

Case Report

Totally Endoscopic Microwave Ablation for Lone Atrial Fibrillation: An Alternative Method of Treatment

NICHOLAS CHAROKOPOS, EFTHIMIA ROUSKA, IOANNIS STYLIADIS*, POLYCHRONIS ANTONITSIS, CHRISTOS PAPA KONSTANTINOY, PANAGIOTIS SPANOS

*1st Department of Thoracic and Cardiovascular Surgery, *1st Department of Cardiology, Aristotle University of Thessaloniki, AHEPA Hospital, Thessaloniki, Greece*

Key words:

Atrial fibrillation, epicardial ablation, thoracoscopy.

Recent studies suggest that pulmonary vein isolation can be an effective method of treatment for atrial fibrillation. This procedure can be performed with minimally invasive, totally endoscopic cardiac surgical techniques.

We report our first successful endoscopic isolation of the pulmonary veins in a patient with paroxysmal atrial fibrillation. The procedure consisted of making a box lesion around the pulmonary veins, using a flexible microwave energy delivery probe which was placed endoscopically (video assisted thoracoscopy) through three ports, bilaterally.

During a six-month follow up there was no recurrence of atrial fibrillation and the patient's quality of life improved significantly.

Manuscript received:

July 24, 2006;

Accepted:

October 10, 2006.

Address:

Nicholas Charokopos

22 Grigoriou E' St.,

Panorama

55236 Thessaloniki,

Greece

e-mail:

[charokoposnick@](mailto:charokoposnick@hotmail.com)

[hotmail.com](mailto:charokoposnick@hotmail.com)

Atrial fibrillation (AF) is the most common "benign" arrhythmia. It affects about 6% of the population aged over 65 years and its incidence increases with age.¹ It is associated with increased morbidity and mortality as well as concomitant cardiovascular diseases and stroke.² Its treatment entails considerable expense.

Haissaguerre's group recognised that in 94% of cases paroxysmal AF originates in ectopic foci located in the region of the pulmonary veins.³ This observation prompted attempts at AF ablation by isolating the pulmonary veins, in a simplification of the conventional Cox-Maze technique.⁴ Various alternative energy sources, such as radiofrequencies, microwaves and cryoablation, have been tried successfully. In the majority of cases, ablation is combined with the surgical correction of ac-

companying disorders (mitral or aortic valve disease, coronary artery disease) and is performed via a median sternotomy.

We present the case of a patient in whom AF ablation was performed on a beating heart, applying a minimally invasive thoracoscopic technique (video assisted thoracoscopy) and using microwave energy.

Case presentation

A 61-year-old male patient presented with a history of drug-resistant paroxysmal AF for the last 5 years. In the last year the patient had experienced worsening of symptoms and had bouts of AF more frequently, which impaired his working capacity.

The patient was admitted to our institution for a video-assisted thoracoscopic epicardial ablation. He had no relevant past medical history. He had a series of

preoperative investigations. A coronary angiogram showed normal coronary arteries. A transoesophageal echocardiogram demonstrated enlargement of the left atrium (59 mm x 47 mm) with no sign of intracardiac thrombi. All heart valves were normal. The patient signed informed consent.

Description of the technique

After anaesthesia sedation was achieved, a double lumen endotracheal tube was used for ventilation. The patient was placed in the supine position. Three 1 cm long thoracoscopic port accesses were created at the level of the third (camera port), second and fourth (arm ports) intercostal spaces, on the anterior axillary line and the middle axillary line, respectively.

After right lung exclusion (CO₂ was not used) the pericardium was incised 2 cm above the right phrenic nerve. The incision was extended superiorly toward the superior *vena cava* and inferiorly to the diaphragm. The pericardial folds between the superior *vena cava* and the right upper pulmonary vein and between the inferior *vena cava* and the right lower pulmonary vein were dissected. Dissection was performed using endokitner or suction irrigation until the transverse sinus (TS) and the oblique sinus (OS) were opened. A urological stylet was introduced in a piece (50 cm) of a Levin[®] tube (Pennine Healthcare Inc, Derby, UK). After being bent slightly into a shallow curve, it was inserted through the most inferior port into the TS. The stylet was removed and the Levin[®] tube was further introduced by a grasper. A second Levin[®] tube was inserted similarly in the OS.

The patient was switched to single right lung ventilation. From the patient's left side endoscopic instruments were placed through a triangle of ports, as on the right side of the chest. The pericardium was opened longitudinally above the left phrenic nerve and the two Levin[®] tubes were retrieved through the most inferior port. Their tips were tied together and the ensemble was then pushed back into the chest.

The guide lead of the Flex 10[®] Microwave Ablation probe (Guidant, CA, USA) was sutured to the end of the TS Levin[®] tube. Traction on the proximal end of the OS Levin[®] tube allowed the Flex 10[®] probe to slide in the chest and encircle the pulmonary veins. Special care was taken regarding the proper orientation of the probe. The probe should lie behind the left atrial appendage in order to avoid any damage to the circumflex artery.

A continuous circular lesion encircling the pul-

monary veins was produced by microwave energy (65 W for 90 s) (Figure 1). An overlapping lesion was created on the right side to connect the two ends of the lesion (Figure 2).

The total operative time was 3 hours and 35 min. There were no complications. The patient was extubated after 5 hours and was transferred to the ward on the second post-operative day.

On the third post-operative day the patient had episodes of AF/flutter which were self-terminating.

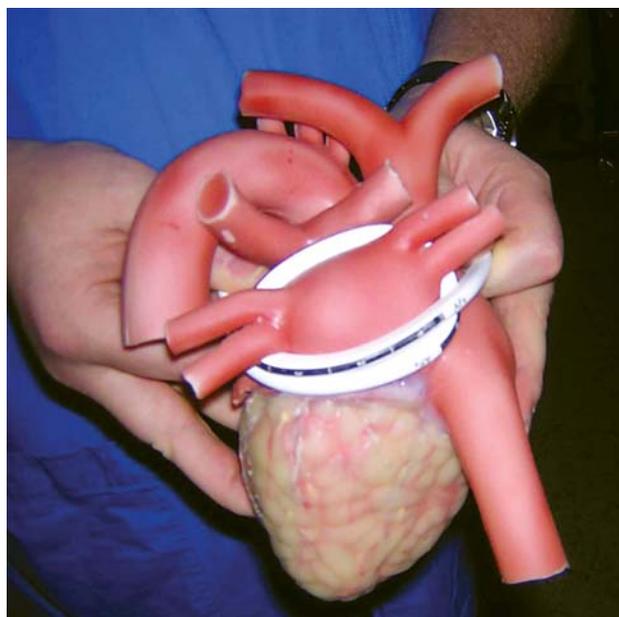


Figure 1. Positioning of the Flex 10 flexible device around the pulmonary veins (box lesion).



Figure 2. The arrow shows the overlapping lesion created from the right side.

Prophylaxis with coumadin anticoagulation treatment was initiated. Post-operative course was uneventful. The chest X-ray was normal. The patient was discharged on the sixth post-operative day in sinus rhythm. He remained in sinus rhythm during the following 6 months, without any palpitation or electrocardiographic evidence of recurrent AF. Monthly Holter monitoring confirmed stable sinus rhythm. The patient's quality of life improved dramatically.

The patient was maintained on oral anticoagulant therapy for 3 months. The oral antiarrhythmic medication was withdrawn gradually after the third post-operative month.

Discussion

The Cox-Maze procedure is a very effective surgical therapy for atrial fibrillation (99% elimination of AF and 2% mortality).⁵ It has not been routinely adopted because of its technical complexity and surgical invasiveness. Surgical ablation using various energy sources (radiofrequencies, microwaves, cryoablation) has been introduced as an alternative to this "cut-and-sew" technique.

Over the past years the latter method has been performed through median sternotomy in conjunction with other cardiac surgery procedures.⁶ Recently, epicardial microwave ablation has become popular because of its minimal invasiveness (reduction of the pump and aorta cross-clamp time). Furthermore, this procedure can be performed in association with off-pump coronary artery revascularisation. This was a major technical advance, which was further improved with the development of a fully endoscopic technique, robotic-guided or video-assisted, as treatment for lone AF (AF that is not accompanied by other cardiac disorders).⁷⁻¹²

Microwave energy creates a thermal transmural lesion, leading to the formation of a scar that impedes the transmission of a stimulus from the atrial myocardium. High frequency electromagnetic radiation (microwaves) causes water molecules within cells to oscillate, transforming the electromagnetic into kinetic, and hence thermal energy. The lesion produced differs from that caused by radiofrequency energy, being deeper and transmural. As the lesion is created on the epicardium there is no endocardial damage, which has been found to predispose to thrombus formation. Damage to adjacent structures, such as the oesophagus, has not been reported from the use of microwaves. With some radiofrequency catheters, ablation damage to the oesophagus has been described.

With the design of the microwave catheter, such damage is unlikely to occur because of the rapid temperature decline beyond a distance of 5 mm from the device.⁶ Special attention must also be paid to the placement of the catheter posterior to the left atrial appendage so as to avoid injury to the circumflex artery.

In recent years there has been significant development in the technique of catheter radiofrequency ablation for AF during an electrophysiological study, to create lesions around the ostia of the pulmonary veins as well as isolating other ectopic foci in the atrial endocardium.¹³ The results from this technique have been encouraging. Various centres have reported restoration of sinus rhythm in 52% of cases without the need for antiarrhythmic medication, while 23.9% of patients also needed antiarrhythmic drugs before sinus rhythm could be restored.¹⁴ Using this method focal lesions are created in the atrial endocardium, in contrast to epicardial ablation with microwaves, which creates a continuous lesion. The incidence of complications has been reported as 6%. The most serious complications of radiofrequency ablation are pulmonary vein stenosis, which occurs in 1.87% of patients, cerebrovascular stroke, myocardial rupture, and the formation of an atrio-oesophageal fistula. AF recurrence rates from 4% to 49% have been reported in various patient series, although differences in the protocols followed make it difficult to draw firm conclusions.

Endoscopic epicardial microwave ablation is gradually being adopted by a large number of centres around the world. In cases of paroxysmal AF, the energy is usually applied around the pulmonary veins, while in persistent or chronic cases thermal lesions are created connecting the pulmonary veins with the left and right auricles, as well as between the superior and inferior *vena cava*, with a view to isolating more focal triggers. This series of lesions can also be applied in many cases with anatomical variations. The largest published study reported results from a series of 50 patients with paroxysmal or persistent AF, with a mean follow up of 7.6 months. Follow up was 100% complete with 79.5% (35 of 44) patients in normal sinus rhythm. In 5 patients (10.0%) microwave ablation and subsequent electrophysiology intervention failed and a Cox-Maze III operation was performed.¹⁵ There were no in-hospital deaths. One patient (2.0%) experienced asymptomatic diaphragmatic dysfunction and one patient (2.0%) symptomatic diaphragmatic dysfunction. No patient experienced any other kind of complication, such as myocardial infarction, transient ischaemic at-

tack, cerebrovascular accident, reoperation for bleeding, or required a permanent pacemaker.

In this case report we present our first video-assisted thoracoscopy for the microwave isolation of pulmonary veins as a treatment for lone AF. This procedure might be more difficult than endoscopic robotic guided procedures, but it is more widely applicable because of its lower cost.

In conclusion, thoracoscopic isolation of the pulmonary veins is a feasible procedure. Longer experience will be required to confirm its reproducibility, as well as to minimise the surgical time. This procedure has emerged as the potentially least invasive, inexpensive, and effective surgical treatment for lone AF. We believe that once established, it will become an appealing first line option alternative to percutaneous transcatheter procedures.

References

1. Feinberg WM, Blackshear JL, Laupacis A, Kronmal R, Hart RG: Prevalence, age distribution, and gender of patients with atrial fibrillation. Analysis and implications. *Arch Intern Med* 1995; 155: 469-73.
2. Gillinov MA, Blackstone EH, McCarthy PM: Atrial fibrillation: Current surgical options and their assessment. *Ann Thorac Surg* 2002; 74: 2210-2217.
3. Haissaguerre M, Jais P, Shah DC, et al: Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. *N Engl J Med* 1998; 339: 659-666.
4. Chen SA. Pulmonary vein ablation for atrial fibrillation: Where do we stand, what more can we expect? *Hellenic J Cardiol* 2004; 45: 129-131.
5. Cox JL, Schuessler RB, Cain ME, et al: Surgery for atrial fibrillation. *Semin Thorac Cardiovasc Surg* 1989; 1: 67-73.
6. Maessen JG, Nijs J, Smeets J, Vainer J, Mochtar B: Beating-heart surgical treatment of atrial fibrillation with microwave ablation. *Ann Thorac Surg* 2002; 74: S1307-1311.
7. Argenziano M, Williams MR: Robotic atrial septal defect repair and endoscopic treatment of atrial fibrillation. *Semin Thorac Cardiovasc Surg* 2003; 15: 130-140.
8. Gerosa G, Bianco R, Buja G, diMarco F: Totally endoscopic robotic-guided pulmonary veins ablation: an alternative method for treatment of atrial fibrillation *Eur J Cardiothorac Surg* 2004; 26: 450-452.
9. Saltman AE, Rosenthal LS, Francalancia NA, Lahey SJ: A completely endoscopic approach to microwave ablation for atrial fibrillation. *Heart Surg Forum* 2003; 6: 38-41.
10. Bisleri G, Manzano A, Argenziano M, Vigilance DW, Muneretto C: Thoracoscopic epicardial pulmonary vein ablation for lone paroxysmal atrial fibrillation. *Europace* 2005; 7: 145-148.
11. Balkhy HH, Chapman PD, Arnsdorf SE: Minimally invasive atrial fibrillation ablation combined with a new technique for thoracoscopic stapling of the left atrial appendage: Case report. *Heart Surg Forum* 2004; 7: 353-355.
12. Manasse E, Infante M, Ghiselli S, et al: A video-assisted thoracoscopic technique to encircle the four pulmonary veins: a new surgical intervention for atrial fibrillation ablation. *Heart Surg Forum* 2002; 5: 337-339.
13. Chen SA, Tai CT: Catheter ablation of paroxysmal atrial fibrillation. *Cardiol Rev* 2005; 13: 87-94.
14. Cappato R, Calkins H, Chen SA, et al: Worldwide survey on the methods, efficacy and safety of catheter ablation for human atrial fibrillation. *Circulation* 2005; 111: 1100-1105
15. Pruitt JC, Lazzara RR, Dworkin GH, Badhwar V, Kuma R, Ebra G: Totally endoscopic ablation of lone atrial fibrillation: initial clinical experience. *Ann Thorac Surg* 2006; 81: 1325-1331.