

PRELIMINARY RESULTS AFTER NUSS PROCEDURE IN 5 CASES OF PECTUS EXCAVATUM

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Abstract

Pectus excavatum (PE) is the most frequent anterior chest deformity occurring in approximately 1 in 1000 live births (1). PE is a depression of the sternum and costal cartilages. PE treatment is surgical. During time more than 50 surgical procedures were done. In 1998 Nuss et al introduced a new minimal invasive surgical procedure for PE correction in which costal cartilage resection or sternal osteotomy is no longer necessary (5). We present 5 case of PE treated by us using Nuss technique. We present you the operative technique and the results for short and medium term. No intraoperative incidences were recorded. Immediate postoperative course was good for all patients. In the 5th patient a left pleural effusion occurred 14 days from the intervention and was immediately solved by pleural puncture. Therapeutic and cosmetic results were considered good by all patients and their parents. Preliminary results indicate that Nuss procedure is safe and has excellent outcomes for PE correction in children.

Key words: pectus excavatum, Nuss, minim invasive, child

Introduction

Pectus excavatum (PE) is the most frequent anterior chest deformity occurring in approximately 1 in 1000 live births (1). PE is a depression of the sternum and costal cartilages. In most of the cases the deformity is asymmetric and maximum depth point is located at the inferior part of the thorax (2). In only a third of the patients the debut of the disease is during childhood (2). More often the disease becomes apparent in the prepubertal growth spurt period. The most frequent associated diseases are: scoliosis (26%), cardiac malformations (1.5%) and asthma (5.2%) (3). Sometimes PE is a component of genetic disorders: Currarino-Silverman, Noonan and Marfan (4). The most frequent symptom is the limitation of the effort ability. An important aspect is the physic disturbances

caused by the esthetic defect. Other symptoms like: cardiac arrhythmia or chest pain are rare.

PE treatment is surgical. During time more than 50 surgical procedures were done. First attempt to correct PE was done by Meyer in 1911. The surgical technique introduced in 1949 by Ravich and modified by Adkins was in short time widely adopted and remained for almost 4 decades the main treatment method for PE. Other treatment options like: magnetic or suction elevation of sternum, sternal turnover or silicon prosthesis had poor outcomes and failed to impose as a treatment viable option.

In 1998 Donald Nuss introduced a new minimal invasive operative technique. Under thoracoscopic surveillance a rigid metal bar is inserted under the sternum trough lateral thoracic incision. The bar is introduced with the concavity facing anterior and then turned posterior in order to correct sternal bending. Cartilage resection or sternum osteotomy is no longer necessary (5). The technique was improved in the last decade by the wildy adoption of the thoracoscopy and the introduction of the lateral bar stabilizers (6). Long term favorable outcomes (95%) led to its wide adoption.

Material and methods

Between July 2007 and September 2008 five PE patients were treated using the minimal invasive technique. The intervention represent premiere because it was performed by a team composed exclusively by Romanian surgeons. We present you the five cases, our operative technique and the short and medium term outcomes.

The Patients

1. Male 14 years old child. Severe, symmetric PE in the lower 1/3 of sternum. Effort dyspnoea was the only symptom present. EKG and cardiac echograpy are normal. Haller index (HI) is 5.98. Left pleural drainage was

- necessary for 2 days. He left the hospital 8 days after surgery.
2. Male 12 years old child. Symmetric PE. Associated disease: mitral valve prolapsed, myopia, isolated atrial extrasystole. Anamnestic effort dyspnoea was present for a least one year before. Sternum has a compressive effect on the right ventricle at the CT scan. HI is 3.82. After the intervention bilateral pleural drainage was necessary for 4 days. He left the hospital 6 days from the intervention.
 3. Male 18 years old patient. Symmetric PE. No symptoms are present. EKG shows a minor right bundle branch block. HI is 3.62. Right pleural drainage was maintained for 5 days. He left the hospital 8 days after surgery.

4. Male 14 years old child. Left rotated asymmetric PE. Associated disease: mitral valve prolaps, dilated cardiopathy, scoliosis, pulmonary hypertension. The thoracic deformity increased significant and the effort dyspnoea accentuated during the past year. CT scan showed that sternum has a compressive effect on the right ventricle and the heart is displaced to the left. HI is 3.7. Bilateral pleural drainage was maintained for 4 days. He was released from hospital 6 days from surgery.
5. Male 14 years old child. Cup shape PE slightly rotated to the left. The deformity increased significant during the past year. Physical exam showed easy effort fatigue. HI is 4.5. The bilateral pleural drainage was removed 2 hours from the intervention. (fig. 1)



Fig. 1 The patients.

Pre-operative preparation

Several evaluations were performed for each patient before surgery: spirometry, cardiologic consult, Rx, CT (fig. 2), EKG, cardiac echography, abdominal echography, genetic consult, ophthalmologic consult. Lab tests performed are: complete blood count, liver function tests, kidney function tests, inflammation tests, glycemia, blood electrolytes, bleeding and coagulation time.

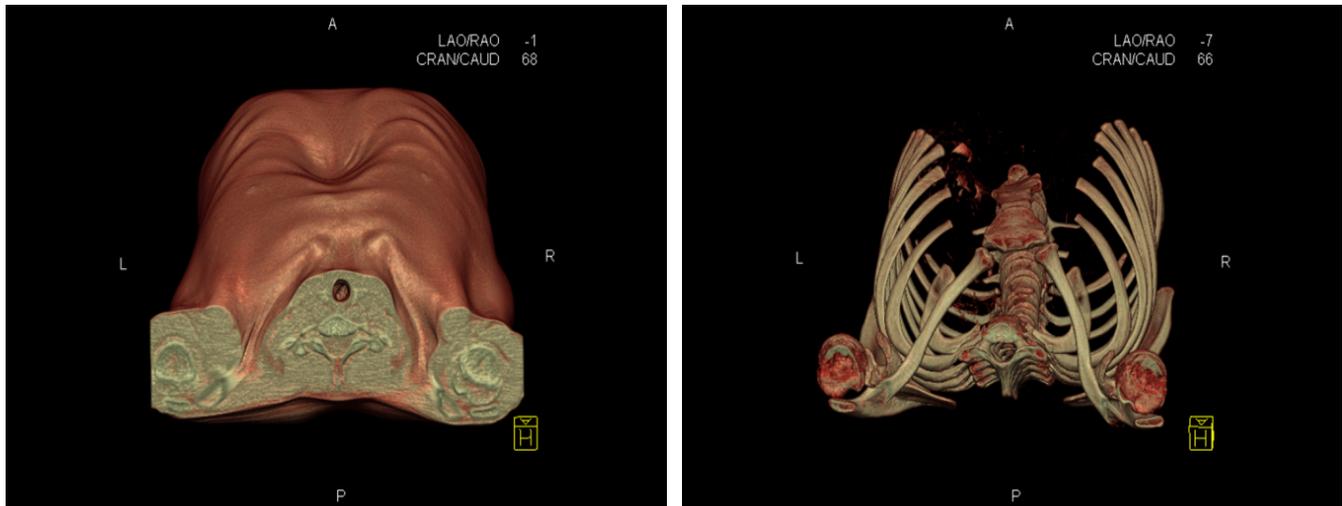


Fig. 2. CT scan with 3D reconstruction.

Operative technique

- Before surgery the Lorenz bar was shaped to the desired shape in order to reduce the length of the intervention.
- The patient is put under general anesthesia with oro-tracheal intubation.
- The trocar for thoracoscope is inserted in 7th right intercostal space in the mid axillary line.
- Bilateral thoracic incisions are performed in the mid axillary line at the level of deepest point of the depression.
- In first 4 patients the incision was transverse while in the 5th case the incision was orientated vertical.
- Skin tunnels are raised anterior from each incision to the top of the deformity where the thoracic cavity is entered.
- When the pleural cavity is opened an iatrogenic pneumothorax is made. This pneumothorax is sufficient to form the necessary work chamber and is maintained by using low ventilation pressures.
- Under thoracoscopic surveillance the introducer is inserted in the right pleural cavity.
- Facing upwards and immediately under the sternum we slowly passed the introducer through the anterior mediastinum to the left pleural cavity.
- The assistant introduce his finger in the left pleural cavity and elevates the sternum when the

introducer is passed through the mediastinum. This maneuver increase the distance between sternum and heart.

- The assistant with his finger introduced in the pleural cavity expect and guide out the introducer.
- The introducer is than elevated and pressure applied above the sternum in order to correct the deformity.
- We attached an umbilical tape to the left end of the introducer and pulled through the tunnel by withdrawing the introducer from the right side.
- We attached the umbilical tape to the Lorenz bar and pulled the bar to the left side with the concavity facing anterior.
- After is introduced the bar is flipped with concavity facing posterior.
- Lateral stabilizer are fitted at each end and sutured to the rib cage.
- The skin is closed using non-resorbable sutures.
- We use bilateral pleural drainage in 3 cases and unilateral in 2 cases.
- On the right side we used the thoracoscope incision for drainage.
- For pain management we inserted an epidural catheter. The patient receives intravenous antibiotic, an anti-inflammatory and an analgesic drug for 5 to 6 days.



Fig. 3. Trocar introduction.



Fig. 4. Transverse skin incision in mid axillary line.



Fig. 5. Longitudinal skin incision in mid axillary line.



Fig. 6 Tunneling.



Fig. 7. The deformity is corrected by applying pressure on sternum and ribs.



Fig. 8. The bar is inserted with the concavity facing anterior.

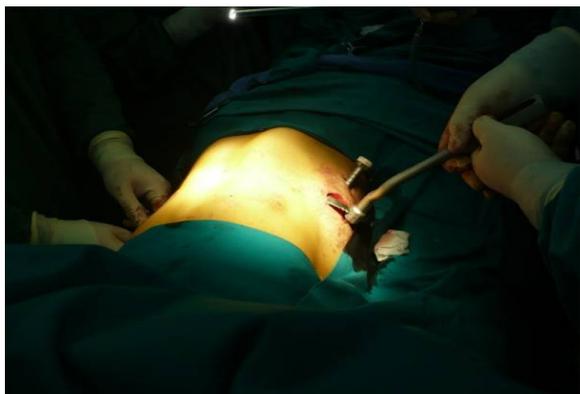


Fig. 9. The bar is flipped with the concavity facing posterior.



Fig. 10. Lateral stabilizer are fitted at each end and sutured to the rib cage.



Fig. 11. The thoracoscope incision is used for right pleural drainage.



Fig. 12. Bilateral pleural drainage.

Results

No intraoperative incidences were recorded.
 Blood loss was minor.
 Time of operation was between 60 and 90 minutes.
 Postoperative course was good for all patients.
 No complication occurred in 4 of the 5 cases.
 In the 5th case right pleural effusion developed 14 days from the intervention and was immediately

solved by pleural puncture with no further complication.

We had no bar displacement.

Postoperative pain was minor.

Therapeutic and cosmetic results were considered good by all patients and their parents.



Fig. 13. Postoperative aspect patient 1.



Fig. 14. Postoperative aspect patient 2.



Fig. 15. Postoperative aspect patient 3.



Fig. 16. Postoperative aspect patient 4.



Fig. 17. Postoperative aspect patient 5.

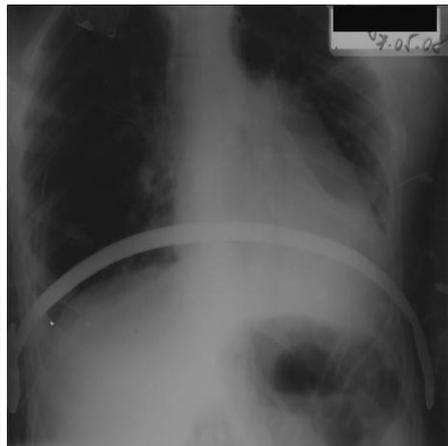


Fig.18. Postoperative Rx patient 1. Fig.19. Postoperative Rx patient 4. Fig.20. Postoperative Rx patient 5.

Discussions

Since its introduction in 1998 Nuss technique for PE correction had stimulate the interest and was adopted by a growing number of surgeons all over the world. Previous studies have established that a HI greater than 3.1 surgery for PE should be considered (9). Indication for surgery was established in all our five case based on objective criteria ($HI > 3.1$), clinical and psychological criteria. Age of the patient was also a key factor in the decision for surgery. The ideal age for PE correction is just before puberty, when the chest is still very malleable and the bar is in place during the pubertal growth spurt, reducing so and the possibility of recurrence (6). For adult

PE patient Nuss technique is still a subject of debate. Four of our patients are in pre- and puberty.

One of the main advantages of Nuss technique is the absence of the anterior thoracic incision, whom in open technique, lead in many cases to big, unaesthetic keloids. For this reasons we modified the initial technique by performing a longitudinal instead of transversal incision. In Nuss technique costal cartilage or sternal osteotomy resection is no longer necessary and operating time is significant reduced (7).

The most frequent complication cited before are: pneumothorax (6.9%), wound infection (4.5%), pericarditis (2.4%), bar displacement (1.2%) (8). None of these occurred in any of our patients. Only one patient developed a pleural effusion 14 days from surgery resolved successfully by pleural puncture.

The initial technique used CO₂ pleural insufflation for creating the necessary work chamber (5). We considered that the pneumothorax formed

spontaneously when the pleural cavity is opened offer sufficient space and positive pleural pressure is not necessary.

We consider thoracoscopy necessary in order to avoid heart or lung lesions. Thoracoscopy was particularly useful for the two cases where the sternum was in direct contact with the heart. The assistant introduce his finger in the left pleural cavity to expect and guided out the introducer. This adaptation of the initial technique offered a better control for introducer. An additional adaptation used by us is to elevate the sternum when the introducer passed through mediastinum increasing the space between the back of the sternum and the heart. This maneuver is achieved by introducing a finger inside the left pleural cavity through the site prepared for the left side exit of the introducer. In this way Rokitansky's subxiphoid incision becomes unnecessary (10).

One of the main problems for Nuss technique is greater postoperative pain (7). For our patient pain level was lower than that cited before. Pain management was done mainly by intravenous drugs and for short time. The epidural catheter was necessary only in 2 cases and for 3 days only.

We considered that intravenous antibiotics for 6 days are necessary for infection prophylaxis.

Conclusions

- Preliminary results indicate that Nuss operation for PE correction is a safe surgical technique.

- Postoperative outcomes are good.

- Hospital stay length is short.

- Blood loss is minimal.

- Cosmetic outcomes are excellent, appreciated by the patients.

- We are waiting for the long times results.

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