

The Journal of
Thoracic and Cardiovascular Surgery

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J Thorac Cardiovasc Surg 2006;131:949-951

DOI: 10.1016/j.jtcvs.2005.12.027

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<http://jtcs.ctsnetjournals.org/cgi/content/full/131/5/949>

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Surgery for atrial fibrillation: Are we heading in the right direction?

Joao Q. Melo, MD, PhD

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Atrial fibrillation surgery has become an area of major interest for cardiac surgeons. This is not surprising, because there is increasing information showing that surgery should play a larger role in the therapeutic armamentarium of this enigmatic syndrome, or primary disease. Starting in 1980, Williams and colleagues¹ and Defauw and colleague² proposed 2 surgical techniques, isolation of the left atrium and the corridor procedure, respectively, to obtain rate control of this difficult and complex pathology.

In 1991, Cox and colleagues^{3,4} described the mazel operation and later the maze 2 and maze 3 operations. These techniques were the first attempts to surgically achieve a rhythm-control therapy for atrial fibrillation, and the maze 3 became the gold standard for surgical treatment of atrial fibrillation. Because the maze 3 is a complex operation, requiring a long ischemic time and having a major potential for bleeding, it never became a widespread technique.

With a completely different approach based on information from Hannover,⁵ in 1998 our group was the first to describe the surgical treatment of permanent atrial fibrillation using bilateral isolation of the pulmonary veins⁶ in patients with mitral valve disease, by using endocardial radiofrequency catheter ablation. The concept behind this approach is to avoid macroreentry, which inside the left atrium is mostly occurring around the ostia of the pulmonary veins, where refractory periods are much shorter than in the cavity of the left atrium.⁷ Cox and colleagues⁸ state that "atrial fibrillation . . . could come from the PV but they were not mapped."

Concomitantly and independently, Haissaguerre and colleague⁹ described ectopic foci within the pulmonary veins as the origin of lone atrial fibrillation in some patients with paroxysmal lone atrial fibrillation, and reported very high early success rates.

The suboptimal results we reported initially were obtained in unselected patients who underwent operation with unipolar dry radiofrequency. Failure may have been caused by the difficulties in achieving consistent transmural or the multiplicity of mechanisms leading to atrial fibrillation, well beyond the role of the pulmonary veins.

In an attempt to improve results, and always using ablation limited to the left atrium, different approaches¹⁰ and additional lines¹¹ were proposed by several groups.

Different heating and cooling energies became available in the surgical armamentarium as alternatives to the cut-and-sew method.^{12,13} So far, only a few of those energies have shown to be consistently transmural.

By analyzing the surgical results of patients who undergo operation with the use of such tools, it is clear that the results are now consistent and the success rate needs to be improved, mainly in patients with lone atrial fibrillation. In many patients the mechanisms for atrial fibrillation are not limited to the left atrium but are also located in the right atrium. This is not surprising and is in accordance with past knowledge. Indeed, for some time our electrophysiologist colleagues have been curing lone atrial fibrillation using right atrial ablation with a 1-year success rate in the range of 15%.^{14,15} The maze operation achieves the higher reported success rates¹⁶ and is a biatrial approach. These facts are in line with Barnett and Ad's article¹⁷ in this issue of *The Journal*, and reinforce the concept that biatrial surgery leads to a higher success rate in the treatment of atrial fibrillation.

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Received for publication Dec 17, 2005; accepted for publication Dec 29, 2005.

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J Thorac Cardiovasc Surg 2006;131:949-51
0022-5223/\$32.00

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doi:10.1016/j.jtcvs.2005.12.027

If surgery is to stay in the mainstream of the armamentarium for the treatment of atrial fibrillation we have to recognize that our current knowledge is not sufficient. The challenge now is how to increase our knowledge and obtain the best sustained results after surgery.

Atrial fibrillation is a multifactor condition and presents under different forms. It is generally accepted as a syndrome of increasing severity. Atrial fibrillation usually starts as a paroxysmal condition and evolves into a permanent condition. It is much easier to cure in the early stages. The results of nonpharmacologic treatment of atrial fibrillation are far superior when performed in patients with persistent or paroxysmal atrial fibrillation than in patients with permanent atrial fibrillation. This is true in patients with lone atrial fibrillation or mitral valve disease. In those with paroxysmal atrial fibrillation, even without ablation a substantial number of patients will recover sinus rhythm by repairing the mitral valve and unloading the atrium.

Barnett and Ad's article¹⁷ reviews a large number of articles discussing more than 6000 patients, but because most of the data were not accessed or analyzed together, its conclusions should be cautiously assessed. It should be noted that although the title of this literature review includes "ablation," some of the articles discuss standard surgery, most frequently the results of the maze operation.

The percutaneous approaches have evolved from the concepts of ectopic foci within the pulmonary veins to bilateral isolation of the pulmonary veins, as described by Pappone and colleagues¹⁸ and later by Macle and colleagues.¹⁹ Comparing the results of surgery with the results of percutaneous ablation is not appropriate because patients undergoing surgery usually have a failed percutaneous ablation. The series from Prasad et al.,¹⁶ performed in an era in which interventions were not available, show that surgical treatment is highly efficient. It should be emphasized that treating this arrhythmia in patients with atrial fibrillation and concomitant heart pathology in addition to the mitral valve is more difficult than in those patients with lone atrial fibrillation.

Surgical approaches need to be simplified and safe. Five years ago our group reported the initial experience of bilateral isolation of the pulmonary veins without cardiopulmonary bypass for the treatment of lone atrial fibrillation using median sternotomy.²⁰ Recently, several groups have reported mini-invasive approaches.^{21,22} Surgeons have the responsibility to document that when these procedures are performed thoracoscopically, the results are similar and long-lasting.

One of the most important benefits we can offer to many patients is a decrease in the incidence of thromboembolic events associated with atrial fibrillation. By analyzing clinical and echocardiographic risk factors it is possible to identify the patients who are at high risk for stroke.²³ Because the left atrium appendage is the origin of these

thrombi, we have the unique opportunity of eliminating the appendage, and because we use no intracardiac foreign bodies, this is likely the most effective method to decrease the incidence of thromboembolism.

Another concept to clarify is the definition of success. Our aim in atrial fibrillation treatment should be to achieve sinus rhythm and to avoid the major drawbacks of atrial fibrillation, that is, thromboembolic events and the need for treatment with antiarrhythmics. All of those medications have proarrhythmic effects that cause a significant number of sudden late deaths.²⁴ When reporting sinus rhythm we should document normal sinus rhythm, which is not the same as free of atrial fibrillation, as too commonly reported. How sinus rhythm is defined cannot be based on symptoms or an occasional electrocardiogram. In those patients with paroxysmal atrial fibrillation, sinus rhythm, definition requires Holter monitoring. In those patients with permanent atrial fibrillation it is essential to document that they do not have paroxysmal atrial fibrillation, thus requiring more than a routine electrocardiogram to detect their basic rhythm. In Barnett and Ad's review,¹⁷ the criteria for rhythm success is freedom from atrial fibrillation. In addition, a substantial number of articles are not detailing the methods used for defining the rhythm, thus becoming less informative and sometimes useless. Eventually we can postulate that the reason Barnett and Ad's study¹⁷ did not show better survival is that the only rhythm that might lead to an improved survival is sinus rhythm and that a substantial number of patients without atrial fibrillation are not in sinus rhythm. Readers are rarely informed on additional medications that patients require during follow-up, which seems to have a direct impact on survival.

At the moment several crucial issues remain to be answered.

1. Is there the need to routinely create lines in the right and left atria?
2. Inside the left atrium the pulmonary veins are a major component for the origin or perpetuation of atrial fibrillation. Are additional lines necessary, and, if so, where should they be created?
3. What is the role of the left atrial appendage in atrial fibrillation? Does it have any proarrhythmic potential?
4. What is the role of the autonomic nervous system in the origin or perpetuation of atrial fibrillation?

These are some of the issues that require a definite answer. The coming years will be rich in research on atrial fibrillation surgery. The ultimate goal is to develop a procedure that will be performed on the beating heart using ports and always eliminating the left atrial appendage. When that technology is available it will be a challenge to decide, with our electrophysiologist colleagues, which is the easiest and safest way to create those ablation lines.

In the meantime it is crucial that surgeons and electrophysiologists work in close cooperation to provide answers to the questions described.

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