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Harmonic Scalpel for Pericardiectomy: Novel Approach to an Old Cardiac Dilemma

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ABSTRACT

Background: Pericardiectomy for constrictive or calcific pericarditis is a technical challenge because of dense adhesions to the epicardial surface of the heart. The procedure is fraught with the possibility of urgent cardiopulmonary bypass from excessive bleeding or cardiac laceration. We propose the use of a harmonic scalpel to perform adhesiolysis with less bleeding and cardiac trauma.

Methods and Materials: A retrospective review of 7 pericardiectomies performed with a handheld harmonic scalpel over the past 2 years was performed. Requirements for blood products, the need for cardiopulmonary bypass, and mortality were examined.

Results: Four of the patients underwent pericardiectomy alone, and 3 patients underwent pericardiectomy with additional cardiac procedures. The 30-day mortality was zero. No patient needed blood transfusions or urgent cardiopulmonary bypass for bleeding. No patient developed malignant arrhythmias.

Conclusions: Use of a harmonic scalpel is a safe and efficient technique for pericardiectomy. Adhesiolysis is less treacherous because of the bloodless operative field; moreover, the harmonic scalpel is not arrhythmogenic.

INTRODUCTION

Ultrasonic technology has penetrated the surgical arena and influenced the practice of surgery in a myriad of specialties. One example of this phenomenon is use of a harmonic scalpel. Many general surgeons have incorporated a harmonic scalpel in their routine surgical interventions, particularly hepatobiliary and bariatric procedures. Cardiothoracic surgeons have used this energy source in mobilizing of the internal mammary artery and harvesting the greater saphenous vein and radial artery [Gosh 1999]. We present our experience with the use of a harmonic scalpel in the management of pericardial disease, specifically constrictive pericarditis. This technology also may be applied to pericardial release in reoperative cardiac surgery.

Although tuberculous pericarditis was common in the past, more recent etiologies of pericarditis include mediastinal irradiation, prior cardiac surgery, and idiopathic causes [Ling 1999]. Constrictive pericarditis is cured surgically. The procedure of choice is radical pericardiectomy involving a 4-chamber cardiac release. In chronic constrictive pericarditis, the pericardium thickens, fuses to the epicardium, and often becomes calcified. This fibrotic mass may become adherent to the myocardium. Pericardiectomy using sharp dissection or electrocautery may be a perilous endeavor owing to the risk of injury to the epicardial vessels and myocardium or of induction of arrhythmias. A harmonic scalpel appears to offer several advantages to the more traditional techniques.

Vibration is the energy source in ultrasound technology. Most commercially available cutting devices convert electrical energy into mechanical energy. The mechanical energy is delivered in the form of blade vibration. The harmonic scalpel blade vibrates 55,500 times per second, cleaving tissue by dividing hydrogen bonds and denaturing protein [de Chaumaray, Gosh 1999]. The denatured proteins form a tenacious coagulum. No electrical energy is transmitted to the tissue. As a result, lower temperatures (80°C) are used with this energy source in comparison with electrocautery. Other forms of energy require temperatures as high as 150°C to 400°C, which cause tissue oxidation and desiccation [Gosh 1999, Uchida 2001]. The aforementioned properties of ultrasonic energy are appealing to cardiothoracic surgeons because of the decreased insult to tissues and minimal collateral damage.

METHODS AND MATERIALS

Between January 2002 and January 2004 we performed 7 radical pericardiectomies for the diagnosis of constrictive pericarditis at Mount Sinai Medical Center, Miami Beach, Florida, USA. The pericardectomies were performed with a combination of scalpel, Metzenbaum scissors, electrocautery, and 5-mm handheld, curved-blade harmonic scalpel (Ethicon, Somerville, NJ, USA) (Figure 1). Cutting and coagulation performance may be adjusted either on the handle or on the generator. Our preference is to use the harmonic

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Figure 1. Handheld harmonic scalpel and the controls on the handle.

scalpel on the generator level of 5, which provides more cutting speed than coagulation power.

The patients included 3 women and 4 men ranging in age from 33 to 68 years with a mean of 61.5 years. Symptoms including shortness of breath and signs such as hepatomegaly, ascites, and edema of the lower extremities suggested the diagnosis of constrictive pericarditis. The diagnosis was confirmed by echocardiography, cardiac catheterization, and computed tomography (Figure 2). These imaging modalities were used to determine whether additional procedures were necessary.

Operative Technique

A pulmonary artery catheter and a radial arterial line were placed preoperatively in all patients. Both sides of the groin were prepared and draped in the event that femoral bypass was required. Our preferred method was median sternotomy. In reoperations, a subxiphoid approach with videoscopic visualization was used. Cardiopulmonary bypass was kept on standby. Dissection was begun on the diaphragmatic surface; however, if this dissection were particularly difficult, a section with less adherent pericardium was approached first. In areas where filamentous adhesions were encountered, we safely used the Metzenbaum scissors and electrocautery to hasten dissection. In areas of thick, dense, and fused adhesions, a harmonic scalpel was used to develop a bloodless dissecting plane. The extent of dissection encompassed the aorta superiorly to the apex of the left ventricle and laterally to the phrenic nerves. The anterior pericardium was removed. On the posterior aspect, the entire surface of the left ventricle and part of the left atrium sparing the pulmonary veins were released. The right atrium and superior and inferior venae cavae were similarly mobilized. Once the pericardium was stripped completely from the heart, 2 chest tubes were placed in the mediastinum, and the sternum was closed with wires.

RESULTS

Four patients underwent pericardiectomy alone, and 3 patients underwent pericardiectomy with additional cardiac

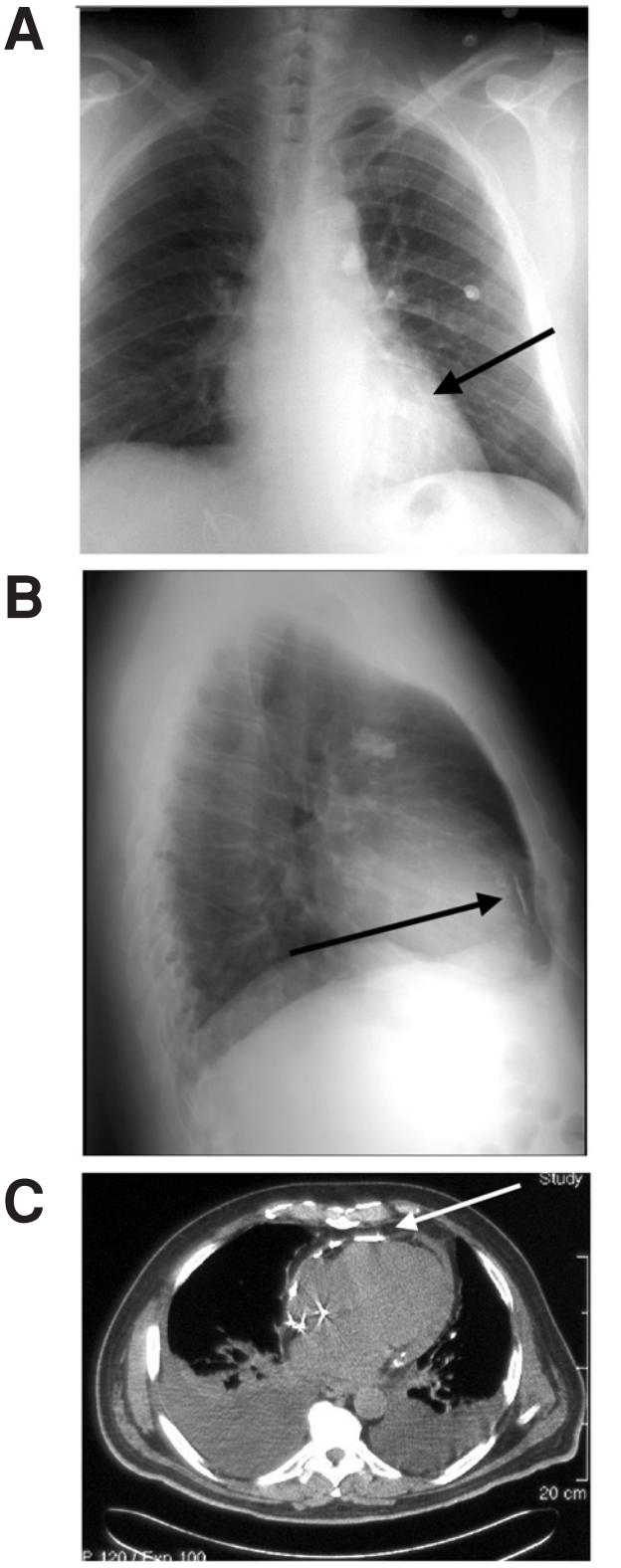

Figure 2. A, Plain chest radiograph shows calcifications on the pericardium (black arrow). B, Plain lateral chest radiograph delineates calcification to the anterior pericardium (black arrow). C, The chest computed tomographic scan delineates thick pericardium and associated calcifications (white arrow).

procedures. The average length of stay was 17 days postoperatively with a range of 8 to 60 days. The 30-day mortality for this procedure was zero. One patient was readmitted and died 2 months postoperatively of an unrelated medical illness.

None of the 7 radical pericardiectomies necessitated intraoperative blood transfusion. No major bleeding was encountered during dissection. There were no arrhythmias associated with harmonic scalpel use. However, ventricular arrhythmias were induced by the electrocautery. No antiarrhythmic drugs were given, nor were cardioversions performed during these procedures. No patients needed cardiopulmonary bypass for pericardiectomy. In the 3 patients who needed additional cardiac procedures, cardiopulmonary bypass was used as necessary.

All patients were initially cared for in the intensive care unit, and no patient needed a return to the operating room because of mediastinal hemorrhage.

DISCUSSION

The small number of patients in this report demonstrates the advantages of a harmonic scalpel in treating constrictive pericarditis. The utility of a harmonic scalpel can be expanded to the mediastinal dissection in reoperative cardiac surgery. The scalpel is easy to use, facilitates dissection, does not induce arrhythmias, and is safe.

The newest generations of harmonic scalpel are extremely user-friendly because the handheld lightweight wand has controls at the finger tips. This feature eliminates the floor pedal or relying on other personnel to coordinate the energy source. Essentially, a harmonic scalpel is comparable with an electrocautery in regard to maneuverability and degree of freedom. Another favorable quality of this device is that no grounding pads are required, and concomitant use of the electrocautery is possible without interference.

A harmonic scalpel facilitates dissection by creating a smokeless and bloodless field. It has significant advantages over scalpel, scissors, and electrocautery in areas where the pericardium is thick and fused to the surface of the heart. Use of scissors or electrocautery can result in untoward bleeding from epicardial vessels or injury to the ventricles. A harmonic scalpel allows release of pericardium without major bleeding. The lack of intraoperative blood transfusion underscores the efficacy of this instrument in developing a concise tissue plane and coagulation. We did not need cardiopulmonary bypass for pericardiectomy because of judicious use of the harmonic scalpel. In addition, use of this device is extremely effective when adhesions are calcified. The vibratory nature guides the harmonic scalpel under the calcific tissues, producing a meticulously clean plane. The instrument separates adhesions without indiscriminate shattering of calcium. The low heat intensity allows for precise and delicate navigation without dispersion or burn injury to adjacent tissues.

Because there is no electrical stimulation of the myocardium, the harmonic scalpel does not induce arrhythmias, as might occur with an electrocautery. Furthermore, the dissector is not sensed as noise or electrical signal by pacemakers or defibrillators.

In brief, an ultrasonic dissector is an excellent addition to the surgeon's armamentarium. A harmonic scalpel is safe, efficient, and nonarrhythmogenic. These qualities are ideal for releasing the heart from adhered pericardium whether in treatment of constrictive pericarditis or in performance of reoperative cardiac procedures.

REFERENCES

de Chaumaray TD, Menasche P. 1995. Ultrasonic dissection: a useful adjunct to operation for calcified constrictive pericarditis. Ann Thoracic Surg 59:1243-4.

Gosh P. 1999. Ultrasonic devices in cardiac surgery. Asian Cardiovasc Thorac Ann 7:333-8.

Ling LH, Oh JK, Schaff HV, et al. 1999. Constrictive pericarditis in the modern era: evolving clinical spectrum and impact on outcome after pericardectomy. Circulation 100:1380-6.

Uchida T, Bando K, Minatoya K, Sasako Y, Kobayashi J, Kitamura S. 2001. Pericardectomy for constrictive pericarditis using the harmonic scalpel. Ann Thoracic Surg 72:924-5.