Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia, affecting approximately 1% of the general population. It is a major risk factor for stroke. The incidence of stroke in patients with AF varies from 5% to 15%, depending on the presence of additional risk factors such as:

- advanced age,
- hypertension,
- cardiovascular disease,
- diabetes,
- congestive heart failure and
- prior stroke.

In AF, the heart is taken out of its normal sinus rhythm by excessive electrical activity in the muscle cells of the atria. As opposed to the 60 to 100 impulses per minute, the atria produces up to 600 impulses per minute. The coordinated contraction of the atria is replaced by irregular and, in some cases, absent mechanical activity, leading to the ineffective transport of blood from the atria to the ventricles and increasing the probability of intracardiac thrombus formation.

It had generally been accepted that sinus rhythm was the preferred rhythm if this could be achieved by drugs and synchronized cardioversions. However, a recent large randomized trial (Atrial Fibrillation Follow-up Investigation of Rhythm Management [AFFIRM] trial) challenged this wisdom. Patients with an average age of 70 years with ongoing, persistent AF and at least one of the risk factors for stroke were randomized to a strategy to maintain normal sinus rhythm or a “rate control” strategy. The latter group had atrioventricular nodal blocking agents prescribed to slow their ventricular rate (Table 1). Both groups received anticoagulation with warfarin therapy. In this large trial of > 4,000 patients, no advantage to sinus rhythm over rate control was found. In fact, all patients had a similar quality of life and similar rates of stroke. It is now clear that a rate control strategy is a reasonable option for patients with ongoing AF.

Unfortunately, many patients, especially those with self-terminating paroxysmal AF, continue to feel significant symptoms during AF and, from a symptom point of view, feel much better in sinus rhythm. Although it is not clear why, these patients do not tolerate a rate control strategy. Furthermore, patients continue to have recurrent spells of AF despite antiarrhythmic
drugs and are exposed to side-effects and the proarrhythmic potential of these agents.

Recently, electrophysiologists studying the initiating impulses in AF found that the pulmonary veins that return oxygenated blood to the left atrium are a significant source of electrical impulses in AF.\(^3\) Moreover, electrically isolating the atrial tissue around the pulmonary veins, using a catheter-based form of cautery called radiofrequency ablation, was shown to abolish AF. Once in the heart, a catheter was directed around each pair of veins to deliver radiofrequency energy and electrically disconnect the pulmonary veins from the left atrium, thereby impairing electrical impulse propagation to the rest of the heart and restoring sinus rhythm (Figure 1).

What are the evidenced-based benefits of catheter ablation?

The use of radiofrequency catheter ablation has significantly improved morbidity in patients with AF. Studies have shown that ablation both reduces the frequency of hospitalizations and increases function and quality of life scores in patients with symptomatic AF.\(^4,5\) Additionally, catheter ablation has been very successful in preventing a recurrence of symptomatic AF and an estimated 70% of post-procedure patients no longer require antiarrhythmic medications. The majority of the remaining patients maintain sinus rhythm with the use of previously ineffective drugs.

**FAQ**

**What are the goals of catheter ablation therapy?**

The goals of therapy are to reduce symptoms and improve quality of life by maintenance of sinus rhythm in patients with AF.

Early data comparing ablation with standard antiarrhythmic drugs have demonstrated a clear advantage of ablation. A small multi-centre trial of 112 patients showed that at one year, 76% in the ablation group, as compared to only 6% in the antiarrhythmic arm, were arrhythmia free.\(^6\) Most studies have examined the efficacy of catheter ablation in symptomatic patients who have failed drug therapy (usually two or more antiarrhythmic medications).

A recent small clinical trial showed that catheter ablation was associated with reduced hospitalizations, improved quality of life and maintenance of sinus rhythm when compared to antiarrhythmic medications in drug-naive patients with symptomatic AF.\(^7\) Therefore, in the near future, catheter ablation may become a first-line therapy for AF. A large multi-centre randomized trial to test this is underway.

The efficacy of catheter ablation at maintaining normal sinus rhythm can vary depending on

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**Table 1**

**Atrioventricular nodal blocking drugs**

- β-receptor blockers:
  - metoprolol,
  - atenolol,
  - bisoprolol
- Calcium channel blockers:
  - diltiazem,
  - verapamil
- Digoxin

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the subtype of AF being treated. In general, patients with paroxysmal, self-terminating AF with structurally normal hearts have success rates as high as 88% six months after the procedure. On the other hand, patients with left ventricular dysfunction, large left atria (> 55 mm) and long-standing AF (especially over many years) have lower success rates and it should be expected that repeat procedures will be required if sinus rhythm is to be maintained.

What are the risks of catheter ablation?

As with any invasive procedure, there are potential complications associated with catheter ablation. A worldwide survey of 8,745 patients examined the safety of catheter ablation from 1995 to 2002. The survey estimated a major complication rate of 6%. Notable complications included:

- periprocedural death (0.05%),
- tamponade (1.22%),
- stroke (0.94%) and
- pulmonary vein stenosis (1.63%).

In one study, the combined prevalence of thromboembolic disease and pericardial tamponade after cardiac ablation was four times higher in patients > 70-years-of-age compared to those ≤ 70-years-of-age. Technology advances have led to newer ablation techniques associated with lower complication rates (1% to 2% compared to 6%). While the risk is small and improving, it needs to be carefully balanced against the potential benefit in individual patients.

Who should get catheter ablation?

Because ablation is an invasive procedure with a small risk, at present it should be reserved for patients in whom a rate control strategy is not an acceptable or is a poorly tolerated strategy and in whom antiarrhythmic agents have failed. Essentially, it should be considered an alternative to drug therapy. Success rates are highest for patients with normal or near normal hearts and these patients make the best candidates (Table 2). Ongoing trials may demonstrate that these patients do better with ablation as a first-line strategy, but for now, a trial of at least one drug seems warranted.

Patients with no symptoms, or minimal symptoms, especially if they become asymptomatic on a rate control strategy, are not likely to obtain a significant benefit from ablation and are rarely offered the procedure.

Patients with significant heart disease and long-standing AF have lower success rates and may require repeat procedures. At present, these patients are not ideal candidates for ablation,
although ablation is offered to highly symptomatic patients in this group. It may turn out that because such patients are at high risk for stroke at baseline, they may receive the most benefit from ablation. However, until trials confirm this, these patients need to be selected carefully, as the risk, especially for stroke, is likely higher in this group.

Despite the fact that the AFFIRM trial showed equivalent survival rates in patients with AF randomized to rate-control or to rhythm-control medications, there is early but growing data that maintenance of normal sinus rhythm was associated with a lower risk of death.11 Large trials of ablation may confirm this, but until then ablation should be considered as an alternative to antiarrhythmic agents to maintain sinus rhythm in those who cannot tolerate a rate control strategy.

Table 2
Candidates for ablation

<table>
<thead>
<tr>
<th>Ideal candidates for ablation:</th>
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<tbody>
<tr>
<td>• Highly symptomatic</td>
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<tr>
<td>• Self-terminating (paroxysmal) episodes</td>
<td></td>
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<tr>
<td>• Structurally normal or near normal heart</td>
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<tr>
<td>• Age &lt; 70 years</td>
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<table>
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<tr>
<th>Potential candidates for ablation:</th>
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<tbody>
<tr>
<td>• Moderate symptoms</td>
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<tr>
<td>• Ongoing (persistent) AF</td>
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<tr>
<td>• Mild-to-moderate heart disease</td>
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<table>
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<tr>
<th>Poor candidates for ablation:</th>
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<tbody>
<tr>
<td>• Asymptomatic</td>
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<tr>
<td>• Want ablation to stop warfarin</td>
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<tr>
<td>• Significant heart disease (ejection fraction &lt; 35%, left atrial size &gt; 55 mm, severe valvular disease)</td>
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<tr>
<td>• Long-standing AF over several years</td>
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</tbody>
</table>

Technology advances have led to newer ablation techniques associated with lower complication rates (1% to 2% compared to 6%).

FAQ

Are there any absolute contraindications to catheter ablation?

The common absolute contraindications to treatment include:

• severe carotid artery disease,
• severe pulmonary hypertension,
• left main or three-vessel coronary disease and
• critical aortic stenosis.

What about anticoagulation?

The AFFIRM trial demonstrated that anticoagulation should be maintained in the vast majority of patients with AF despite the resumption of sinus rhythm. One of the surprising findings was the unacceptably high rate of stroke in the sinus rhythm arm for patients who had anticoagulation stopped because they had been returned to sinus rhythm.2 Many speculate that this is due to the asymptomatic nature of some episodes of arrhythmia with treatment. Following the AFFIRM trial, anticoagulation is generally continued based on risk factors regardless of ongoing rhythm. For most groups performing ablation, this has carried over to the management of evenly successfully ablated patients. This strategy is likely to continue until there is clear evidence that it is safe to stop anticoagulation.
Catheter Ablation

Conclusion

Catheter ablation significantly reduces morbidity and improves maintenance of sinus rhythm in patients with AF when compared to antiarrhythmic medications. The best candidates are those with highly symptomatic AF, despite a trial of antiarrhythmic drugs and a structurally normal heart. Ablation is offered to select patients with structural heart disease and long-standing AF. Asymptomatic patients are not candidates for ablation. Anticoagulation should be maintained based on a risk score for stroke, regardless of the success of the ablation procedure.

References


FAQ

Is catheter ablation therapy associated with a mortality benefit in patients with AF?

Thus far, there have been no randomized studies powered to look at the mortality benefit with catheter ablation therapy in patients with AF.

Patients with paroxysmal, self-terminating AF with structurally normal hearts have success rates as high as 88% six months after procedure.