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Thoracoscopic Ablation for Treatment of Atrial Fibrillation: A 2-Port Approach

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ABSTRACT

We describe epicardial ablation using a 2-port, right-sided, thoracoscopic approach for pulmonary vein isolation on the beating heart in the treatment of atrial fibrillation. Our early success rate with this procedure for the epicardial lesion pattern is 86%. Utilizing new ablation energy sources, such as laser and microwave, this port access approach offers surgeons a true minimally invasive, safe, and efficacious option that will support the lone treatment of atrial fibrillation.

INTRODUCTION

Midline sternotomy provides excellent access for valve, coronary artery bypass graft (CABG) and ablation, but the driving force for patients and our referral community is for minimally invasive approaches to surgery. Minimally invasive approaches must be evaluated in terms of their safety, as evaluated by complication rates relative to established approaches; their efficacy, as evaluated by outcomes relative to standard procedures; their utility, defined as accessible and straightforward for the average surgeon to perform; and their cost, comparable relative to the standard procedure. With the potential to reduce recovery time and morbidities, and given procedures with equal safety, efficacy, utility, and cost, thoracoscopic approaches will be favored over time. New energy sources, such as laser energy and microwave, have supported promising advancements in the development of a thoracoscopic, 2-port approach to epicardial ablation treatment of atrial fibrillation (AF) that meets these criteria.

Surgical Treatment for Atrial Fibrillation

Primary foci for AF are concentrated in the ostiae of the pulmonary veins on the adventitial surface. Isolation of these primary foci is a base treatment for the eradication of AF. Secondary AF can have multiple other causes, such as major re-entrant circuits within the left atrial surface itself, re-entrant pathways through the mitral valve annulus, and superior and inferior vena cavae orifices. The original surgical treatment for AF, the Maze procedure, consisted of creating lesions to isolate the pulmonary foci from the rest of the heart as well as secondary lesions to address the re-entrant circuits and right atrial issues. Despite its 96% success rate [Prasad 2003], the highly invasive Maze procedure is not widely used today. Over the past 5 years, several energy sources have been explored as capable of providing less invasive methods of treating AF, including laser, microwave, bipolar radiofrequency, ultrasound, and cryotherapy.

Epicardial Ablation for Pulmonary Vein Isolation

The past 2 years have seen significant growth and interest in utilizing pulmonary vein isolation (PVI) alone as a primary surgical treatment for AF. The success rate for epicardial-based PVI has been surprisingly good, ranging from 70% to 88% for primary treatment [Verma 2005]. Although the success rate is less than that of the full surgical Maze procedure, PVI affords the surgeon a minimally invasive approach that offers greater success and less morbidity than catheter-based approaches, thus making the treatment suitable for a greater percentage of the population. All factors considered, epicardial ablation utilizing laser and microwave energy sources is now the standard, first-line therapy at Enloe Medical Center in the surgical treatment of AF.

Minimally Invasive Access to Achieve Pulmonary Vein Isolation

Once epicardial PVI became accepted as a primary therapy, we began exploring minimally invasive accesses to perform this therapy for patients with lone AF. These minimally invasive methods (generally considered as excluding extracorporeal circulation and a sternal sparing incision) have included minithoracotomy, subxyphoid endoscopic approaches, bilateral thoracoscopy, and more recently a 2-port right-sided thoracoscopic approach, as the least invasive of these techniques.

TECHNIQUE

Pericardioscopy

Periacardioscopy is required to perform the sole right-sided approach to thoracoscopic ablation. A standard endoscope with a modified conal covering enables surgeons to

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perform this complete pericardial endoscopy and support accurate dissection on the back side of the heart. This therapeutic approach has been explored extensively as an aid to sympathectomy, stem cell injection therapy, pacemaker lead implantation, and more recently, closed approaches to coronary revascularization. Various protected scopes are available, including the Vasoview system from Guidant (Santa Clara, CA, USA), the endoscopic vein harvesting system from Cardiovations (Somerville, NJ, USA), and a recent system from Terumo (Ann Arbor, MI, USA). This type of protected scope allows the surgeon to dissect out the pericardial reflection covering the entrances to the transverse sinus and oblique sinus, which is critical in the treatment of AF. Furthermore, the surgeon can scope along the entire back wall of the cardiac surface to view proper placement of the energy source's malleable sheath on the back of the heart along its entire extent. The surgeon is provided the visibility necessary to confirm that an appropriate lesion has been affected around the pulmonary veins. The scope also allows the surgeon to traverse above the heart to ligate the left atrial appendage, if desired, from the right-sided thoracoscopic ports.

Two-Port Thoracoscopic Approach for Pulmonary Vein Isolation

In the supine position, under general anesthesia with double lumen endotracheal intubation, the right lung is deflated to create required access and visualization space. The supine positioning assures the deflated lung will not overlap or interfere with pericardial access. The right arm is raised over the patient's head in a sling-type fashion to help expose the midaxillary line and to stretch the lateral rib cage. Two 12-mm ports are inserted over the right thorax at the 2-3 and 4-5 intercostal spaces in the midaxillary line, resulting in the superior port placement at the approximate level of the superior vena cava (SVC)/right atrium (RA) junction and the inferior port placement at the approximate level of the inferior vena cava (IVC)/RA junction.

The SVC/RA junction is identified by localizing the bulge of the pericardium over the RA and by the deflection that occurs at the junction. Care should be taken to confirm identification of the right phrenic nerve, and to ensure that dissection of the pericardium occurs above and well away from the nerve itself. Extensive pericardial dissection over the SVC/RA junction will provide clear identification of the SVC, right pulmonary artery, and RA. The pericardium is then incised over the RA/IVC junction to afford a view of the right inferior pulmonary vein, IVC, and RA.

The pericardial reflection under the SVC and above the right pulmonary artery/right superior pulmonary vein is carefully dissected to ensure no damage occurs to these structures. The protected conus dissecting scope is then passed between the SVC and just superior to the right superior pulmonary vein into the transverse sinus along the dome of the left atrium until full visualization of the left atrial appendage is made. Next, the scope is retracted into the right hemithorax and passed through the pericardial reflection underneath the IVC, just inferior to the right inferior pulmonary vein. Again, care should be taken to ensure no damage occurs to these structures. Once through the pericardial reflection, the scope is passed through the oblique sinus and then passed superiorly until the left atrial appendage is seen, now from the inferior passageway.

Next, soft tubing such as silastic nasogastric tubing (NGT) is passed through the transverse sinus. The NGT is inherently directed by the left pericardial surface inferiorly when emerging from the transverse sinus along the left atrial appendage. The protected endoscope is again passed through the oblique sinus to catch and pull the end of the NGT through the oblique sinus. The NGT will serve as a guide in directing the malleable sheath of the preferred energy source (laser or microwave) to lie above the right superior pulmonary vein, pass along the dome of the left atrium, come out of the transverse sinus, lie lateral to the left atrial appendage, turn 90° around the left inferior pulmonary vein, run along the inferior base of the left atrium superior to the coronary sinus, and finally emerge from the oblique sinus just inferior to the right inferior pulmonary vein.

Confirmation of the positioning and lie of the malleable sheath is now performed by passing the protected conus scope around the heart. Ablation therapy is conducted to perform a fully contiguous isolation line around the pulmonary veins. A specific ablation is also performed over the right anterior ganglion and a partial isthmus ablation is performed over the posterior and medial aspect of the IVC. Once the therapy is concluded, the scope is passed again to confirm the ablation scar on the surface of the heart. If present, the probe is removed. If a continuous uniform scar line is not observed, that specific area is reablated. If desired, the left atrial appendage can be stapled at this time using an endo-stapler. The right lung is then reinflated and a drainage tube may be used at the discretion of the surgeon. The patient can return home later that same day or the following morning.

COMMENTS

Our early success rate in the epicardial lesion pattern was 86%. In more than 60 cases completed to date using the thoracoscopic epicardial approach, we have experienced a statistically similar success rate, although a significant proportion of the lone AF patients were of the paroxysmal or intermittent type. With the availability of the laser device this past year, we have increased our usage of this more penetrating energy source.

The population for lone AF is estimated at about 2.5 million people in the US and is expected to increase as the aging population grows. Using a 2-port thoracoscopic approach for PVI will afford surgeons a minimally invasive, safe, and efficacious option, making epicardial ablation available to a greater percentage of the AF population.

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