

# Determinants of successful direct current cardioversion for atrial fibrillation and flutter: the importance of rapid referral

ANDREW R HOUGHTON

ANDREW SHARMAN

J E F POHL

## SUMMARY

*Direct current (DC) cardioversion is an effective means of restoring sinus rhythm in patients with atrial fibrillation or flutter; however, the existing literature contains conflicting evidence on which factors are useful predictors of success. In a study of 171 patients undergoing DC cardioversion, we found that duration of arrhythmia prior to DC cardioversion was the only significant predictor of both successful cardioversion and subsequent maintenance of sinus rhythm ( $P < 0.001$ ). Rapid DC cardioversion after the onset of atrial fibrillation or flutter significantly increases the likelihood of a successful outcome in both the short-term and long-term.*

**Keywords:** DC cardioversion; atrial fibrillation; arrhythmia.

## Introduction

Atrial fibrillation is the most common sustained cardiac arrhythmia<sup>1</sup> and is associated with troublesome symptoms and a mortality rate almost double that in matched controls.<sup>2</sup> In addition, atrial fibrillation is responsible for 23.5% of strokes in those aged 80 to 89 years.<sup>1</sup> Restoration of sinus rhythm is associated with improvements in exercise capacity, haemodynamic parameters, and atrial size. Despite the benefits there is reluctance to use direct current (DC) cardioversion in the management of this condition.<sup>3</sup> This may in part be owing to a perception that in certain patients, such as the elderly or those with enlarged atria, cardioversion is likely to be futile. The existing literature on predictors of a successful outcome with cardioversion is somewhat inconsistent. To clarify the existing literature, we undertook the present study to investigate the value of several variables in predicting the outcome of cardioversion.

## Method

Using the hospital coding database, we identified patients who had undergone DC cardioversion between January 1996 and December 1998 and examined their casenotes for clinical data and information about the outcome of their cardioversion. Sustained atrial fibrillation or flutter was defined as patients who had repeatedly been documented to have arrhythmia on consecutive occasions prior to cardioversion. Onset of arrhythmia was taken as the first documented time of onset of this episode of

arrhythmia by a medical practitioner (where patients were asymptomatic) or the first onset of symptoms (where patients were symptomatic). Successful cardioversion was defined as the restoration of sinus rhythm for at least one hour. Descriptive data are shown as median values and interquartile ranges (IQR). Non-parametric tests were used throughout. Between-group comparisons were made using the Mann-Whitney U-test or the chi-squared test.

## Results

Two hundred and thirty-three patients underwent DC cardioversion and 232 sets of casenotes were available for review. We excluded 22 patients cardioverted for ventricular arrhythmias, 17 for paroxysmal atrial fibrillation, five for re-entry tachycardias, and 17 who had undergone previous cardioversions. This left 171 patients who had undergone their first cardioversion for sustained atrial fibrillation or flutter during the period in question. Table 1 shows their characteristics. There was a documented history of hypertension in 93 (54%) patients, coronary artery disease in 47 (27%), alcohol abuse in 7 (4%), valvular disease in 20 (12%), and thyrotoxicosis in 1 (1%).

DC cardioversion restored sinus rhythm in 115 (67%) patients. During follow-up, atrial fibrillation or flutter recurred in 77 (45%) patients. Thus, the long-term success rate of a single cardioversion (i.e. those patients who remained in sinus rhythm throughout the whole of their subsequent follow-up) was 38 out of 171 patients (22%) with a median follow-up of 36 weeks.

Patients successfully cardioverted had been in atrial fibrillation or flutter for a significantly shorter period of time than patients whose cardioversion was unsuccessful (median = 18 [IQR = 4 to 37] weeks versus median = 30 [IQR = 19 to 66] weeks,  $P < 0.001$ ). Figure 1 shows the proportion of patients successfully cardioverted to sinus rhythm according to the duration of their arrhythmia. Of the 52 patients in whom cardioversion was attempted within three months of arrhythmia onset, sinus rhythm was restored in 48 (92%). Beyond three months, sinus rhythm was restored in 67 out of 119 (56%) patients ( $P < 0.001$ ).

Duration of arrhythmia also influenced the likelihood of relapse. Of the 115 patients for whom cardioversion was initially successful, those who remained in sinus rhythm had a shorter median duration of prior arrhythmia than those who relapsed (median = 4 [IQR = 0 to 22] weeks versus median = 23 [IQR = 12 to 48] weeks,  $P < 0.001$ ). Of the 48 patients successfully cardioverted within three months of the onset of the arrhythmia, sinus rhythm was maintained in 22 (46%). For patients successfully cardioverted more than three months after the onset of the arrhythmia, sinus rhythm was maintained in 16 out of 67 (24%).

Age did not predict successful cardioversion nor subsequent relapse. The median age of patients successfully cardioverted was 67 (IQR = 62 to 75) years, compared with a median of 71 (IQR = 62 to 77) years in those whose cardioversions failed ( $P = 0.11$ ). The sex of the patient was also not a predictive factor. Cardioversion was initially successful in 72 out of 107 (67%) male patients and in 43 out of 64 (67%) female patients ( $P = 0.88$ ). Left atrial size did not influence the likelihood of success

AR Houghton, MA, MRCP, specialist registrar; A Sharman, MB BS, senior house officer; and JEF Pohl, FRCP, senior lecturer, Department of Cardiology, Leicester General Hospital.  
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**Table 1.** Characteristics of patients with atrial fibrillation or flutter ( $n = 171$ ).

Characteristic	
Demographic and clinical factors	
Median (IQR) age in years	70 (62–76)
Gender ratio (male:female)	107:64
Number of patients in atrial fibrillation (%)	150 (88)
Median (IQR) duration of arrhythmia in weeks	24 (11–42)
Median (IQR) duration of follow-up in weeks	36 (17–74)
Numbers (%) of patients taking drugs prior to cardioversion	
Digoxin	85 (50)
b-blockers	39 (23)
Calcium channel blockers	42 (25)
Amiodarone	33 (19)
Flecainide	6 (4)
Echocardiographic findings ( $n = 146$ )	
Median (IQR) left atrial size in centimetres	4.4 (4.0–4.8)
Number of patients with left ventricular dysfunction (%)	56 (38)

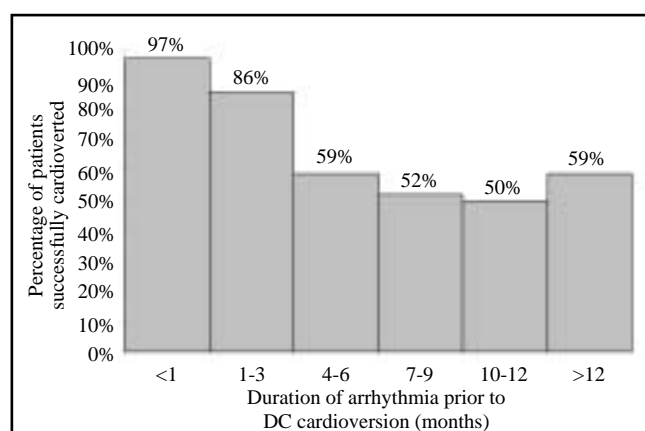


Figure 1. Percentage of patients successfully cardioverted according to the duration of their arrhythmia.

or relapse. A background of coronary artery disease, hypertension, valvular disease or left ventricular dysfunction did not predict the initial or long-term outcome of cardioversion. None of the antiarrhythmic drugs taken by our study population (digoxin,  $\beta$ -blockers, calcium channel blockers, amiodarone or flecainide) was associated with a greater or lesser likelihood of success for cardioversion.

## Discussion

We have found that duration of arrhythmia is the only factor that predicts the initial and long-term outcome of DC cardioversion for atrial fibrillation or flutter. This is not the first time that this relationship has been demonstrated. Van Gelder *et al* studied 246 patients with atrial fibrillation or flutter and found that arrhythmia duration significantly influenced cardioversion rate.<sup>4</sup> Brodsky *et al* found that atrial fibrillation duration of less than one year was associated with the successful maintenance of sinus rhythm following cardioversion.<sup>5</sup> While it is plausible that delays in referring patients may be a 'proxy' for some other factor (such as age or co-morbidity) that might influence success of cardioversion, in our study we found that patient age, patient sex or the presence of other pre-existing cardiovascular conditions were not related to success or failure. Previous investigators have also shown that patient age does not influence the success of cardioversion and this should not influence the decision to refer.<sup>5,6</sup>

In myocardial infarction the relationship between effectiveness

of thrombolysis and the speed with which it is delivered has led to an emphasis on short 'door-to-needle' times. We would argue that a similar concept holds true in atrial fibrillation and flutter. The fall-off in effectiveness of cardioversion after arrhythmia onset means that we should act upon the need for rapid referral for cardioversion, thereby reducing 'door-to-paddle' times.

In summary, we should not be complacent about the time taken to organise cardioversion for patients in atrial fibrillation or flutter and policy makers need to consider implications of these findings in planning the provision of services for patients with atrial fibrillation and flutter. General practitioners should not hesitate in referring these patients for cardioversion and hospital physicians should make every effort to minimise the time that these patients spend on waiting lists.

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## Address for correspondence

Dr Andrew R Houghton, Department of Cardiology, Glenfield Hospital, Groby Road, Leicester LE3 9QP. E-mail: houghtons@talk21.com