The Heart Surgery Forum #2004-1093
7 (6), 2004 [Epub August 2004]
doi:10.1532/HSF98.2004-1093

Online address: www.hsforum.com/vol7/issue6/2004-1093.html

Minimally Invasive Atrial Fibrillation Ablation Combined with a New Technique for Thoracoscopic Stapling of the Left Atrial Appendage: Case Report

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ABSTRACT

Background: Surgical therapy for atrial fibrillation (AF) is becoming increasingly popular in the concomitant setting. Minimally invasive techniques are being developed for management of the patient with stand-alone AF. We report on our first case of a patient undergoing thoracoscopic microwave epicardial AF ablation combined with the incorporation of a new device for left atrial appendage (LAA) exclusion.

Methods: The patient is a 62-year-old man with a 10-year history of drug-resistant paroxysmal AF. He had failed multiple electrical cardioversions, as well as a percutaneous attempt at left and right superior pulmonary vein (PV) isolation. On October 8, 2003, he was admitted to undergo an off-pump thoracoscopic epicardial microwave ablation. While the patient was under general anesthesia, 3 thoracoscopic access ports were created in the right chest. The pericardium was widely opened. Red rubber catheters were positioned in the transverse and oblique sinuses. The 2 catheters were retrieved on the left side and tied together, forming a guide to the Flex 10 microwave ablation probe (Guidant Corporation, Fremont, CA, USA). The Flex 10 sheath was positioned to encircle all 4 pulmonary veins. The position of the ablation catheter was confirmed visually to be behind the LAA. Sequential ablation was then performed in the segments of the Flex 10 to create a continuous ablation line around the PVs. A connecting lesion to the base of the LAA was then performed. The LAA was then stapled using the SurgASSIST computer-mediated thoracoscopic stapling system (Power Medical Intervention, New Hope, PA, USA).

Results: The procedure was uneventful and lasted for a total of 2.5 hours. The patient was discharged home on postoperative day 2 in rate-controlled AF. He was successfully electrically cardioverted to normal sinus rhythm (NSR). At latest follow-up he remained in NSR and continued to take dofetilide (Tikosyn).

Conclusion: Thoracoscopic epicardial microwave ablation of AF is a technically feasible procedure with minimal risk. The computer deployment and motion controlled stapling system that we used in this case has the potential to become a safe and reliable alternative to conventional stapling instruments.

INTRODUCTION

Atrial fibrillation (AF) continues to be a significant health care problem. More than 2.2 million patients in the United States have AF, and it is estimated that 150,000 new cases are diagnosed every year. Patients can be severely symptomatic and debilitated during paroxysms of AF, and its long-term complications are well documented and include an increased risk of stroke, congestive heart failure, and death [Wolf 1998, Benjamin 1998]. Currently available therapies have had a poor track record in effectively treating this very common problem, and health care dollar expenditures for treatment of this disorder continue to be high [Nattel 2003]. A very effective surgical therapy for AF exists (The Cox maze 3 procedure, pioneered by Dr. James Cox in the 1980s), but is underused because it is highly invasive and is perceived to have a high complication rate [Cox 1991]. Newer surgical approaches are being investigated to minimize the invasiveness and potential side effects of the procedure [Gillinov 2002].

We have been using microwave technology for surgical ablation of atrial fibrillation in the concomitant setting during coronary artery or valve surgery, with relatively good results. Therapy for the "lone AF" patient is a new surgical frontier and demands a redefinition of the acceptable level of invasiveness of the procedure in relation to the expected efficacy. Thoracoscopic surgical AF ablation has emerged as the potentially least invasive surgical cure not requiring an expensive robotic setup, and it has a 75% to 80% long-term success rate. When this procedure is coupled with left atrial (LA) appendage stapling and/or excision, the potential to positively affect outcomes in AF is maximized, and the need for long-term anticoagulation and antiarrythmic therapy is minimized.

MATERIALS AND METHODS

The patient is a 62-year-old man with a longstanding history of drug-resistant paroxysmal AF for the last 10 years. He

Winner of the Best Surgical Video Award at New Era Cardiac Care 2004, Dana Point, California, USA, January 9-11, 2004.

Received June 3, 2004; accepted July 6, 2004.

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had failed multiple electrical cardioversions, as well as a percutaneous attempt at left and right superior pulmonary vein (PV) isolation. He was on dofetilide (Tikosyn) for several months with some improvement but continued to be in AF the majority of the time, as documented by Holter monitoring. On October 8, 2003, he was admitted to undergo an off-pump thoracoscopic epicardial microwave ablation.

The procedure was performed using double-lumen general endotracheal anesthesia. An initial transesophageal echocardiogram was performed to exclude clot formation in the LA appendage. Three right-sided thoracoscopic access ports were created in the third, fourth, and fifth intercostals spaces (IS), and the pericardium was widely opened anterior to the right phrenic nerve. A blunt instrument was used to circumferentially dissect the superior vena cava (SVC) and inferior vena cava (IVC) to provide direct access to the transverse and oblique sinuses, respectively.

As shown in the video, a red rubber catheter was positioned below the SVC and advanced gently through the transverse sinus. Similarly, a second red rubber catheter was introduced below the IVC and advanced through the oblique sinus. Three thoracoscopic access ports were then created on the left side at similar levels. The left pericardium was opened (inferior to the left phrenic nerve), and the 2 catheters were retrieved. The catheter tips were then tied together, forming a guide to the Flex 10 microwave ablation probe (Guidant, Santa Clara, CA, USA), which was attached to the proximal end of the transverse sinus catheter. Traction on the proximal end of the oblique sinus catheter allowed the Flex 10 to slide in the chest and to encircle the PVs. After visually confirming the position and orientation of the Flex 10 ablating sheath posterior to the left atrial appendage (LAA), we performed sequential ablation until a continuous ablation line around the PVs was produced. A connecting lesion to the base of the LAA was then performed by manipulating the position of the ablation catheter from the left side.

A novel computer-mediated flexible thoracoscopic stapling system from Power Medical Intervention (New Hope, PA, USA), the SurgASSIST, was introduced through the left lowermost port. Under transesophageal echocardiographic (TEE) observation and without grasping the LAA, we performed stapling and excision. The patient remained in AF throughout the procedure and was cardioverted to sinus rhythm (SR) at the end prior to extubation.

RESULTS

The operation lasted approximately 2 1/2 hours. At the end of the procedure the patient was in SR, and the TEE revealed a smooth LA wall contour with absence of the LAA. The patient was maintained on dofetilide and warfarin therapy postoperatively. He converted back to rate-controlled AF prior to discharge. About 3 weeks later cardioversion to SR was performed. At last follow-up (6 months) he was in SR; however, he did have some infrequent mostly asymptomatic episodes of short-lived AF as determined by Holter monitoring. Both the patient and his referring cardiologist reported significant clinical improvement in his symptoms after surgery. This improvement was related to a nearly complete absence of symptomatic AF after surgery, compared with nearly 100% continuous AF on Holter monitoring preoperatively. The patient underwent a postoperative echocardiogram that revealed good right and left atrial contractions. The treatment plan was to continue this patient's current medical regimen until further reevaluation at 9 months after surgery.

DISCUSSION

Minimally invasive surgery for the treatment of AF has become a reality. The video accompanying this manuscript shows our technique for video-assisted thoracoscopic epicardial microwave ablation for atrial fibrillation combined with a new device for stapling of the left atrial appendage.

The Flex 10 microwave probe used in this procedure is very versatile because it can be introduced through a small (10-mm) port and positioned around the 4 pulmonary veins to achieve a continuous ablation line, thereby creating a "box" lesion. A connecting line to the base of the left atrial appendage is also easily performed by manipulating the flexible probe from the left side. The amount of dissection needed to penetrate through the transverse and oblique sinuses is quite minimal, as has been shown in the animal model [Manasse 2002]. The clinical use of the thoracoscopic technique was first described by Adam Saltman, MD, in a patient with paroxysmal AF [Saltman 2003]. For patients with chronic AF, right atrial (RA) ablation lines can be performed by positioning the probe on the epicardial surface of the RA to create a superior vena cava–inferior vena cava line and a cruciate line to the AV groove.

We use right thoracoscopic ports for the initial positioning of the Flex 10 device, after which the orientation of the probe and its relationship to the LAA are confirmed by left thoracoscopic ports. This is a very important step to ensure both the efficacy and safety of the procedure. Although there have been reports that the LAA can be seen from the right side, it is much easier and more accurate to view it via the left ports. In addition to facilitating the creation of the connecting lesion to the base of the LAA, left-sided ports allow effective management of the LAA during an ablation procedure. Thoracoscopic obliteration of the LAA has been described as a stand-alone technique for stroke risk reduction in patients with atrial fibrillation who are not candidates for anticoagulation [Odell 1995, Blackshear 2003]. We feel that this is an integral part of any modified maze procedure, not because of its electrophysiologic implications but because of its benefit in stroke prevention in these patients, should there be a recurrence of AF, because the intention is to eventually stop all anticoagulation. The availability of a safe device for closed-chest appendage excision is definitely a welcome development.

The device used for LAA excision in this case is a new computer-mediated, automatically powered linear stapler. It is motored and controlled by a central processing unit that transfers power through the flexible shaft to the functional stapling end, thereby ensuring a smooth transfer of the linear

stapling and cutting force to the fragile LAA tissues. Originally designed for use in gastrointestinal applications, the SurgASSIST linear stapling device appears well suited to handling the delicate nature of LAA stapling, especially in a closed-chest setting. The addition of pericardial strips to the staple line, as was performed in this case, gives an added measure of protection from staple-line bleeding. We have used this technique with no major complications in more than 30 LAA excisions to date in both the open- and closed-chest setting.

The lesion pattern performed in this patient, consisting of encirclement of the 4 pulmonary veins with a connecting lesion to the base of the left atrial appendage, combined with excision of the appendage, is our standard pattern for patients with paroxysmal AF. As has been widely referenced, the aberrant electrical triggers responsible for paroxysmal AF have been shown to be concentrated around the pulmonary veins [Haissaguerre 1998, Chen 1999]. The box pattern isolates these triggers from the rest of the atrial tissue. The connection to the base of the appendage is designed to help minimize postoperative LA flutter, as described by Dr. Cox [Cox 1995].

Epicardial microwave ablation has been shown to create transmural lesions in both the arrested and beating heart models. Dosimetric studies in the animal lab have been performed to delineate the time and energy level of ablation required to create a specific lesion depth [Williams 2002]. In the clinical setting Dr. Manasse et al confirmed histologic transmurality in right atrial appendage specimens following epicardial off-pump ablation with the Flex 4 probe in patients undergoing valve surgery prior to heart arrest [Manasse 2003]. Microwave ablation has been used in more than 4000 patients in all different kinds of settings (eg, arrested heart, beating heart, epicardial, endocardial) with no reported major adverse clinical events. The overall success rate with this type of ablation appears to be approximately 80% freedom from AF.

In conclusion, we have presented a technical paper on our first minimally invasive surgical microwave ablation for AF. We feel that with the current microwave technology using the Flex 10 device we are able to offer this procedure with minimal morbidity and reasonably good outcomes. The automated computerized stapling device for excision of the left atrial appendage has potential for becoming the instrument of choice for closed chest management of the appendage. We feel this is an integral part of the ablation procedure given its implication in stroke reduction.

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