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Case reports

Cardiopulmonary resuscitation in patients with a Nuss bar—a case report and review of the literature

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Abstract Pectus excavatum (PE) is a common chest wall deformity that may produce a variety of physiological and psychological effects in children and adolescents. In addition, some of these patients have associated cardiac diseases (ie, mitral valve prolapse and Marfan syndrome). Recently, a minimally invasive surgical repair of PE that requires sternal bar placement has become increasingly frequent to enhance patients' cardiopulmonary functioning as well as their self-esteem. However, despite this innovative technique, it is possible for such patients to have a cardiac arrest while their sternal bar is in place. Whether the presence of a metal bar on the underside of their sternum may hinder resuscitative chest compressions (cardiopulmonary resuscitation) is an issue that concerns us, our patients, and their families; the answer requires further investigation. We present a 21-year-old man with PE who underwent a minimally invasive pectus repair but had a fatal cardiac event before bar removal. Paramedics conducting cardiopulmonary resuscitation on the patient later reported that they were unable to deliver effective cardiac compressions and that the sternal bar may have contributed to this.

Pectus excavatum (PE) accounts for more than 90% of congenital chest wall deformities affecting 1 in 300 children. In addition to the cosmetic defect, the disorder can have substantial physiological (decreased pulmonary and decreased cardiac functioning) and psychological effects on children and adolescent patients; some of these patients (eg, those who have Marfan syndrome) may have life-threatening cardiac effects requiring cardiopulmonary resuscitation (CPR). Surgical repair of PE has been performed for many years using the Ravitch technique, in which the deformed cartilages are resected while preserving the perichondrial sheaths [1]. Recently, Nuss et al [2] have developed a miniature-access repair of PE, which requires a metal bar to be placed within the patient's chest wall. This bar applies pressure to the underside of the sternum, remodels the affected cartilages, and enlarges the intrathoracic space. The bar is removed in 2 to 3 years with a greater than 90% excellent operative result. Although PE repair improves cardiopulmonary functioning in some cases, it is possible that patients with a bar in place could have a cardiac event that would require external CPR. However, the metal bar that was placed within their chest at the time of repair may hinder the CPR technique by making it impossible for the rescuer to conduct effective chest compressions. We present a case of a 21-year-old patient who sustained a sudden cardiac arrest 36 months after bar insertion and was unable to be resuscitated.

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1. Case report

A 19-year-old man with a nonmarfanoid habitus presented with an asymmetric PE. His left chest was larger than his right, and the deformity affected approximately 7 costal cartilages. Medical history was otherwise unremarkable. He had no signs of heart murmur, and his breath sounds were normal. Chest x-ray (CXR) showed scoliosis with vertebral anomalies and demonstrated clear lungs with a normal cardiomediastinal silhouette shift into the left chest. An echocardiogram showed mild mitral valve prolapse with normal ventricular function. There was no evidence of mitral regurgitation, and his aorta and aortic valve were normal. Pulmonary function tests demonstrated a restrictive pattern and a modest reduction in exercise capacity. His electrocardiogram showed a normal sinus rhythm.

The patient underwent an uncomplicated Nuss pectus repair with a 38.1-cm bar and foot plate stabilizers. Postoperative CXR showed clear lung fields (Figs. 1 and 2). The patient was discharged to home in good condition 4 days postoperatively. He was evaluated at 1 month after pectus repair and was found to have full excursion of intercostal muscles and complete range of motion of his shoulders. The patient was started on an exercise regimen to increase upper body strength.

At 8 months after pectus repair, the patient sustained a sports-related left chest injury that was later confirmed by CXR to have dislodged the pectus bar from the foot plate on his left side. At 9 months after pectus repair, the patient underwent an uncomplicated left chest wall exploration to wire the lateral foot plate to the bar and to secure them to the chest wall. The patient was discharged to home the next day.

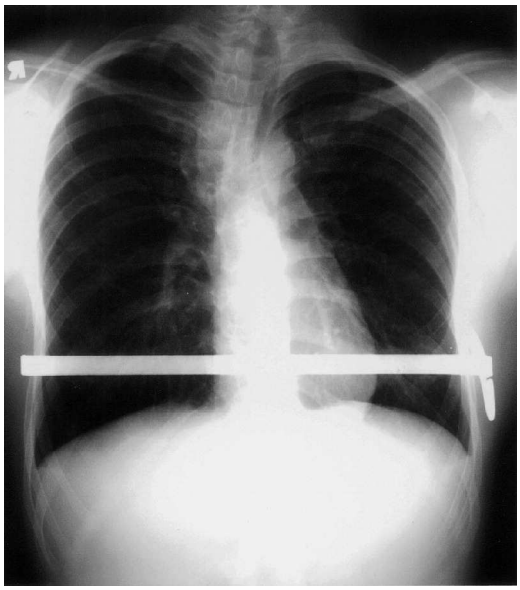

Fig. 1 Postoperative anteroposterior view of the chest demonstrates a normal cardiomediastinal silhouette shift into the left chest, scoliosis, and clear lung fields with pectus bar and foot plate stabilizers in place.

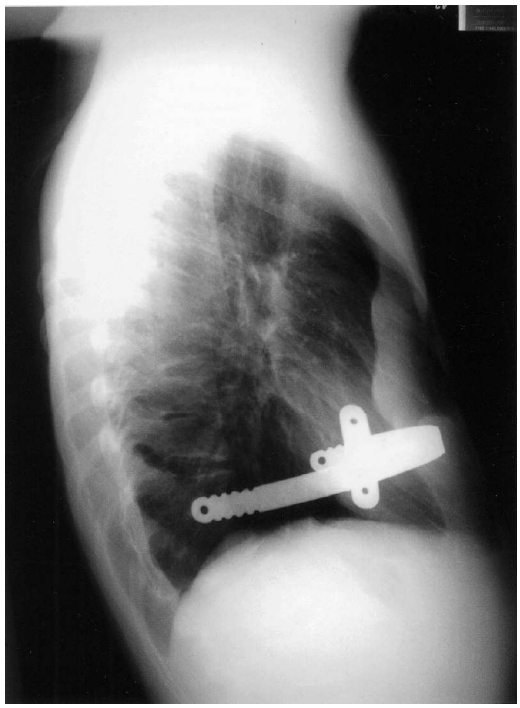

Fig. 2 Postoperative lateral view of the chest presents clear lung fields and pectus defect with pectus bar and foot plate stabilizers in place.

One-week follow-up revealed no signs of wound infection and a full range of motion in the patient's upper extremities. The patient was advised to discontinue contact sports.

At 35 months after pectus repair, the patient was evaluated for bar removal. The wounds were well healed without signs of infection, and the patient had good cosmetic results. Pulmonary function tests and exercise testing were performed, but they were terminated preemptively due to abnormally high blood pressure and an irregular heart rate. The patient was referred to a cardiologist who performed an electrocardiogram showing frequent resting premature ventricular contractions and demonstrating low-voltage primary atrioventricular block. A 2-dimensional echocardiogram showed mitral valve prolapse and mild aortic insufficiency. The patient was scheduled for a Holter monitor, but he collapsed at work before it could be placed. Upon arrival of the paramedics, he was noted to be in ventricular fibrillation (VF). The paramedics began advanced cardiac life support, but the patient had no response to defibrillation, to medication, or to chest compressions. The patient became asystolic and was pronounced dead shortly after arrival at the emergency room. Paramedics subsequently reported difficulty in performing CPR because of bar placement within the patient's sternum, but they had been able to obtain a weak pulse while performing compressions. Autopsy demonstrated no complications that are caused by the pectus repair or bar placement. The cause of death was deemed to be a cardiac arrhythmia resulting from the patient's preexisting cardiac disease (ie, mitral valve prolapse). Of note, his aorta