

Strategies In Surgery

Surgical Innovations for Atrial Fibrillation, only available in Oklahoma at OU Physicians

Thoroscopically-assisted, limited thoracotomy for radiofrequency ablation of atrial fibrillation

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CLINICAL CONSIDERATIONS OF ATRIAL FIBRILLATION

Atrial fibrillation (AF) represents rapid, repetitive, irregular contractions of atrial myocardium originating from areas of excitation at the base of the pulmonary veins. Irregular and often accelerated ventricular rate follows atrioventricular conduction.^{1, 2} Atrial fibrillation affects one percent of the general population and six percent of those older than 65.^{3, 4} This malady accounts for 1.4 million hospital visits each year with an estimated 227,000 annual hospital admissions, 50 percent of which occur as emergency concerns.^{5, 6}

Clinical indications may include:

- General discomfort
- Anxiety
- Sense of ill-being
- Critical alterations of cardiac hemodynamics with congestive heart failure

Patients are also vulnerable to blood vessel blockage and cerebral vascular insult with stroke syndrome as a result of stasis, thrombosis and embolization from the atrial appendage. Medical management is often unsuccessful. In this regard, catheter-based and more directed surgical intervention has been the focus of development and evolution of care.

HISTORY OF PROCEDURES FOR ABLATION OF ARRHYTHMIA

Catheter-based mapping and ablation of tachyarrhythmia was introduced in the 1960s.^{7, 8} In 1968, the first surgical procedure to eliminate accessory pathways for atrial arrhythmia occurred after catheter mapping,⁹ and the development of radiofrequency ablation by endocardial catheter application followed.^{10, 11, 12} The surgical isolation of abnormal pathways as a contributing factor for AF, known as the Cox-Maze procedure, was developed in 1987 by James Cox, M.D. and has evolved to the present time.¹³ In 2002, the application of radiofrequency current to the epicardial surface at the base of the left atrium was found to be effective in resolving atrial fibrillation.¹⁴ Radiofrequency current induces transmural fibrosis of the myocardium in the area of application.

thereby interrupting pathways of electrical conduction.

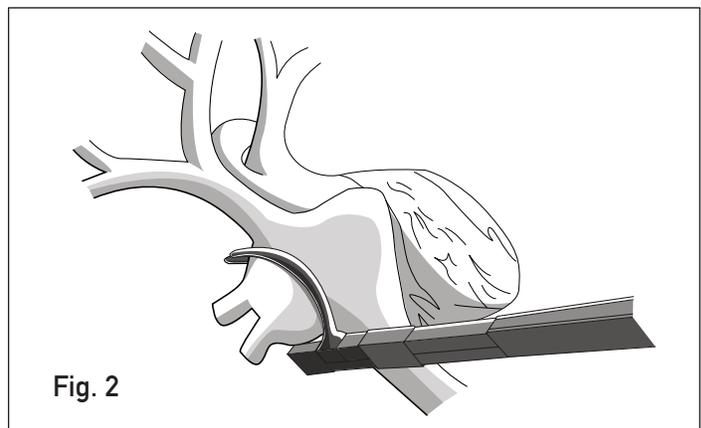
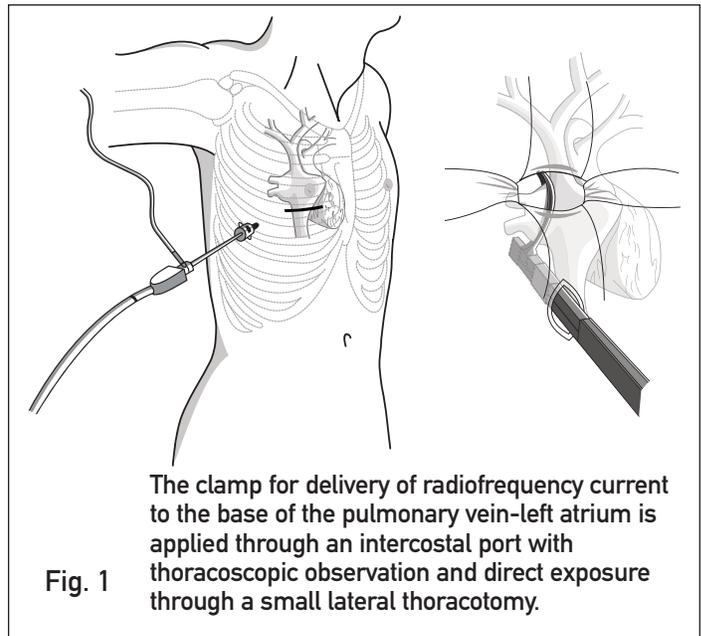
Particular concerns with catheter ablation include pulmonary vein stenosis with endocardial injury and subsequent constricting fibrosis at the base of the pulmonary veins entering the left atrium. The endocardium has been seen as a point of origin for thrombosis and thromboembolism with this technique.^{15, 16, 17, 18}

Initial studies with external delivery of radiofrequency energy to the base of the pulmonary veins have shown a reduction of the incidence of pulmonary vein stenosis with a more limited area of endocardial injury.¹⁹ This technique was initially devoted to those patients with surgical exposure for other procedures of intervention. For patients without need of surgical intervention for other concerns of cardiac dysfunction, a more limited, directed surgical approach was developed. In 2003, Randal Wolf, M.D. introduced the mini-Maze procedure involving thoroscopically-assisted, limited thoracotomy to apply epicardial radiofrequency current to the pulmonary vein-left atrial interface, as well as excising or isolating the left atrial appendage as a source for potential embolization.²⁰ This directed surgical intervention may offset complications of catheter ablation.

In comparison, endocardial catheter-based ablation has remained less successful than surgical-based intervention with recurrence rates of approximately 50 percent.^{21, 22, 23} While studies have demonstrated the pulmonary vein-left atrial interface to be the focus of aberrant conduction to "trigger" atrial fibrillation in approximately 90 percent of patients, there remain other factors related to chronic AF. Mapping studies reveal areas of sensitivity to high frequency stimulation at the base of the pulmonary vein and left atrial wall compatible with autonomic ganglia, which with stimulation demonstrate a profound vagal response. The interruption of these areas of ganglia further improve the success for ablating AF.^{24, 25, 26}

BACKGROUND FOR DEVELOPING DIRECTED SURGICAL ABLATION OF AF

Working with the hypothesis that conversion of atrial fibrillation to a sinus rhythm by epicardial delivery of radiofrequency current to the pulmonary vein-atrial interface is enhanced by ablating autonomic ganglia as a source of stimulation for AF, a clinical protocol has been developed and is being offered at OU Physicians. Intraoperative assessment to assure interruption of



conduction and ganglia sensitivity may improve clinical results. The surgical technique follows the developed procedure of Dr. Wolf as the "Wolf mini-Maze procedure." It involves:

- Exposing the base of the pulmonary veins through thoracoscopic surveillance and an associated small lateral thoracotomy
- Incising the pericardium anterior to the phrenic nerve for appropriate exposure
- Isolating the pulmonary vein-atrial interface
- Applying a clamp to deliver radiofrequency current
- Assessing conduction and area of ganglia sensitivity by topical application of a sensing probe both before and after delivery of radiofrequency

Figure 1 depicts in schematic fashion the surgical approach with **Figure 2** demonstrating the application of the clamp for delivery of radiofrequency current. **Figure 3** is a schematic demonstration of the areas of usual location for autonomic ganglia at the base of the pulmonary vein and left atrial wall. The procedure is accomplished with sequential exposure of the right

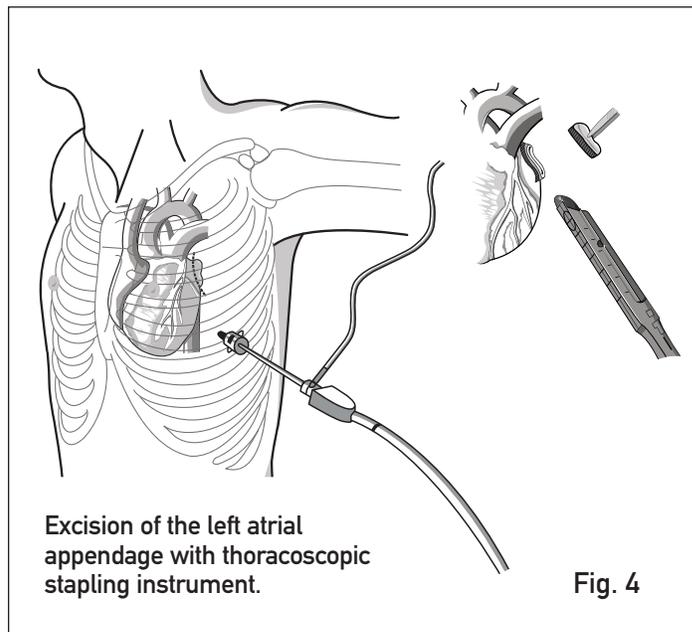
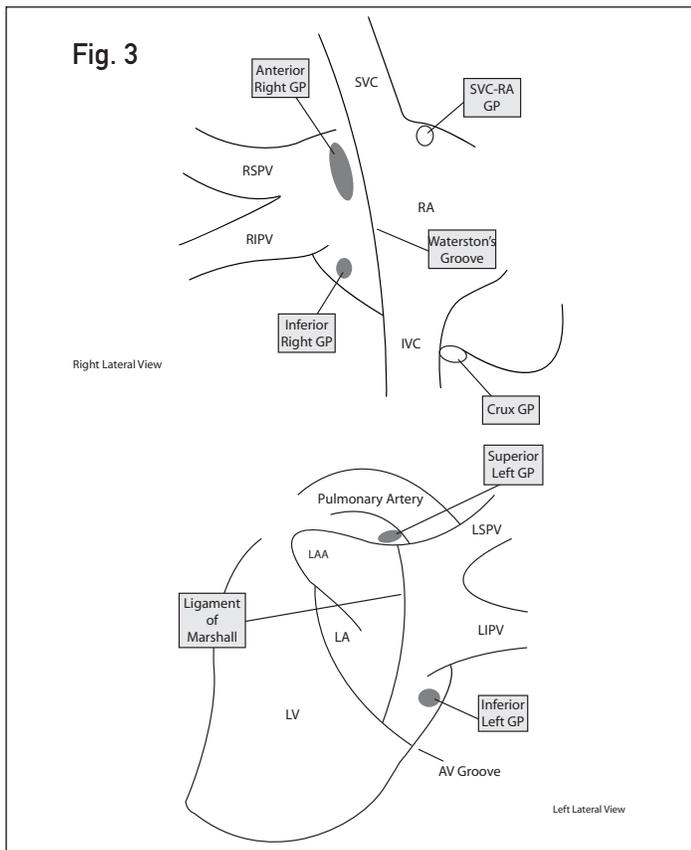


Table II

Thoracoscopic RF Ablation Results
18 Patients

Chronic atrial fibrillation	8 patients
- Converted to sinus rhythm	7 patients (88%)
Paroxysmal atrial fibrillation	10 patients (1 death)
- Converted to sinus rhythm	8 patients (80%)

Table I

Presenting History
18 Patients

Chronic atrial fibrillation	8 patients
Paroxysmal atrial fibrillation	10 patients
Previous catheter ablation	7 patients
Medical management	18 patients

pulmonary vein interface followed by similar exposure of the left side. This technique also incorporates isolation or excision of the left atrial appendage. **Figure 4**

RESULTS AND EXPECTATIONS

In our initial series of patients undergoing directed surgical ablation with radiofrequency current, the procedure has yielded an approximate 88 percent rate of conversion to sinus rhythm for both chronic and paroxysmal atrial fibrillation (**Tables I and II**). National results are similar.

This initial experience suggests a percentage success for ablating AF approaching that of the Cox-Maze procedure, which has been held as the benchmark for comparison. The conversion rate of 88 percent for

patients with chronic atrial fibrillation is particularly encouraging. The mortality reflects comorbid factors of risk involved with the care of patients' cardiac disease. Careful assessment and scrutiny is warranted for the disposition of this procedure, as with any modality of intervention.

CONCLUSIONS FOR CLINICAL CONSIDERATIONS

Directed surgical ablation of atrial fibrillation can be offered by sequential, bilateral, limited thoracotomy with thoracoscopic assistance for radiofrequency interruption of aberrant conduction across the pulmonary vein-left atrial connection. Ablating areas of autonomic ganglia as an additional source of origin for AF may well enhance success. The additional removal or isolation of the left atrial appendage serves to further reduce the concerns for thromboembolism and stroke syndrome. This procedure can be considered for your patients encumbered by AF with its potential mortality when refractory to medical management. To refer a patient who may be a candidate, please call OU Physicians Cardiothoracic Surgery at 405-271-5789.

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