Evidence-Based Medicine

IS EMERGENCY DEPARTMENT CARDIOVERSION OF RECENT-ONSET ATRIAL FIBRILLATION SAFE AND EFFECTIVE?

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Abstract—Background: Atrial fibrillation (AF) is a very common dysrhythmia presenting to Emergency Departments (EDs). Controversy exists regarding the optimal clinical therapy for these patients, which typically focuses on rhythm rate-control and admission or cardioversion and discharge home. Clinical Question: Is ED cardioversion of recent-onset atrial fibrillation safe, effective, and does it result in positive meaningful patient outcomes? Evidence Review: Five observation studies with nearly 1600 ED patients with atrial fibrillation treated with either rate-control or cardioversion were reviewed and results compiled. Results: Overall, ED cardioversion for recent-onset AF seems safe and effective, with success rates ranging from 85.5% to 97% in these studies. Although further research should seek to identify patients at low risk for thromboembolic complication, more rigorously assess patient satisfaction, and show cost savings, emergency physicians should feel comfortable using this approach in select patients. Conclusion: ED cardioversion for recent-onset AF seems safe and effective. © 2013 Elsevier Inc.

Keywords—atrial fibrillation; cardioversion; effectiveness; recent onset; Emergency Department

CASE REPORT

A 35-year-old woman presents to your Emergency Department (ED) with palpitations beginning 10 h prior. She has no significant past medical history and denies alcohol or illicit substance abuse. On review of systems, she notes no chest pain, syncope, shortness of breath, or neurologic symptoms. She is well appearing, in no distress, and has stable vital signs, with a blood pressure of 110/50 mm Hg and an irregular heart rate of 135 beats/min. She is breathing comfortably with no rales on pulmonary auscultation. The electrocardiogram (ECG) demonstrates atrial fibrillation (AF), which was not present on the only other ECG that you can find, which was from 5 years ago; there are no ST-segment changes and no T-wave inversions. You consider your treatment options; your standard practice in patients with new-onset AF is to control the ventricular rate, initiate anticoagulation, and admit to the cardiology service. However, because the patient is young and healthy, with a recent onset of symptoms, you consider the possibility of cardioversion, either chemical or electrical, which would allow for much earlier discharge home directly from the ED. Do you become an “early adopter,” or do you reflexively admit this patient to “work-up” her new-onset AF, justifying your plan by telling the patient that she needs to be monitored for worsening AF or hypotension while awaiting an inpatient echocardiogram and serial cardiac enzymes? How comfortable are you with the data and do you want to be “the early adopter”?
CLINICAL QUESTION

In patients presenting to the ED with recent-onset AF or atrial flutter (defined as onset < 48 h before presentation), is there a subset of patients for whom ED cardioversion followed by discharge home is safe, cost-effective, and results in improved patient satisfaction?

CONTEXT

AF is a common cardiac dysrhythmia in the United States (US), with an estimated prevalence of 1.1% in patients presenting to the ED (1). There were an estimated 2.7 million US ED visits for AF between 1993 and 2004, with an increase in visit rate from 0.6 to 1.2 per 1000 US population over this time period; 64% of these visits resulted in hospital admission, with an average cost of $8412 per hospitalization (2,3). In one study, 21% of patients presenting to the ED had recent-onset AF, defined as symptom onset < 48 h before presentation (4).

There has been research into the optimal management of chronic AF and atrial flutter, with the debate between rate control and rhythm control still unresolved (5–7). Although some studies of chronic AF suggest that rate control strategies are more cost-effective than rhythm control strategies, there has been far less research into the management of recent-onset AF (8,9). Current management in the US often involves rate control with anticoagulation and hospital admission, allowing echocardiography to be performed before elective cardioversion to assess for atrial thrombus.

An ED management algorithm incorporating early electrical cardioversion of patients with recent-onset AF may be safe and effective (10,11). Although this method may not be current standard of care in the US, the potential economic impact cannot be ignored. Primary concerns among US emergency physicians are likely to include the risks of the procedural sedation, the electrical cardioversion itself, and subsequent risk of thromboembolic (TE) events in patients discharged without anticoagulation. Although emergency physicians are acquainted with the safety of procedural sedation, and the safety of electrical cardioversion in AF has been well established, TE risk remains a primary concern.

Chronic AF, defined as dysrhythmia lasting at least 7 days, is known to cause a significant increase in the risk of TE events, with a risk of 1–7% observed in patients undergoing electrical cardioversion in the absence of anticoagulation (12–15). Systematic reviews of the literature have shown no increased risk of stroke in patients undergoing pharmacologic rhythm control versus rate control, but a statistically non-significant trend towards increased stroke in patients undergoing electrical cardioversion (16,17). However, recent evidence suggests that in patients with < 48 h of symptoms before conversion to sinus rhythm, the risk is as low as 0.8% (18). This small study suggests that electrical cardioversion of ED patients with recent-onset AF may be safe, with a low risk of adverse outcomes.

One barrier often encountered is concern over the accuracy of the estimated time of onset of AF. Although it is known that patients with AF may be asymptomatic, there is no evidence that patients presenting to the ED with symptoms related to AF are unreliable in estimating the time of onset of the dysrhythmia (19–21). This often-propagated myth may underlie much of the resistance to early cardioversion in the US.

The question then remains whether ED cardioversion of recent-onset AF is safe and effective, and whether such a management strategy will provide any benefit. Potential benefits include decreased length of stay, decreased cost, and improved patient and physician satisfaction. In addition to TE complications, risk of recurrent AF requiring subsequent ED visits must be addressed.

EVIDENCE SEARCH

A PubMed search was performed using the combined keywords “atrial fibrillation,” “emergency department,” and “cardioversion.” This search yielded 124 citations. These were reviewed along with the bibliographies of relevant articles. A search was performed of the Cochrane Database of Systematic Reviews using the same strategy, which yielded no relevant reviews. Articles were excluded that compared different cardioversion strategies or pharmacologic agents, or included patients without recent-onset AF. Five articles were selected for review specific to the topic of ED cardioversion for recent-onset AF.

EVIDENCE REVIEW

Thirty-day Outcomes of Emergency Department Patients Undergoing Electrical Cardioversion for Atrial Fibrillation or Flutter, 2010 (22)

Population. Subjects included consecutive eligible patients presenting to St. Paul’s Hospital and Mt. St. Joseph’s Hospital in Vancouver, BC, Canada between January 1, 2000 and September 30, 2007 undergoing direct-current cardioversion (DCCV) for AF or flutter. A total of 1830 ED encounters were identified for AF or flutter, with 409 undergoing DCCV. Of these, 150 random charts were reviewed for detailed descriptive analysis, with nine of these encounters excluded from the final analysis. The mean age of the remaining 141 encounters was 57 ± 14 years. There were 400 total remaining...
encounters: 342 cases of AF (85.5%) and 58 cases of atrial flutter (14.5%). All patients either had symptoms < 48 h or were therapeutically anti-coagulated with warfarin.

**Study design.** This was a non-industry-sponsored, retrospective, two-center cohort study. The two hospitals’ ED databases were queried and patient visits were identified by a diagnosis of “AF” or “atrial flutter,” with DCCV listed under the “procedures” category of the ED chart; visits were excluded if the patient had been enrolled in the previous 30 days. A regional database was queried to identify repeat visits to any ED within 30 days of the index visit. In addition, the British Columbia Vital Statistics database was cross-referenced to identify any patients who died within 30 days of the index visit. Of the 409 visits identified, 150 were randomly selected for detailed chart review by two trained reviewers who were blinded to patient outcomes. CHADS2 scores were calculated based on the data obtained. Immediate complications were defined as: hypotension requiring intravenous fluids or vasoactive agents; respiratory compromise requiring bag-valve mask ventilation, oral airway, non-invasive positive pressure ventilation, or intubation; new dysrhythmia requiring pharmacologic intervention; allergic reaction, emesis, or nausea requiring medication administration; stroke or other TE event; unplanned hospital admission; and death. Electrical cardioversion was considered successful if normal sinus rhythm was restored within three attempts at cardioversion.

**Primary outcome.** Immediate outcomes included failure of electrical cardioversion or immediate complication. Thirty-day outcomes included repeat ED visit, DCCV on repeat visit, hospital admission on repeat visit, stroke, other TE event, and death.

**Exclusion criteria.** Patients were excluded if they were found to have an underlying medical etiology for their atrial dysrhythmia, required immediate cardioversion due to medical instability, had a terminal illness, or were non-residents of British Columbia.

**Main results.** For the data abstracted, inter-observer agreement was calculated ($\kappa = 0.65$ for duration of AF, $\kappa = 1.0$ for warfarin use, prior atrial dysrhythmias, and adverse events). CHADS2 scores were as follows: 0 in 75 (61%) patients, 1 in 46 (37%) patients, and > 1 in 3 (2%) patients. There were five (3%) DCCV failures, with no correlation to age or comorbidities. The only immediate complications involved 6 patients (4.3%, 95% confidence interval [CI] 0.9–7.6%) with transient respiratory depression from procedural sedation. Evaluation of 30-day outcomes revealed 22 patients (5.5%) with ED visits potentially related to the index visit, 6 patients (1.5%) requiring repeat DCCV, and 2 patients (0.5%) requiring admission. No patients suffered stroke, TE event, or death in the 30 days after the index visit (0%, 95% CI 0.0–0.8%).

**Electrical Cardioversion of Emergency Department Patients with Atrial Fibrillation, 2004 (23)**

**Population.** The study included a consecutive cohort of ED patients with clinically stable AF undergoing electrical cardioversion at one of four hospitals during a 42-month period from October 1998 to March 2002. The study was conducted at three suburban community hospitals, which are members of a large group-model health maintenance organization, and one urban tertiary-care hospital. There were 395 electrical cardioversion attempts obtained from a total of 3686 ED AF visits; five of these encounters were excluded due to incomplete records, and two encounters involved unstable AF. The remaining 388 encounters comprised the final study cohort (mean age 61 ± 13 years, range 20–93 years). In 381 (99%) cases, the duration of AF symptoms was < 48 h; in two (1%) cases the duration was > 48 h with therapeutic anticoagulation; duration was not documented in five (1%) cases. For comparative analysis, an additional cohort of patients was selected from the Maine Medical Center in Portland comprising patients with AF who underwent either attempted ED chemical cardioversion (30 patients, mean age 68 ± 16 years) or no attempt at electrical or chemical cardioversion (266 patients, mean age 68 ± 16 years).

**Study design.** This was a non-industry-sponsored, retrospective, four-center cohort study. Patients were identified by a query of the hospital databases at each institution via billing and discharge records. Separate queries of ED quality review records identified patients undergoing procedural sedation and analgesia for electrical cardioversion. These two groups were combined for each study site, resulting in the final study cohort. A standardized data collection instrument was designed and data were collected from the medical records by one of three independent trained personnel. A sample of 50 charts was used to evaluate inter-rater reliability. Each study site was queried for return ED visits within 7 days of the index visit. Care provided during each visit was at the discretion of the treating physician and the patient, with no protocols or pathways employed. Success of chemical or electrical cardioversion was defined as restoration of sinus rhythm sustained to ED discharge. Rate control success was defined as achieving a sustained pulse rate ≤ 120 beats/min within 1 h of medication administration. Adverse events were predefined as vital sign...
changes (pulse rate < 50 beats/min, systolic blood pressure < 90 mm Hg, oxygen saturation < 90%, apnea), acute allergic reactions, nausea, emesis, cardiac dysrhythmia other than AF, and changes in physical examination or assessment consistent with a TE event.

**Primary outcome.** Immediate outcomes included success of cardioversion or rate control, complications related to cardioversion or rate control, and complications related to procedural sedation and analgesia. Delayed outcomes included unscheduled and scheduled return ED visits within 7 days of the index visit and complications related to cardioversion or rate control, complications related to procedural sedation and analgesia, Delayed outcomes included unscheduled and scheduled return ED visits within 7 days of the index visit and complications related to such visits.

**Exclusion criteria.** Patients were excluded if they required emergent electrical cardioversion for clinically unstable AF, defined by the presence of ischemic chest pain, shortness of breath, decreased level of consciousness, hypotension, pulmonary congestion, congestive heart failure, or acute myocardial infarction.

**Main results.** Inter-rater reliability was found to be excellent for five outcome measures (previous episodes of AF, cardioversion success, patient disposition, procedural sedation agent used, and cardioversion complications) with κ values ranging from 0.739 to 1.0. Restoration of sinus rhythm was achieved in 332 (86%) cases, compared to 5 (17%) of 30 cases in the chemical cardioversion group and 44 (17%) of 266 cases with no chemical or electrical cardioversion. Before attempted electrical cardioversion among the study cohort, 142 (37%) underwent rate control interventions (112 meeting criteria for success) and 111 (29%) underwent attempted chemical cardioversion, with similar success rates between patients who underwent attempted rate control (87%), successful rate control (88%), and attempted chemical cardioversion (90%). A slightly lower success rate was seen in cases involving unsuccessful rate control (83%). There were 22 complications related to procedural sedation and analgesia, of which only one resulted in admission for observation. Return ED visits occurred in 39 (10%) patients. Twenty-five patients returned for recurrent AF. No TE complications were observed.

**Managing Emergency Department Patients with Recent-onset Atrial Fibrillation, 2012 (24)**

**Population.** Patients were a convenience sample of ED patients with AF or atrial flutter presenting with < 48 h of symptoms to one of 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 with atrial flutter (7.3%). The mean age was 64 ± 14.4 years (range 21–96 years), and 83 (40.3%) were women. Chemical or electrical cardioversion was attempted in 115 (56.3%) patients.

**Study design.** This was a non-industry-sponsored, prospective, three-center cohort study. ED patients with suspected AF or flutter were identified by triage nurses or treating physicians, and patients were enrolled based on the presence of AF or flutter on the initial ECG and a well-defined onset of rhythm-related symptoms < 48 h before evaluation. Patients were then managed at the discretion of the treating physician with no protocol or treatment pathway in place. Demographic features, baseline characteristics, management variables, and adverse events were recorded prospectively by the treating physician. Two methods were used to collect 30-day follow-up information: the electronic medical records of the Health Plan in Northern California (comprising 18 hospitals) were reviewed for all study subjects, and at least three attempts were made to contact each patient (or a surrogate) for telephone interview at least 45 days after the index visit.

**Primary outcome.** No primary outcomes were identified. Immediate outcomes included successful cardioversion or ventricular rate reduction, vomiting, hypotension, dysrhythmia, and respiratory compromise. Thirty-day outcomes included TE events and death. Recurrent AF and return visits to the ED were not reported.

**Exclusion criteria.** Exclusion criteria included imprecise time of onset of symptoms, uncertainty about whether presenting symptoms were rhythm related, and inability to confirm AF or flutter by ECG.

**Main results.** Rate reduction was attempted in 109 patients and was successful in 79 (72.4%). Spontaneous conversion occurred in 59 patients. 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%), and DCCV was attempted in 83 patients and was successful in 80 (96%). Sixteen patients were managed with home observation, and 11 (68.8%) spontaneously converted to sinus rhythm by their follow-up visit; for the 5 patients who remained in AF, one was successfully treated with electrical cardioversion, one was admitted for rate and symptom control, and 3 were discharged on warfarin. There were 15 patients in whom cardioversion was felt to be contraindicated. Overall, 183 (88.8%) patients in the study were discharged home from the ED. There were 6 (2.9%, 95% CI 1.1–6.2%) adverse events in the ED: vomiting (n = 1), hypotension (n = 2), hypoventilation (n = 1), and ventricular tachycardia secondary to DCCV.
1. Assessment
   - Stable without ischemia, hypotension or acute CHF?
   - Onset clear and less than 48 hours?
   - Severity of symptoms?
   - Previous episodes and treatments?
   - Anticoagulated with warfarin and INR therapeutic?
2. Rate control
   - If highly symptomatic or not planning to convert
   - Diltiazem IV (0.25 mg/kg over 10 min; repeat at 0.35 mg/kg)
   - Metoprolol IV (5 mg doses every 15 min)
3. Pharmacologic cardioversion
   - Procainamide IV (1 g IV over 60 min; hold if blood pressure < 100 mm Hg)
4. Electrical cardioversion
   - Consider keeping patient NPO °— 6 h
   - Procedural sedation and analgesia given by emergency physician (propofol IV and fentanyl IV)
   - Start at 150–200 J biphasic synchronized*
   - Use anterior–posterior pads, especially if not responding
5. Anticoagulation
   - Usually no heparin or warfarin for most patients if onset clearly < 48 h or if therapeutic INR for > 3 weeks
6. Disposition
   - Home within 1 h after cardioversion
   - Usually no antidyssrhythmic prophylaxis or anticoagulation given
   - Arrange outpatient echocardiography if first episode
   - Cardiology follow-up if first episode or frequent episodes
7. Patients not treated with cardioversion
   - Achieve rate control with diltiazem IV (target heart rate < 100 beats/min)
   - Discharge home on diltiazem (or metoprolol)
   - Discharge home on warfarin and arrange INR monitoring
   - Arrange outpatient echocardiography
   - Follow-up with cardiology at 4 weeks for elective cardioversion
8. Recommended additions to protocol
   - Consider transesophageal echocardiography if onset unclear
   - Alternate rhythm-control drugs: propafenone, vernakalant, amiodarone
   - If TEE-guided cardioversion > 48 h, start warfarin
   - If CHADS2 score ≥ 1, consider warfarin and arrange early follow-up

Association of the Ottawa Aggressive Protocol with
Rapid Discharge of Emergency Department Patients
with Recent Onset of Atrial Fibrillation or Flutter, 2010 (25)

Population. The study involved a consecutive cohort of
patients presenting to Ottawa Hospital Civic Campus
from January 1, 2000 to June 30, 2005 with recent-
onset AF or flutter where ED cardioversion was attemp-
ted. Repeat visits were included if they occurred more
than 7 days from the prior visit. There were 1057 ED
visits for recent-onset AF, of which 660 visits (341 pa-
tients) involved ED cardioversion. Mean age was
64.5 years (range 19–92 years), and 55.6% were men.
There were 628 (95.2%) patients with AF and 32
(4.8%) with atrial flutter.

Study design. This was a non-industry-sponsored retro-
spective cohort study. Patients were identified from the
Ottawa Hospital health records database based on the di-
agnosis of AF or flutter combined with procedure codes
for electrical cardioversion or anti-dysrhythmic intrave-
nous therapy. Two trained research nurses, unaware of
(n = 2). Only two of these events led to admission for ob-
servation. Four of these events were associated with
DCCV attempts (4/115; 2.6%). Of the 206 patients, 204
(99%) were successfully contacted for follow-up. There
were 2 (1.0%; 95% CI 0.1–3.5%) TE events, both involv-
ing cerebrovascular accident, and both within 48 h of the
index ED visit. Only one of these occurred in the ED car-
dioversion group, the other in the contraindicated group.
There were no reported deaths.
the study objectives, performed data abstraction using a standardized data collection form consisting of 30 variables. Adverse events occurring within 7 days of the initial visit were obtained from the chart review. Patients were treated according to the Ottawa Aggressive Protocol (Figure 1), considered standard of care at Ottawa Hospital.

**Primary outcome.** Primary outcomes included proportion converted to sinus rhythm, length of stay, adverse events, and final disposition. Immediate adverse events included hypotension or dysrhythmia, and 7-day adverse events included stroke, death, or relapse to AF or flutter.

**Exclusion criteria.** Patients were excluded for chronic AF if time of onset was > 48 h or was unknown (unless the patient was therapeutically anti-coagulated with warfarin for at least 3 weeks), or if they had another primary diagnosis requiring admission.

**Main results.** Out of 660 visits, 261 (39.6%) received rate control medications, 660 (100%) underwent attempted chemical cardioversion with intravenous procainamide, and 243 (36.8%) underwent attempted electrical cardioversion. Chemical cardioversion was successful in 385 (58.3%) attempts, with success in 376 (59.9%) patients with AF and 9 (28.1%) with atrial flutter. Electrical cardioversion was successful in 223 (91.8%) attempts, including 203 (91%) patients with AF and 20 (100%) with atrial flutter. A total of 639 (96.8%) patients were discharged home: 609 (97%) presented with AF and 30 (93.8%) with atrial flutter. Of these, 595 (90.2%) were in sinus rhythm: 567 (90.3%) in the AF group and 28 (87.5%) in the atrial flutter group. Adverse events occurred in the ED in 50 (7.6%) patients, with 44 (6.7%) of these cases involving transient hypotension; additional adverse events included bradycardia (n = 2), atrioventricular block (n = 2), ventricular tachydysrhythmia (n = 1), and atrial tachydysrhythmia (n = 1). None of these events was attributed to procedural sedation or electrical cardioversion. Average length of stay in discharged patients was 4.9 h overall, 4.8 h in the AF group, and 6.3 h in the atrial flutter group. There were 57 (8.6%) cases of recurrent AF or flutter requiring repeat ED visit within 7 days, and no cases of stroke or death were identified.

**Synchronized Emergency Department Cardioversion of Atrial Dysrhythmias Saves Time, Money, and Resources, 2005 (26)**

**Population.** The study utilized a convenience sample of patients enrolled prospectively at St. Luke’s Hospital in Bethlehem, PA, a community teaching hospital with an annual census of 50,000. Twenty-four patients (30 ED visits) were enrolled with recent-onset AF or flutter of < 48 h duration, or of uncertain onset in patients therapeutically anti-coagulated with warfarin (international normalized ratio > 2). A control group of 30 patients was retrospectively identified. Mean age in the two groups was 62.7 years in both groups. Males comprised 63% of the cardioversion group and 53% of the control group. The groups were similar with respect to vital signs, presenting symptoms, and presenting rhythm.

**Study design.** Patients were enrolled at the discretion of the treating physician, after being made aware of the option to undergo ED cardioversion or rate control and admission. Evaluation and treatment were performed at the discretion of the treating physician, with no protocol or pathway in place. The control group was obtained by systematic sampling from a list of 288 patients discharged from the hospital with a primary diagnosis of AF. To be included, each chart had to clearly identify a time of onset of symptoms < 48 h with no other indication for admission. A single investigator used the same data sheet as for the prospectively enrolled subjects to abstract data on the control group. Hospital charges were obtained for all patients from the hospital billing office; physician charges were not included in these data. Complications were assessed by chart review and telephone follow-up.

**Exclusion criteria.** Patients were excluded if the duration of symptoms was > 48 h without therapeutic anticoagulation.

**Primary outcomes.** Measured outcomes included proportion of patients successfully cardioverted, hospital length of stay (LOS), hospital charges, patient satisfaction, and TE complications.

**Main results.** ED electrical cardioversion was successful in 29 (97%) of 30 cases. In 28 cases where number of shocks was recorded, 21 (75%) cases required only one. Six patients were admitted, including the one failed cardioversion. The mean hospital LOS for the ED cardioversion group, including those admitted, was 22.8 h (95% CI 1.7–44.0); this was significantly less than the mean LOS for the control group of 55.6 h (95% CI 41.6–69.6); p < 0.001. Excluding one outlier who was admitted for 12 days and required a mitral valve replacement, the mean LOS was 11.6 h in the cardioversion group. There was no statistically significant difference in mean hospital charge between the cardioversion group, $4841 (95% CI 0–$10,347), and the control group, $4846 (95% CI $3790–$5901); p > 0.999. There was, however, a statistically significant difference in median hospital charge for the cardioversion group ($1598) and control group ($4271); p = 0.001. Excluding the aforementioned
outlier, the mean hospital charge in the cardioversion group was $2194, less than half that in the control group. Telephone follow-up occurred in 100% of patients over a range of 9 days to 50 weeks after the ED visit. There were no reported TE complications. Only one patient expressed dissatisfaction with the ED cardioversion.

CONCLUSION

Although no guidelines currently exist in the US dealing with ED management of AF in the ED, the 2010 guidelines from the Canadian Cardiovascular Society recognize ED cardioversion for recent-onset AF as a safe alternative to rate control (27). The current studies seek to address the safety of this management strategy, but suffer from limitations that may make acceptance difficult.

The included observational studies relied on clinician judgment for patient selection and offer no guidelines to determine which subgroups of patients are at low risk for complications. Before widespread implementation, further research will be needed to help identify specific patients in whom ED cardioversion is safe. The CHADS2 score, derived by Gage et al., has been used to assess stroke risk in patients with chronic AF (28,29). However, no clinical prediction rules have been derived or validated in ED patients to assess risk of TE events. Consideration should be given to validating the CHADS2 score in ED patients, specifically those with recent-onset AF.

Of the 1593 total cases involving ED cardioversion in these studies, only one (0.06%) TE complication was reported, involving a stroke. This low TE complication rate suggests that ED cardioversion for recent-onset AF is safe. Pooled estimates have shown that 98% of TE events occur within 10 days of cardioversion, mandating follow-up within at least that timeframe (30). Whereas two of the
larger studies limited follow-up to 7 days, and observed no TE complications, the one observed stroke occurred within 48 h of the index visit (23–25). Unfortunately, none of the studies compared the incidence of complications to a control group of patients receiving alternative management strategies.

Although it would seem likely that rapid cardioversion and discharge would result in significant monetary savings, the only study to address the potential cost benefit showed no cost difference (26). This was likely due to the presence of an outlier, whose hospital charge of $81,633 skewed the results; excluding the outlier, a substantial difference in mean hospital charge was observed between the cardioversion and control groups ($2194 vs. $4846). Additionally, no power analysis was performed a priori or post hoc for the primary outcome of cost. Assuming a sample size of 30 and a standard deviation of $6000, for a cost difference of $1000 the study would have a power of 0.1; in other words, such a study would have a 10% probability of rejecting the hypothesis that there was no cost difference (31,32). Some have called into question the ethics of underpowered studies (33,34). Future studies with a priori power analyses should be undertaken with adequate size to demonstrate the potential cost savings of this regimen (35).

This article was also the only one to address patient satisfaction. Only one of the 24 subjects expressed dissatisfaction. However, they do not report the methodology of this conclusion, nor do they mention the use of a validated patient satisfaction survey (36,37). Further studies may wish to address standardized satisfaction scores and compare these to a control group receiving alternative management (Figure 2).

An additional barrier to implementation will be access to timely outpatient follow-up. In the US, 41.8% of ED visits involve patients with Medicare or Medicaid, and 17.7% involve the uninsured (38). In one study, patients with Medicaid and those with no insurance were, respectively, 30.2% and 39.3% less likely to be able to obtain follow-up appointments than patients with private insurance (39). Many emergency physicians may feel uncomfortable with rapid cardioversion and discharge given these barriers to care.

Overall, ED cardioversion for recent-onset AF seems safe and effective, with success rates ranging from 85.5% to 97% in these studies. Although further research should seek to identify patients at low risk for TE complication, more rigorously assess patient satisfaction, and show cost savings, ED physicians should feel comfortable using this approach in select patients. Barriers to follow-up may need to be addressed in most US institutions before widespread acceptance can occur.

**COMMENTARY BY DONALD M. YEALY, MD**

The authors provide an excellent and realistic ED case coupled with a solid evidence review; the question is “Why is this – this being early conversion of selected and clearly new-onset atrial fibrillation when first seen – a question?” The query underscores two fundamental truths in physician decision-making and behavior change: we fear “bad outcomes” and over-estimate the risk of their occurrence, and we demand much more evidence to change an ingrained behavior than we required to embrace that behavior. Our fear of bad outcomes may be driven by fable, teaching drawn from different populations (more entrenched atrial fibrillation or with structural heart disease), or the natural fear of the unknown. Our non-Emergency Medicine partners may encourage fear for the same and economic reasons – that is, the ability to “do more” in their areas of care. This is understandable but not relevant or helpful for our patients.

In the ED, we seek first to identify the life- and limb-threatening illness, then those that could impair functioning, and finally those that are common and treatable. New-onset atrial fibrillation has elements of all of these, though the elegant data analysis shows that fears of acute events in the short term are likely disproportionate to the reality. Once this dysrhythmia occurs, the risk of stroke or death is elevated compared to those similar but without atrial fibrillation; return to normal rhythms can mitigate that risk. However, the change in risk between ED conversion and “someone else’s conversion, later” is very small – permitting a leisurely approach. That leisurely approach comes at a cost – in financial terms (need for more health care visits and longer therapy) and in humanistic terms (prolonged anxiety, concern for the rhythm symptoms even if minor, and a general aggravation surrounding those new visits required to resolve the issue.)

These data from varied sources show that carefully selected patients, treated with a clear ED protocol (with electrical conversion more effective than chemical, though both potential options), can and should be offered the option of ED cardioversion followed by appropriate follow-up. Although death and non-fatal outcomes differences will not likely vary much between groups that offer or avoid ED cardioversion, we can offer a return to (more) health with a trimmed set of costs. The key is carefully constructing these pathways, engaging other concerned physicians and getting cooperation, explaining the steps in simple terms, and closely monitoring ED and follow-up performance for safety and other care opportunities. As emergency physicians, we have the unique skill and knowledge set to complete the task at hand safely – simply put, we deliver “one stop shopping.”
One residual question is defining the upper limit of duration that signifies “new onset”; clearly, 48 h or less fits that category, and 2 weeks does not. A needed next step in a large cohort is seeing where the change in complication or failure rate begins to jump — is it 72 h, 5 days, or some other time point? Can it be defined as a dichotomous event, or perhaps another tailored approach is needed? I hope others will seek the funding and create the structure to hone our knowledge in this important area.

Equally important is not conflating this selected ED atrial fibrillation approach to other forms of atrial fibrillation management. We know that a desire to restore or maintain sinus rhythm in all patients with atrial fibrillation doesn’t universally improve health or outcomes, and that the path to attempting that can cause harm. The circumstances described in this case and evidence review exclude that topic; however, it is easy to mix the risks of one with the other.

If uncertain about atrial fibrillation duration, considering alternative strategies — although not discussed in this piece, a streamlined search for existing clot and assessment of cardiac structure followed by a similar cardioversion attempt if risks are absent — in an observation setting or analogous rapid care venue — makes similar sense. Once again, emergency physicians sit in a strong position to lead these changes and pathway creation, joining our other partners to optimize — not maximize — care. Our strength is seeing through the clutter, deploying our pragmatic and patient-centered skills to deliver effective care. The traditional “get rate control, admit to an inpatient unit, and move on” approach is best reserved for the remainder of those in the ED with atrial fibrillation.

As health care focuses more on value and quality, these steps will become more important in the ED and for all health care systems. The embrace of this particular option — ED-based atrial fibrillation conversion for those with new onset and no complicating features — is a small step but a model for that impending change. Our Canadian and European Emergency Medicine partners have already begun this transformation; it is time for us in the US to follow.

REFERENCES


ARTICLE SUMMARY

1. Why is this topic important?
   Atrial fibrillation (AF) is one of the most common dysrhythmias seen by emergency physicians.

2. What is the clinical question?
   Is Emergency Department (ED) cardioversion of recent-onset AF safe, effective, and does it provide the patient a meaningful benefit?

3. Search strategy
   PubMed search as well as a search of the Cochrane Database of Systematic Reviews using combined keywords of “atrial fibrillation,” “emergency department,” and “cardioversion.”

4. Citations appraised
   Thirty-day Outcomes of Emergency Department Patients Undergoing Electrical Cardioversion for Atrial Fibrillation or Flutter (22)
   Electrical Cardioversion of Emergency Department Patients with Atrial Fibrillation (23)
   Managing Emergency Department Patients with Recent-Onset Atrial Fibrillation (24)
   Association of the Ottawa Aggressive Protocol with Rapid Discharge of Emergency Department Patients with Recent-onset Atrial Fibrillation or Flutter (25)
   Synchronized Emergency Department Cardioversion of Atrial Dysrhythmias Saves Time, Money, and Resources (26)

5. Are the results valid?
   Yes – for new-onset AF with no complicating features.

6. What are the results?
   Overall, ED cardioversion for recent-onset AF seems safe and effective with success rates ranging from 85.5% to 97%.

7. Can I apply the results to my practice?
   Yes.