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Case Report

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Sternal Pre-lifting Procedure During the Minimally Invasive Repair of Pectus Excavatum-Case Report

Esra YAMANSAVCI SIRZAI, Mustafa KIZIL,
Cagrı SAR

Correspondence

Esra YAMANSAVCI SIRZAI
SBÜ Dr. Suat Seren Göğüs Hastaliklari Ve Cerrahisi Eğitim Ve Araştirma Hastanesi Gaziler Cad. No: 331 Posta Kodu:35110 Yenişehir / Izmir

e-mail: yamansavci@gmail.com
Phone: +90 (232) 433 33 33

ID: 0000-0002-2262-4274

Abstract

Background

Pectus excavatum (PE) is the most common congenital chest wall deformity. While mild cases may cause cosmetic concerns, severe deformities can lead to cardiopulmonary symptoms, including chest pain, palpitations, and decreased exercise tolerance. Surgical correction with the Nuss procedure has become the standard, but deep deformities, especially in underweight patients, pose significant risks during retrosternal dissection.

Case

We report the case of a 23-year-old female patient who presented with complaints of chest pain, particularly while eating solid foods. On physical examination, her height was 168 cm and her weight was 42 kg. A deep, asymmetric pectus excavatum deformity of the anterior chest wall was noted. Her Haller index was calculated as 5.67. Pulmonary function tests revealed a forced vital capacity (FVC) of 74 %. Cardiological evaluation did not show any evidence of cardiac compression. The patient received six months of nutritional support prior to surgery. A minimally invasive Nuss procedure with the placement of three bars was performed. Due to limited intraoperative visualization, a modified sternal elevation technique based on Park's method was utilized, involving CT-guided placement of a sternal screw. The perioperative course was uneventful, with no complications observed.

Conclusion:

This case highlights the importance of individualized planning and a multidisciplinary approach in deep PE cases. Preoperative nutritional support and modified surgical techniques-particularly sternal elevation-contribute significantly to safe and effective outcomes.

Keywords

Pectus excavatum, Nuss procedure, Sternal elevation, Sternal screw, Chest wall deformity

Introduction

Pectus excavatum (PE) is the most prevalent congenital chest wall deformity, occurring in about 1 in every 300–400 live births (1,2). Though mild deformities are asymptomatic in childhood, severe deformities can lead to aesthetic issues, cardiopulmonary symptoms, and decreased exercise tolerance in adolescence and young adulthood. Repair in patients with low body mass index (BMI) and deep deformities is technically demanding and needs careful preoperative and intraoperative planning. To minimize the risk of cardiac injury with retrosternal dissection, various techniques of sternal elevation have been described. Vacuum bell elevation allows for gradual external

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elevation but can be anatomically limited, especially in female patients. The crane technique, as first described by Park, involves a sternal screw to directly apply mechanical elevation, with enhanced visualization and safety during dissection. Additional modifications involve traction sutures or external retractors with variable effectiveness and applicability based on the severity of the deformity and individual patient factors. Here we report the case of a female patient with severe, asymmetric PE deformity and low BMI, who was successfully treated with preoperative nutritional supplementation and a modified Park sternal elevation method via a minimally invasive Nuss procedure.

Case

A 23-year-old female patient presented with chest pain, particularly when consuming solid food. She had no history of chronic illness or previous surgeries. On physical examination, her height was 168 cm and her weight was 42 kg. A deep, asymmetric pectus excavatum deformity was observed on the anterior chest wall. Posteroanterior chest radiograph and thoracic computed tomography (CT) revealed a Haller index of 5.67 (Figure 1). Pulmonary function test showed a forced vital capacity of 74%. Cardiological evaluation did not reveal any cardiac compression.

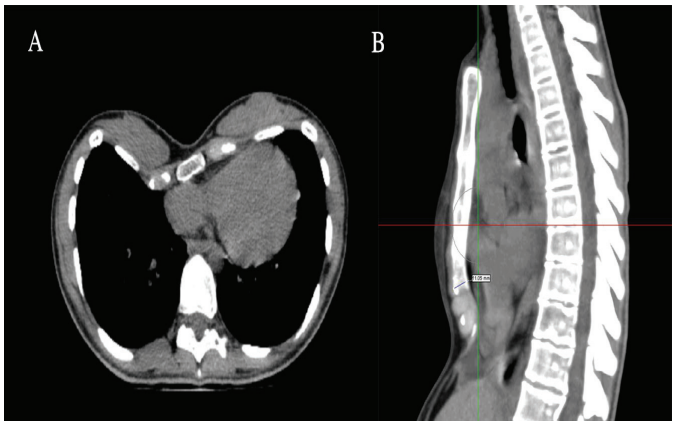

Figure 1- A. Preoperative Chest CT Axial Scene B. Preoperative Chest CT

The patient received nutritional support with oral liquid dietary supplements in addition to her regular diet for six months. Surgery was scheduled after her weight increased to 48 kg. Under general anesthesia, following single-lumen endotracheal intubation, the patient was placed in the supine position with the right arm suspended. No bladder catheter was inserted. Arterial monitoring was performed, but no central venous or epidural catheter was used. After marking the intercostal spaces while standing, bilateral incisions were made from the submammary skin folds. A 305 mm bar was placed into the intercostal space where the deformity began. A stabilizer was applied to the right side. Although intrathoracic carbon dioxide was used during this step, the visual field remained insufficient. Therefore, sternal pre-lifting using a specially designed screw, as described by Park, was performed. The screw size was selected based on preoperative sagittal CT measurements of the sternum, and a 10 mm screw was chosen. After placing the first bar, the visual field improved significantly (Figure 2). Due to the short sternum, banana-shaped deformity, and flaring of the bilateral costal arches, the decision was made to place crossed bars.

Two 280 mm bars were inserted in a crosswise configuration with their stabilizers positioned superiorly. Intraoperatively, 100 mg of bupivacaine was administered to five intercostal spaces bilaterally. No intraoperative complications occurred. No chest drain was placed. Multimodal analgesia (paracetamol, NSAIDs, and tramadol if necessary) was provided. The patient resumed oral intake 6 hours after surgery, began in-bed exercises at 8 hours, and was mobilized at 24 hours. She was discharged on postoperative day 4 without complications.

Discussion

Although pectus excavatum is often associated with cosmetic concerns, severe cases can exert significant pressure on the heart and great vessels, leading to symptoms such as chest pain, palpitations, and exercise intolerance. In this case, postprandial palpitations and pain were likely due to such mechanical compression.

While the Nuss procedure is the standard of care for minimally invasive correction of PE, deep deformities increase the risk of cardiac injury during retrosternal dissection. The real prevalence of life-threatening complications related to the minimally invasive repair of pectus excavatum (MIRPE) is unknown. Major complications with MIRPE are infrequent. Awareness of the risk of life-threatening complications is essential to ensure optimal safety. Factors such as operative technique, patient age, pectus severity and asymmetry, previous chest surgery, and the surgeon's experience play a role in the overall incidence of such events (3).

Peroperative vacuum elevation is commonly used. However, in female patients like ours, difficulties may arise due to breast positioning. Although intrathoracic CO_2 insufflation was used in our patient, Park's sternal elevation screw was utilized to proceed more safely with the operation (4). The screw size was selected by measuring the sternum thickness in the sagittal section of the preoperative thoracic CT, and a 10 mm screw was chosen. During the procedure, the screw should be inserted into the sternum at a 90-degree angle, taking into account the slope of the deformity. Intrathoracic video thoracoscopic visualization must be ensured during screw insertion. In cases where the sternum is

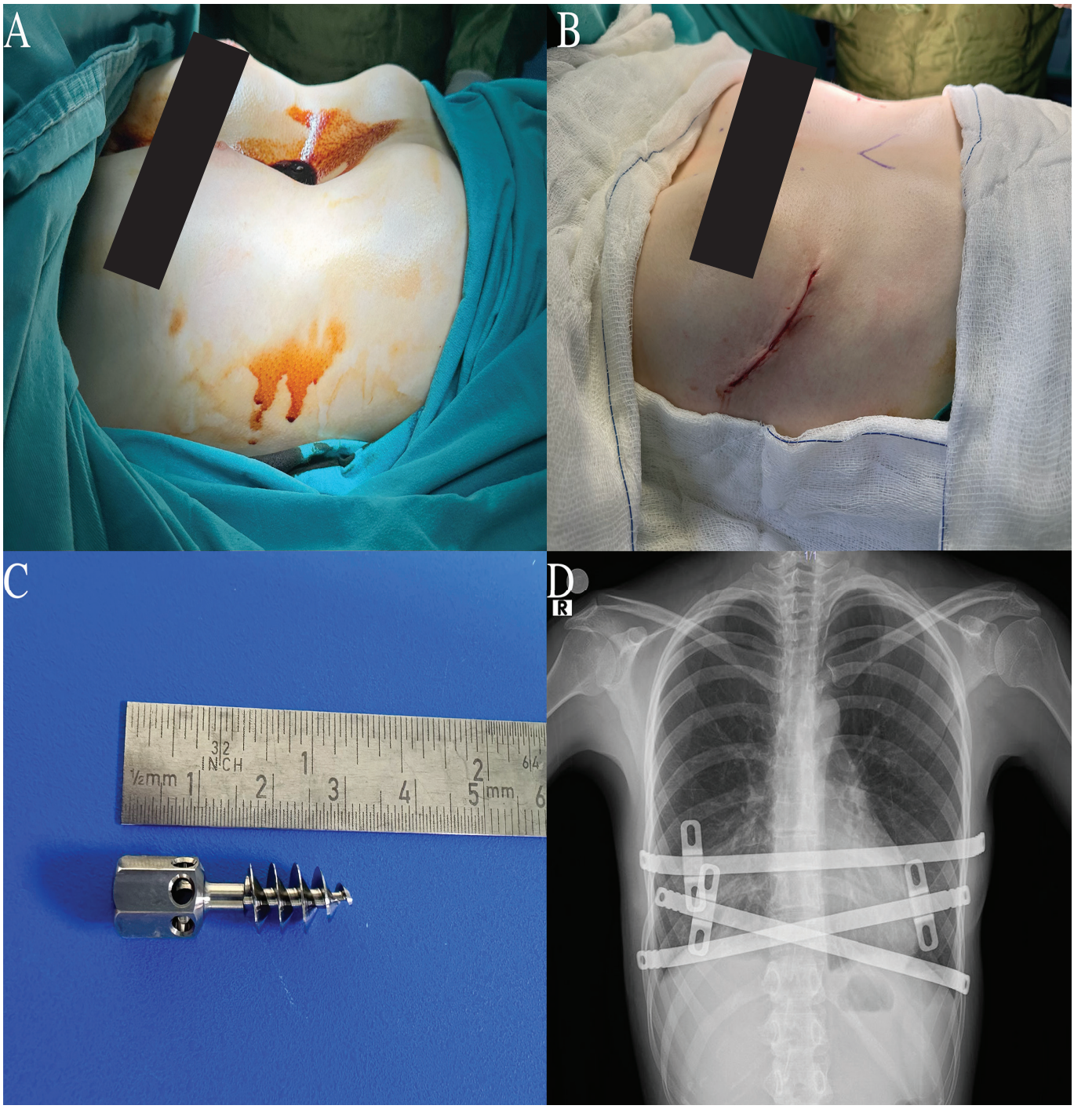

Figure 2- A. Patient preoperative view, B. Postoperative view of the patient. C.Park sternal elevation screw. D. Postoperative X-Ray of the patient

highly rigid, placement of a second screw should not be avoided. In our patient, a single 10 mm screw was sufficient. Elevation with the crane system can be applied until all bars are in place. However, in our patient, for procedural practicality, manual elevation was performed only during the placement of the first bar. The team's experience becomes crucial at this point, allowing secure bar placement without complications.

Additionally, preoperative nutritional support is vital in underweight patients. Malnutrition can impair wound healing and increase infection risk. In this case, weight gain and improved nutritional status likely contributed to the smooth postoperative course. This report highlights the importance of a multidisciplinary approach and the use of modified surgical techniques in managing complex PE cases safely and effectively.

Conclusion

In cases of deep pectus excavatum with low BMI, individualized preoperative preparation, including nutritional support and surgical technique modification, is essential for safe and effective outcomes. The combination of the Nuss procedure and Park's sternal elevation technique significantly enhances intraoperative safety. This case underscores the value of a multidisciplinary strategy in complex thoracic deformities.

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