Atrial Fibrillation in the Emergency Department

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Introduction

Atrial fibrillation (AF) and atrial flutter (AFL) are the most commonly occurring arrhythmias in the United States. Management strategies for AF and AFL emphasize ventricular rate control, cardioversion to normal sinus rhythm and long-term interventions such as anticoagulation to reduce the risk of stroke. In patients in whom cardioversion is an option, either pharmacological or electrical cardioversion may be considered. While there is a significant amount of literature comparing the effectiveness and safety of pharmacologic versus electrical cardioversion in acute AF, studies which analyze discharge rates and hospital length of stays are becoming more frequent due to concerns over rising health care costs and ED overcrowding. This review focuses on treatment strategies for patients presenting to the ED with acute atrial fibrillation; in particular, rate control versus cardioversion, options for cardioversion (chemical versus electrical) and the safety of these strategies when used in the ED.


The authors provide a review of five observational studies compiling a total of 1,593 ED patients with atrial fibrillation treated by either rate control or cardioversion. The clinical question asked by these authors was whether or not a particular subset of patients presenting to the ED with recent-onset (defined as onset less than 48 hours prior to presentation) AF or AFL for whom direct-current cardioversion (DCC) followed by discharge home is safe and effective. Previous studies have shown the risk of thromboembolic events among these patients to be as low as 0.8%. Potential benefits from DCC include decreased length of stay, decreased cost, and improved patient satisfaction.

Five articles were selected for review from a PubMed search specific to the topic of ED cardioversion for recent-onset AF. Of the cohort studies reviewed, two were retrospective and three were prospective. In total, eleven medical centers were included in these non-industry-sponsored cohort studies ranging from Maine to Vancouver. Combining the five observational studies revealed 1,593 cases involving ED DCC. Overall, success rates ranged from 85.5% to 97%, with only one (0.06%) thromboembolic complication reported. The one observed stroke occurred within 48 hours of visiting the hospital in a patient who was not on anticoagulation post DCC.

Unfortunately, none of the studies compared complication rates to a control group of patients treated with alternative strategies. Furthermore, patient satisfaction rates of DCC were not adequately assessed and compared to alternative treatment regimens. Regarding cost effectiveness, only one article that was reviewed addressed the potential cost benefit for rapid cardioversion and found no significant cost difference. That said, additional studies are needed to determine if there is a potential for cost savings. Further research may also better assess patient satisfaction of DCC compared to alternative treatment regimens, and better identify patients at low risk for thromboembolic events. The authors of this review also bring up the question of whether the upper limit of new onset should be defined as less than 48 hours, or is there some other time point where failure rate begins to rise. Based on this review of five cohort studies regarding ED cardioversion of recent-onset AF or AFL, DCC should be offered as a safe and effective treatment with success rates ranging from 85.5-97% and risk of thromboembolic phenomena as low as 0.06%.


The authors of this study performed a prospective cohort multicenter study of patients with AF or AFL presenting to the emergency department with less than 48 hours of symptoms. Of note, this study is one of the included trials in the review by Cohn et al., discussed in the section above. The study was performed with convenience sampling among three suburban community-based hospitals within Kaiser Permanente Northern California between June 1, 2005 and November 30, 2007. A total of 206 patients were enrolled, 191 (92%) with AF and 15 (7.3%) with AFL, with a mean age of 64. Cardioversion, whether chemical or electrical, was attempted in 115 patients (56.3%).

The inclusion criteria for the study were the following: the presence of AF or AFL on the initial electrocardiogram and a well-defined onset of rhythm-related symptoms within 48 hours of evaluation. Patients were then managed by the discretion of the physician with no treatment protocol in place. The treating physician also prospectively recorded demographic features, baseline characteristics, management variables, and adverse events. Immediate outcomes were documented and a 30-day follow up period was selected to capture short-term embolic events.

During the study period, rate reduction was attempted in 109 patients and was successful in 79 (72.4%), defined as a ventricular rate less than 100 beats/minute for a sustained period of time. The duration of a “sustained period” varied according to the treating physician. Cardioversion was attempted in 115 patients, with success in 110 (95.7%). Of these, chemical cardioversion was attempted in 52 patients and was successful in 31 (60%). DCC with procedural sedation was attempted in 83 patients and was successful in 80 (96%).

Of the 206 patients enrolled in the study, 183 (88.8%) were discharged from the ED. Six adverse events in the ED were recorded that required interventions: vomiting (n=1) secondary to procainamide, hypotension (n=2) secondary to diltiazem, ventricular tachycardia (n=2) secondary to DCC, and hypotension (n=1) secondary to procedural sedation. Only four of these events led to admission for observation and no patients died or developed a more severe dysrhythmia.

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Two hundred and four patients (99%) were successfully contacted for follow up by at least 45 days after the index visit. None of the patients died during the follow up period and thromboembolic events were diagnosed in two patients (1.0%; 95% CI 0.1-3.5%), both of which developed expressive aphasia within 48 hours of their ED visit. One patient who developed a cerebrovascular accident was already on flecainide and aspirin, and requested DCC in the ED, which was successful at returning normal sinus rhythm. The other patient was on a calcium channel blocker and deemed a non-candidate for cardioversion. Neither patient was receiving anticoagulation at the time of their thromboembolic event.

This study found that a large proportion of their cohort underwent attempted cardioversion with relatively high success rates. Rates of adverse events were quite low, and observed thromboembolic events within 30 days were very uncommon. DCC seems to be a safe and effective approach to ED patients with presumed recent-onset atrial fibrillation. The study had multiple limitations including the potential for selection bias and lack of generalizability to other settings and patient populations.


The authors of this review performed a literature search in which the articles addressed at least one of the following outcomes: time to conversion, length of stay in the ED, safety and relapses or readmissions. Exclusion criteria were the following: studies that included patients with AF for greater than 48 hours, patients who developed AF post-operatively or post-MI, unstable AF and studies which did not include the rate of conversion to NSR. Fourteen studies were included with a total of 2,765 enrolled patients. Eight studies were prospective randomized controlled trials, four were prospective nonrandomized controlled trials and two were retrospective nonrandomized controlled trials.

In four articles (Cristoni et al.,1 Bellone et al.,2 Vinson et al.,3 and Dankner et al.,4) DCC was compared with pharmacologic cardioversion or with a conservative option, and in all four articles DCC was found to have superior efficacy for conversion to NSR. In the study by Cristoni et al., DCC was compared to pharmacologic cardioversion with amiodarone or class IC antiarrhythmics. Restoration of NSR occurred in 93% of patients in the DCC group versus 51% of those in the pharmacologic cardioversion group (P<0.001). In the study by Bellone et al., in which DCC was compared with intravenous propafenone, 89.3% of patients treated with DCC had conversion to NSR compared with 73.8% of patients treated with propafenone (P=0.02). The third study, by Vinson et al., is discussed separately above. The fourth and final trial by Dankner et al., is a retrospective study comparing DCC, chemical cardioversion (with propafenone, procainamide, or amiodarone) and rate control (with digoxin, verapamil, or beta-blockers) and observation for spontaneous conversion. The DCC group again had the highest rate of restoration of NSR at 78.2% (P<0.001).

Several of the included studies analyzed agents used for chemical cardioversion. Four articles addressed amiodarone in particular. One of these trials, Martinez-Marcos et al., is a prospective randomized study comparing amiodarone with class IC antiarrhythmics. Hirschl et al., and Conti et al., also compare amiodarone with class IC drugs but are both nonrandomized.5,6 All three studies demonstrated a higher rate of cardioversion to NSR and also a shorter time to cardioversion with class IC antiarrhythmics when compared to amiodarone. In Hirschl et al., ibutilide was also included in the comparison and had a greater conversion rate than amiodarone but less than the IC drugs (P<0.005). A retrospective trial by Viktorsdottir et al., compared ibutilide with rate control and found a higher rate of conversion with ibutilide (64% vs. 29%, P<0.005). A study by Madonia et al., compared administration of oral versus intravenous propafenone and found similar conversion rates but shorter time to cardioversion with the intravenous form.5 Two studies included magnesium, one (Cybulski et al.) comparing amiodarone with magnesium, and one (Chu et al.) comparing magnesium with placebo. In Cybulski et al., amiodarone was found to be more effective than magnesium for cardioversion (50% vs. 26% at eight hours, P<0.05) and in Chu et al., the conversion rate at two hours was similar for both magnesium and placebo.

Two prospective randomized studies by Thomas et al., and Joseph et al., compared chemical cardioversion alone with combined DCC and chemical cardioversion (if NSR at not been accomplished after 48 hours). The agents which were studied in both trials were amiodarone, sotalol and digoxin. A study by Thomas et al., found a low rate of cardioversion with all of the drugs, but found a high rate of cardioversion (94, 95, and 98%, with each drug respectively) with combined treatment with chemical and electrical cardioversion. Joseph et al., found highest conversion rates and shortest time to cardioversion with sotalol compared to amiodarone and digoxin.

Five trials included data on discharge rates and four studies included data on hospital length of stay. Two of the three trials in which DCC was the first treatment strategy utilized, Cristoni et al., and Vinson et al., reported high discharge rates (94% and 91%, respectively). In the third study, by Dankner et al., the discharge rate with DCC was similar to that with pharmacologic cardioversion. All three trials that included data on length of stay (Decker et al.,14 Cristoni et al., and Bellone et al.) found that patients who were cardioverted with DCC had a short length of stay and in two of these trials (Decker et al., and Bellone et al.), the length of stay in the patients converted with DCC was found to be shorter than those converted by pharmacologic means (Bellone et al., P<0.001, P value for Decker et al., was not reported). The study by Conti et al., found a longer length of stay with amiodarone compared with Class IC antiarrhythmics. Vinson et al., compared the “wait-and-see” approach with home observation and found a high rate of discharge (94%), which was comparable to that achieved with DCC.

Thirteen of the trials reported adverse events and/or complications, though in all of the studies these were in general rare. There were five early embolic events (0.1% of all patients from all trials), two of which occurred in patients who were cardioverted (one after DCC and one after chemical) and the other three occurred in patients being rate controlled. Serious adverse events such as hypotension and arrhythmias were infrequent and no deaths were reported.
Recurrences of AF and readmission rates were reported in five trials. There were no significant differences in recurrence of AF among management strategies. Readmission rates varied from 0% at two hours to 26-28% at two months.

This study demonstrated that DCC is likely more effective for restoration of NSR than chemical cardioversion and also that DCC is associated with high discharge rates and short lengths of stay. It also showed that amiodarone is inferior to both class IC antiarrhythmics and ibutilide for chemical cardioversion. Furthermore, in patients with sustained AF for longer than 48 hours, combined DCC and chemical cardioversion was highly successful for cardioversion to NSR. The main limitation of this study is the variability of the included studies. Though all of the studies were controlled, some were not randomized. They varied in interventions used and duration of follow up. Also, some studies were excluded because the interventions were performed by cardiologists and were not studied in an emergency department.


The Ottawa Aggressive Protocol includes eight clinical steps: assessment, rate control, pharmacologic cardioversion, electrical cardioversion, anticoagulation, disposition, plans for patients not treated with cardioversion, and recommended additions to the protocol. The assessment is based on clinical judgment of the provider and includes assessing for stability and duration of atrial fibrillation or atrial flutter. Rate control is often omitted. Pharmacologic cardioversion is often attempted first with 1g of procainamide in 250ml of D5W run over one hour. Electrical cardioversion is attempted if pharmacologic intervention was not successful (or not attempted) with procedural sedation. For anticoagulation in this protocol, patients with time of onset less than 48 hours prior or with therapeutic INR did not receive any anticoagulation. Patients who undergo successful cardioversion are discharged home within one hour without additional medications usually with ECHO and cardiology follow-up. If cardioversion was not attempted, patients are discharged home on anticoagulation and rate control.

This study was performed at the Ottawa Hospital and was based on medical records from January 2000 to June 2005. The study enrolled consecutive cohorts of ED patients with the primary diagnosis of new onset AF or AFL. Patients could be enrolled in the study more than once if they presented multiple times for new onset AF or AFL. Patients with permanent AF, symptoms for longer than 48 hours, or symptoms for an unknown timeframe, and patients with an alternative diagnosis that required hospital admission were excluded.

Primary outcomes for the study included the proportion of patients that converted to sinus rhythm prior to discharge, length of ED stay, final disposition, and adverse events. Adverse events included hypotension, arrhythmia, death, stroke, and relapse to AF within seven days.

Within the study time frame, there were 1,057 ED visits for AF or AFL. Six hundred sixty subjects had the aggressive protocol applied. The most common reason for not using the aggressive approach was unclear timing of the arrhythmia, timing greater than 48 hours, or spontaneous conversion to sinus rhythm. The mean age was 64.5 and 55.6% of the subjects were men. Of the included patients, 39.6% received rate-controlling medications, 100% received IV procainamide, and 36.8% received subsequent electrical cardioversion. The conversion rates for AF and AFL with procainamide were 59.9% and 28.1%, respectively. The conversion rates for AF and AFL for electrical cardioversion were 91% and 100%, respectively. For AF, 97% were discharged home and 90.3% were in sinus rhythm upon discharge. For AFL, 93.8% were discharge home and 87.5% were in sinus rhythm upon discharge.

Overall, the rate of adverse events was 7.6% with 3.2% of the patients requiring admission. The most common adverse event was hypotension. There were no patients with stroke or death. Length of ED stay for AF and AFL were 4.8 hours and 6.3 hours, respectively.

This study is the largest report on aggressive management of ED strategies for recent onset AF or AFL. Given that the management of these patients is often variable, this demonstrated one safe, effective, and time saving protocol to follow for these patients. There were several limitations to this study including that it is a retrospective, observational, single site study. There is a large need for further clinical trials. However, this study is the largest study of its kind with a focus on safe, effective, rapid ED care.


While there exists a significant amount of literature comparing the efficacy of pharmacological versus electrical cardioversion, one major advantage of pharmacological cardioversion is that, unlike electrical, it does not require sedation or anesthesia. One of the agents that can be used for pharmacological cardioversion is ibutilide, a Class III antiarrhythmic which acts by activation of a slow, inward sodium current, thereby prolonging the action potential and increasing the refractory period of the myocardium. While it has been found to be safe in most instances, ibutilide has been shown to induce torsades de pointes in 1.7-4.3% of patients, though this risk is increased further in patients with heart failure and reduced left ventricular ejection fraction.

This study is a retrospective chart review which aims to assess the efficacy and safety of using ibutilide for cardioversion of AF or AFL in cancer patients, a subset of patients which usually have other comorbidities and may be taking other medications which have the potential for QT prolongation. All patients had EKGs and/or telemetry monitoring recorded before and after drug administration. Most patients had a baseline corrected QT interval on a 12-lead EKG or telemetry of <450 milliseconds. Ibutilide was initially administered at a dose of 1mg in 50mL of normal saline which was infused over 10 minutes. If the arrhythmia persisted 10 minutes after the end of the initial infusion, a second 10-minute infusion of ibutilide 1mg was given. Cardioversion was considered successful if conversion to NSR was accomplished during administration and up to four hours after the end of drug infusion. Maintenance of NSR at 24 hours was also recorded.

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Eighty-one patients who received ibutilide for cardioversion of AF or AFL over a four year period were included. Fifty-three (65%) of these patients had AF, while 11 patients (14%) had AFL, and 17 patients (21%) had AF/AFL. Only 5% of patients had left ventricular ejection fraction <50%, and 22% had history of coronary artery disease.

Successful cardioversion with intravenous ibutilide was achieved in 75% of patients and only five patients (6%) required a second dose of ibutilide after the initial infusion failed to convert to NSR. Sixty-eight (84%) of patients were taking at least one other medication with potential for QT prolongation. Although patients who were concomitantly taking amiodarone (47% of study population) were found to have a significant change (mean of 37 milliseconds) in QT interval after ibutilide administration, no adverse cardiovascular events occurred.

The authors conclude that ibutilide is a safe and effective agent for pharmacologic cardioversion of patients with AF and AFL. They address the potential risk for QT prolongation and torsades de pointes in patients who are given ibutilide while taking another medication that can prolong the QT interval. As nearly 50% of the study population was concomitantly taking amiodarone and suffered no adverse cardiovascular events, the authors infer that administration of ibutilide in these patients may be safe with proper monitoring of EKGs and serum electrolytes.

The two major limitations of this study are its retrospective design and small sample size. The latter casts doubt that the results are sufficiently powered to support the authors’ conclusions. In addition, there was no follow up to assess maintenance of NSR beyond 24 hours. Furthermore, only a very small percentage of the study population had left ventricular dysfunction with depressed ejection fraction. Therefore the study results cannot be applied to these patients who are at highest risk for arrhythmias.

Biecher GE, Stiell IG, Rowe BH, et al. Use of rate control medication before cardioversion of recent-onset atrial fibrillation or flutter in the emergency department is associated with reduced success rates. CJEM. 2012 May;14(3):169-77.

Recent-onset atrial fibrillation or flutter (RAFF) is a term that includes a patient’s initial episode of atrial fibrillation or atrial flutter or a recurrent persistent (or recurrent paroxysmal) AF/AFL when presenting within 48 hours of symptom onset. For unstable patients presenting with RAFF, cardioversion to sinus rhythm in the ED may be lifesaving, but it can also reduce the need for anticoagulants and associated complications, such as bleeding. Emergency physicians may choose to restore sinus rhythm through electrical or chemical cardioversion. However, standard treatment for this condition in the ED is not well defined; some believe that slowing ventricular rate before cardioversion or attempting medical cardioversion before electrical cardioversion increases benefit, but there is little evidence to support this.

In this study, researchers used univariate analysis on medical records reviewed from RAFF patients in eight Canadian EDs over a 12 month period (2008) to see which variables were associated with successful conversion to sinus rhythm. They included RAFF patients and patients with AF/AFL who had onset within seven days and were anticoagulated with an INR >2. They excluded patients with permanent AF/AFL and patients whose primary presentations were for other conditions (ie: ACS or PE). Six hundred thirty-four of the 1,068 patients who met criteria underwent cardioversion (428 electrical, 354 chemical and 148 underwent both). The researchers calculated that rate and rhythm controller medications were associated with a reduction in the success of a subsequent electrical cardioversion (OR 0.39 (95% CI 0.21-0.74) and 0.28 (95% CI 0.15-0.53) with p values both <0.001). However, the use of procainamide was associated with an increased success of chemical cardioversion (OR 2.32 (95% CI 1.43-3.74) with p value of 0.0002). Female sex was also significantly associated with successful cardioversion. Notably, only 37% of the chemical group converted, requiring 32.8% of patients in that chemical group to have subsequent electrical cardioversion.

The authors advise not attempting to slow ventricular response in RAFF before attempting cardioversion since these medications are associated with decreased success of subsequent electrical cardioversion. They argue that this extra step is also a waste of time and may lead to unnecessary complications (i.e., hypotension from medications). However, this was an observational study and thus can only provide associations between variables, not causal relationships. Also because this was not a randomized trial, it is possible to conclude that those who required both chemical and electrical interventions are in some way more resistant to conversion than those who only underwent one type of cardioversion. In addition, the results are difficult to interpret because the data for patients who received both types of cardioversion was used in the analysis of both electrical and chemical groups instead of being analyzed separately. Another drawback to this study is that it does not comment on clinical outcomes. For example, it would be interesting to know how many patients remain in sinus rhythm after each type of cardioversion; what percentage go on to have a thromboembolic event; how many relapse and return to the ED.

In summary, this study challenges the practice of initially treating RAFF with a rate controller medication. However, the type of data analyzed in this study limits us from drawing conclusions on how to change our clinical practice. Randomized clinical trials and studies that address clinically relevant outcomes still need to be performed.

Conclusion

Atrial fibrillation and atrial flutter are arrhythmias that are commonly encountered by the ED physician. While the management of unstable AF or AFL is unambiguous, there are several potential treatment modalities for stable but symptomatic AF or AFL.

Direct current cardioversion appears to be more effective than chemical cardioversion for patients with acute AF and AFL and carries a low risk for adverse effects. Ventricular rate control should ideally not be attempted prior to cardioversion, as this may be associated with a decreased rate of successful conversion to NSR.

Chemical cardioversion is advantageous over DCC in that it does not require procedural sedation. If this is preferred over DCC, procainamide, ibutilide or a class IC antiarrhythmic should be used. If chemical cardioversion is unsuccessful, use of DCC should be considered if there are no contraindications.
Additional References:


