The role of radiofrequency ablation in the treatment of cardiac arrhythmias

In the early 1980s, catheter ablation heralded a new era in the treatment of cardiac tachyarrhythmias. With the development of radiofrequency energy, the procedure has become widely used and has been shown to be safe and effective. This editorial outlines the nature of the procedure and its role in the management of cardiac arrhythmias.

Catheter ablation of cardiac arrhythmias is performed under local anaesthesia. Cardiac electrodes introduced percutaneously allow pacing from various sites to stimulate the clinical tachycardia. Examination of intracardiac electrograms enables an accurate diagnosis to be made and manipulation of the ablation catheter to the source of the tachycardia allows delivery of radiofrequency energy and destruction of the arrhythmia substrate. This editorial discusses which cardiac arrhythmias are amenable to ablation and when it should be offered.

SUPRAVENTRICULAR TACHYCARDIA

The commonest clinical problem amenable to ablation is the supraventricular tachycardia (SVT). This comprises three diagnoses: atrioventricular nodal re-entry tachycardia (AVNRT), atrioventricular re-entry tachycardia (AVRT) and atrial tachycardia. Without pre-excitation on the sinus rhythm electrocardiogram, a pragmatic approach to these arrhythmias is that none is life-threatening and ablation is only necessary if patients are highly symptomatic or intolerant of drug therapy. However, ablation carries a high chance of a cure, obviates the need for drug therapy and improves quality of life (Bubien et al, 1996).

AVNRT is the commonest SVT and is mediated by a re-entry circuit using the 'slow' and 'fast' inputs to the AV node (*Figure 1*). Ablation in the slow pathway area of the right atrium produces success rates between 98 and 100% (Jackman et al, 1992). However, there is a 1% incidence of heart block requiring permanent pacing.

AVRT utilizes a macro re-entry circuit involving the AV node and an accessory pathway (*Figure 2*). Ablation of the accessory pathway (left-sided pathways require an arterial or a transseptal approach) carries an overall success rate of about 95%, although this varies according to pathway position (Kay et al, 1993). Complications include heart block (0.5%) and cardiac tamponade (0.5%). Ablation for accessory pathways with pre-excitation is discussed below.

Atrial tachycardias account for a relatively small proportion of SVTs. They may be left-sided, requiring a transseptal approach, and may have multiple foci. Success rates for ablation are around 92%, but there is a high rate of recurrence (8–10%) (Walsh et al, 1992). Complications are rare.

WOLFF–PARKINSON–WHITE SYNDROME

Electrocardiographic pre-excitation with symptomatic tachycardias constitute the Wolff–Parkinson–White syn-

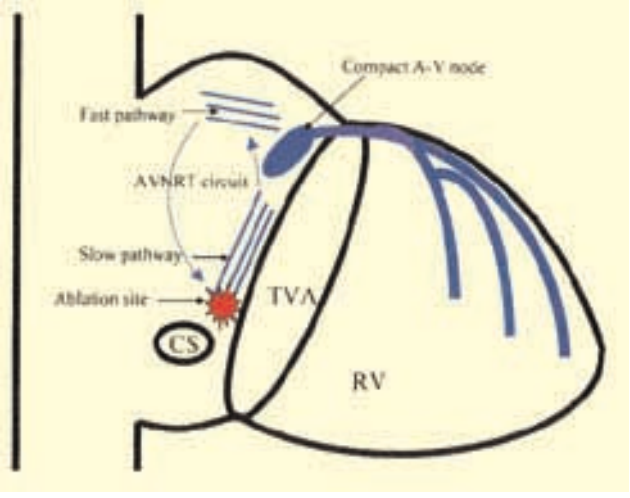

Figure 1. Schematic diagram of the right atrium showing the relative positions of the 'slow' and 'fast' pathways and the site for ablation of atrioventricular nodal re-entry tachycardia (AVNRT). CS = coronary sinus; RV = right ventricle; TVA = tricuspid valve annulus.

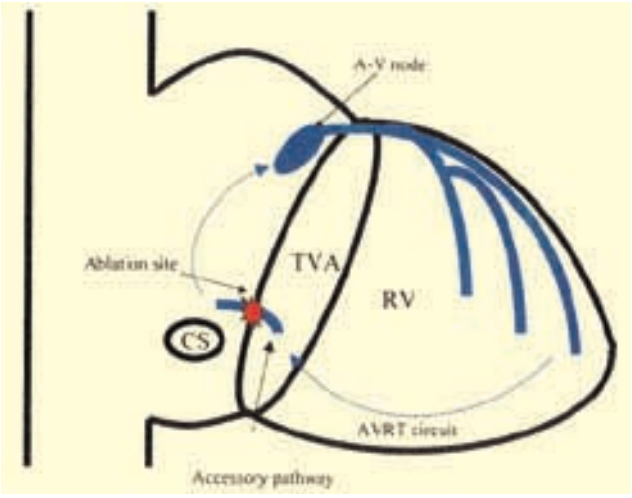

Figure 2. Schematic diagram showing the macro re-entry circuit in atrioventricular re-entry tachycardia (AVRT) and the site of ablation on an accessory pathway — in this case the right septal position. CS = coronary sinus; RV = right ventricle; TVA = tricuspid valve annulus.

drome (WPW). This carries a risk of sudden death from rapidly conducted atrial fibrillation of around 1 per 1000 per year (Munger et al, 1993). Given high success and low complication rates, most patients should undergo accessory pathway ablation.

In asymptomatic patients, the risk of sudden death is less clear but some form of risk assessment should be offered with ablation if appropriate. Some centres advocate electrophysiological testing; others recommend exercise testing and Holter monitoring to see if pre-excitation persists at high heart rates (>180 beats per minute). As neither approach has proven superiority, the choice often depends on local availability of invasive testing.

ATRIAL FIBRILLATION

As yet there is no widely available ablation procedure to cure atrial fibrillation (AF). AV node ablation and permanent pacemaker implantation is a simple palliative procedure for rate control of AF. Success rates approach 100%, complication rates are low and there is good evidence that it improves quality of life (Marshall et al, 1999). However, as it does not cure AF and demands lifelong pacemaker dependence, it is considered a treatment of last resort.

ATRIAL FLUTTER

Typical atrial flutter is mediated by a macro re-entry circuit around the right atrium (*Figure 3*). This circuit traverses a narrow passage between the tricuspid valve and the inferior vena cava and ablating a line across this area interrupts the circuit (Cauchemez et al, 1996). Success rates for flutter ablation are about 95% with low complication rates: thus it is appropriate for those who are drug refractory or intolerant.

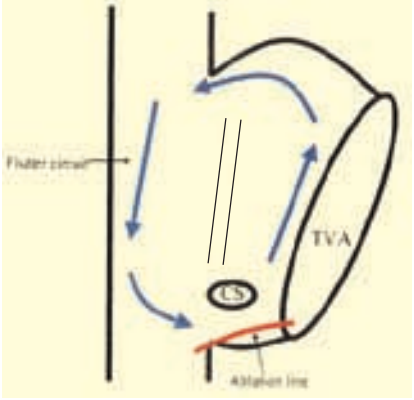

Figure 3. Schematic diagram of the right atrium showing the circuit of typical atrial flutter and the line of ablation between the tricuspid valve annulus and the inferior vena cava. CS = coronary sinus; TVA = tricuspid valve annulus.

VENTRICULAR TACHYCARDIA

Ventricular tachycardias (VT) in structurally normal hearts usually arise from the right ventricular outflow tract (left bundle, right axis morphology) or one of the left bundle fascicles (usually posterior giving rise to right bundle, left axis morphology). These tachycardias are amenable to ablation with few complications and as success rates are around 90%, patients are probably best treated with ablation (Coggins et al, 1994).

In contrast, the results for ablation of VT associated with other pathology are less impressive, particularly as these patients frequently have more than one VT morphology. Consequently, ablation is usually only used as an adjunct to drugs or an implantable defibrillator (Strickberger et al, 1997).

CONCLUSIONS

Radiofrequency ablation offers a high cure rate with a low incidence of complications for SVT, WPW and normal heart VT. It should therefore be offered to symptomatic or drug intolerant patients or those at increased risk of sudden death. For AF, ablation and pacing offers an effective palliative therapy for drug-resistant patients. For VT associated with other cardiac pathology, antiarrhythmic drugs and implantable defibrillators are the mainstay of therapy. HM

Howard J Marshall

Specialist Registrar in Cardiac Pacing and Electrophysiology

Queen Elizabeth Hospital

Edgbaston

Birmingham B15 2TH

Bubien RS, Knotts-Dolson SM, Plumb VJ, Kay GN (1996) Effect of radiofrequency catheter ablation on health related quality of life and activities of daily living in patients with recurrent arrhythmias. *Circulation* **94:** 1585–91

Cauchemez B, Haissaguerre M, Fischer B, Thomas O, Clementy J, Coumel P (1996) Electrophysiological effects of catheter ablation of the inferior vena cava-tricuspid annulus isthmus in common atrial flutter. *Circulation* **93:** 284–94

Coggins D, Lee R, Sweeney J et al (1994) Radiofrequency catheter ablation as a cure for idiopathic tachycardia of both left and right ventricular origin. *J Am Coll Cardiol* **23:** 1333–41

Jackman W, Beckman K, McClelland J et al (1992) Treatment of supraventricular tachycardia due to atrioventricular nodal reentry, by radiofrequency ablation of slow pathway conduction. *N Engl J Med* **327:** 313–8

Kay G, Epstein A, Dailey S, Plumb V (1993) Role of radiofrequency ablation in the management of supra ventricular arrhythmias: experience in 760 consecutive patients. *J Cardiovasc Electrophysiol* **4:** 390–2

Marshall H, Harris Z, Griffith M, Holder R, Gammage M (1999) Prospective randomised study of ablation and pacing *vs* medical therapy for paroxysmal atrial fibrillation: effects of pacing mode and mode switch algorithm. *Circulation* **99:** 1587–92

Munger T, Packer D, Hammill S et al (1993) A population study of the natural history of Wolff-Parkinson-White syndrome in Olmsted County, Minnesota, 1953–1989. *Circulation* **87:** 866–73

Strickberger S, Man K, Daoud E et al (1997) A prospective evaluation of catheter ablation of ventricular tachycardia as adjuvant therapy in patients with coronary artery disease and an implantable cardioverter-defibrillator. *Circulation* **96:** 1525–31

Walsh E, Saul J, Hulse J et al (1992) Transcatheter ablation of atrial ectopic tachycardia in young patients using radiofrequency current. *Circulation* **86:** 1339–40

KEY POINTS

- Radiofrequency ablation is a safe and effective procedure which is performed under local anaesthesia.
- Supraventricular tachycardias can be successfully ablated in 90–100% of cases with low complication rates.
- Patients with Wolff–Parkinson–White syndrome should be referred for ablation as there is an excess risk of sudden death.
- Asymptomatic patients with pre-excitation should have their risk of sudden death assessed.
- Atrioventricular node ablation and pacing improves symptoms for the majority of patients with drug-refractory atrial fibrillation.
- Atrial flutter can be ablated in about 95% of cases.
- Normal heart ventricular tachycardia should referred for ablation but drugs and defibrillator are the mainstay of treatment for other ventricular tachycardias.