

Minimally Invasive Concomitant Cardiac Procedures and Repair of Pectus Excavatum: Case Report

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ABSTRACT

A minimally invasive concomitant repair of an atrial-septal defect II with patent ductus arteriosus and pectus excavatum, using a substernal steel bar was successfully done in a 10-year-old girl. Postoperative outcomes and cosmetic appearance were excellent. Therefore, a simultaneous repair of pectus excavatum with cardiac lesions performed in a minimally invasive way is feasible and should be considered, particularly in female children.

INTRODUCTION

Cardiac procedures performed through a midsternal approach in a patient with severe pectus excavatum are known to be complicated. Reports of simultaneous correction of sternal deformity and cardiac disease have been published [Kalanog 1995, Uchida 1997, Wilekes 1999, Pevin 2000]; however, none of these articles reported the use of a minimally invasive combined procedure. We describe a successful simultaneous repair of sternal deformity using a substernal steel bar and closure of an atrial-septal defect (ASD) II with patent ductus arteriosus (PDA) as a minimally invasive procedure.

CASE REPORT

A 10-year-old girl with exercise intolerance and sternal deformity was admitted to our hospital. Transthoracic echocardiography confirmed a large ASD II with left to right shunt (Qp/Qs = 2.4) and a small PDA with a diameter of 2 mm. Chest computed tomographic scan revealed a pectus excavatum with pectus index of 3.5. Preoperative pulmonary function test results could not be obtained, because of cooperation difficulties. However, the patient seemed to have severely diminished pulmonary function.

Received December 11, 2003; received in revised form February 27, 2004; accepted March 17, 2004.

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Surgery was performed with the patient under general anesthesia. A lower midline skin incision was made starting from the costoxiphoid angle toward the suprasternal notch. A median sternotomy was done from the base of the xiphoid process to the right sternal border of the third intercostal space, avoiding intrathoracic invasion. With anterolateral traction of the partially divided sternum, a transverse sternotomy was made unilaterally using a vibrating saw. A small sternal retractor was used to open the sternum and an Army-Navy retractor to elevate the intact upper sternal edge anteriorly and superiorly. The hypertrophic thymus was partially divided. The pericardium was entered through a median anterior longitudinal incision and traction sutures were placed only on the right free edges of pericardium. Purse-string stitches were placed in the ascending aorta as proximally as possible, to leave just enough space for the cross clamp and the aortic root cannula. Nylon umbilical tapes were placed around both vena cavae and purse-string stitches were used on them. After heparinization, cardiopulmonary bypass was initiated when the cannulations were done. With the patient under normothermia, the PDA was exposed and doubly ligated. After the aortic cross clamp, antegrade hypothermic blood cardioplegia was delivered into the aortic root to arrest the heart. Right atriotomy parallel to the atrioventricular groove was made, and a large ASD II (diameter of 1.5 cm) was found. It was closed primarily without traction of surrounding tissue. The right atriotomy was closed and the aortic cross clamp was removed. The heartbeat resumed normal sinus rhythm spontaneously. Systemic temperature was rewarmed to 36.5°C. Weaning from the cardiopulmonary bypass was uneventful. Cannulas were removed and heparin was reversed. One chest tube (#24F) was inserted into the mediastinal space for pericardial drainage. Thereafter, bilateral 2-cm long lateral thoracic incisions were made in the midaxillary line at the level of maximum pectus depth, where the sternal bone is present. Two tunnels were fashioned bilaterally along the outside of the rib cage, under the pectoral muscles. At the level of the sternum, these tunnels extended retrosternally and communicated with each other. Nylon umbilical tape was inserted along the tunnel and passed to the other side of the lateral incision using a pectus clamp. A steel bar (Sciencity, Seoul, Korea) was shaped to match the curvature of a template fitted on the patient's chest using a pectus bender. Along the taped tunnel, the

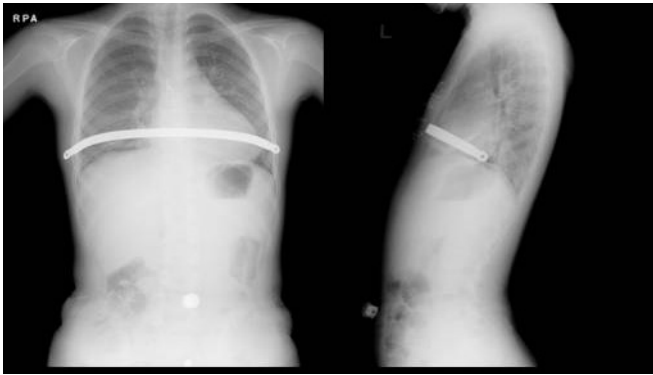


Figure 1. Postoperative chest x-rays, posterior-anterior (left) and lateral (right) views, showing well-corrected chest deformity.

curved steel bar was passed through one tunnel, under the sternum, and out the other tunnel with the convexity facing posteriorly. The steel bar passing retrosternally could be well visualized through the ministernotomy. No damage of surrounding structures was observed, and hemostasis was easily maintained. The ministernotomy was closed using peristernal steel wires. Thereafter, the curved steel bar was inverted using a pectus rotator so that the convexity faced anteriorly, resulting in protrusion of the chest. Both ends of the bar were secured in position with sutures on the fascia, and the wounds were closed by layers. The chest tube was connected to the underwater seal 3-bottle system.

The patient's postoperative course was uneventful. A patient-controlled analgesia pump with fentanyl was applied to reduce the postoperative pain. Early the next morning, the patient was weaned from the ventilator and the chest tube was removed. At the general ward, the patient had mild atelectasis of the left lower lung, which was well managed by physiotherapy. Postoperative chest x-ray showed well-corrected chest deformity (Figure 1). The patient was discharged from the hospital 2 weeks after surgery with an excellent outcome and cosmetic result.

DISCUSSION

Concomitant repair of pectus excavatum and intracardiac lesions has been previously reported [Kalangos 1995, Uchida 1997, Wilekes 1999, Pevin 2000]. However, to the best of our knowledge, this is the first paper reporting minimally invasive combined cardiac procedure and repair of pectus excavatum. Previously published concomitant procedures to repair the sternal deformity were mostly sternal turnover with removal of costal cartilages [Ravitch 1949, Wada 1970]. However, those techniques have some limitations: long operation time, bleeding due to broad excision of deformed cartilages, sternal instability after sternal turnover together with sternal splits, poor cosmetic results due to long incisions, and poor chest growth in children because of sternal devascularization. The Nuss procedure [Nuss 1998] currently being performed to repair sternal deformity has more benefits. The sternal stability is excellent because of support of the sternum by a substernal steel bar. The recov-



Figure 2. Oblique views of the chest before (left) and after (right) surgery.

ery time is shorter, with less postoperative pain, and cosmetic appearance is excellent with minimal incisions. Nevertheless, this procedure has never been done concomitantly with open heart surgery.

Therefore, we applied the idea of the Nuss procedure to repair the chest deformity in a patient who needed a cardiac procedure at the same time, avoiding possible complications. We found that it was not difficult to approach the intracardiac lesion (ASD II) through the lower ministernotomy as well as to expose the PDA. Also, ministernotomy allowed us to use all standard retractors, cannulas, and myocardial preservation techniques, as well as allowing introduction of fingers to tie knots as described recently [Lee 2002]. Our experience of a minimally invasive concomitant procedure revealed an excellent surgical exposure, minimal postoperative bleeding, no postoperative infection, maximum sternal stability, minimal postoperative pulmonary dysfunction, and satisfactory cosmetic appearance (Figure 2). Therefore, a simultaneous minimally invasive repair of cardiac lesions and pectus excavatum is feasible and should be considered, particularly in female children.

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