient is otherwise stable and not severely symptomatic. This is supported by the articles that observed reasonably high rates of spontaneous conversion to NSR, as well as the studies mentioned that observed high rates of safe discharges, regardless of ED intervention[31,37,38]. Future studies exploring optimal ED management for symptomatic AF/AFL with rate control or observation alone could help elucidate if and when aggressive rhythm control is actually merited.

Limitations

There are several limitations to consider in this review. We performed a qualitative assessment of a somewhat heterogeneous group of articles based on our study design, and thus did not perform any summative statistical calculations for either population baseline characteristics or outcomes. We did not restrict study inclusion based on individual study quality, which may inherently allow for bias in our overall assessment based on the individual study results. Although many of the studies had relatively large sample sizes, some of the studies involved small patient populations, which could limit the external validity of their results[16,21,25,16,21]. Finally, we excluded non-English language studies, and it is possible that in doing so excluded some studies that may have been pertinent to our review.

Disclosures

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Conclusion

This systematic review is the first study to our knowledge to evaluate the optimal management of symptomatic AF/AFL in the ED with a direct impact on ED disposition. Based on our findings, there are several viable strategies to employ, all of which may result in a safe ED discharge to home in the right patient population. A suggested general protocol is included in [Figure 2]. The decision aids included in our study can be helpful for determining which patients can be safely managed in the outpatient setting and which require inpatient evaluation. The use of cardioversion in the ED can help expedite discharge, and DCCV has a higher success rate than chemical cardioversion, but conversion to NSR is not a requisite for a safe ED discharge.Early outpatient follow-up is crucial to prevent repeat ED visits and ensure long-term care.However, future studies of acute AF/AFL care are needed to develop management strategies that are comprehensive, in order to determine best practices and demonstrate scalability of systems of care to a variety of settings.

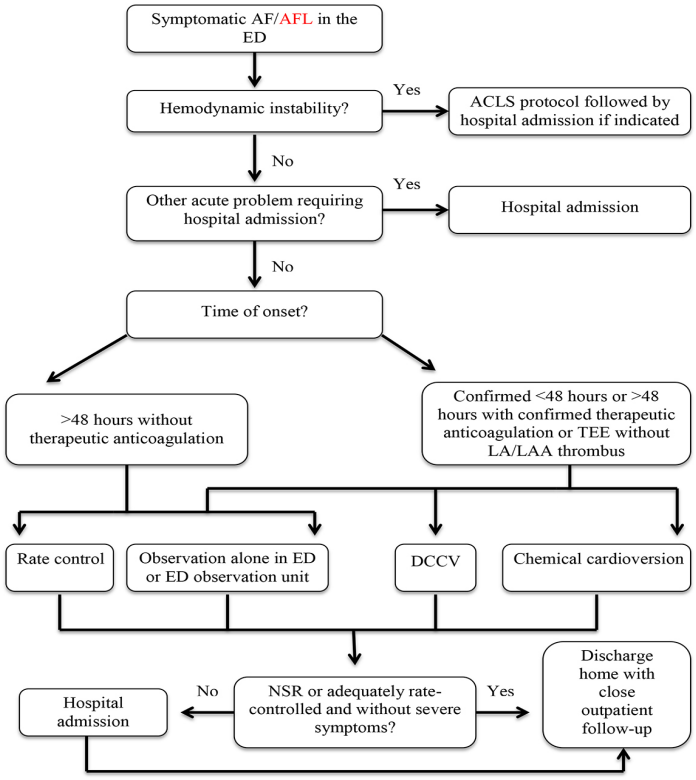

Figure 2: Suggested Protocol for ED Management of AF/AFL

ACLS = advanced cardiovascular life support, AF = atrial fibrillation, AFL = atrial flutter, DCCV = direct current cardioversion, ED = emergency department, LA/LAA = left atrium/left atrial appendage, NSR = normal sinus rhythm, TEE = transesophageal echocardiogram

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