FIGURE 2. Thoracoscopic view of the transparent blue seal after spray application of PleuraSeal lung sealant at the site of pulmonary tissue resection (with an endoscopic linear stapler).

When PEG and trilycine solutions are mixed, they polymerize almost instantaneously to form a 3-dimensional absorbable hydrogel.⁴ The polymerization is a gentle process on tissue with no exothermic reaction and minimal tissue response. The rapid influx of the liquid form of PEG and trilycine into tissue crevices enables hydrogel formation that has a strong mechanical bond with underlying tissue. The combination of high cohesive strength and flexibility of the hydrogel renders it the capability to accommodate natural expansion and contraction of the underlying lung tissue.⁵

For proper spray application during thoracoscopic procedures, the MicroMist applicator tip should be held 2 cm from

the target site, and the sealant should be applied in a way to create a 1- to 2-mm-thick hydrogel. The application site should be prepared by removing all blood and fluids before spraying. When compared with the injection technique, the spray applicator enables uniform spraying of the sealant to cover a larger surface area and enables paucity between spray intervals without clogging of the applicator tip or denaturing of the sealant components.

PleuraSeal has received the CE mark (Conformité Européenne) for lung sealing and has been available in the European Union since 2006; however, at present, it is not for sale in the United States. A single-use application kit costs approximately €400. PleuraSeal offers a novel off-the-shelf synthetic biodegradable lung sealant that can be applied as a visible blue-colored spray and can be used as a prophylactic adjunct in thoracoscopic lung procedures.

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The application of nitinol thermoreactive Flexigrips for late post-cardiac surgery sternal instability

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Median sternotomy is the most frequently used incision in cardiac surgery. Sternal instability is a chronic complication

following malunion or nonunion. This is traditionally managed by reopening the sternum completely, removing fractured or loose metalwork, and rewiring. Reoperation may be hazardous due to adhesions, adjacent right ventricle, and patent grafts. We report for the first time the application of nitinol thermoreactive Flexigrips (Preasidia SRL, Bologna, Italy) in the management of sternal instability without the need to enter the mediastinum.

CLINICAL SUMMARY

Patient 1

An 80-year-old man with FEV₁ of 0.8L was admitted with unstable angina. After an urgent coronary angiogram, he underwent quadruple coronary artery bypass grafting (CABG;

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FIGURE 1. A, The unstable, nonunited sternum. The wires have been removed. The head of the patient is on the right. B, The 4 Flexigrips in place. Note the redovac drain in the wound. The head of the patient is on the right.

left internal thoracic artery to left anterior descending artery, reversed long saphenous vein [LSV] to second diagonal, LSV to second obtuse marginal, and LSV to posterior descending artery) with cardiopulmonary bypass. The chest was closed with 7 stainless steel wires. Postoperative recovery was uneventful, and the patient was discharged home 1 week after surgery. One year later, he presented with symptomatic unstable sternum. The patient was readmitted for sternal reconstruction. Thoracic epidural catheter was inserted. At surgery, 6 of the sternal wires were found to be fractured, and the 2 halves of the sternum were nonunited (Figure 1, A). All the fractured wires were removed. The fibrous union between the sternal edges was not divided. Flexigrips were inserted by incisions made through the external intercostal ligaments and internal intercostal muscles as close as possible to the sternum with diathermy in the third, fourth, and fifth intercostal spaces bilaterally. The edges of the sternum were approximated and the distance between the incisions measured with calipers. This determined the size of Flexigrip required (20–40-mm width). In this fashion, 4 Flexigrips (1 to the manubrium and 3 to the body) were

applied with the help of an applicator. The patient was extubated immediately after the operation. The patient was discharged 5 days after surgery.

Patient 2

A 72-year-old man had triple CABG for unstable angina. The chest was closed with 7 stainless steel wires. Postoperative recovery was uneventful, and the patient was discharged home 5 days after surgery. When the patient was seen during follow-up 8 months later, the 2 halves of the sternum were freely mobile. A chest radiograph revealed fractured wires. Surgery was performed to stabilize the sternum. The broken wires were removed, and 4 Flexigrips were inserted as described above with an excellent result (Figure 1, B). The patient was discharged 7 days after surgery.

DISCUSSION

We have reported for the first time the application of Flexigrips for the correction of late postoperative sternal instability. The major benefit of using Flexigrips is that they can be placed without the need to dissect underneath the sternum, avoiding the risk of damaging the underlying grafts and the right ventricle. Nitinol (Nickel Titanium Naval Ordnance Laboratory) is a metallic alloy of nickel (55%) and titanium (45%) that exhibits extraordinary properties of shape memory and superelasticity. At temperatures below 10°C, nitinol is malleable and can be molded into shape as required. Heating the alloy to >27°C causes it to begin to return to its initial shape. Nitinol is chemically more stable, less corrosive, and more biocompatible than stainless steel.¹ Flexigrips are C-shaped prostheses used in the closure of median sternotomy incisions. Flexigrip is then placed in iced sterile saline solution for several minutes. The clip can then be manipulated, allowing the ends to be inserted through the openings in the intercostal spaces. By warming the Flexigrip to body temperature with sterile saline solution at 45°C, the clip returns to its original shape, approximating the sternal edges. Due to elasticity, Flexigrips do not cut through osteoporotic bone, and as they do not completely encircle the sternum, they can be applied and removed with greater ease. Nitinol does not interfere with magnetic resonance imaging. Flexigrips have been shown to reduce sternal dehiscence as compared with steel wiring after cardiac surgery.²

In the setting of postsurgical instability, however, placement can be cumbersome with the presence of nonuniform tissue on the superior surface of the sternum, which may need to be shaved or resected for symmetrical and flat positioning of the Flexigrips. Also, insertion through the openings in the intercostal spaces, especially on the left side, may injure the adherent left lung, leading possibly to an air leak and pneumothorax. This occurred in the first patient, and we placed a redovac drain at the site of the air leak and

also inserted a left intercostal chest drain. Routine postrepair chest radiograph is advised. In our practice, we recommend the routine use of a sternal support for the following 3 months. We believe that correction with Flexigrips is a safer and simpler way of dealing with post-cardiac surgery sternal instability and should be used more frequently.

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A novel solution for repeated migration of an implantable cardiac defibrillator

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Migration and extrusion of pacemakers and implantable cardiac defibrillators (ICDs) has been reduced over the years as devices have become smaller and lighter. However, this phenomenon still occurs. We present a case in which this problem occurred repeatedly, leading to a novel easily fashioned solution for this previously more common problem.

CLINICAL SUMMARY

A 69-year-old man was referred to the cardiothoracic surgeons for help with repositioning of a migrating ICD in 2007. A dual-chamber ICD was originally inserted in 2004 for sustained ventricular tachycardia. The pulse generator was placed in a subpectoral pocket. The pulse generator subsequently migrated laterally and was repositioned in 2005 to a more medial subpectoral pocket. The patient returned with pain and threatened erosion to the inferior part of the male breast fold. The patient's recurrent problem had a number of predisposing factors. He was overweight at 89 kg and had signs of gynecomastia owing to spironolactone therapy. He had a history of chronic obstructive airway disease with

home oxygen therapy and inhaled steroid medication, with multiple enteral steroid courses. He also had a history of ischemic heart disease for which he had undergone a coronary artery bypass graft many years previously.

There was no evidence of twiddler's syndrome, as has been described in many previous case reports of ICD migration or failure requiring repositioning.¹⁻³ The ICD itself was still functional and there was no evidence of lead dislodgment, fracture, or malfunction from chest radiographs and from ICD interrogation.

With the patient under general anesthesia, the ICD was approached via the left deltopectoral scar from previous insertions. The generator and leads were easily located and dissected free. The generator was detached and the leads were checked and found to be functioning normally. The opportunity was taken to insert a new generator.

Prolene mesh (Ethicon, Inc, Somerville, NJ) and 2-0 polypropylene sutures were used to fashion a pouch around the ICD. The mesh was folded around the ICD and the two open edges were sutured with a horizontal running mattress suture, followed by a continuous over-and-over suture (Figures 1 and 2). The mesh was ensured to be tight around the lead-box connections (Figure 3). The pouch and the enclosed ICD were returned to the subpectoral space, ensuring the sutured edges of the pouch were facing superiorly. With multiple interrupted 2-0 polypropylene sutures applied to the edge of the pouch, the pouch was sutured to the underlying subpectoral fascia. The overlying pectus muscle was closed with interrupted 2-0 absorbable braided suture, and the remaining layers were closed in routine fashion.

The patient was discharged home without complication and on last consultation, approximately 6 months after the procedure, was well and described no problems with the ICD. Specifically, there were no problems with ICD displacement or discomfort.

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