

Ablate and pace revisited: long term survival and predictors of permanent atrial fibrillation

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Objective: To assess long term mortality and identify factors associated with the development of permanent atrial fibrillation after atrioventricular (AV) node ablation for drug refractory paroxysmal atrial fibrillation.

Design: Retrospective cohort study.

Setting: UK tertiary centre teaching hospital.

Patients: Patients admitted to the University Hospital Birmingham between January 1995 and December 2000.

Interventions: AV node ablation and dual chamber mode switching pacing.

Main outcome measures: Long term mortality and predictors of permanent atrial fibrillation, assessed through Kaplan-Meier curves and logistic regression.

Results: 114 patients (1995–2000) were included: age (mean (SD)), 65 (9) years; 55 (48%) male; left atrial diameter 4 (1) cm; left ventricular end diastolic diameter 5 (1) cm; ejection fraction 54 (17)%. Indications for AV node ablation were paroxysmal atrial fibrillation in 95 (83%) and paroxysmal atrial fibrillation/flutter in 19 (17%). The survival curve showed a low overall mortality after 72 months (10.5%). Fifty two per cent of patients progressed to permanent atrial fibrillation within 72 months. There was no difference in progression to permanency between paroxysmal atrial fibrillation and paroxysmal atrial fibrillation/flutter (log rank 0.06, $p = 0.8$). Logistic regression did not show any association between the variables collected and the development of permanent atrial fibrillation, although age over 80 years showed a trend ($p = 0.07$).

Conclusions: Ablate and pace is associated with a low overall mortality. No predictors of permanent atrial fibrillation were identified, but 48% of patients were still in sinus rhythm at 72 months. These results support the use of dual chamber pacing for paroxysmal atrial fibrillation patients after ablate and pace.

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Atrial fibrillation is the most common sustained cardiac rhythm disturbance, occurring in 0.5% of the population at the age of 50 years and in almost 9% of individuals after the eighth decade.¹ Since the modern description of this re-entrant arrhythmia by Moe and colleagues,² several different methods of treatment have been proposed. The mainstay of treatment is still pharmacological, but very often patients do not tolerate the haemodynamic consequences of the poorly controlled ventricular rates that occur during atrial fibrillation.³

Atrioventricular (AV) node ablation and pacing is the only truly validated non-pharmacological strategy to treat paroxysmal atrial fibrillation.^{4,5} However, this form of treatment is palliative and is not a true cure. Its benefits are mainly on the patients' symptoms, as the arrhythmia persists. Short term progression to permanent atrial fibrillation is common (32% within two months),⁵ suggesting that resources may be wasted on unnecessary dual chamber systems.

It is not known which patients are most likely to develop permanent atrial fibrillation in the long term, or, if such patients could be identified, whether they should be given VVIR pacemakers routinely, or indeed whether other forms of pacing might improve their prognosis.

METHODS

Data collection

A six year retrospective analysis (1995 to 2000) was carried out in our unit on patients undergoing AV node ablation plus implantation of a dual chamber mode switching pacemaker

for drug refractory paroxysmal atrial fibrillation. AV node ablation was undertaken with insertion of two quadripolar catheters (Cordis) through two femoral vein sheaths. A fixed curve catheter was placed in the right ventricular apex for back up pacing. A deflectable long reach catheter was used to map the proximal AV node. This technique has been described elsewhere.⁶ The acceptable site showed balanced atrial and ventricular electrograms plus a sharp His deflection.⁷ Radiofrequency energy was applied until complete heart block was achieved with a narrow complex escape rhythm (rate 40–50 beats/min). Pacemaker implantation was done immediately after ablation, and all antiarrhythmic drug treatment was discontinued after the procedure. The atrial lead was positioned in the right atrial appendage, and the ventricular lead in the right ventricular apex. Pacemakers were routinely programmed to DDDR, lower rate 70 beats/min, mode switching on.

Population data were obtained from the patients' medical notes. Variables collected included age, sex, antiarrhythmic drug history, history of direct current (DC) cardioversion, and presence of ischaemic heart disease, valvar heart disease, cardiomyopathy, hypertension, diabetes, or thyroid dysfunction. The date and cause of any deaths were also recorded. Echocardiographic variables were recorded, including left atrial diameter, left ventricular end diastolic diameter (LVEDD), and ejection fraction. Pacing notes and electrophysiology logbooks were examined for data on the development of permanent atrial fibrillation and the presence of atrial fibrillation at the time of ablation. The presence of permanent atrial fibrillation was assessed through atrial rate histograms in Medtronic/St Jude

Table 1 Population baseline characteristics (n = 141)

Age (years) (mean (SD))	65 (9)
Sex	
Male	55 (48.2%)
Female	59 (51.8%)
Indications for AV node ablation	
Paroxysmal AF	95 (83.3%)
Paroxysmal AF/flutter	19 (16.7%)
AF at the time of ablation	23 (20.2%)
History of DC cardioversion	7 (6.1%)
Heart disease	
Ischaemic	39 (34.2%)
Valvar	19 (16.7%)
Cardiomyopathy	32 (28.1%)
Systemic disease	
Hypertension	31 (27.2%)
Diabetes	9 (7.9%)
Thyroid dysfunction	17 (14.9%)
Number of previous antiarrhythmic drugs (mean (SD))	4 (2)
Echo parameters (mean (SD))	
LAD	4 (1) cm
LVEDD	5 (1) cm
EF	54 (17)%

AF, atrial fibrillation; DC, direct current; EF, ejection fraction; LAD, left atrial diameter; LVEDD, left ventricular end diastolic diameter.

Medical pacemakers and through the percentage of pathological atrial rates in Vitatron pacemakers. Pathological atrial rates were defined as any atrial rates above 200 beats/min.

Statistical approach

Continuous variables were expressed as mean (SD). Overall mortality and survival free from permanent atrial fibrillation were evaluated with Kaplan-Meier curves. The significance between the different indications for AV node ablation (paroxysmal atrial fibrillation and paroxysmal atrial fibrillation/flutter) was calculated using the log rank test. Binary logistic regression was used to identify patients at higher risk of developing permanent atrial fibrillation after ablation. All calculations were done with 95% confidence intervals, and a probability value of $p < 0.05$ was considered significant.

RESULTS

In all, 114 cases were included in the database. The population baseline characteristics are summarised in table 1. Indications for AV node ablation were paroxysmal atrial fibrillation in 95 patients (83.3%) and paroxysmal atrial fibrillation/flutter in the remaining 19 (16.7%).

Overall mortality was 10.5% at 72 months (fig 1). Only one death was associated with an arrhythmic event and happened six months after the ablation. This patient had a past medical history of ischaemic heart disease, and the arrhythmic episode was associated with an acute coronary syndrome, as stated on the death certificate. A Kaplan-Meier curve showed no difference in mortality between subjects who had purely paroxysmal atrial fibrillation and those who had both atrial fibrillation and atrial flutter (log rank statistic 0.63, $p = 0.43$).

Fifty two per cent of the patients progressed to permanent atrial fibrillation within 72 months—in other words, 48% still showed evidence of sinus rhythm after six years. The presence of atrial flutter did not correlate with the development of permanent atrial fibrillation (log rank statistic 0.06, $p = 0.81$; fig 2).

Although technical echocardiographic comments were available for most patients, only a quarter of the cases had full measurements in their echo reports. Analysis of echocardiographic variables was thus done separately. There was a trend towards an association between age over 80 years and

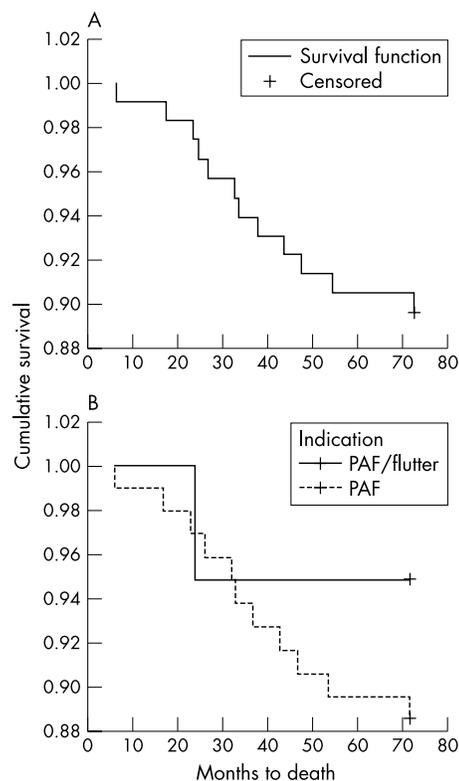


Figure 1 (A) Overall mortality after atrioventricular (AV) node ablation for drug refractory paroxysmal atrial fibrillation (AF): 10.5% of patients had died at 72 months after the implant. (B) Survival according to the indication for AV node ablation. There was no difference between paroxysmal AF (PAF) and paroxysmal AF/flutter (PAF/flutter): log rank = 0.63; $p = 0.83$.

progression to permanent atrial fibrillation, but this did not reach significance (score 3.29; $p = 0.07$). No other clinical variables were able to predict the progression to permanent atrial fibrillation in this study (table 2). The echocardiographic variables also failed to predict progression to permanent atrial fibrillation ($p = 0.11$, $p = 0.17$, and $p = 0.39$ for left atrial diameter, LVEDD, and ejection fraction, respectively).

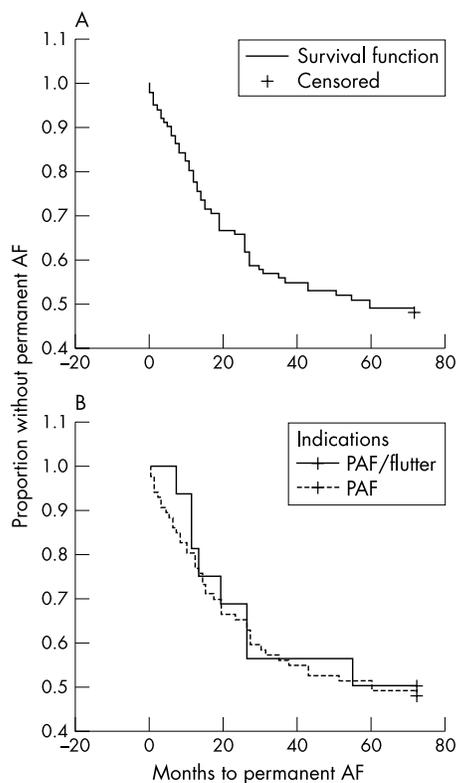


Figure 2 (A) Proportion of patients without permanent atrial fibrillation (AF) after atrioventricular node ablation: 52% of patients progressed to permanent AF at 72 months. (B) There was no difference between paroxysmal AF (PAF) and paroxysmal AF/flutter (PAF/flutter): log rank = 0.06; $p = 0.81$.

Table 2 Predictors of permanent atrial fibrillation

Variable	Score	p Value
Age over 80	3.29	0.07
Sex	0.54	0.46
Indication for ablation	0.17	0.68
More than 4 previous AA drugs	2.42	0.12
AF at the time of ablation	1.15	0.28
History of cardioversion	0.01	0.94
Valvar heart disease	1.43	0.23
Ischaemic heart disease	0.05	0.83
Cardiomyopathy	0.003	0.96
Hypertension	0.76	0.36
Diabetes	0.23	0.63
Thyroid dysfunction	1.03	0.31

AA, antiarrhythmic; AF, atrial fibrillation.

DISCUSSION

AV node ablation and pacing is the standard treatment for drug refractory atrial fibrillation. Brignole and colleagues compared AV junction ablation and pacing with pharmacological treatment and showed that the former was associated with significantly lower scores for heart failure, palpitations, effort dyspnoea, exercise intolerance, and fatigability.⁴ Palpitations were absent in 81% of the ablation group, compared with only 11% of the drug group. However, at the end of six months, permanent atrial fibrillation was present in 24% of subjects in the ablation group and in none of those in the drug group. Similar results were found in another prospective study conducted by Marshall and colleagues,⁵ who showed that AV node ablation and dual chamber pacing was better than pharmacological treatment in terms of overall symptoms, palpitations, and breathlessness. Dual chamber mode switch-

ing pacing was also far superior to single chamber ventricular pacing in terms of quality of life improvement. The only improvement for ablation and VVIR pacing compared with baseline was in terms of palpitations, and eight patients could not tolerate this mode owing to pacemaker syndrome. Similarly, after 18 weeks, permanent atrial fibrillation was much more common in the ablation group (33% v 11%). This higher incidence of permanent atrial fibrillation in patients who undergo AV junction ablation has been blamed on the withdrawal of all antiarrhythmic agents after the procedure. Brignole and associates have recently addressed this topic in a prospective trial.⁹ They assigned patients to continued drug treatment and no drug treatment after AV node ablation. The drug treatment arm had a 57% reduction in the risk of developing permanent atrial fibrillation. However, quality of life was not different between the two groups, and hospital admissions and episodes of heart failure were more common in the drug treatment arm. Therefore, it is not justified to continue medical treatment after AV node ablation.

The main aim of the present study was to identify predictors of permanent atrial fibrillation in a population of patients treated with AV node ablation and dual chamber pacing for drug refractory paroxysmal atrial fibrillation. None of the cases selected had VVIR pacing systems implanted or were in permanent atrial fibrillation at the time of the procedure. Overall mortality was also assessed, but no comparison was made with a control group.

Age over 80 years appeared to be associated with progression to permanent atrial fibrillation, but this did not reach significance. None of the other variables analysed could predict progression to permanent atrial fibrillation in the long term. Gribbin and colleagues,⁹ in a similar retrospective analysis, showed that increasing age, history of cardioversion, and VVIR pacing were positively associated with the development of permanent atrial fibrillation. In the present study we only assessed dual chamber systems, so the mode of pacing was not one of the variables studied. Furthermore, only 6% of our patients had a history of cardioversion, and this might explain why this variable failed to reach significance. Gianfranchi and colleagues showed that age > 75 years and structural heart disease were related to the development of permanent atrial fibrillation.¹⁰ In the current study, all cardiac conditions were carefully discriminated and no clear cut association could be found. It seems rather simplistic and impractical to group all cardiac pathologies under structural heart disease to achieve significant values. Finally, it has also been suggested that the presence of atrial fibrillation at the time of ablation is associated with the development of permanent atrial fibrillation.¹¹ It does not seem unreasonable to postulate that atrial fibrillation at the time of ablation and a history of cardioversion would reflect a high stage of atrial electrical remodelling,¹² thus predicting permanent atrial fibrillation. However, such a correlation could not be demonstrated in our cohort.

We also showed that the presence of concomitant atrial flutter did not have a negative effect on the progression to permanent atrial fibrillation. Curiously, sinus rhythm was still present in 48% of patients after 72 months. In the work by Gribbin and colleagues,⁹ 75% of patients were in permanent atrial fibrillation at a longer follow up period (84 months). If sinus rhythm persists long term, dual chamber pacing seems fully justified as the routine method after AV node ablation. As discussed previously, the short term study by Marshall and colleagues has already shown that dual chamber pacing is associated with better quality of life than ventricular pacing in patients with paroxysmal atrial fibrillation undergoing AV node ablation.⁶

Overall mortality was low in our study, at 10.5% at six years. The only arrhythmic death was associated with an acute coronary event. This is in accordance with a recently published retrospective analysis of long term survival after AV node ablation and pacing.¹³ The ablation group was compared with

an age and sex matched atrial fibrillation control group treated only with antiarrhythmic drugs, and there was no difference in mortality between the two groups. The overall six year mortality in the ablation group was 22.3%, however. In a meta-analysis, Wood and colleagues pooled data from prospective trials of AV node ablation and pacing and included a total of 1181 patients.¹⁴ Overall mortality at 12 months was 6.3%, which was comparable to the number of deaths in the population followed up in the stroke prevention in atrial fibrillation trial (6.7% at 1.3 years).¹⁵ It is possible that AV node ablation and pacing might have some positive impact on mortality, which could be explained by reversal of tachycardia related cardiomyopathy.¹⁶ Based on the evidence available, it can be stated that atrioventricular node ablation and permanent pacing does not have an adverse effect on long term survival.

The inability to identify predictors of permanent atrial fibrillation after AV node ablation precludes any attempt to use VVIR pacing in patients with paroxysmal atrial fibrillation. It also makes it difficult to assess which patients should be offered other treatments, such as overdrive pacing, to improve their prognosis. Overdrive pacing has been suggested as a useful tool in the management of paroxysmal atrial fibrillation,¹⁷⁻¹⁹ but further evidence is required. Its logical use would be before AV node ablation to avoid the irreversible damage to the electrical conduction system. Nevertheless, if this pacing mode is to be offered after ablation, some benefit to the quality of life would have to be demonstrated as well.

Conclusions

Ablate and pace is associated with a low overall mortality. No predictors of permanent atrial fibrillation could be identified from the variables analysed, but 48% of patients still had evidence of sinus rhythm after six years. These results support the routine use of dual chamber pacing for patients with drug refractory paroxysmal atrial fibrillation after AV node ablation.

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REFERENCES

- 1 Kannel WB, Wolf PA, Benjamin EJ, et al. Prevalence, incidence, prognosis, and predisposing conditions for atrial fibrillation: population-based estimates. *Am J Cardiol* 1998;82:2-9N.
- 2 Moe G, Rheinboldt W, Abildskov J. A computer model of atrial fibrillation. *Am Heart J* 1962;67:200-20.
- 3 Alboni P, Scarfo S, Fuca G, et al. Hemodynamics of idiopathic paroxysmal atrial fibrillation. *Pacing Clin Electrophysiol* 1995;18:980-5.
- 4 Brignole M, Gianfranchi L, Menozzi C, et al. Assessment of atrioventricular junction ablation and DDDR mode-switching pacemaker versus pharmacological treatment in patients with severely symptomatic paroxysmal atrial fibrillation: a randomized controlled study. *Circulation* 1997;96:2617-24.
- 5 Marshall HJ, Harris ZI, Griffith MJ, et al. Prospective randomized study of ablation and pacing versus medical therapy for paroxysmal atrial fibrillation: effects of pacing mode and mode-switch algorithm. *Circulation* 1999;99:1587-92.
- 6 Marshall HJ, Harris ZI, Griffith MJ, et al. Atrioventricular nodal ablation and implantation of mode switching dual chamber pacemakers: effective treatment for drug refractory paroxysmal atrial fibrillation. *Heart* 1998;79:543-7.
- 7 Scheinman MM, Morady F, Hess DS, et al. Catheter-induced ablation of the atrioventricular junction to control refractory supraventricular arrhythmias. *JAMA* 1982;248:851-5.
- 8 Brignole M, Menozzi C, Gasparini M, et al. Maintenance of sinus rhythm after ablation and pacing for AF. *Europace* 2001;2(suppl B):B31.
- 9 Gribbin GM, Bourke JP, McComb JM. Predictors of atrial rhythm after atrioventricular node ablation for the treatment of paroxysmal atrial arrhythmias. *Heart* 1998;79:548-53.
- 10 Gianfranchi L, Brignole M, Menozzi C, et al. Determinants of development of permanent atrial fibrillation and its treatment. *Europace* 1999;1:35-9.
- 11 Mitchell MA, Ackerman SJ, Nath S, et al. Atrial rhythm after atrioventricular junctional ablation. *Am J Cardiol* 1996;78:1251-4.
- 12 Wijffels MC, Kirchhof CJ, Dorland R, et al. Atrial fibrillation begets atrial fibrillation. A study in awake chronically instrumented goats. *Circulation* 1995;92:1954-68.
- 13 Ozcan C, Jahangir A, Friedman PA, et al. Long-term survival after ablation of the atrioventricular node and implantation of a permanent pacemaker in patients with atrial fibrillation. *N Engl J Med* 2001;344:1043-51.
- 14 Wood MA, Brown-Mahoney C, Kay GN, et al. Clinical outcomes after ablation and pacing therapy for atrial fibrillation: a meta-analysis. *Circulation* 2000;101:1138-44.
- 15 Flaker GC, Blackshear JL, McBride R, et al. Antiarrhythmic drug therapy and cardiac mortality in atrial fibrillation. The stroke prevention in atrial fibrillation investigators. *J Am Coll Cardiol* 1992;20:527-32.
- 16 Redfield MM, Kay GN, Jenkins LS, et al. Tachycardia-related cardiomyopathy: a common cause of ventricular dysfunction in patients with atrial fibrillation referred for atrioventricular ablation. *Mayo Clin Proc* 2000;75:790-5.
- 17 Coumel P, Friocourt P, Mugica J, et al. Long-term prevention of vagal atrial arrhythmias by atrial pacing at 90/minute: experience with 6 cases. *Pacing Clin Electrophysiol* 1983;6:552-60.
- 18 Blommaert D, Gonzalez M, Mucumbitsi J, et al. Effective prevention of atrial fibrillation by continuous atrial overdrive pacing after coronary artery bypass surgery. *J Am Coll Cardiol* 2000;35:1411-15.
- 19 Greenberg MD, Katz NM, Iuliano S, et al. Atrial pacing for the prevention of atrial fibrillation after cardiovascular surgery. *J Am Coll Cardiol* 2000;35:1416-22.