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Review

# Treatment of atrial fibrillation<sup>☆</sup>

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## Summary

In recent years, the interest towards non-pharmacological treatment of atrial fibrillation has dramatically increased. Less invasive left atrial approaches are today widely adopted in cardiac surgery, mainly for concomitant treatment of secondary AF. Epicardial ablation, especially with the latest generation devices, has rendered most of the ablation feasible off pump, on the beating heart, thus opening the way to minimally invasive and thoracoscopic developments. In the meantime, percutaneous procedures have been greatly refined. Complete left lesion sets similar to those performed surgically are today feasible with good clinical results. Presently, even if percutaneous approaches seem more suitable as a first-line treatment for lone AF, surgical ablation is proving useful in a growing number of patients. It is possible to envision a stronger role of surgery in patients with lone AF refractory to percutaneous ablation or in those with a higher thromboembolic risk.  
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*Keywords:* Atrial fibrillation; Ablation; Thromboembolism; Stroke

## 1. Introduction

The prevalence of atrial fibrillation (AF) is 0.4% in the general population and about 5% in people older than 60. Lone AF accounts for about 30% of the cases. AF doubles mortality and increases dramatically the risk and the severity of stroke. A patient with AF and a prior cerebral ischemia has a 10-12% risk of stroke per year [1]. Medical treatment aimed at either rhythm or rate control does not yield satisfactory results. This has fuelled the interests of physicians and of industries in non-pharmacological treatment options.

When Cox proposed the maze procedure in 1991 [2] the only alternative non-pharmacological treatment of lone AF was His bundle ablation and pacemaker implantation. Nevertheless, despite progressive refinement and a >95% success rate, the maze operation has never become popular. This because it is technically demanding and it is quite heavy surgery, it takes about 1 h of cross clamp time, it leads to permanent PM implantation in 10% and mortality in up to 1-2% of the patients [3].

## 2. Current practice

### 2.1. Surgery

In 1996 the first evidences of the dominant role played by the left atrium in causing AF, prompted the proposal of simplified approaches only targeting the left atrium (LA).

Sueda first described a simple LA procedure to cure permanent AF in mitral valve patients with a 75% success rate [4]. The only reported experience with open-heart cryo LA ablation in the treatment of lone AF resulted in a successful cure in 93% of the patients [5].

In the last few years, the introduction of radiofrequency (RF), microwave and argon cryoenergy surgical probes allowed to further simplify left atrial procedures. Minimally invasive RF open-heart ablation of lone AF yielded a 95-97% success rate. But the only reported experience shows an unappealing 1% rate of esophageal perforation [6].

Epicardial ablation, first reported in 2000 [7] has renewed the interest in lone AF surgery. While yielding success rates in the range of 75-95% in mitral patients, epicardial ablation allowed performing most of the ablations off pump, on the beating heart.

This of course led the way to the modern minimally invasive surgical approaches to treat lone AF. Saltman et al. recently reported the feasibility of an epicardial ablation approach using a linear microwave probe through a small right thoracotomy or through thoracoscopy [8]. All latest

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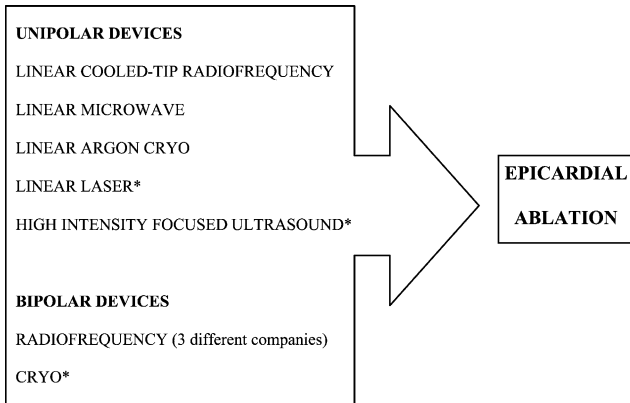


Fig. 1. Latest generation tools: \*not yet available for clinical use in Europe.

generation surgical devices are devised for epicardial ablation (Fig. 1).

The major concern about epicardial ablation with unipolar probes is transmural. The depth of an epicardial lesion achieved with a unipolar device is limited by the composition of the atrial wall and by convective cooling exerted by circulating blood.

Bipolar RF clamping devices, seem a promising way to obviate such problems. In fact they eliminate blood flow across the ablated area and optimize energy delivery to the tissue. The first trials demonstrated that bipolar RF ablation produces persistent continuous transmural scars [9]. A preliminary experience on patients showed the tool to be versatile and fast [10].

## 2.2. Percutaneous ablation

After right ablations proved ineffective in the cure of AF, the EP cardiologist tried focal ablation within the pulmonary veins (PVs) [11]. The technique was then abandoned due to a high rate of relapses and to the risk of PV stenosis. PV disconnection through segmental ostial ablation allowed cure of paroxysmal or recent onset permanent AF in 65-85% of the patients but it still carried a 0-7% risk of PV stenosis and a 1% thromboembolic risk [12].

Circumferential RF LA ablation around the PVs with connecting lines, proved to be more effective than ostial PV disconnection and did not cause PV stenosis. The reported success rate is about 85% for paroxysmal and 65% for permanent AF [13]. The drawback is technical difficulty in performing continuous transmural lines with conventional RF catheters.

The diverse evolutions occurring to the surgical and to the percutaneous procedures, brought both approaches to approximately identical target lesion sets.

The future respective fortunes will depend upon the differences in:

- Feasibility/technical aspects
- Efficacy/success rate
- Safety/complications
- Ancillary procedures
- Costs
- Recognized role.

## 2.3. Drivers for change

Today a state of the art percutaneous ablation takes little over 2 h in experienced hands, a few minutes of which under X-ray exposure thanks to modern non-fluoroscopic navigation systems. Despite some technical difficulty hindering diffusion, at present percutaneous ablation seems to fulfil the prerequisites of a first-line approach to drug-refractory lone AF: it is fairly effective, low-risk and hardly invasive at all.

The current surgical options do not seem to compare favourably with catheter-based procedures principally in terms of reduced invasiveness. Epicardial surgical ablation of lone AF is in a developmental phase and however it still requires access to both pleural cavities. Robotic and video-assisted procedures will probably not help countering this trend since they are generally burdened by high costs and difficult learning curves.

Epicardial ablation should theoretically allow a lower risk of thromboembolism and of collateral damage. But thromboembolism occurs in <1% of the patients after percutaneous ablation and serious sequelae are actually rare. Likewise, the risk of injuring surrounding structures through endocardial ablation is real although probably low.

Neither surgical nor percutaneous ablation have an official role in the guidelines for the treatment of AF due to the absence of randomized studies. It is probable that trials about percutaneous ablation will be carried out much earlier thanks to preferential referral and to the rapidly increasing numbers of the EP procedures. A potential scenario will be that catheter-based procedures will prove more beneficial than antiarrhythmic drugs.

## 2.4. Options for progress

One of the advantages of surgical ablation is the possibility of a concomitant obliteration of the left appendage (site of thrombus in >90% lone AF patients), which is today feasible through thoracoscopy using stapling devices. Surgery for lone AF could have a rationale in the context of secondary prevention of stroke, where concomitant appendage obliteration can actually ameliorate prognosis. Of course such indications should pass the test of controlled comparative studies.

Should percutaneous ablation yield a better prognosis than conventional medical treatment, surgical ablation could find an important role in those 10-20% of patients who do not respond to percutaneous ablation.

The relative impact of percutaneous and of surgical treatment strategies on costs, including the rate of new hospital admissions for repeat procedures or for stroke should then be analysed.

The added value of surgery has traditionally been efficacy. Thanks to the ongoing technical developments, surgeons will have more effective ablation means with respect to the cardiologist, at least for this decade. Such developments should therefore find us aware that electrophysiological effectiveness (=transmural) will probably be the key distinctive feature of surgery in the field of AF

treatment. Therefore we should not place technical feasibility before transmural ablation.

Finally, thanks to the simplicity and effectiveness of modern surgical approaches, it is possible to envision an expansion of the indications to surgery in asymptomatic patients with early-stage repairable valve disease and associated AF.

Apparently therefore, in order to actively comply with the ongoing challenges of AF treatment, the cardiac surgeon of the new millennium should be aware of the principles of AF cure and closely follow the development of the latest technical options.

### 3. Key issues

Indication for AF surgery in lone AF  
 Chances for a randomized study (local environment)  
 Minimum requirements for an effective lesion set  
 Need for a predictably transmural tool vs on line mapping apparatus vs both.

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### Appendix. Conference discussion

**Dr D. Cosgrove (Cleveland, OH, USA):** That is a very nice presentation. We have a little bit in common with you in that we have a very aggressive group of EP doctors, and frankly, they have waiting lists that go on probably almost as long as yours do, and they refer no one to us with lone atrial fibrillation unless in fact they have failed.

I think the one advantage that we do have over them is that we obliterate the left atrial appendage, and if you look closely at Cox's data and having no strokes, the question is, is it because he has obliterated the left atrial appendage in all these patients or because he has cured the atrial fibrillation, and that may be our single advantage over catheter therapy in these patients with atrial fibrillation.

**Dr Benussi:** Yes, I totally agree. We should pursue a strong unity of intent and promote multicenter trials to validate our procedures. A study on the efficacy of Afib surgery in the secondary prevention of stroke can be of great consequence. Joao Melo is already working on such a program. In fact, patency of the left appendage can be one of the reasons why stroke was not prevented by either rate control or rhythm control in the AFFIRM study, not even in patients with sinus rhythm.

**Dr L. Bockeria (Moscow, Russia):** We studied this pathology for many years since I guess the problem of arrhythmias started about 25 years ago. And not to do the discussion very long, I consider there are very few indications for endovascular treatment of atrial fibrillation: it is an idiopathic form and that is all. Even in this case, probably we will come soon to the epicardial approach using thoracoscopy. It is very easy and effective.

So in a case when a patient has mitral valve disease complicated by atrial fibrillation, he should be treated surgically. This approach gives more possibilities, because, really, the left atrial appendage should be resected. That is very clear for us. It is my understanding that for the moment the indications for the endovascular and surgical approaches to the treatment of this pathology is pretty clear.

**Dr F. Mohr (Leipzig, Germany):** It is a pity that industry is no longer in the room, because you showed all the devices, and industry has pushed us for years to try any device and their device is better and they made a major investment; if you just think about St. Jude, I think they paid \$150 million US to buy Epicor.

And the question is, I was hesitating two years or three years ago whether this investment into the surgical field was the right investment, does it really help us so much? We certainly will not expect many, many more patients from this field.

**Dr Benussi:** I agree with this.

**Dr D. Cosgrove (Cleveland, OH, USA):** But even if we don't, we are going to improve the care of the patients we are operating on now that have atrial fibrillation. So I think that there is a place for it, even if it is only as an adjunct.

**Dr Benussi:** Another potential application of ablation surgery is in the prophylaxis of Afib. I think it is not time for such an indication yet. If you only think that until 1998 there was no specific surgical tool for Afib ablation. There was only surgery. An now there are 10-12 companies investing a lot of money on new tools for surgical ablation. With every new tool there are new complications, probably because science in this field is young yet.

For instance, in our experience the bipolar devices seem very effective. But we have noticed that about 5 to 7% of the patients have left atrial flutter after surgery. These patients need an EP study with transseptal approach. This arrhythmia takes quite a tough EP expertise to be dealt with, and I would not fancy that happen to a patient who has never experienced Afib in his life.

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