Complex Repair of Pectus Excavatum Recurrence and Massive Chest Wall Defect and Lung Herniation After Prior Open Repair

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For more than 50 years, surgeons used traditional open surgical methods to correct pectus excavatum deformities. These techniques have undergone multiple modifications but involve resection of costal cartilages and mobilization of the sternum to an anterior position. Long-term post-operative complications are rarely published. Recurrence with lung herniation presents unique challenges. We report a technique to repair this condition in a patient with massive chest wall defect and residual excavatum deformity after open repair of his excavatum deformity.

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Pectus excavatum (PE) is one of the most common chest wall deformities, and open surgical correction has been performed with various modifications since the early 1940s [1]. Extensive resection of the costal cartilages and perichondrium can lead to subsequent failure of the cartilages to regenerate or heal properly [2–7]. Rib mal-union, sternal floating, and extensive necrosis with recurrence have been infrequently reported [2, 6, 7]. These complications may require reconstruction to stabilize the chest wall to correct defects. Published techniques to repair complex, failed open PE are limited [2, 5, 6]. Reconstruction of a massive chest wall defect with unstable PE recurrence using poly methyl methacrylate (PMMA), titanium plating, and stainless steel support bars is described here.

A 50-year-old man with a history of two prior open PE repairs at another institution 14 years earlier presented with chronic chest wall pain. His initial operation had been followed by an open reexcision of a chostochondral malunion of his left fifth through seventh ribs. Since that operation, the patient had experienced severe chest wall pain and dyspnea that required chronic high-dose narcotic use and prevented him from all but sedentary activity. On physical examination, the lower sternum was depressed and freely mobile. Manual compression of the sternum into the normal position ameliorated his pain. A palpable defect of the anterior left chest wall showing respiratory reverberation was also noted. Computerized tomography showed a costochondral defect in the left anterior medial chest wall with herniation of the lung (Fig 1). Preoperative cardiopulmonary exercise testing showed a functional capacity <75% of expected and VO2max <40% of predicted, with an unusually high breathing reserve (>50%). A preoperative transthoracic echocardiogram was functionally normal with mild right ventricular impingement.

The patient was taken for surgical reconstruction that used his previous transverse incision scar. A large left anterior chest wall defect with herniation of the lung was identified (Fig 2). Costochondral sternal cartilage and medial anterior cartilage and ribs were absent from the second rib and lower, and the pectoralis muscle was attached laterally to the defect. No regrowth of the left cartilages had occurred. Mobilization of bilateral pectoralis major muscles was performed. On the right, the anterior chest wall was depressed, with a combination of abnormal fibrous scar alternating with fixed, calcified attachments of the ribs to the depressed sternum. No residual cartilage remained, and osteotomy cuts to detach the rigid plate of the right chest wall and elevate it anteriorly were necessary. Debridement of abnormal fibrotic scar to viable cartilage was performed. The sternum was grossly deformed, and sternal osteotomy at the manubrium was performed to allow elevation and derotation. A star-shaped titanium plate (Synthes, Inc., West Chester, PA) was used for fixation of the manubrium and sternum. The individual ribs on the right were then reattached to the sternum with FiberWire braided polyblend suture (Arthrex, Inc., Naples, FL). To stabilize the lower right chest wall attachments to the sternum, a 20-hole straight titanium plate (Synthes, Inc.) was attached to the sternum and lower ribs. Two stainless steel 13.5 inch Lorenz bars (Biomet Microfixation, Jacksonville, FL) were shaped, woven under the sternum, and then rotated into position for additional anterior support of the sternum and chest wall. These were secured to the chest wall with 360° fixation of the bars to the underlying mediolateral rib by use of FiberWire suture. Antibiotic-impregnated Palacos PMMA (Zimmer Surgical, Inc., Dover, OH; mixed with 1 g vancomyocin, 1 g tobramyocin, and 1 g cefazolin) was mixed and allowed to harden for 2 minutes. While still malleable, the PMMA was fashioned to fit the chest wall defect with overlap of the borders and “molding.” It was then removed and allowed to completely harden for another 20 minutes. Significant heating of the substance occurs while curing, and it is recommended to be away from tissues during this time. The hardened PMMA implant was attached to the sternum and lateral ribs with Ethibond Suture (Ethicon, Inc., Raleigh, NC) with incorporation of holes drilled into the implant (Fig 3). The pectoralis flaps and rectus abdominus muscle were brought to the midline and attached to the chest wall and each other. Chest tubes were placed bilaterally. The estimated blood loss during the procedure was 500 mL, and the operating time was 4 hours 49 minutes. The patient was extubated immediately after the operation; however, a ketamine drip was necessary for 24 hours in addition to his thoracic epidural to obtain adequate pain

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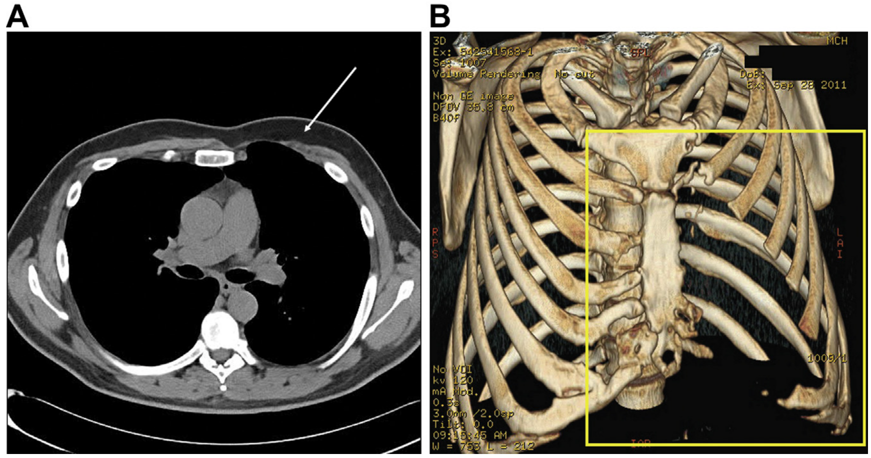

Fig 1. Computerized tomographic images showing (A) thoracic cuts and (B) three-dimensional reconstruction images of recurrent pectus excavatum and left anterior chest wall defect (arrow).

control without significant respiratory depression. Epidural pain management was necessary for a total of 7 days until the patient was able to be transitioned to a 100-μg fentanyl patch, gabapentin, oral narcotics, and intravenous Dilaudid supplementation. Issues secondary to long-term narcotic use with tolerance required an additional 3 days of hospitalization until adequate pain control with oral medications alone was obtained. He received a transfusion of two units of red blood cells because of postoperative anemia (hemoglobin level 6.6 g/dL). At the 1-year follow-up visit, the patient had resolution of his preoperative pain and cardiopulmonary symptoms without evidence of instability or recurrence. He was weaned from all narcotics and returned to full activity.

Comment

Extensive resection of cartilage and perichondrium during open repair of PE may result in failure of the chest wall to heal and reattach [2–7]. Minimal data have been published on the occurrence and morbidity in these patients with failed open repair; however, significant pain, chest wall instability, respiratory dysfunction, and exercise intolerance can be associated with this complication [2–7]. In the case described here, the patient presented with dysfunction suspected to be secondary to chronic pain from lung herniation through a chest wall defect, recurrent PE with cardiac compression, and chest wall instability. The complex nature of the recurrent PE and the relatively large chest wall defect necessitated the use of several techniques to achieve repair. Titanium plating was used to help secure rib and sternal attachments. The use of PMMA to provide a rigid chest wall reconstruction and correct the defect between the residual bony structures created a solid foundation and will prevent recurrent lung herniation. In addition, stainless steel support bars provided improved stability to support the chest wall reconstruction [8]. Finally,

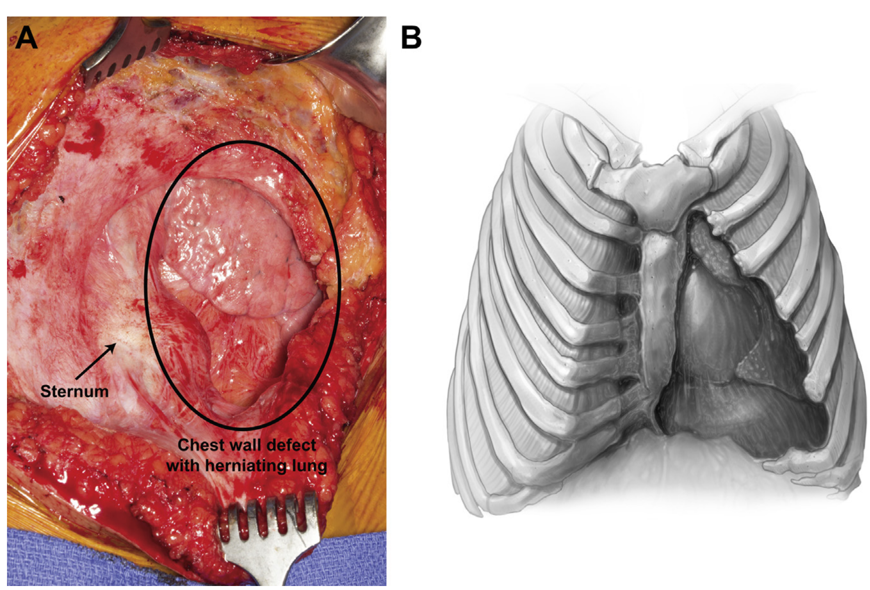

Fig 2. (A) Intraoperative view of mobilized soft tissues of anterior chest wall with underlying large bony defect and lung herniation. (B) Preoperative view of chest wall defect and lung hernia.

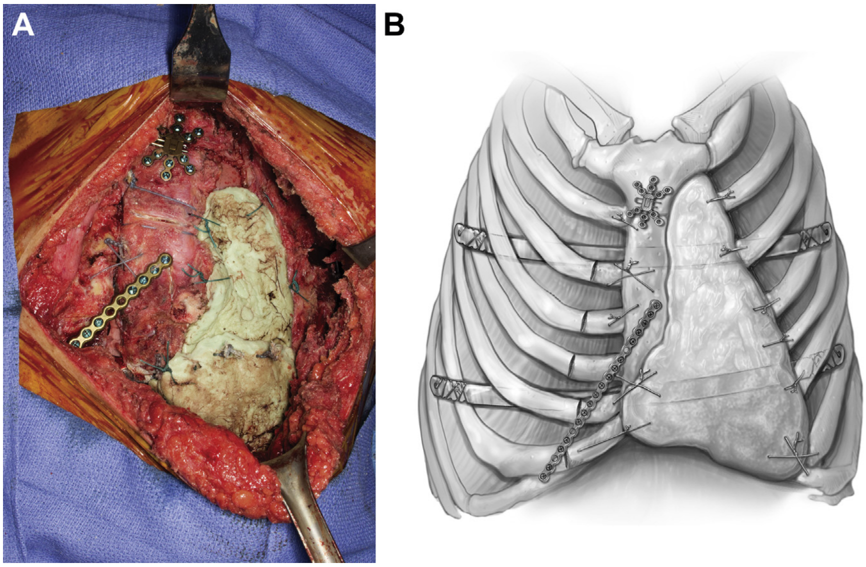

Fig 3. (A) Intraoperative view showing reconstruction of chest wall including methyl methacrylate coverage of bony defect and titanium plating. (B) Postoperative view of reconstruction including methyl methacrylate coverage of bony defect and titanium plating.

mobilization and attachment of the pectus major and rectus abdominis muscles provided coverage of the reconstructed chest wall. These stainless steel support bars will be electively removed in 3 to 4 years.

Combined reconstruction techniques allowed this patient to achieve an excellent result with restoration of chest wall stability, correction of recurrent pectus deformity, and return to pain-free function.

References

1. Lopushinski SR, Fecteau AH. Pectus deformities: a review of open surgery in the modern era. Semin Pediatr Surg 2008;17:201–8.
2. Prabhakaran K. Management of a floating sternum after repair of pectus excavatum. J Pediatr Surg 2001;36:159–64.
3. Ellis DG, Snyder CI, Mann CM. The “re-do” chest wall deformity correction. J Pediatr Surg 1997;32:1267–71.
4. Fonkalsrud EW. 912 open pectus excavatum repairs: changing trends, lessons learned: one surgeon’s experience. World J Surg 2009;33:180–90.
5. Luu TD, Kogon BE, Force SD, Mansour KA, Miller DI. Surgery for recurrent pectus deformities. Ann Thorac Surg 2009;88:1627–31.
6. Mansour KA, Anderson TM, Hester TR. Sternal resection and reconstruction. Ann Thorac Surg 1993;55:838–43.
7. Haller JA Jr, Colombani PM, Humphries CT, Azizkhan RG, Loughlin GM. Chest wall construction after too extensive and too early operation for pectus excavatum. Ann Thorac Surg 1996;61:1618–25.
8. Nuss D, Kelly RE Jr, Croitoru DP, Katz ME. A 10-year review of a minimally invasive technique for the correction of pectus excavatum. J Pediatr Surg 1998;33:545–52.