Ablation for atrial fibrillation

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Atrial fibrillation (AF) has multiple causes, is associated with almost all cardiac and pulmonary disease and generates substantial health-care costs. The underlying mechanisms are still a matter of debate, but AF is mostly characterized by re-entrant loops in the atrial myocardium initiated by the rapid discharge of ectopic foci, commonly from sleeves of atrial tissue located within the pulmonary veins.

Several studies of AF therapy were undertaken 5–10 years ago, of which the largest was the AFFIRM trial. These studies demonstrated that attempting to maintain sinus rhythm with the therapy available at the time (antiarrhythmic drugs) yielded no advantage over tolerating the AF and controlling the ventricular rate. Subgroup analyses showed that survival was higher among patients who were in sinus rhythm and who used anticoagulants than among those treated with antiarrhythmic drugs. Thus, speculation arose that the advantage of sinus rhythm was negated by the toxic effects of antiarrhythmic drugs and inadequate anticoagulation. Attention turned, therefore, to catheter-based ablation techniques for the restoration and maintenance of sinus rhythm.

The rapid ectopic foci that trigger and re-stimulate AF can be isolated from the wider atrial myocardium by ablation techniques, in which blocking lines are created by the application of radiofrequency (heat) or 'cryo' (cold) energy. If successful, AF should be 'cured' or much reduced. In patients in whom AF has led to substantial atrial remodeling, triggers as minor as sinus tachycardia or one premature beat might be sufficient to trigger the arrhythmia. Thus, AF ablation procedures for these patients must provide some degree of atrial compartmentalization, for example blocking lines connecting the two upper pulmonary vein orifices along the roof of the left atrium, a blocking line joining the left lower pulmonary vein to the mitral annulus, or both. Further modification can be provided by ablating regions of slow or

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abnormal conduction, areas richly innervated by cardiac autonomic nerves, and areas that are repetitively activated at a high frequency.

Pulmonary vein ablation techniques have yielded very encouraging results so far (see Supplementary Table 1 online) and can be useful in paroxysmal (mostly trigger-dependent), persistent and so-called permanent (more substrate-dependent) AF, and even in some patients with arrhythmia related to severe underlying heart disease. In four randomized trials that compared antiarrhythmic drugs with catheter ablation, left atrial ablation consistently led to improved outcomes. These studies were, however, small, employed 'soft' endpoints, such as the recurrence of AF, and were undertaken in the most expert centers. Issues such as whether anticoagulation should be continued after an apparently successful procedure also remain unclear. These results alone, therefore, should not persuade doctors and will not convince health-care payers that these techniques should be made available to all AF patients. New trials of catheter ablation are planned and should be started soon lest equipoise be lost. The forthcoming CABANA trial will test whether left atrial catheter ablation reduces total mortality more than rate control or antiarrhythmic drug therapy in new-onset AF; the ablation group will be further randomized to continue or discontinue anticoagulation.

Irrespective of whether future findings support greater availability of left atrial ablation, the cost will inevitably be too high initially for widespread application, and the technique is unlikely to be useful for patients with unremitting underlying disease and badly damaged atria. The studies will, however, improve understanding of the mechanism of AF and offer a fundamental step forward in therapy.

Supplementary information is available on the *Nature Clinical Practice Cardiovascular Medicine* website.

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Competing interests

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