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Meyer Children's Hospital

Chairman: Prof. Antonio Messineo

ABSTRACT BOOK

IMPORTANT PSYCHOLOGICAL FACTORS REGARDING PECTUS EXCAVATUM INTERVENTION IN CHILDREN

Oral Communication

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Pectus excavatum is the most common congenital deformity of the sternum and anterior chest wall and usually becomes evident in patients around ages 8-10 years and during adolescence. Pectus excavatum can create concerns on both physical and psychological levels. On a psychological level, and especially so in adolescents, it is possible to note significant body shame, difficulty in freely engaging with peers or the opposite sex, low self-esteem, and a strong sense of shame and guilt. Body transformation during adolescence, evolving from a child's body to an adult body, requires the individual to undergo the very important work of psychological processing. With growth and maturity, the changes involve not only the body, but also overall self-image. Despite the "minimal-invasiveness" of the operation (which allows the patient to return to normal physical activity within a short period of time), it is often difficult to gain parental support to undergo the surgery. This reluctance is especially noted in cases where physical suffering is mild and the child is still young. Also under serious consideration are the bars implanted during the Nuss procedure, which are removed only after 3 years. Consequently, the patient must approach the surgery well aware that he or she will be living with a foreign object in the body during those years. The surgery and post-op recovery are relatively short (5 to 8 days), however in some cases recovery can be more painful than expected and cannot be fully controlled through medication. The role of the psychologist is essential within the medical team on several levels: during the initial screening stage for assessing the patient's intrinsic motivation; supporting the decision-making process and successfully mediating between the patient, family and medical staff; post-surgery by assisting the patient with pain management via non-pharmacological techniques, if necessary; and during the monitoring stage and follow-up to help the patient cope with emerging changes in self-perception and body image.

CHANGES IN CHILDREN'S QOL AFTER PECTUS EXCAVATUM REPAIR - SECOND REPORT

Oral Communication

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We previously examined changes in pediatric patients' QOL after pectus excavatum repair (Nuss procedure) in Japan, as reported at the 16th CWIG meeting. In this study, we examined such changes based on the sex, age, and treatment method, in an increased number of subjects.

Between April 2013 and August 2015, a questionnaire survey was conducted using a Japanese version of the (14-item) Pectus Excavatum Evaluation Questionnaire developed by Lawson et al., in 54 pediatric patients aged 8 to 17 to compare their answers before and 1 year after surgery (Wilcoxon signed-rank test, $P < 0.05$). The study was approved by the ethics committee of the study hospital (No. 1253-1).

1. Among patients aged 8-11, scores for 1 and 8 items decreased and increased, respectively, after surgery.
2. Among patients who decided to undergo surgery based on their own decision, scores for 1 and 7 items decreased and increased, respectively. Among those who had surgery following their parents' or doctors' advice, scores for 3 and 2 items increased and decreased, respectively.
3. All patients' scores for <recognition of one's own naked body> increased after surgery, confirming their improved QOL. Their QOL-related scores for <being absent from physical education classes due to the chest condition> decreased the most markedly after it.

The pediatric patients' QOL clearly improved after surgery. Those younger than 12, who frequently had to change clothes in the presence of others to wear a swimsuit, perceived improvements in their QOL more markedly. Females and those who decided to undergo surgery, following their parents' or doctors' advice, regarded chest pain as a cause of their reduced QOL. The results suggest the necessity of providing an explanation in consideration of individual patients' situations before surgery.

This study was supported by a Grant-in-Aid for Scientific Research (C) (Grant Number: 24593421).

STANDARDIZATION OF CLINICAL CARE PATHWAY LEADS TO DECREASED LENGTH OF STAY FOLLOWING NUSS PECTUS REPAIR

Oral Communication

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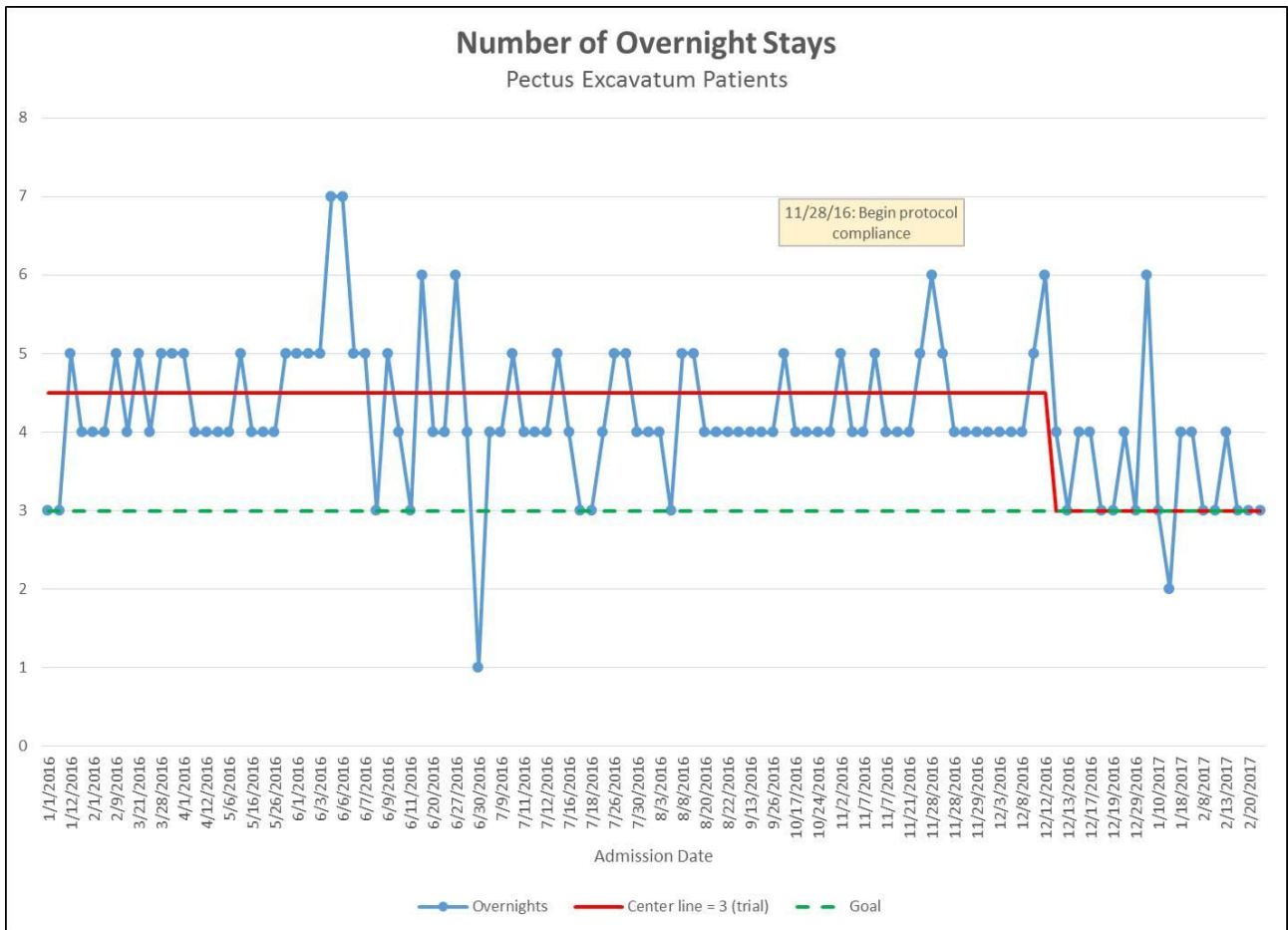
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After Nuss pectus repair, patients must reach specific milestones related to pain, diet, and function prior to discharge home. Use of standardized clinical care pathways (CCPs) expedites this process. The objective of this study was to update our existing CCP, increase reliability of the new CCP from 0% to 90% within 5 months of implementation, and achieve a median length of stay (LOS) of 3 days. We hypothesized that strict adherence to the updated CCP would decrease post-surgical LOS and reduce cost.

A multidisciplinary team collaborated to modify and implement an updated CCP which included goals for mobility, lung recruitment, pain control, intake, and output. One major change was decreased length of epidural analgesia. The full protocol included 37 measures, tracked using chart reviews and a patient-directed checklist. The primary process measure was compliance with the updated CCP. The primary outcome measure was LOS with secondary outcome measures of cost, patient satisfaction, and hospital readmission. Patients were surveyed post-discharge to assess their satisfaction with the updated CCP.

Over the last 14 months, 108 patients underwent Nuss pectus repair – 80 patients using the previous CCP and 28 patients using the updated CCP implemented 3 months ago. Over the last 2 months (19 patients), median LOS decreased from 4.7 to 3 days with > 90% adherence to the updated CCP. There were no readmissions due to pain despite earlier termination of epidural analgesia. Patient satisfaction remained high per survey analysis. Reduced LOS resulted in a 37% cost reduction.

Using quality improvement methodology with strict adherence to a CCP, we observed a significant reduction in LOS and cost without compromising pain management or patient satisfaction.



QUANTITATIVE AND NON INVASIVE ASSESSMENT IN PATIENTS WITH PECTUS EXCAVATUM

Oral Communication

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Pectus communities use standard pectus assessment tools as the Haller index (HI), depression index (DI) and Correction index (CI) [1] to evaluate chest wall deformities. However, these conventional indexes require manual measurements of parameters from tomography (CT) image. In order to reduce radiation exposure, surface topography has been suggested to assess chest wall deformities [2, 3]. To improve measurement reproducibility, this study aims to propose a new objective parameters based on external 3D shape of patient. The proposed indexes estimate deformation without taking account of the breast deformation.

The main purpose of this research is to present a new methodology to assess quantitatively the chest wall deformities for pectus excavatum.

Measurements are performed with an OrtenBody[one] system (Orten, Lyon, France). It consists in optical data acquisition system to acquire the whole surface of the patient. The 3D relief is processed on dedicated OrtenClinic software. Two relevant measurements as depth and the anteroposterior distance were retrieved from each acquisition in sagittal and transversal plane. For this case study, five consenting clinic patients (females) with confirmed excavatum pectus were scanned.

Sagittal measurements were compared to transversal measurements. First results shows a good correlation ($r=0.97$) between sagittal and transversal anteroposterior distances. However, transversal depth is greater than sagittal depth. Sagittal depth doesn't take into account the breast deformation and is more representative of pectus deformity.

First results show that the proposed assessment in sagittal plane is a valid method to evaluate and estimate the chest wall deformity in patients with pectus excavatum. The proposed method was tested with the comparison between transversal and sagittal method (using 5 patients). Further studies should continue to corroborate and reinforce the preliminary findings, by prospective studies and performing long-term assessments.

3D BODY SCANNING FOR THE TREATMENT OF PECTUS EXCAVATUM

Oral Communication

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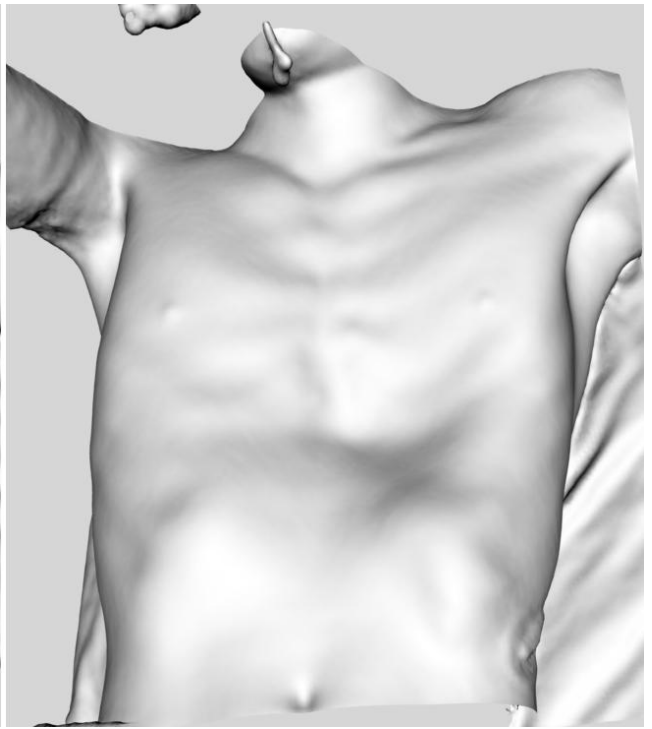
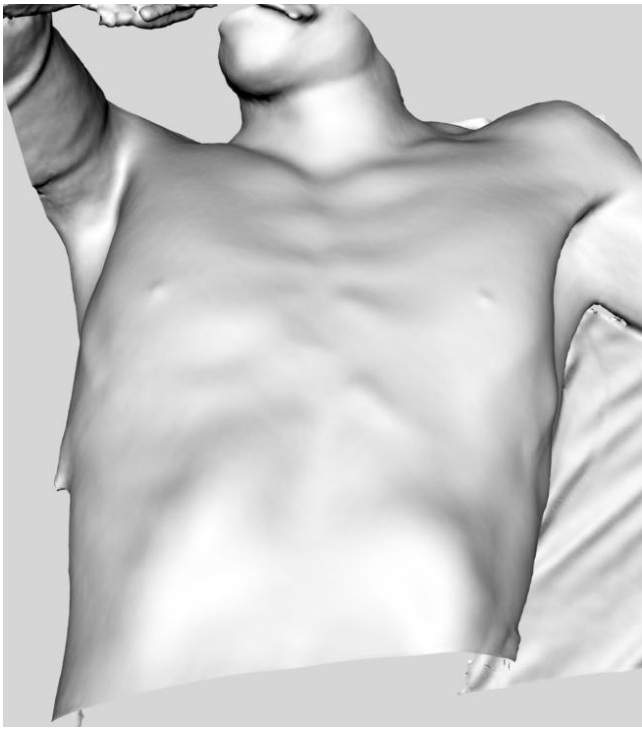
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For the preoperative and postoperative evaluation of the chest wall in patients with pectus excavatum, photos or X-ray examinations have been commonly used. Recent technology of 3D scanning has revealed development of a handy camera and useful soft ware. We have just started using 3D scanning of the chest before and after the Nuss procedure. Our experience of 3D scanning for patients with pectus excavatum is presented.

We introduced 3D scanning camera named Structure Sensor, which is a camera that augments the built-in optics of the iPad. This camera is handy and cost friendly. Scanning is easy and 3D data is clearly seen using a soft wear named Scanner on iPad. After scanning the chest, measurement of the body elements can be done using Msoft.

What I have found from my own experience in the short term was that pre-operative chest scanning is informative for planning the operation and preoperative discussions. Comparing pre- and post-operative 3D images showed excellent presentation tool for patients who underwent the operation. Measuring the chest size like CT index is possible with Msoft. However, this application needs more development for our requirement.

It is possible to show skin level figure with 3D body scanning, but boney structure cannot be seen. In cases with fatty body, real deformity of the sternum and the rib may be masked with this device. However, This is another option to show the figure of pectus excavatum in 3D. In the future, preoperative CT examination can be omitted if we have 3D images.



Correction of congenital chest wall malformations with custom-made silicone implants: contribution of computer aided design reconstruction, a 23 years experience.

Oral Communication

Chavoïn J.P.*

Pectus excavatum and Poland's syndrome are merely congenital deformities, albeit with a marked psychological impact. Many patients without a demonstrable functional impairment, do not wish or need to undergo thoracic remodeling surgeries, such as the Ravitch and Nuss procedures (pectus), or flaps (poland).

From 1993 to may 2017, we designed 533 custom-made silicone implants to treat funnel chests. and 134 cases of Poland syndrome with often mixed procedures. In the two series, the sex ratio is 6 males for 4 females. Prior to 2007, implants were made from plaster molds of the chest. Beginning in 2007, 3D reconstructions were made from CT scans by computer-aided design (CAD)

Patient's satisfaction with custom-made implants for Pectus has grown from 72% to 86% with CAD reconstruction (Plast. Reconstr. Surg. 137: 860e, 2016)) One infection and three hematomas were recorded for pectus Peri-prosthetic seroma was evident in all cases of pectus, few in Poland. Patients rated the cosmetic outcomes of CAD implants significantly higher than those of the earlier implants made using plaster molds. All types of pectus are presented following Chin's classification with the definitive results on men and women. We point on the high interest of CAD implants for correction of asymmetries (Chin type 3) and breast dystrophies induced.

Correction of pectus excavatum and poland's syndrome, using a CAD silicone implant, fulfils esthetic and psychological demands. The technique is simple, reliable, and yields high-quality results.

FIRST DECADE'S EXPERIENCE WITH VARIOUS BAR REMOVAL TECHNIQUES AFTER THE NUSS PROCEDURE: A SINGLE CENTER STUDY WITH 1,876 CASES

Oral Communication

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Although the Nuss procedure has been widely accepted as the standard procedure for the repair of pectus excavatum, few reports have systemically documented the methods for bar removal. In this study, we retrospectively evaluated the different techniques for bar removal after the Nuss procedure.

We retrospectively reviewed data for all patients with pectus excavatum treated with the Nuss procedure in our institution from July 2001 to October 2015. A total of 3,278 patients who underwent the Nuss procedure were included in this study, including 1,876 cases who underwent bar removal with a median age of 10.42 years (range 5.50–18.75 years).

Bar removal surgery was successfully performed in 1,876 patients (1,453 males and 423 females) with a mean operation time of 23.7 min (range 15–180 min). Most bars were removed within 3

years after the Nuss procedure (range 10–72 months). No patient experienced intraoperative complications, and all were discharged from hospital within 2 days after surgery.

The Nuss bar can be safely and easily removed with different methods and appropriate bar-stay time after the Nuss procedure according to the individual situation of each patient. Our study suggests that surgeons should pay careful attention to the details of the first operation, the existence of rib ossification and the shape of the bar.

MAJOR BLEEDING DURING BAR REMOVAL DOES NOT ALWAYS REQUIRE THORACOTOMY OR STERNOTOMY

Oral Communication

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Minimal invasive repair of pectus excavatum needs a bar removal operation approximately 3 years after the initial correction. While bar removal is generally believed to be safe, major bleeding may be experienced.

From 693 Nuss operations between August 2005 and February 2017, 388 patients' Nuss bar (%56) was blindly removed. During removal mean age was 19 years. Average time to bar removal was 34 months. In only 5 out of 388 bar removal, major hemorrhage occurred and they were managed conservatively.

1300, 300, 400, 500, 300 cc hemorrhage was detected respectively. Intraoperative echocardiogram was performed in all cases. Pericardial effusion was detected in 2 cases. There was no tamponade. The vital parameters were all stable. One patient required left videothoracoscopy. One patient's right internal mammarian artery laceration controlled by extension of the incision. Only packing with gauzes was performed in other three cases. Blood transfusion was needed in one case. Postoperative period was uneventful in all cases.

In terms of intraoperative management, it is very important to have multidisciplinary care. If the vitals are stable, it is possible to manage conservatively. Noninvasive methods are employed (such as transesophageal ECHO, transthoracic ultrasound, C-arm and X-Ray etc.) to pinpoint the source and decide on a more invasive approach if necessary.

REMOVAL OF PECTUS BARS

Oral Communication

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Removal of the Pectus bars is a simple procedure, but one in which many serious major bleeding complications have been described. My aim is to avoid the complications of major bleeding. Most of the bleeding is thought to be from the internal mammary, the intercostal vessels and even in a few cases from the right ventricle.

The side of the stabilizer is opened. The bar is straightened. The bar is twisted in a rotational manner to loosen it from the chest wall as well as from the opposite side. Once loosened it is removed with ease. The opposite side is only opened if bone ingrowth prevents the bar from being loosened. (Only required in one of my first 15 cases.)

One case required the opposite side to be opened. No major bleeding in any of my 15 cases.

The first method to avoid bleeding is to insert the bar correctly, thus outside the pericardium. Intra-pericardial placement of the bar leads to the danger of adherence to the right ventricle and catastrophic bleeding with removal. Loosening both sides of the bar is an option but the middle part of the bar may still be adherent to the underlying structures. Pulling with force may tear the middle part where the intercostal vessels and internal mammary artery is and especially the right ventricle if the bar is intra-pericardial. Rotation of the bar loosens it with much less tension before the bar is extracted with minimal force.

A MASSIVE BLEEDING DURING NUSS BAR REMOVAL REQUIRING EMERGENCY STERNOTOMY, A CASE REPORT

Oral Communication

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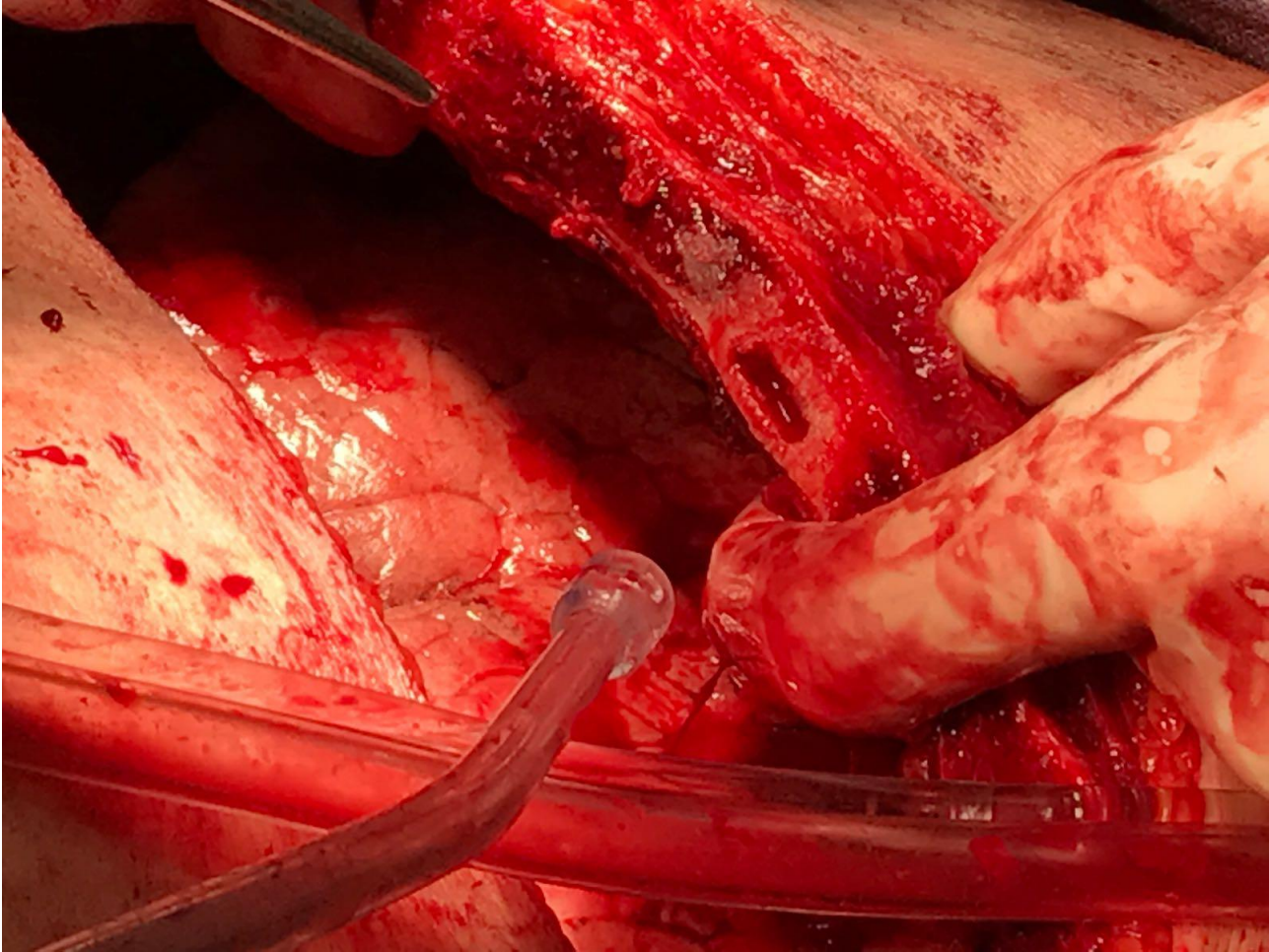
A 49 year male with pectus excavatum, with symptoms of exercise intolerance, lack of endurance underwent a Nuss procedure with one stabilizer on the left. His physical condition was markedly improved and we removed the Bar after 3 years.

Under general anesthesia, with blood and cardiopulmonary bypass stand-by, the original incisions were opened, and the stabilizer removed. The bar was pulled out from the right in the direction of the curvature of the bar. After the bar was removed a massive pulsatile bleeding was coming out of the right port. There was no way of controlling the bleeding and the decision was made to perform a median sternotomy.

A bleeding from the right mammary artery was found to be cause of the bleeding and was sutured. The bar was found to be migrated into the sternal body. (fig 1)

The postoperative course was uneventful.

Nuss Bar removal can be a risk for serious bleeding.



THE SUBPLEURAL INTERCOSTAL CATHETER (SIC) - AN ALTERNATIVE TO EPIDURAL ANESTHESIA IN PAIN MANAGEMENT OF PATIENTS UNDERGOING MIRPE?

Oral Communication

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Managing patients' peri- and postoperative pain after MIRPE is challenging, and the optimal pain management regimen has not yet been determined. In the past, we employed a combination of epidural catheter along with systemic analgesia. Recently, we devised a novel technique of thoracoscopic subpleural, intercostal catheter placement for continuous local anesthetic infusion as an alternative.

A prospective pilot study was performed in patients undergoing MIRPE from June 2016 until February 2017. Instead of traditional epidural anesthesia, and before the actual pectus excavatum repair, we thoracoscopically placed bilateral 23cm long subpleural microperforated catheters over at least 3 intercostal spaces lateral to the bar placement site. Both catheters were initially infused with a loading dose of 8 ml 2mg/ml Ropivacain solution, followed by a continuous infusion rate of 3-8ml/h for 48-72hrs until the catheters were removed. All patients also received standing metamizol and diclofenac medication. Salvage analgesia with piritramid (opioid) PCA was available to the patients if needed. Outcome parameters were maximal daily pain scores (0-10), length of stay, and demand for salvage analgesia.

In the study period, a total of 12 patients were included (9 males, 3 females). There were no intra- or postoperative complications concerning the pain catheters. Three patients (25%) received opioid salvage medication (one 3 doses, two 2 doses). Median maximal pain scores were 4 in the first 24hrs, 2.5 in the following 24hrs. Average postoperative length of stay was 5.5 days.

Our method of thoracoscopically placed subpleural intercostal pain catheter therapy is associated with low postoperative pain scores, and a low rate of salvage opioid analgesia, with no complications in our first 12 patients. Subpleural, intercostal pain therapy may be a promising alternative to epidural pain management for pectus repair.

PITFALLS OF ELASTOMERIC PUMPS IN PECTUS EXCAVATUM REPAIR: A CRITICAL ANALYSIS

Oral Communication

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Pectus excavatum repair (PEX) is among the most painful thoracic procedures performed. Optimizing postoperative pain control is an ongoing challenge. Elastomeric pumps (EP) are used to infuse local anesthetic to provide regional anesthesia. They have proven efficacious in reducing pain after thoracic interventions in adults and appear to be ideal for use in pediatric PEX. Yet, surgical site infections (SSI) in PEX spiked to 27.7% following the introduction of EPs. Here, we would like to share the pitfalls of EP use in PEX, as identified by our team's root cause analysis.

Our institution introduced EPs to PEX in May 2015. We performed a retrospective case review of all PEX from 05/2015 to 06/2015. Data on demographics, Haller Index (HI), use of Fiberwire, length of stay (LOS), adherence to the SSI prevention bundle, preoperative staphylococcus

screening, time to symptoms and organisms cultured was collected. Statistical analysis using Fisher's exact test and Mann Whitney U test was performed.

11 patients received an EP, 10 did not. Following EPs 6 (54%) patients developed an SSI, while none without did ($p=0.008$, Fisher's exact test). Adherence to SSI prevention measures, number of bars placed, preoperative staphylococcus colonization, HI and LOS did not differ between groups. Identified pitfalls linked to the increased risk of SSI were the greater proximity of catheters to the wound in adolescents as compared to adults, a delay of using EPs until the second postoperative day after cessation of epidural analgesia, and a disruption of the skin barrier by removing loban® prior to catheter implantation.

EP implantation offers potential advantages for pain control in PEX. Our team has identified three potential pitfalls linked with a tenfold increase in risk of SSI with EP use in PEX. Further study is needed to confirm our observations.

PAIN MANAGEMENT IN MIRPE PATIENTS, THE FLORENCE EXPERIENCE

Oral Communication

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NUSS AFTER RAVITCH: IS IT FEASIBLE?

Oral Communication

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We aimed to assess the feasibility of minimal invasive repair of pectus excavatum (MIRPE) after failed open repair methods.

From 742 pectus excavatum patients operated in single institute between August 2005 and February 2017, 34 consecutive patients matching the criteria retrieved. Group A (n:12) represented patients with subxyphoid incision and group B (n:22) represented patients without subxyphoid incision.

Average age was 19,7 (range 7-35). Twenty-two patients had symmetrical deformity, while 5 had asymmetrical. Both groups did not show significant difference in postoperative pain control, mean operation duration, mean length of hospitalization, chest tube requirement and average bar duration. There is no mortality in both groups. Although it is not statistically significant, patients without subxyphoid incision (group B) tend to require double bar instead of single bar, more often than group A. Group B seems to be more vulnerable for major complications such as cardiac damage and parenchymal laceration. The reasons for bar removal in group A were bar allergy (1 patient) and end of the planned duration (8 patients). However, in group B the causes was about complications: unbearable pain (1 patient), bar dislocation (1 patient), skin adhesion (1 patient), bar allergy (2 patients) and end of the planned duration (12 patients). Followups are still ongoing and mid-term cosmetic results are favourable.

To make the redo surgery safer, to minimize blood loss, to shorten the length of operation duration, to reduce the risk of damaging pulmonary, cardiac and anterior mediastinal structures, making an additional incision on the subxyphoid area may be useful. It has to be admitted that the correction may be limited in the patients developed acquired Jeune Syndrome. MIRPE can be a good option even after failed open repairs. Further investigations in larger series may be helpful.



RE-REPAIR OF COMPLEX PECTUS DEFORMITY AFTER FAILED OPEN RESECTIONAL SURGERY: “PECTUS BAR PLUS PECTOPLASTY”

Oral Communication

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Open pectus repair with costal cartilage resection often results in distorted chest wall, residual depression, and chest wall defects. The aim of this study is to evaluate the repair technique using pectus bars and reconstruction of the defect.

We had 41 patients of failed open surgery (37 Ravitch, 4 Wada procedures), from our pectus database with 2,795 patients for 17 years. The operative technique includes the followings. The crane was applied to lift the depressed chest wall and to avoid internal organ injury. Pectoscopy for visualization/dissection or direct vision through the previous sternal incisions were used to pass the pectus bar across the mediastinum. Morphology-tailored technique was employed for each specific deformity. Pectus bars were fixed with wire pericostal sutures, claw fixators or bridge technique according to the period. The pectoplasty was utilized to repair the costo-sternal defects.

The mean age at the prior surgery was 8.8 ± 5.5 years and 17 ± 6.2 at the reoperation. The techniques used were the crane in 30 (73.2%), the half bridge technique in 5, the bridge fixation in 5, and the cross-bar technique in 1 case. Single bar in 15, two bars in 24, and three bars in 2 cases were applied. The mean hospital stay was 7.4 ± 4.8 days. We had no operative mortality, but there were 2 pneumonias, 2 wound problems, 1 bleeding, 1 pneumothorax and 1 pleural effusion. Among 28 (68.2%) bar removal cases after 3.6 ± 1.3 years, 3 patients with a mild regression were repaired with pectoplasty, but one patient (3.5%) required re-insertion of the pectus bar.

Re-repair using pectus bars for failed previous open repair achieved favorable outcomes with low morbidities. The crane, pectoscopy were essential for the safety of the procedure, and pectoplasty was a valuable option for a cosmetic favor.

THE EXPERIENCE OF SURGICAL TREATMENT OF CHEST WALL MASS IN CHILDREN: A SINGLE CENTER 281 CASES REPORT

Oral Communication

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To review the experience of diagnosis and surgical treatment for 281 cases with chest wall mass.

Analysis the data of 281 cases of chest wall mass in our center, between January 2000 and December 2016.

All the surgeries of 281 patients were successfully performed without serious complications. The median age was 4.74 years (11 days - 16 years), 183 cases for male, 98 cases for female. 56(19.9%) cases of lymphangioma, 43(15.3%) cases of PNET/Ewing, 23(8.2%) cases of osteochondroma, 20(7.1%) cases of lympho-hemangioma, 14(5.0%) cases of lipoma, 12(4.3%) cases of hemangioma, 10(3.6%) cases of LCH, 10(3.6%) cases of lipoblastoma, 10(3.6%) cases of mesenchymal hamartoma, 10(3.6%) cases of fibromatosis, 73(26.0%) cases of rhabdomyosarcoma, neurofibromatosis, etc. The median operation time was 70 min (10-360 min), the median blood loss was 5ml (0.5-600 ml), and the mean days for hospitalization were 8 days (5-38 days).

The surgical treatment for chest wall mass in children should be assessed by the range of the lesions, malignant potential and growing development. For the cases of large chest wall defect, how to overcome the restorative materials in harmony with the growth of children is still a problem.

OUTCOMES OF STERNECTOMY FOR PRIMARY OR SECONDARY STERNAL TUMOURS

Oral Communication

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We analysed our experience in sternal resections for sternal tumours focusing on technical aspects of reconstruction, post-operative outcomes and long term survival.

From January 2005 to December 2015, 36 patients (24 males, 67%) underwent surgical excision of primary (chondrosarcoma n=18 patients, 50%, osteosarcoma n=2, 5%, Ewing sarcoma n=1, 2% other n=2, 5%) or secondary (breast cancer n=7, 19%, kidney carcinoma n=2, 5%) sternal tumour. We performed n=30 partial sternectomy and n=6 total sternectomy with en-bloc resection of the sternocostal cartilages in all patient and extended resection in 7 patients. Stability was obtained with rigid material (Strasbourg Thoracic Osteosyntheses System –STRATOS-, MedXpert GmbH) and muscle flap n=11 (30,5%); polytetrafluoroethylene patch and muscle flap n=6 (16,5%); muscle flap alone n=19 (53%).

The 30-day mortality rate was zero, overall complication rate was 19%. The median ICU-stay was 1 day and mean hospital stay was 10,6±5,9 days. Two patients (5%) developed wound infection treated with Vacuum Assisted Closure (VAC) therapy or surgical revision. We experienced a symptomatic bars displacement in n=1 (9%) case solved with the surgical removal and re-reconstruction.

We obtained a complete (R0) resection in all patients, with wide margins in 31 (86%) and marginal margins in 5 (14%). Overall survival at 5 and 10 years were 59% and 40%; in the group of primary neoplasm overall survival rate at 5 and 10 years was 79% and 54%. Higher grading was identified as negative prognostic factor on overall survival and wide margin was identified as prognostic factors on disease free survival rate at multivariable analysis.

Sternal wide radical resections are essential in the multimodality treatment for primary or secondary neoplasm of the anterior chest wall. Stabilization with titanium bars and clips is safe and provides rigidity of chest wall with good functional results.

STERNAL RESECTION AND COMBINED PROSTHETIC RECONSTRUCTION: MIDDLE-TERM RESULTS.

Oral Communication

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Anterior chest wall malignancy represent a challenging issue for Thoracic Surgeons. Their optimal surgical management still continues to evolve. Aim of this study is a middle-term evaluation of combined prosthetic sternal reconstruction with titanium bars, synthetic non- absorbable mesh and soft tissue flap.

Between December 2011 and July 2016, 8 patients (4F/4M) underwent radical partial sternal resection and anterior chest wall reconstruction for cancer (middle age 58, age range 16-81). The

indication for sternal reconstruction were primary malignant sternal tumor (n=4), sternal metastasis (n=3) and direct sternal infiltration of mediastinal tumor (n=1). All patients underwent subtotal sternectomies with costal cartilage removal. In all cases a combined anterior chest wall reconstruction with titanium bars and clips (Stratos Strasbourg, Medxpert, Heitersheim, Germany), an e-polytetrafluoroethylene patch (Gore Dualmesh Plus, W. L. Gore & Associates, Flagstaff, AZ, USA) and soft tissue flap were performed.

Two patients received previous chemo-radiotherapy and 2 patients neoadjuvant chemotherapy. Complete resection (R0) has been achieved in all cases. Histological analysis showed osteosarcoma (n=1), condrosarcoma (n=3), breast cancer metastasis (n=2), kidney cancer metastasis (n=1), and thymic carcinoma (n=1). No mortality or perioperative complications were reported. Median follow-up was 39±19,6 month (range 9-65 month). At one year follow-up 1 patient presented an asymptomatic spontaneous fracture of two ipsilateral titanium bars. All patients were alive at last follow-up, in 2 patients distant relapses were detected. Three-dimension volume rendering CT scan detected optimal chest wall stability in all the patients.

Combined anterior chest wall reconstruction for cancer with titanium bars, synthetic mesh and soft tissue flap is a feasible and safe technique. This procedure acknowledges middle-term good results in terms of complication and chest wall stability.

STERNUM FRACTURES: SURGICAL OPTIONS AND APPROACHES.

Oral Communication

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To discuss the surgical options and approaches to sternal fractures. Sternum fractures are responsible up to 0,5% of all body fractures, mainly caused by blunt anterior chest wall contusions. Indications for surgery include: associated injury demanding thoracotomy, respiratory dysfunction despite aggressive medical treatment, thoracic deformity, severe pain and flail-chest

There are several options available to surgically correct sternum fractures including steel wires, titanium plates and steel plates. Regardless of the chosen material and shape, the fixation is done on the anterior part of the sternum. However, some fractures cannot be corrected that way. Some authors described the use of Nuss bars in cases of flail chest due to horizontal or oblique sternum fractures and multiple adjacent bilateral rib fractures. This allows to a posterior support of the sternum fracture.

A PubMed database search was conducted. Keywords used were “sternum fracture”, “steel wires”, “titanium plates” and “Nuss bar”. Chosen articles were case reports, original articles and clinical research.

A total of 86 cases were analysed. Steel wires are usually readily available, have a low profile and are quickly removed if necessary, although they are less stable than titanium plates. Divisi et al compared the use of titanium plates (30 patients) and steel wires (5 patients), showing a shorter operative time (45 vs 68 minutes) and hospital stay (3 vs 6 days) using titanium plates. Byun et al, compared longitudinal-shaped (7 patients) and T-shaped (12 patients) titanium plates, concluding that T-shaped plates are more efficient. In those cases where a posterior support of sternum is needed a Nuss bar may be considered.

Titanium plates are the most widely used, providing good stability with shorter operative time and faster recovery from the procedure. In a group of selected patients in which a bilateral posterior support is needed, a Nuss bar may be considered.

REPAIR OF RIB FRACTURES: INDICATIONS, TIPS AND TRICKS.

Oral Communication

Scarci M.

London ~ UK

ADDITION OF VIDEO-ASSISTED THORACOSCOPIC SURGERY TO THE TREATMENT OF FLAIL CHEST AFTER HIGH-ENERGY TRAUMA.

Oral Communication

Schots J., Van Loo E.*, Meesters B., Hustinx P., Pijnenburg A., Siebenga J., Hulsewé K., Vissers Y., De Loos E.

Zuyderland Medical Center ~ Heerlen ~ Netherlands

Flail chest is a common injury after high-energy trauma, and almost 25% of the patients develop a hemothorax. Video-assisted thoracoscopic surgery (VATS) is increasingly used in chest trauma and the treatment of hemothorax. This report describes our initial single-institutional experience with VATS in the surgical treatment of patients with flail chest after high-energy trauma.

From January 2013 to July 2014, 15 patients with flail chest after high-energy trauma were treated in our hospital. The Injury Severity Score (ISS) ranged from 16 to 44. Rib fixation was performed with precontoured plates or intramedullary splints. In all patients we additionally used VATS to explore the thoracic cavity and evacuate any hemothorax.

In 10 patients a prominent hemothorax was present, which needed evacuation. In one patient, the apical segment of the left upper lobe was captured in between the fracture fragments and needed to be released from the thoracic wall. The mean stay in the intensive care unit was 5.3 days (SD 6.8). The mean duration of mechanical ventilation was 2 days (SD 4.2). Three patients had minor postoperative adverse events (e.g. wound infection, urinary tract infection, fever of unknown origin). All patients were discharged after 6 to 44 days (mean, 11.9 hospitalization days) (SD 9.6).

We believe VATS is effective and safe and can be of additional value by providing the possibility to adjust the planned incision for rib fixation and decrease the area of muscle destruction. Additional pulmonary or mediastinal pathologic conditions can be identified and complete evacuation of hemothorax can be achieved simultaneously.

STERNAL RECONSTRUCTION FOLLOWING CARDIAC SURGERY USING THE STRATOS SYSTEM, 'IN SITU' BONE GRAFTING AND OMENTOPLASTY: A SINGLE CENTRE EXPERIENCE

Oral Communication

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Sternal wound dehiscence following median sternotomy for cardiac surgery is a rare but serious complication with high morbidity and mortality. Many sternal repair techniques, including the

Robicsek procedure, rely on reasonable bone quality for success. We present a case series using the Strasbourg Thoracic Osteosyntheses System (STRATOS) with autologous bone grafting and omentoplasty to augment and facilitate sternal healing.

A retrospective analysis was performed of patients who underwent sternal reconstruction using STRATOS system in our institution between September 2010 and February 2017. In each, bone graft was harvested from the sternum and ribs and used 'in situ'. Titanium bars were used for anterior chest wall reconstruction and an omentoplasty performed in the majority of patients.

Ten patients who underwent this procedure were identified. All the patients were male with a mean age of 60 years. Co-morbidities included COPD (2/10), diabetes (3/10), obesity (3/10). The initial incision was median sternotomy in nine out of the ten patients with one patient having undergone a clamshell incision for bilateral lung transplantation. There were no intra-operative complications. All patients were extubated immediately following surgery. The median length of hospital stay was 12.5 days. All the patients were discharged home and 80% made an uneventful recovery. Two patients developed recurrent sternal wound infections necessitating removal of the STRATOS bars and additional vac assisted closure (VAC) therapy. Both of these patients subsequently made a good recovery.

Rigid sternal fixation with or without omentoplasty can be performed successfully in the management of sternal wound dehiscence with good outcomes. Patient factors have to be carefully considered and the optimum method of chest wall stabilisation remains a matter of debate. This small series adds to the current evidence available for the application of this technique with excellent functional and cosmetic outcomes.

RIB FIXATION BY SINGLE MUSCLE-SPARING THORACOTOMY IN TRAUMATIC FLAIL CHEST

Oral Communication

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Bundang CHA Medical Center ~ Sunnam ~ Korea, Republic of

Flail chest is an emergent surgical condition which needs timely and adequate restoration of chest wall rigidity. However, there are debates regarding when, what, and how. In our institution, relatively strict indication for flail chest has been applied, which is summarized as single muscle-sparing thoracotomy after exact identification of flail segments.

From 2013 to 2016, eighteen male patients with traumatic flail chest underwent open reduction and metal plate fixation. Age varied from 42 to 83, median 59 years. Combined other organ injury was found in 11 (2 liver, 1 clavicle, 2 scapular, 1 pelvic bone, and 2 facial bone, 3 limb). Brief descriptions of surgery are as follows;

1. Surgical correction of flail chest as soon as possible.
2. Meticulous identification of flail segments with and without anesthesia
3. Single muscle-sparing thoracotomy with sufficient layer-by-layer dissection

4. Bicortical multiple screw overcorrection and fixation of multi-segmented ribs.

Number of fixed rib varied 2 to 6 (median 3). Number of plate used varied 2 to 10 (median 5). 11 patient had right-side surgery, the other 7 had left-side one. In 3 early patents, clavicle plate was use, then in all the other 15 patients, Sternalock Titanium plate was used. Surgery time varied fromm 60 to 120 minutes (median 75 minutes). Postoperative ICU care was required from 1 to 13 days (median 1 days), and 7 patients required postoperative ventilator care due to combined injury of other organs. Postoperative hospital stay resulting from rib fixation seems to be lesser than a week. No plate migration, dislocation nor breakage was noticed until now. Post-discharge analgesics required only in 5 patients and moderate to severe pain complaint was observed in only 3 patients.

Rib fixation by single muscle-sparing after exact identification of flail segments seems to be sufficient for flail chest correction. Surgical outcome and post-treatment pain score was also acceptable.

BIOMECHANICAL COMPARISON OF MONOCORTICAL VERSUS BICORTICAL RIB FIXATION IN A CADAVERIC MODEL

Oral Communication

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The introduction of a hybrid titanium rib plating system (Synthes MatrixRIB) has revolutionized the management of rib fractures. It comprises of a set of anatomically pre-contoured plates and locking screws. Due to the close proximity of ribs to pleura, rib fixation in a bicortical manner can inadvertently cause pleural tear, irritation, or lung damage. We aim to evaluate if plates secured in a monocortical manner can provide the same stability as bicortical.

Ten pairs of fresh frozen ribs(Ribs 5 to 9) were harvested from two human cadavers. Intact ribs were subjected to biomechanical testing by the E-1000 Dynamic Tester(Instron Corp., USA). First, native stiffness of each ribs were measured and loaded to failure to induce a realistic rib fracture. Next, fractures were stabilized with matching plate with 3 screws on each side of the fracture. Left-sided ribs were fixed in a bicortical manner and right-sided monocortical. Ribs were subjected to cyclic loading of 50000 cycles at 3Hz, 2-6N simulating physiological respiration. The pre- and post-cyclic stiffness of each rib was measured. Finally, ribs were loaded to failure to determine the failure modes. Non-parametric Mann-Whitney U-test was used for statistical analysis.

Left-sided ribs(nL=9) demonstrated native stiffness of 10.0N/mm and right-sided(nR=10) 11.9N/mm. One left rib was omitted because the fracture occurred at the mounting side rendering it too short for fixation. Pre and post-cyclic stiffness for left side(bicortical) was 3.3N/mm and 4.41N/mm; right side(monocortical) was 3.1N/mm and 3.9N/mm. Statistically, both groups revealed no significant difference ($p>0.5$). Failure mode for all the ribs in bicortical group was re-fracture at original site, two demonstrated screw pull-out in the monocortical group.

The pre- and post-cyclic stiffness for two method of fixation revealed no statistical difference. This suggested that monocortical fixation of the ribs can provide sufficient stability and mitigate the complications caused by a bicortical fixation.

Indications and treatment concept for the stabilization of chest wall following trauma

Oral Communication

Fisher H.*

Due to the increasing number of instable thoracic wall injuries from traffic and household accidents we developed a concept for the surgical treatment of rib serial fractures. Since 2010 we have surgically stabilized up to 40 patients annually. Most of the patients underwent surgery on the day of the accident. Invasive ventilation was only intraoperatively necessary. After an intensive care stay of 1 – 2 days the most patients have been discharged from the hospital within 14 days. We observed and documented a significant reduction of pain on a pain from 7 to 3 in a scale of 1 – 10. Furthermore, an early mobilization and a quick occupational rehabilitation were possible. Unfortunately, follow up controls in 3 months intervals were barely accepted. According to our experiences an early and quick surgical treatment of instable rib serial fractures is advantageous for the outcome of the patients.

THE DYNAMIC COMPRESSION BRACE FOR PECTUS CARINATUM: INTERMEDIATE RESULTS IN 286 PATIENTS

Oral Communication

De Beer S.A., Gritter M.*, De Jong J.R., Van Heurn E.L.

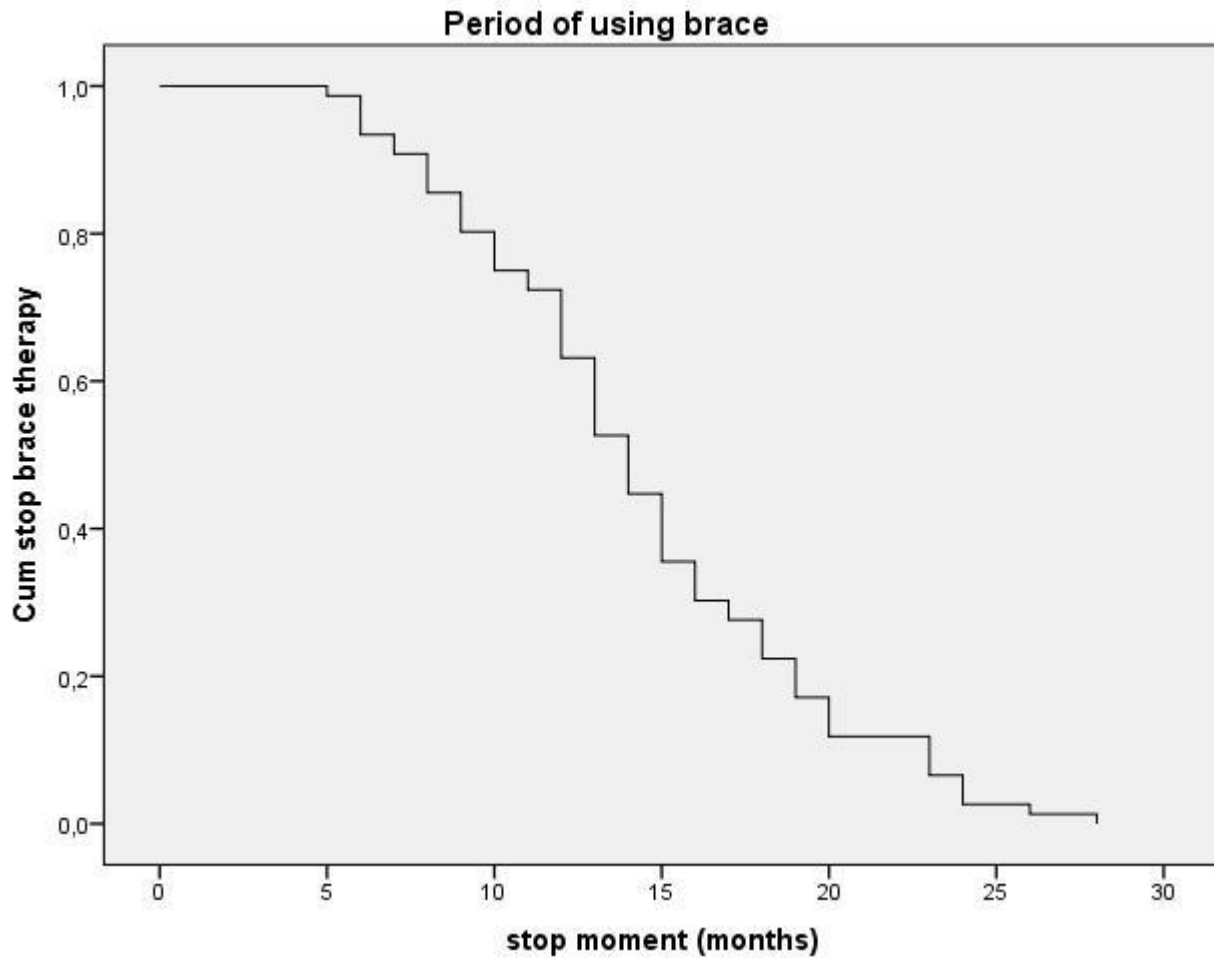
Pediatric Surgical Centre of Amsterdam (AMC and VUmc) ~ Amsterdam ~ Netherlands

To evaluate the effectiveness of treatment with the dynamic compression brace in patients with pectus carinatum

Patients referred to our pediatric surgical center were screened for treatment with the dynamic compression brace. Patients with a pressure of initial correction (PIC) ≤ 10.0 pounds per square inch were offered treatment with the brace. Patients with a PIC > 10.0 pounds per square inch were offered surgical correction. Between March 2013 and April 2016, 286 patients were treated with the brace; 260 were male (91%), 26 female (9%). Their mean age was 14 years (range 4–21).

78 patients completed brace treatment with a mean treatment time of 14 months. 27 patients abandoned treatment because of lack of motivation, loss to follow-up, persistent protrusion of the sternal bone or flaring for which surgical correction, failure of treatment due to a bifid rib, fear of locking the brace and delayed correction. 181 patients are still wearing the brace, either in the active or retainer phase. Patients with a high PIC also showed improvement when compliant. Complications were minor and included skin lesions (n=4, 1%), and vasovagal reactions at the start of therapy (n=3, 1%).

These data show that brace therapy can be considered as a valuable treatment option to correct pectus carinatum in patients with a flexible thorax



Global treatment for thoracic anomalies in Poland Syndrome

Oral Communication

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Poland syndrome is a congenital deformity characterized by unilateral hypoplasia to absence of pectoralis muscles, breast, nipple, areola, axillary fold, decreased subcutaneous fat; ribs defects, pectus excavatum, pectus carinatum, and hypoplasia, syndactily, brachydactily, oligodactily of the ipsilateral upper limb. The thoracic anomaly, the pathognomonic malformation of Poland syndrome, presents a wide phenotype variability. The aim of this study is present a classification of the all types of thoracic anomalies of PS and an algorithm of surgical treatment with their results

Since 2008, 100 patients were evaluated by the same team of surgeons at San Martino Hospital and Istituto Giannina Gaslini of Genoa, Italy using the Thorax, Breast and Nipple-areola complex (TBN) classification. Thoracic malformations were classified as: thorax (T), from T1 (muscle anomaly only) to T4 (complex deformity with rib and sternal involvement); breast (B), divided in B1 (hypoplasia) and B2 (aplasia); and nipple-areola complex (N), from N1 (dislocation <2 cm) to N3 (athelia). The data about sex, age, clinical presentation, specific anomaly of PS and the different surgical techniques are described and discussed. The evaluation was based on pre and post: clinical presentation, operative thoracic measurements, pictures. A written informed consent was signed. A questionnaire of quality of life was given to all patients.

T1 and N2 were the most frequent thoracic anomalies in both males and females. In females, breast hypoplasia (B1) was more common than amastia (B2). An algorithm of treatment is presented for each kind of anomaly. In most of cases of N2 it was necessary to position an expander and later the implant. In all cases fat grafting was indicated.

The TBN classification associated to the algorithm can be useful in the decision of the surgical treatment specifying each thoracic anomaly with good results.

Poland's Syndrome and allied disorders

DOES INTRODUCTION OF THE ABRAMSON PROCEDURE IMPROVES QUALITY OF LIFE? ANALYSIS OF INITIAL EXPERIENCE IN A EUROPEAN TERTIARY REFERRAL CENTRE.

Oral Communication

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The Abramson procedure is a relative new minimally invasive procedure for Pectus Carinatum (PC) repair. Half 2013 the Abramson procedure was introduced in our centre as alternative treatment for PC. The objective of this study was to evaluate the initial experience obtained three years after the implementation of the Abramson procedure in our institution and to assess postoperative quality of life (QoL).

In this single centre retrospective study we analyzed the complications after the Abramson procedure, graded according to the Clavien-Dindo classification between August 2013 and December 2015. Health questionnaires (EQ-5D-5L, SF-36 and Single Step Questionnaire) were sent to the patients after consent of our local ethical committee.

20 patients, all male, were included in the study. Median age at time of surgery was 14,92 years. In all of the patients, low self-esteem was an indication for surgery. All patients received a patient-controlled epidural analgesia for 5 days. Median length of stay was 7 days. In 12/20 patients the bar is already removed after a median treatment duration of 1,95 years. There were 23 complications early postoperatively, mostly pneumothorax (n=17). One patient needed revisional surgery for bar dislocation. During the two-year treatment 9 patients had an uncomplicated treatment pathway. 10 patients had grade I complications (breakage of cable). Two patients had neuropathy treated with medication. Mean VAS-score in our population was 87,31 compared to 82,80 in the Flemish control group (p=0,017). SF-36 revealed that the mean value for each domain was above the norm.

3 years after the implementation of the Abramson procedure, we had a complication profile comparable to literature. Health questionnaires show that the Abramson procedure brings adolescents to a normal or even higher health status. Abramson procedure has therefore become a safe and valuable alternative for Ravitch procedure in selected patients with malleable PC.

HEAVY METAL RELEASE AFTER MINIMALLY-INVASIVE REPAIR OF PECTUS EXCAVATUM USING STAINLESS STEEL BAR

Short Oral Communication

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Several studies showed that metallic debris has been released after metal-on-metal hip arthroplasty leading to severe complications. Symptoms of metal allergy have also been observed after minimally-invasive repair of pectus excavatum (MIRPE).

We evaluated the contamination with chromium, cobalt and nickel in blood, urine and tissue in patients prior to MIRPE and in patients who underwent an explantation of the 1.4441 ASTM F 138 stainless-steel bar(s) after three years. The institutional review board approved this study (No. 6659), and all patients and legal guards gave their informed consent.

Our study group consisted of 20 patients (mean age 19 years) who had bar explantation and our control group included 20 patients (mean age 16 years) prior to MIRPE. At the time of bar removal we detected very high concentrations of chromium and nickel in the tissue compared to patients prior to the procedure ($p < 0,001$). We also found a significant increase in the levels of chromium in urine and nickel in blood in patients three years post MIRPE ($p < 0,001$). Four patients temporarily developed symptoms of metal allergy, all had elevated metal values in blood and urine at explantation.

Minimally invasive repair of pectus excavatum can lead to a significant release of heavy metal ions that can cause allergic symptoms up to heavy metal intoxication.

DYNAMIC BRACE THERAPY FOR THE CORRECTION OF PECTUS CARINATUM IN DENMARK

Short Oral Communication

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^[1]Rigshospitalet ~ Copenhagen ~ Denmark, ^[2]Aarhus University Hospital ~ Aarhus ~ Denmark

External bracing therapy has gained increased popularity in recent years and is currently the preferred technique for the correction of pectus carinatum in patients with a flexible chest wall. However, short and long-term effects of bracing therapy are poorly described.

In the time period from January 2015 to December 2016 patients with pectus carinatum scheduled for external bracing therapy were consecutively recruited at two thoracic surgical departments in Denmark. Patients were instructed to use the brace 24/7 only removing it during sports and bathing. Patients were asked to record the daily use of the bracing system (0-24 hours) and any brace-related rest and movement-evoked pain on an 11-point numerical rating scale (NRS: 0=no pain; 10=worst pain imaginable) for the first 6 weeks after initiating the treatment.

A total of 106 patients (98 males) with a mean age of 14 ± 2 years (range: 6 to 23 years) were included. The mean pressure for initial correction (PIC) was estimated at 5.64 ± 1.74 (range: 1.54 to 8.78). There was a significant association between age and PIC ($\rho = 0.25$; $P = 0.01$). The brace was used for 13 ± 7 hours on the first day. From day 2 and onwards the brace was used approx. 17-19 hours daily. Pain was initially 4.2 (95%CI: 3.7 to 4.7) at rest and 4.1 (95%CI: 3.4 to 4.8) with movement. Pain gradually decreased with time and was considered mild from around day 10; pain at rest 1.9 (95%CI: 1.5 to 2.3) and pain with movement 2.1 (95%CI: 1.5 to 2.6).

Patients rapidly accepted external bracing therapy for the correction of pectus carinatum. Brace-related pain was in the acceptable range from initiating treatment and decreased to a mild level within 10 days of treatment.

MOVING TOWARDS AN INTERDISCIPLINARY MODEL FOR PECTUS EXCAVATUM ASSESSMENT: EVALUATING PATIENTS' INTEREST IN NARRATIVE THERAPY FOR DECISION-MAKING ABOUT TREATMENT

Short Oral Communication

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The decision to proceed with surgical or non-surgical treatment of pectus excavatum (PE) can be complicated by many factors. Patients interested in surgical treatment may be referred for evaluation by numerous different specialists, but clinical social workers are not currently included in this process. As such, we tested the hypothesis that PE patients would be interested in formal assistance with the decision-making process surrounding PE surgery using narrative therapy principles, which unfold aspects of the person's life that contradict his or her most traumatic life events (Payne 2006).

The decision to proceed with surgical or non-surgical treatment of pectus excavatum (PE) can be complicated by many factors. Patients interested in surgical treatment may be referred for evaluation by numerous different specialists, but clinical social workers are not currently included in this process. As such, we tested the hypothesis that PE patients would be interested in formal assistance with the decision-making process surrounding PE surgery using narrative therapy principles. Resulting emancipation narratives focus on aspects of the person's life that compensate or contradict his or her most traumatic life events (Payne 2006).

We found that 82% of participants were interested in these three forms of counseling to assist with the decision-making process surrounding PE surgery. Individuals most interested in narrative therapy tended to be more interested in correction ($p < 0.05$) to improve the way they feel about their body ($p < 0.05$). We propose that narrative therapy should be offered to PE patients during the treatment evaluation process to address the psychosocial difficulties associated with PE and the surgical decision-making process overall.

The majority of PE patients are interested in narrative therapy practice principles. Future studies should assess the clinical feasibility and effectiveness of an interdisciplinary model for PE evaluation that includes clinical social workers familiar with this counseling style.

PECTUS BAR INFECTION: DO WE NEED TO REMOVE THE BAR?

Short Oral Communication

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Pectus bar infection has been a persistent problem. The aim of this study is to elucidate the characteristics of its nature, management strategies, and outcomes from a large-scale database.

We retrospectively reviewed 1,087 consecutive patients who underwent pectus excavatum repair using pectus bars between March 2011 and May 2016. Variables from patient demographics, clinical characteristic, and surgical techniques were evaluated using multivariate analysis.

We had 38(3.5%) patients of infection after pectus bar repair of their pectus deformity. The mean interval until the postoperative infection occurred was 32 days (6-197), and the mean hospital stay of them was 12 days (4-65). Twenty-seven patients (71.1%) had culture-positive organisms from the wound. The most common organism cultured was methicillin resistance staphylococcus aureus (52.6%), followed by methicillin-sensitive staphylococcus aureus(18.4%). Multivariable analysis failed to reveal any clinically relevant independent risk factors for infection, only except for the season of operation (summer) (HR=2.380, p=0.043). Patient factors or surgical techniques including hardware, the number of bars, fixation technique, and asepsis method were not associated with the infection. Our strategy of management includes antibiotics (vancomycin and cephalosporin), wound managements with aspiration (80.6%), compression dressing (48.3%), closed wound catheter drainage (27.4%), and strong suction drainage (20.9%). Of the 38, 3(7.8%) patients, who ended up with the wound of chronic leaking seroma, sustained until the elective bar removal after 2 to 3 years as indicated. Four (10.5%) patients needed stabilizer removal, and 3(7.8%) required early bar removal.

Pectus bar infection seemed to be one serious unresolved problem throughout our experience of pectus bar surgery. However, we could manage the bar infection with a reasonable success rate with our adaptive management strategy, although we had to remove the bars prematurely from 3 patients. We were not able to elucidate any clinically relevant risk factors for infection from our large-scale database.

CAUSES OF EXERCISE INTOLERANCE IN PECTUS EXCAVATUM: A 111 CASES AND 20 CONTROLS STUDY

Short Oral Communication

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Multiple studies demonstrate lower effort capacity in patients with pectus excavatum (PE). The aim of the study was to evaluate the cardiac hemodynamics and the systolic and diastolic function at rest and during exercise in patients with PE and compare with healthy controls, utilizing the supine cycle stress echo methodology.

Stress echocardiography was performed in 111 PE (Haller index $5,7 \pm 4,4$), and 20 controls (C).

The tricuspid ring was lower in the PE: 1.29 ± 0.26 cm/m² vs $1,89 \pm 0.25$ cm/m² ($p < 0,01$).

Peak exercise capacity was lower in the PE: 8.3 ± 1.4 vs. 15 ± 4.5 MET ($p < 0,0001$).

In maximal effort, signs of diastolic dysfunction were observed of the left ventricle (LV) in 34,6 % of the PE and 5 % of the C ($p = 0,007$), and of the right ventricle in 40 % of the PE and 15 % of the C ($p = 0,04$).

The mean trans-tricuspid gradient in effort was higher in the PE: 6.21 ± 2.29 mmHg, vs. 4.8 ± 1.17 mmHg in the C ($p = 0,01$).

While in C the tricuspid area increases during exercise, from 1.55 ± 0.7 cm²/m² to 2.11 ± 0.88 cm²/m², it remained fixed in the PE $1.47 \pm 0,43$ cm²/m² at rest and $1,48 \pm 0,57$ in maximum effort, and lower than C ($p = 0.0001$).

Patients with pectus excavatum present functional abnormalities probably due to external compression of the heart, which are evident by a small tricuspid annulus, a higher tricuspid pressure gradient during exercise, tricuspid area that remains fixed at exercise and rest, and signs suggestive diastolic dysfunction of both ventricles. Such abnormalities contribute to explain the lower exercise performance.

POSTOPERATIVE COMPLICATIONS IN MODIFIED NUSS PROCEDURE FOR CORRECTION OF PECTUS EXCAVATUM: A COMPARISON BETWEEN ADOLESCENT AND ADULT PATIENTS.

Short Oral Communication

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Zuyderland Medical Center ~ Heerlen ~ Netherlands

The modified Nuss procedure is considered to be the gold standard for treatment of pectus excavatum, and is mostly performed at a younger age. The aim of our study was to examine the risk of complications by a modified Nuss procedure in adolescent- compared to adult patients with pectus excavatum.

We retrospectively evaluated all patients undergoing a modified Nuss procedure for pectus excavatum between 2006 and 2016 at our institution ($n=262$). General anesthesia and epidural analgesia was applied in all patients, and procedures were performed with thoracoscopic assistance. Patients aged <18 years (group A) were compared to patients aged ≥ 18 years (group B). Primary outcome was bar dislocation. Secondary outcome measures were the number of bars used per patient and the total number of complications. Outcome was analyzed using student t-test

or chi-square test where appropriate ($p < 0.05$). Data are presented as means with standard deviations.

Group A consisted of 138 patients (age 16 ± 1.5 years), and group B 123 patients (age 26 ± 9.3 years). Mean follow-up amounted 20 months. The severity of the pectus (Haller index) was similar in both groups (A 3.7 ± 1.4 ; B 3.8 ± 1.5 , ns). There was a significant difference in the number of bars used: two bars were placed in 1.4% of patients in group A and 6.5% in group B ($p < 0.05$). Bar dislocation occurred significantly more often in group B (5%) compared to group A (1%), $p < 0.05$. Other postoperative complications (infection, seroma, hemorrhage, pneumothorax) occurred in 7% versus 10%, respectively ($p < 0.05$). Mortality rate was 0%.

In a modified Nuss procedure, the risk of bar dislocation is higher in adults compared to adolescents. In addition, two bars are more often necessary in adults, and postoperative complications occur more frequently. Nevertheless, the modified Nuss procedure is a safe technique with acceptable risks for treatment of pectus excavatum in adults.

IMPACT OF CUSTOMIZED PRE-BENT BAR IN NUSS PROCEDURE

Short Oral Communication

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Automatic pre-surgical bar bending for pectus excavatum correction, based on the patient 3D computed tomography (CT) scan, allows the molding with the exact size and shape. This study reviews the experience of a tertiary center for surgical correction of PE and analyses the impact of the automatic pre-bent bar (PB) in the outcomes of Nuss procedure (NP).

Patients submitted to NP from January 2000 to July 2015 were included. Clinical files were analyzed for demographics, previous PE correction, surgical time and complications. Patients operated with the PB were compared to those with classic manual bent bars (MB). The first chronologic half of patients of MB and PB were compared respectively with the second half of MB and PB. The MB2 was compared with PB1.

149 patients (78.5% males) underwent NP with a mean age of 14.9 ± 3.1 years. Ten patients had been previously submitted to Ravitch procedure. The PB was used in 105 patients (70.5%). MB and PB groups were identical regarding gender and previous Ravitch surgery, however the MB group patients were submitted to surgery at a younger age. In PB group, the surgical time was inferior, the hospital length of stay was shorter and the complication rate was lower. When comparing the MB2 with PB1, the groups were identical regarding gender, age and previous Ravitch surgery. The surgical time and hospital length of stay continued to be shorter in the PB1 group, however the complication rates were similar.

The outcomes improved with the introduction of the PB, with a reduction in the surgical time, LOH and complications. If the learning curve of the procedure is taken into account (MB2 vs. PB1), there is no reduction in the complication rate, but there is still a clear reduction in the operative time and hospital stay.

STERNO-VERTEBRAL DISTANCE FOR THE EVALUATION OF RECURRENCE AFTER NUSS-BAR REMOVAL

Short Oral Communication

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Studies of post-operative recurrence in children after the Nuss procedure have been carried out based on inspection of the chest not on objective study. We have followed patients with pectus excavatum after bar removal and measured sterno-vertebral distance for an index of recurrence using lateral chest X-ray film in different age groups in children.

Fifty-four patients (male; 40, female; 14) with pectus excavatum who underwent the Nuss procedure less than 10 years old (average; 6.5) were followed-up for more than 3 years after bar removal. We divided them into two groups according to the age of bar-removal; early group (n=36) < 10 and late group (n=18) >= 10. Using lateral chest X-ray film, sterno-vertebral distance (SVD) was measured at the lowest part of the sternum. SVD was measured using a film just after bar-removal (A) and 3 years after bar-removal (B), and the ratio (B/A) was calculated. The ratio was defined as no change; 1 ± 0.05 , increased; more than 1.05 and decreased; less than 0.95.

The period of bar-in-place showed no difference in two groups. Average SVD ratio in the early group was 0.97 and in the late group was 1.05. In early group, 15 of 36 cases (42%) showed decreased SVD and 10 of 36 cases (28%) were increased. On the other hand, only 3 of 18 cases (14%) in late group showed decreased SVD, and 9 of 18 cases (50%) were increased.

Early operation and early bar-removal less than 10 years old showed a high risk of decrease of SVD. Children around the age of 10 or more grow rapidly and the height as well as the chest increases in size. Our data suggested that the chest might have a risk of depression after bar-removal in cases with early operation.

EXPERIENCE IN THE MANAGEMENT OF PECTUS EXCAVATUM WITH PROCEDURE OF NUSS IN CHILDREN OF THE NORTHWEST REGION OF MEXICO.

Short Oral Communication

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Pectus excavatum (PE) is the most common malformation of the anterior wall of the thorax. Multiples techniques have been described for surgical correction, since 1987, Dr. Donald Nuss, reported his procedure that quickly gained popularity. Since 1998 the substernal dissection is performed using thoracoscopy, after that multiple modifications have been published. We treat patients with PE with the technique of NUSS for repair from 2013 at the Medical Unit of High Specialties Hospital of the Paediatrician of the Western Medical Center, Mexican Institute of Social Security.

To describe the experience with NUSS technique for the correction of PE in children in the region Northwest of Mexico, a descriptive study conducted from August 2013 to February 2017, included twenty patients with diagnosis of PE, which underwent to technique of NUSS and thoracoscopy. The study was accepted by the Local Committee of Investigation of the hospital (Number 2017 - 1302-2). This study did not receive external funding.

There were 14 boys and 6 girls. Age average was 12.2 years (SD \pm 3.2). Haller index average was 5.65, (DS \pm 1. 6). Surgical time was 2 hours in 8 patients, from 2 to 4 hours in 10 patients, and >4 hours in 2 patients. Eighteen patients need only ones bar and in 2 patients 2 bars were required. We decided to place chest tube in 12 patients. Postsurgical complications were observed in four patients. The mean hospital stay was seven days in fifteen patients, five patients was > 7 days. Average time for bars removed was 21 months. In eighteen patients there were an improved tolerance to exercise after surgery. There was no any mortality

NUSS technique is safely for the correction of PE in children treated at our Hospital and we have passed the learning curve.

BILATERAL VS. UNILATERAL VATS ASSISTED APPROACH IN PECTUS EXCAVATUM SURGERY – SINGLE INSTITUTION EXPERIENCE

Short Oral Communication

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The safety of minimally invasive pectus excavatum repair has been demonstrated as an actual issue. Numbers of Nuss technique's modifications have been developed in order to prevent and minimize the risk of serious operative complications. The aim of present study is to compare intra-operative course and early postoperative results in patients with pectus excavatum repaired by minimally invasive approach with unilateral and bilateral VATS control. A single-institution experience with MIRPE correction using unilateral thoracoscopy routinely performed until the year 2015 are currently changed by bilateral thoracoscopy assistance.

A retrospective analysis of patients who underwent primary pectus excavatum repair at a single tertiary hospital in period 2014-2017 was performed. Two groups of patient were established: i, patients treated in period 2014-2015 (unilateral VATS assisted MIRPE correction), ii, patients operated in period 2016-2017 (bilateral VATS assisted MIRPE). Data collected included demographics, operative characteristics (length of surgery), intra-operative complications, early and late post-operative complications and length of hospital stay.

Overall authors analyzed 31 patients operated on during period 2014-2017. First group represented 21 patients operated with unilateral VATS assistance, in the second group there were 10 patients with bilateral VATS assistance. Analysis of parameters did not confirm significant differences in operating time, intra-operative and post-operative complications, nor length of hospital stay. We observed higher incidence of postoperative pleural effusion in first group of patients, probably influenced by different type of bar used during surgery.

Our experiences of last two years endorse bilateral thoracoscopy assistance during MIRPE surgery as safe and feasible method without increased operative burden for patients. The approach offers advantage of better visualisation during introducer loading and withdrawing. Thus

emphasizes surgeon's convenience and safety for a patient. Eventually authors advocate bilateral thoracoscopy in all patients indicated for pectus excavatum minimally invasive repair.

THE USE OF VACUUM BELL IN PECTUS EXCAVATUM

Short Oral Communication

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Pectus excavatum (PE) is the most common congenital chest wall deformity, affecting 1 to 8 per 1,000 live births. Psychological symptoms are common and can affect the life quality. Cardiovascular and pulmonary impairments, aren't so common. Several surgical techniques are available: Modified Ravitch, Nuss and more recently PectusUP (Taulinoplasty). In 1992 Klobe developed the Vacuum Bell (VB) to elevate externally the sternum.

Since 2010 we introduced the VB as the first treatment for patients with PE before indication of any surgery in 48 patients (41 men/7 women) from 5-47y/o (mean 22±15,3), all of them without cardiac or respiratory abnormalities. After one year or more of use, a minimum of 8h/day, the next step of the treatment was decided, depending on patient satisfaction.

Nine patients were lost for follow up and 10 never started the treatment. 29 patients were followed, 6 (20,68%) referred no changes despite of a proper use; 4 (13,79%) referred no changes due to poor use; 11 patients (37,93%) referred high satisfaction and 8 (27,58 %) still wanted surgery (1 Ravitch, 5 Nuss, 2 Pectus-Up) with very good results. Only one patient reported complications: unbearable pain and thrombocytopenia not clearly related to the treatment.

The adhesion to VB treatment is difficult, but after proper hours of use, satisfactory results are reported. We recommend it use during at least one year as a first step of treatment and only after this period, we re-evaluate the need of surgery depending on patient satisfaction. The preoperative use of the VB in adolescent and adult patients may predispose to better chest malleability and improve outcomes and pain after surgery, for which further studies are requie

CONGENITAL CHEST WALL DEFORMITIES : A MODIFIED SURGICAL TECHNIQUE

Short Oral Communication

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□ Congenital chest wall deformities are the most common disorders among the other congenital diseases in thoracic surgery.
□ Standard surgical techniques seem to be sufficient, but to prevent recurrence and complications other surgical approaches have to be chosen, such as freeing the sternum from the second rib cartilage to the costal arch, completely and bilaterally, and external application of Kirschner wire or bars for stabilization.
Aim of study is to present our experience in diagnosis and treatment of congenital chest wall

deformities from January 2003-Juni 2017 in Single Unit Thoracic Surgery Service ,University Hospital Tirana Albania.

21 patients with congenital chest wall deformities were examined. 13 patients with pectus excavatum and 8 patients with pectus carinatum. Mean age presentation was 13 years (range from 8-21 years old). 15 patients were male and 6 patients female. The surgical method consists Ravitch modification method ,of resecting rib cartilages from the second rib up to the costal arch bilaterally and the application of Kirschner wire or metallic struts(BAR) for the stabilization of the chest wall.

No mortality occurred. Three patients had complications, such as wound infection and pneumothorax, hemothorax ,chest wall instability, anxiety status .

Metalic struts(bars) was removed on the 18 months (between 10-24 months).

Mean hospital stay was 16 days (6-23 days).

Patients were followed up between 2 months and 12 years. Recurrence was observed in one patient.

To prevent recurrence and complications of cosmetic surgery is of vital importance.

After resection of the cartilages, the soft tissue and perichondrium have to be stretched against the rotational direction of the sternum by using absorbable suture materials.

Metalic strut is useful and cheaper than the other materials used for stabilizing the anterior chest wall.

Key words: Pectus Excavatum ,Pectus Carinatum ,Surgical Ravitch modification procedures.

FIXATION OF THE STERNUM USING LOCKING COMPRESSION PLATES IN MODIFIED RAVITCH PROCEDURE REDUCES THE RISK OF SYMPTOMATIC PSEUDARTHROSIS.

Short Oral Communication

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Mesh support is the standard method for sternum fixation in a modified Ravitch procedure. Pseudarthrosis is a possible complication, occurring in up to 30%. The aim of our study was to investigate whether fixation of the sternum with locking compression plates reduces the risk of symptomatic pseudarthrosis.

For this retrospective cohort study, we included all patients undergoing a modified Ravitch procedure for pectus excavatum at our institution between 2006 and 2016 (n=49). From 2006 to 2012, the sternum was fixated with non-absorbable mesh support. From 2012 to 2016, locking compression plates were used for fixation. Primary outcome was symptomatic pseudarthrosis. Secondary outcome measure was the total number of complications. Outcome was analyzed using student t-test or chi-square test where appropriate (p<0.05). Data are presented as means with standard deviations.

In 21 patients (43%) sternum fixation was performed with mesh support and in 28 patients (57%) with locking compression plates. Mean follow-up was 21 months (range 1-59). The severity of the pectus (Haller index) was similar in both groups (mesh 3.5 ± 2.3 ; locking compression plates 3.7 ± 1.1 , ns). Symptomatic pseudarthrosis occurred significantly more often in the mesh group (14%) compared to the locking compression plate group (0%) (p<0.05). Complications occurred

more often following mesh fixation (33%: wound infection, pericardial effusion, seroma) than after the locking compression plates (7.1%: wound infection, seroma, atrial fibrillation) ($p < 0.05$).

Achieving union of the sternotomy following a modified Ravitch procedure is a challenge. This study showed that fixation of the sternum with locking compression plates instead of mesh support, significantly reduces the risk of symptomatic pseudarthrosis as well as the risk of postoperative complications.

A BENCHMARKING PROJECT ON THE QUALITY OF PREVIOUS GUIDELINES ABOUT PECTUS REPAIR

Short Oral Communication

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We developed a benchmarking project on quality of previous guidelines on the management of pectus repair.

A literature search using recognized health and social care databases was performed. A mixture of keywords and subject headings were used to ensure a thorough search of the selected databases and websites. The results were de-duplicated using the Healthcare Database Search tool and Endnote. The Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument was used to assess each guideline. Each item was scored on a seven-point scale. Scores for each domain were calculated.

Table I shows a descriptive analysis of six domain scores and overall assessment. Five guidelines fitted the inclusion criteria and were assessed. Clarity of presentation and scope and purpose (objectives and health questions target population) had the higher scores. The applicability of guideline and stakeholder involvement domains had the lowest score. The rigour of development was low. Involvement of stakeholders was strongly correlated with the rigour of development ($\rho = 0.78$) and clarity of presentation ($\rho = 0.84$). Rigour of development was strongly correlated with clarity of presentation ($\rho = 0.93$).

The quality of guidelines assessed by the AGREE II criteria was found to be extremely variable and low. Guidelines with higher scores had a direct involvement of scientific societies in their development. We would develop a cross-societies cooperation to promote more robust guidelines.

Domain	Mean ± SD %	95% CI for the mean %	Median %	Min %	Max %
D1 – Scope and purpose	69 ± 12	59 – 69	71	51	82
D2 – Stakeholder involvement	41 ± 12	35 – 47	44	23	54
D3 – Rigour of development	47 ± 6	41 – 53	49	39	55
D4 – Clarity of presentation	62 ± 14	53 – 71	69	40	71
D5 – Applicability	44 ± 7	38 – 50	47	35	51
D6 – Editorial independence	49 ± 13	42 – 56	49	31	65
Overall assessment	53 ± 10	47 – 60	58	36	58

Table I. Appraisal of Guidelines for Research and Evaluation (AGREE) II scores by domain with the inter-rater reliability between observers. SD = Standard Deviation; CI = Confidence Interval.

TREATMENT OF ISOLATED STERNAL FRACTURE USING THE VACUUM BELL IN AN 8-YEAR OLD BOY

Short Oral Communication

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Isolated sternal fractures (ISF) are very rare in children. Pain management is the method of first choice, but surgery may be indicated. However, the indication for open reduction of sternal fractures is discussed controversially.

To the best of our knowledge, we present the first report of a child with displaced ISF who was treated by conservative treatment using the vacuum bell (VB).

The fracture was reduced by application of the VB under general anesthesia. Follow-up sonography after 1 week showed a secondary displacement of 5 mm. The patient temporarily applied the VB for 6 weeks (30 min twice a day). Clinical and radiological follow-up examinations conducted 9 months after trauma showed a stable reduction and consolidation of the fracture of the sternum.

In children, displaced ISF without concomitant injuries may be reduced completely and cost-effectively by using the VB, thus avoiding surgery.

COMPARISON AMONG DIFFERENT SURGICAL PROCEDURES FOR TREATING ASYMMETRIC PECTUS CARINATUM WITH PRE- AND POST OPERATIVE CT IMAGES.

Short Oral Communication

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The bracing is the first-line treatment for the patients with pectus carinatum. However, pectus carinatum with severe asymmetric deformity is difficult to treat with brace. Surgical treatments such as open treatment or bar technique were recommended, therefore. In our institute, we have employed four different surgical procedures of treating for pectus carinatum with severe asymmetry.

Here, we retrospectively evaluate the efficacy of each procedure using pre- and postoperative CT images.

We evaluated twenty-one pectus carinatum patients with asymmetric deformity undergoing surgical treatment at our institute. We treated five patients with modified Ravitch procedure (Group R), three with resection of the protruded rib cartilage, which was transplanted in the lower chest wall for augmentation (Group I), six with Nuss procedure (Group N) and five with our new method using J-shaped pectus bar (Group J). Using pre- and one-year post-bar removal CT images, we calculated the flattening ratio ($FR = \text{transthoracic diameter} / \text{anteroposterior diameter}$), the change ratio of both anteroposterior distance of each side of the thorax (Thoracic thickness:TT) and the sternum distortion angles(SDA) at the most deformed portion. These data were analyzed by Wilcoxon-Mann-Whitney tests and Kruskal-Wallis tests.

Preoperative FR was largest in Group N. The change ratio of TT was statistically larger in both group N and J. The change ratio of SDA was statistically lower in group I and higher in group N

and J. In comparison of two bar techniques between group N and J, group J more effectively improved distortion of the sternum.

Correction of asymmetric pectus carinatum requires not only reduction of the protruded site in the thoracic wall but also elevating the opposite site of the thorax that relatively located in lower position. Our data analyzing the surgical procedures suggest that bar technique (group J and N) significantly improved the asymmetric deformity.

CHESTWALL REMODELING AFTER CHESTWALL DEFECT DUE TO TUMOR RESECTION

Short Oral Communication

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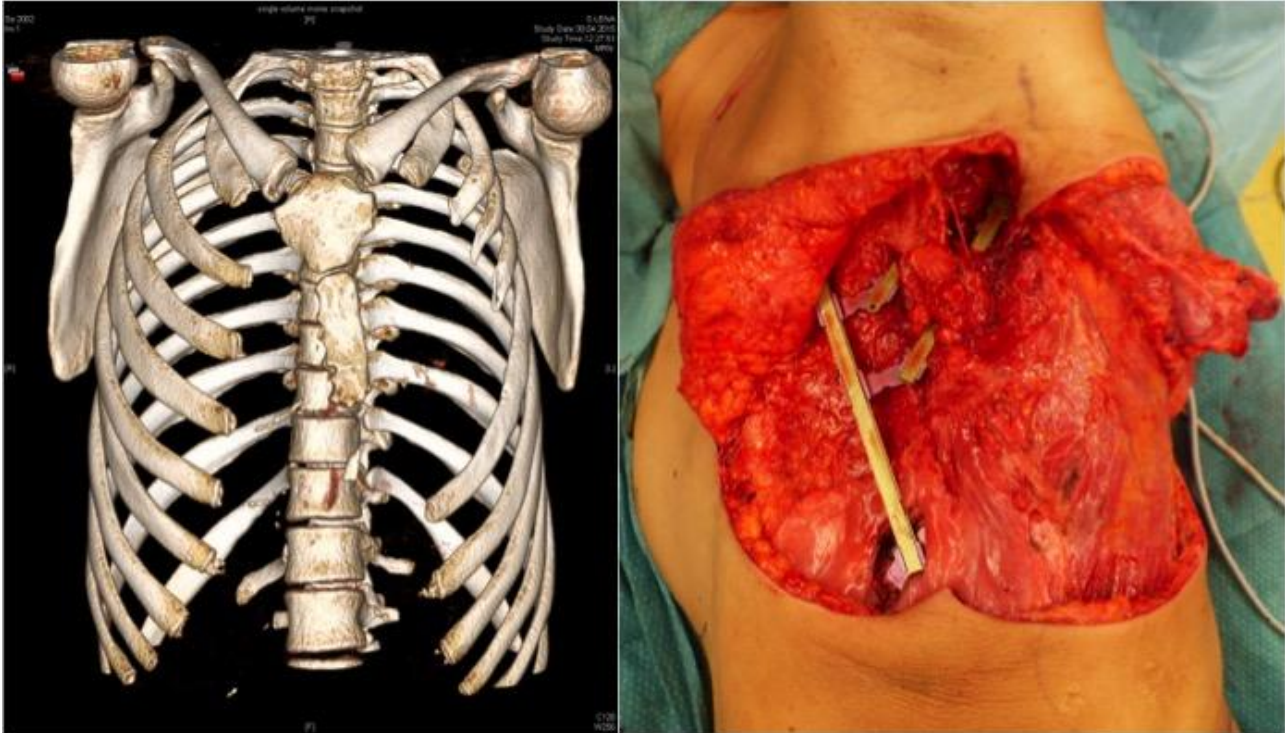
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We report the case of a 22-year old woman who had a resection of an Askin's tumor including resection of the 2nd to 4th ventral left rib at the age of 6 resulting in a big defect of the anterior chest wall on the left side.

In cooperation with the plastic surgeons we performed a remodeling of the left thoracic wall.

In a first operation two expanders were implanted on the left side infraclavicular and inframammary to create enough soft tissue for the following reconstruction. After several fillings of the tissue expanders we performed a reconstruction of the 3rd and 4th rib using a connective titanium bar system that was covered with a Gore-Tex-patch. In the same procedure a latissimus dorsi musculocutaneous flap was done to cover the anterior chest wall where the pectoralis muscle has been resected at the time of the tumor resection. In a last step a reconstruction of the hypogenetic left breast is planned through serial lipo filling.

After several operations in cooperation with the plastic surgeons the chest wall is now reconstructed with titanium bars and a muscle flap and reconstruction of the breast was done through autologous lipotransfer.



INITIAL EXPERIENCE WITH THE ABRAMSON PROCEDURE, A NEW TECHNIQUE FOR TREATMENT OF PECTUS CARINATUM

Short Oral Communication

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The Abramson procedure is a relative new minimally invasive procedure for Pectus Carinatum repair. Half 2013 the Abramson procedure was introduced in our centre as alternative treatment for PC. The objective of this study was to evaluate the initial experience obtained three years after the implementation of the Abramson procedure in our institution.

In this single centre retrospective study we analyzed the complications after the Abramson procedure, graded according to the Clavien-Dindo classification between August 2013 and December 2015. Health questionnaires (EQ-5D-5L, SF-36 and Single Step Questionnaire) were sent to the patients.

20 patients, all male, were included in the study. Median age at time of surgery was 14,92 years. In all of the patients, low self-esteem was an indication for surgery. All patients received a patient-controlled epidural analgesia for 5 days. Median length of stay was 7 days. In 12/20 patients the bar is already removed after a median treatment duration of 1,95 years. There were 23 complications early postoperatively, mostly pneumothorax (n=17). One patient needed revisional surgery, this is part of the learning curve. During the two-year treatment 9 patients had an uncomplicated treatment pathway. 10 patients had grade I complications (breakage of cable). Two patients had neuropathy treated with medication. Mean VAS-score in our population was 89,9 compared to 82,8 in the Flemish control group (p=0.026). SF-36 revealed that the mean value for each domain was above the norm.

3 years after the implementation of the Abramson procedure, we had a complication profile comparable to literature. Health questionnaires show that the Abramson procedure brings

adolescents to a normal or even higher health status. Abramson procedure has therefore become a safe and valuable alternative for Ravitch procedure in selected patients with malleable PC.

PARALYSIS OF THE RECTUS ABDOMINIS MUSCLE AFTER VATS

Short Oral Communication

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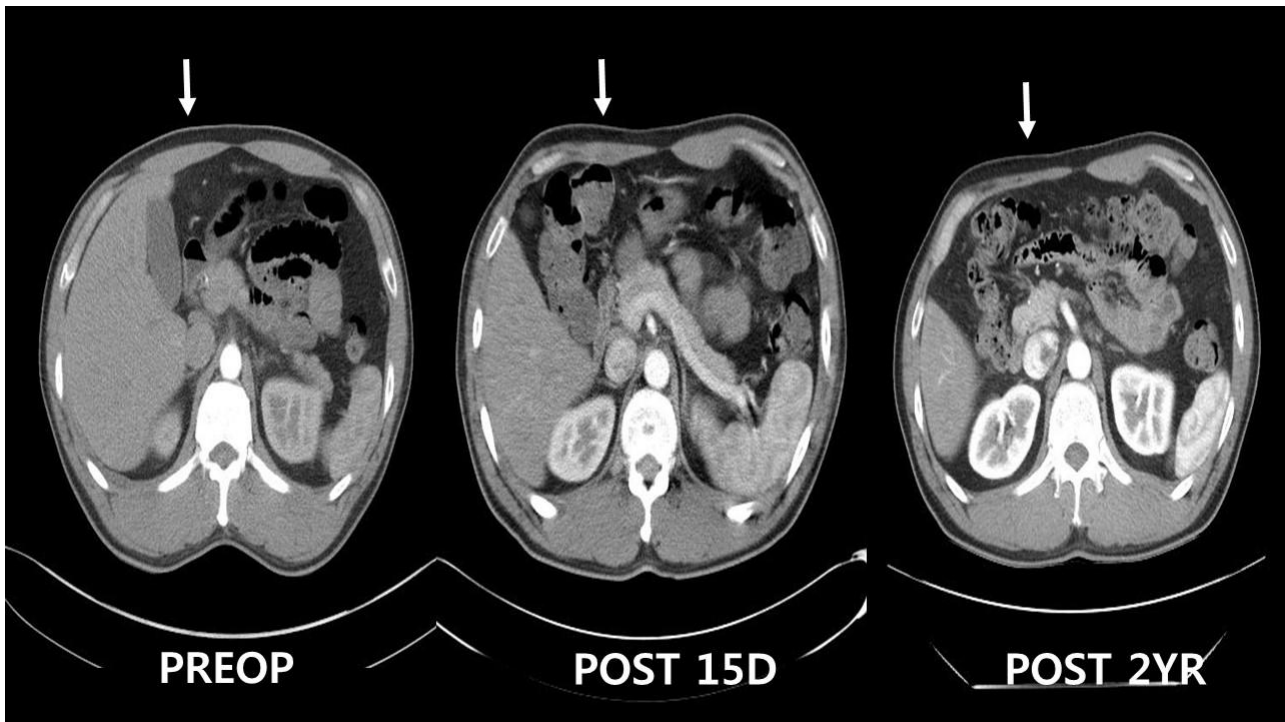
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The rectus abdominis muscle is innervated by intercostal nerves T7 to T12. Most thoracotomies are performed through the fourth to sixth intercostal spaces, so direct damage to these nerves seems unlikely. However, most trocars are inserted below the 7th intercostal space, and injury of the 7th or lower intercostal nerve with related paralysis of the rectus abdominis is possible, albeit rare. Only two cases of rectus abdominis paralysis caused by video-assisted thoracoscopic surgery (VATS) have been reported.

A 42-year-old man underwent a VATS right upper lobe anterior segmentectomy, total pleurectomy, and intrapleural hyperthermic chemotherapy for lung cancer and a malignant pleural effusion. Postoperatively, he felt numb from the right chest to around the navel and complained of repeated painful stabbing pain; asymmetry of the upper abdomen developed.

Physical examination showed a T3 to T9 level sensory abnormality. Computed tomography (CT) performed 15 days postoperatively to assess the right upper abdominal bulging and weakness showed asymmetry of the rectus abdominis thickness. Routine CT to evaluate the status of the rectus abdominis over 2 years showed progressive worsening of this muscle atrophy (Figure 1). The diagnosis was permanent paralysis of the rectus abdominis muscle due to the thoracic operation.

Although clinically apparent injury to an intercostal nerve associated with paralysis of the upper rectus abdominis is a rare complication of VATS, any surgical intervention performed below the 7th intercostal space can cause such injuries. Careful attention is necessary to prevent paralysis of the rectus abdominis when a thoracotomy or trocar insertion is performed below the 7th intercostal space.



EFFECTS OF NUSS PROCEDURE ON RESPIRATORY MUSCLE STRENGTH

Short Oral Communication

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In this study the effects of Nuss procedure (Pectus Excavatum) on respiratory muscle strength were investigated by measuring maximum respiratory pressures.

31 patients, aged between 7 and 25 years, who had undergone Nuss procedure (MIRPE) between June 2014 and March 2017 were recruited to the study pre- and postoperative procedure. A hand-held respiratory pressure meter (Micro RPM; Micro Medical, Chatham, UK) was used to measure respiratory muscle strength (Figure.1). Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) were measured. Maximal inspiratory pressure (MIP) was acquired from residual volume (RV) and the maximal expiratory pressure (MEP) was acquired from total lung capacity (TLC). Pre- and post-procedure maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) were measured. A correlation between the MIP and MEP changes and patient characteristics and Nuss procedure variables were investigated.

The mean value of MIP was 48,67 (24-78) and the mean value of MEP was 59,64 (21-110) for preoperative period. On the other hand, for the postoperative period the mean value of MIP was 61,96 (40-80) and the mean value of MEP was 73,67 (42-118). The results were significant ($p < 0,005$).

In this study, our knowledge the effects of Nuss procedure on respiratory muscle strengths were investigated for the first time, This procedure significantly increased in both MIP and MEP values were observed.



MINIMAL INVASIVE SURGERY FOR THE CORRECTION OF PECTUS EXCAVATUM IN PATIENTS WITH MARFAN SYNDROME: THE MEXICAN EXPERIENCE.

Short Oral Communication

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In Mexico, the focus has been placed on the cardiac aspects of Marfan syndrome patients. Limited attention is drawn to chest wall malformations, and these also have an adverse implication for the correction of cardiac alterations. Our research intends to demonstrate that treating Pectus Excavatum leads to the improvement of the cardiac functions of patients with Marfan syndrome.

Retrospective study. Patients in the study were diagnosed with Pectus Excavatum and Marfan syndrome. Analytical variables included age, gender, patient evolution, Haller index, cardiac symptomatology, surgery duration, bar number, bleeding, pneumothorax, allergy to bars and complications.

From December 2013 to February 2017, 9 patients, 8 males and 1 female with an age range from 12 to 33 years, were treated. Treatment included losartan and all displayed progressive dyspnea. 2 patients had mitral insufficiency, 2 ventricular fibrillation, 4 moderate aortic insufficiency, 5 precordial pain and 3 cyanosis. Haller index from 4.5 to 53. 5 patients required 1 bar and 4 patients 2. Surgical time of 1 bar patients was 60 minutes and 2 bar patients 95 minutes. Average bleeding

20 ml. After treatment, patients improved their cardiac symptomatology. Cardiac arrhythmia was corrected in the 2 patients. A valvular exchange in patients with severe mitral insufficiency was conducted 1 and 2 years after treatment. In case with 53 Haller index one bar was dislocated. Bar was retrieved in 3 patients after 3 years, without recurrence or cardiac symptomatology. Esthetical result satisfactory in 8 patients.

The Nuss procedure not only improves the cardiac symptomatology in patients with Marfan syndrome but allows cardiac correction procedures. It is more than an esthetical procedure. Furthermore, early treatment is recommended to mitigate complications.

COMPARISON BETWEEN ANTHROPOMETRIC MEASUREMENTS AND PECTUS INDEX IN CHEST WALL DEFORMITIES

Short Oral Communication

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Pectus excavatum is the most commonly seen chest wall deformity of childhood age. One of the most widely accepted method in preoperative patient evaluation is pectus index. In this study, it is aimed to measure the depth perception which is not aesthetic; aimed to establish an objective criteria which is simple, cheap, effective and can be measured with physical examination or anthropometry instead of radiological examination dependent measurements. Anthropometric measurements and pectus index were compared.

For this purpose, 9 patients whose pectus index were positive and 9 patients whose pectus index were negative were included to the study. Sternal deformity's depth, anthropometric measurements, pectus indexes, echocardiography and pulmonary function test results and patient symptoms were classified.

There were no significant difference between pectus index and sternal depth. Patients who were referred with aesthetic complaints and whose sternal deformity depth was 1,2 cm or deeper were evaluated as patients who have surgical indication by thoracic surgeon.

These findings showed that, positivity of pectus index is not significant for patients who were determined as patients with surgical indication. According to this study, there's surgical indication in patients whose sternal depth is 1,2 cm and higher, regardless of the pectus index.

Patient (N=18)	Age (mean=14,27)	Gender (M/F)	Pectus (Haller) index	Sternal depression index	Anthropometri c index	Sternal Deep (cm)	Pectus index group
1	16	M	3,50	1,97	0,07	1	PI+
2	18	M	2,50	1,77	0,15	3	PI-
3	11	F	3,96	2,16	0,13	1,5	PI+
4	11	M	3,96	1,58	0,08	1,2	PI+
5	9	M	2,22	1,50	0,08	1,2	PI-
6	18	F	3,08	1,82	0,07	1,4	PI-
7	14	M	3,09	1,85	0,08	1,4	PI-
8	22	M	4,50	2,72	0,29	3,5	PI+
9	10	F	4,44	2,91	0,15	2,4	PI+
10	14	M	3,17	2,03	0,12	2,5	PI-
11	16	M	4,80	2,60	0,17	3	PI+
12	9	F	4,37	2,50	0,16	2	PI+
13	7	M	2,77	1,90	0,11	1,7	PI-
14	13	M	2,69	1,69	0,17	3	PI-
15	13	M	3,08	1,99	0,20	3	PI-
16	15	F	4,33	2,39	0,14	2,5	PI+
17	17	M	3,87	2,52	0,20	3,5	PI+
18	24	M	2,97	1,76	0,11	1,8	PI-

RIGHT VENTRICULAR CARDIAC COMPRESSION IN PATIENTS WITH PECTUS EXCAVATUM(PE): CAN CARDIAC MAGNETIC RESONANCE(CMRI) BE REPLACED BY COMPUTED TOMOGRAPHY(CT)?

Short Oral Communication

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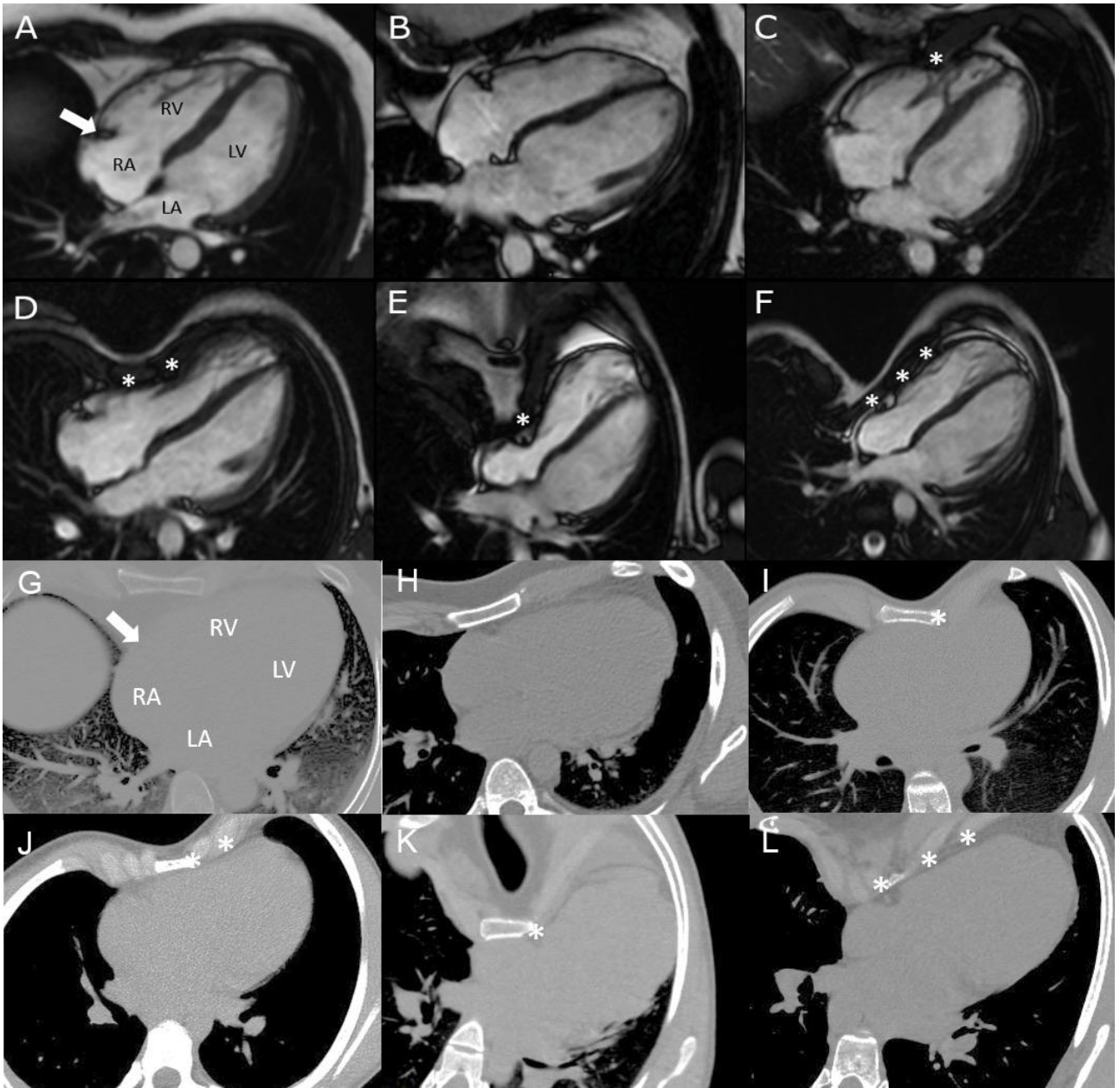
To explore and classify the impact of the malformation severity over the right heart compression cardiac structure by CMR and non-contras CT and their relationship with CT indexes in pectus excavatum(PE) patients.

We included patients with diagnosis of PE who underwent non-contrast chest-CT and cardiac-MRI. CT chest and cardiac deformity measurements were calculated. Cardiac-MRI right heart side compression classification in the horizontal long axis plane were

perform.

Sixty patients with PE underwent CMR and chest CT. Fifty (81%) patients were male, median age 17.5 (14.0; 23.0) years. There was no RV compression in 15 (24%) patients, mid RV and mid/basal RV compression in 22 (36%) and 6 (10%) patients respectively, isolated compression of auriculoventricular (AV) groove in 1 (2%) and AV groove/RV compression in 18 (29%) patients. Three categories (CAT) were established, based on the AV groove compromise. CAT I: no cardiac compression. CAT II: mid and basal RV compression. CAT III: isolated AV groove and AV groove/RV compression. There was a good correlation between cardiac MRI and CT in the classification of cardiac right heart compression $r = 0.9285$ CI 95% = 0,8790 to 0,9575. (Figure 1). There was significantly relationship between CAT I, II and III and CT chest wall and cardiac deformity indexes: Haller index 3.9 ± 1.1 , 4.8 ± 2.0 , 6.4 ± 3.1 ($p=0.009$); correction indexes 22.1 ± 10.4 , 31.6 ± 16.1 , 46.9 ± 16.3 ($p<0.0001$); Cardiac asymmetry index 1.6 ± 0.9 , 1.3 ± 0.2 , 1.7 ± 0.3 ($p=0.024$), Cardiac rotation angle 51.1 ± 16.3 , 55.1 ± 8.9 , 62.4 ± 9.9 ($p=0.018$) respectively.

Chest-CT demonstrated an excellent agreement with CMR regarding the right heart side compression classification.



MONITORING THE EFFECTIVENESS OF THE VACUUM BELL DURING PECTUS EXCAVATUM TREATMENT: TECHNICAL INNOVATION

Short Oral Communication

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The vacuum bell (VB) is a valid and the only non-invasive treatment for pectus excavatum (PE). A distance and differential pressure measuring device (DPMD) enables us for the first time to assess objectively those parameters.

Patients were recruited retrospectively, and distributed into three groups (group 1 aged 6 to 10 years; group 2 aged 11 to 15 years; group 3 aged 16 to 20 years). Sternum elevation and differential negative pressure inside the VB compared to atmospheric pressure were assessed with the DPMD. Pressure-elevation curves were recorded during VB therapy. For statistical studies, analysis of variance (ANOVA) was used. A p-value of less than 0.05 was considered to be statistically significant.

53 children (39 males, 14 females) aged from 6 to 20 years (average, 14 years) were included. Relationships were established between the differential negative pressure inside the vacuum bell, the elevation of the sternum, and the patient's age. The younger the patient, the lower is the differential negative pressure difference required to obtain a complete elevation of the sternum. Patient's age, weight, the pectus depth, the differential negative pressure inside the VB, and the elevation of the sternum were correlated. A statistically significant difference was verified between the groups 3 and 1 ($p=0.0291$) and 3 and 2 ($p=0.0489$) when comparing the depth of the pectus excavatum to the patient's age. However, no statistically significant difference between the groups was found when comparing the sternum elevation to the patient's age ($p=0.4574$) and furthermore when comparing the elevation to pressure ratio to the patient's age ($p=0.8048$). Finally, a statistically significant correlation was found between the patient's age and the depth of the sternum ($r^2=0.15095$).

Correlation between the patient's age, the elevation of the sternum and the pressure inside the VB were demonstrated.

SURGICAL MANAGEMENT OF THORACIC OUTLET SYNDROME VIA TRANSAXILLARY APPROACH: 20 YEARS OF SINGLE CENTER EXPERIENCE

Short Oral Communication

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Thoracic outlet syndrome (TOS) is a complex group of disorders involving compression of neurovascular bundle that is mainly outlined by pain, numbness, swelling of the effected arm. It is mainly caused by congenital abnormalities of the structures or servical rib. In this study, we aimed to investigate results of 1st rib removal along with/without servical rib in the surgical management of thoracic outklet syndrome performed in a 20 years period.

In total, 138 operations were performed in 131 patients between 1996 and 2016. The surgery was bilateral in seven and performed for a recurrence in 13 patients. All but 18(14%) patients were

female with a mean age of 31.4 years old (range 16-60y). Approx. 7cm incision below the hair line in the axilla was performed and division of the scalenius muscles along with total removal of 1st and servical rib (if evident) in all patients. The pleura was deliberately opened in all cases in order to avavoid hematoma and compression of neurovascular structures. Low dose prednisolone along with NSAID was postoperatively used for a month in all patients.

The surgery was performed for a pure neurogenic TOS in 74(53%) and neurovascular TOS in the rest of the patients. The most common complication was a temporary injury of thoracic longus nerve in 7 (5%) patients, Horner's syndrome in five (3.6%, temporary in four pts.), hematoma in three (2%) and venous thrombosis in one patients. Median hospital stay was 48 hours (range 2-6 days). The result was excellent/well in 85% of the patients. Meticulous surgical technique is the key for succes in this complex disease.

It is evident that meticulous decompressive surgery through an axillary approach is a safe and effective surgery not only in patients with servical rib but also with pure neurogenic thoracic outlet syndrome.

INFRACHONDULAR CARTILAGE IN A PATIENT WITH HISTORY OF SLIPPING RIB SYNDROME: WHEN THE HOOK MANEUVER DOESN'T WORK

Short Oral Communication

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Slipping rib syndrome is an underdiagnosed cause of abdominal and chest pain. It occurs when the attachments between the costal cartilages of the false ribs are disrupted, allowing the lower cartilage to move up, or slip, impinging upon the underside of the adjacent cartilage and neurovascular bundle, causing pain. Trauma can be the inciting factor, or vigorous, repetitive movements. The diagnosis may be achieved by physical exam, with a hook maneuver to retract the lower costal cartilages, replicating both the motion and the pain. Treatment is first conservative, with rest, NSAIDs, physical therapy. Rib blocks may be performed to localize the affected cartilages and temporarily alleviate the pain. If the pain is severe enough, surgery is offered. A lower costal incision is used to remove the affected cartilages.

We present a case report of a 13 year old with a one year history of left sided chest pain severely limiting her activity. She underwent two MRIs, multiple chest x-rays, and was placed on muscle relaxants, anti-inflammatories and gabapentin. For a year, she suffered until her family doctor diagnosed slipping rib syndrome. A hook maneuver confirmed this and she underwent surgery to remove her deformed left 10th and 11th costal cartilages resulting in excellent relief. Four months later she had recurrent pain and ultrasound demonstrated her 8th rib entirely beneath her 7th and 9th ribs.

The 8th costal cartilage was resected after removing the overriding 7th and 9th costal cartilages, resolving her pain.

This is the first case reported of a detached costal cartilage riding beneath the adjacent cartilages with lower cartilages still attached. The traditional hooking maneuver would not diagnose this because the cartilage involved was protected by the overriding ribs and not at the costal margin. Ultrasound was the key in diagnosing this patient's extra slipping rib.

SURGICAL CORRECTION OF PECTUS ARCUATUM IN A WOMAN, A CASE REPORT

Short Oral Communication

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Introduction

From all the thoracic wall deformities that cause protrusion, a pectus arcuatum, is one of the rarest. The unique features of this deformity are a short shield-like sternum with a fused sterno-manubrial junction and sharp angle at this point causing a forward angulation. The most common indication for correction is cosmetic.

Patient

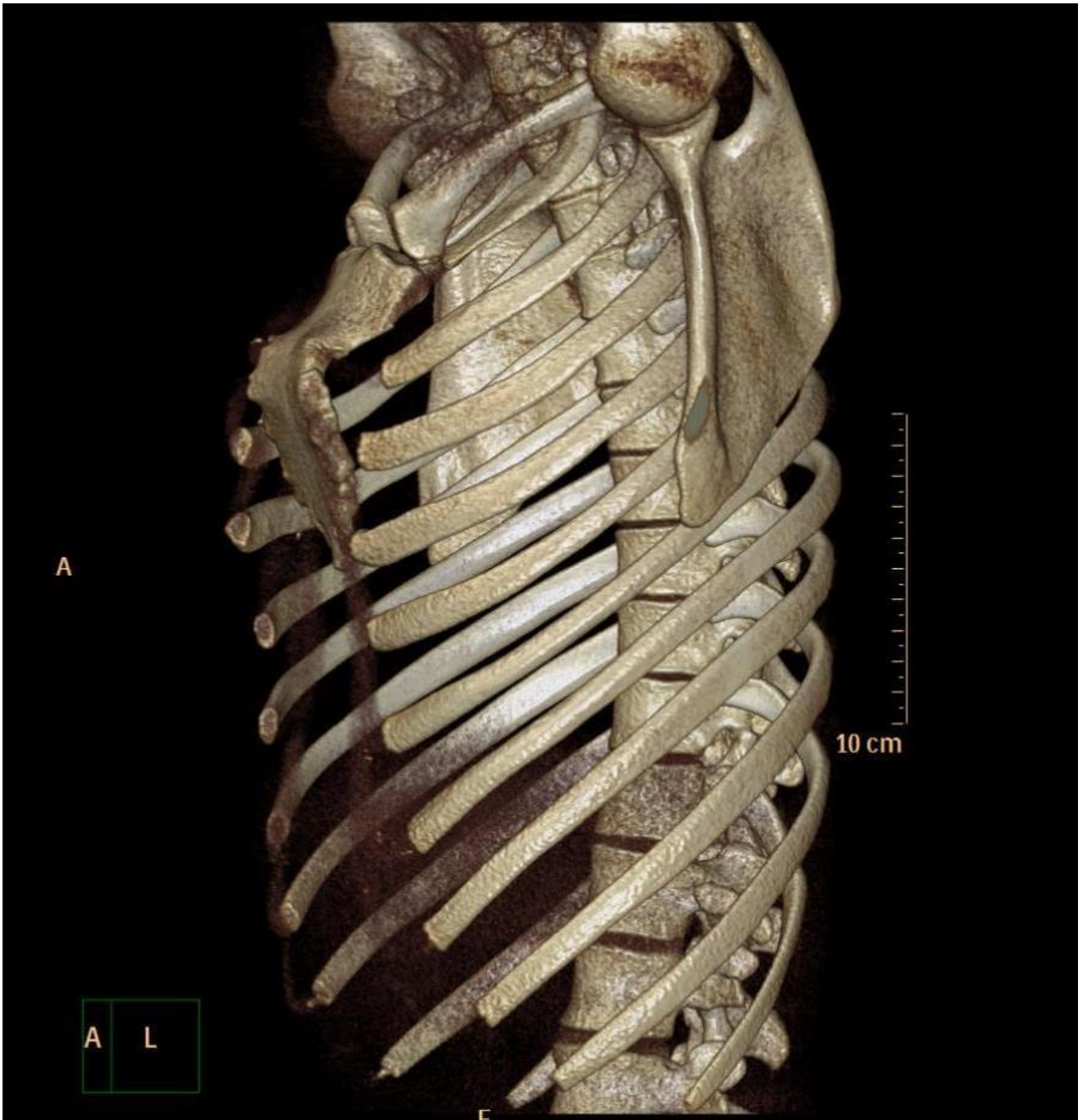
A 19 year old women, with cosmetic complaints, an no further medical history, is presented .CT-scan revealed a short broad sternum with a remarkable dorsal angulation at the sterno-manubrial junction.(fig1) Because in many reported series, cardiac defects have been reported we also made a cardiac echography showing no abnormalities.

Operative

Technique

A submammary incision was made, and skin /muscles flaps were mobilized towards the manubrium. After a Ravitch-type operation and a wedge osteotomy, the sternum was aligned straight and fixated with 2 titanium plates.

Post operative course was uneventful and the cosmetic result good.



SPONTANEOUS TITANIUM PLATE FRACTURE

Short Oral Communication

Torres C.*, Cabral D., Alvoeiro M., Calado T., Antunes M., Mendes S., Rodrigues C., Félix F.

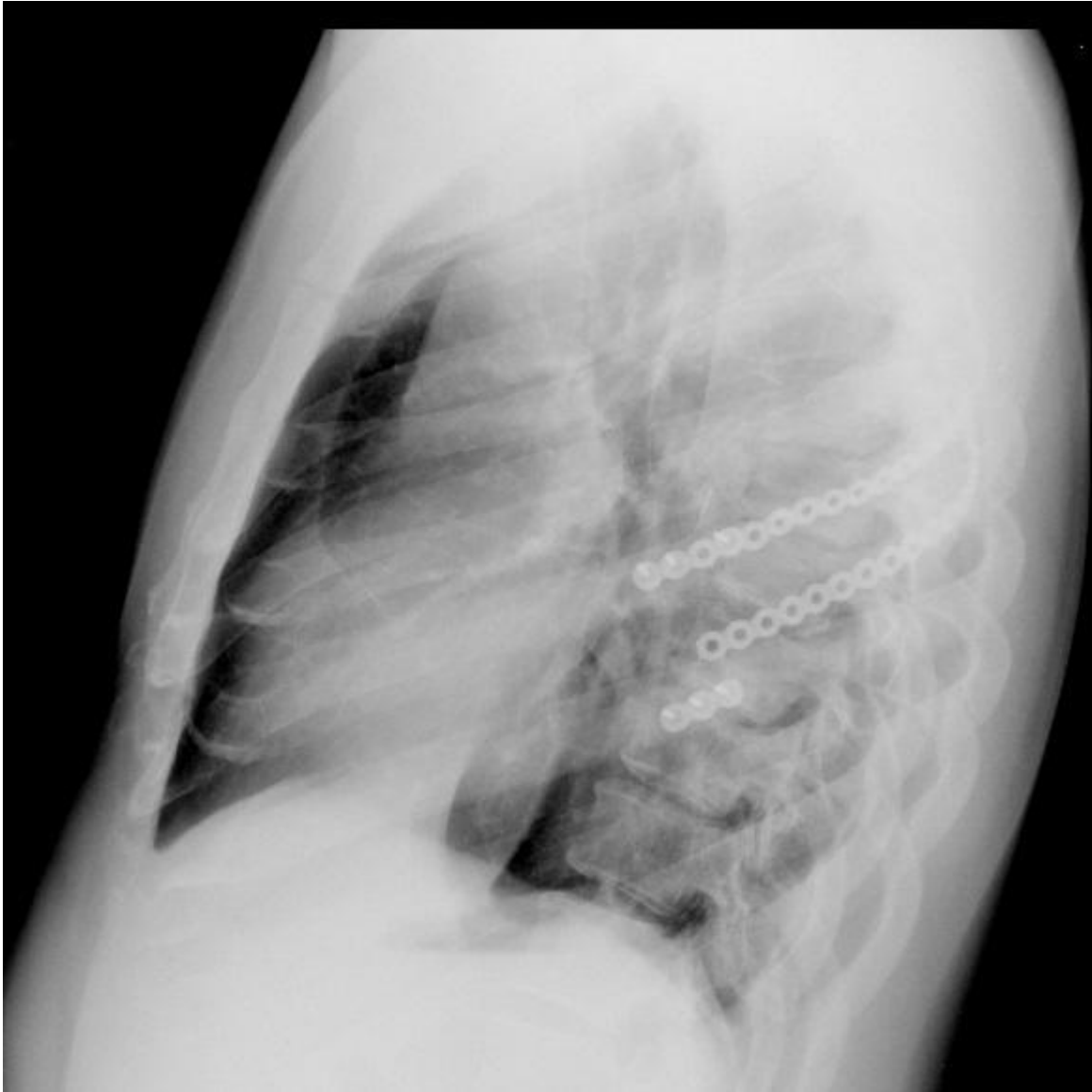
Hospital Pulido Valente ~ Lisbon ~ Portugal

Titanium plates are widely used in chest wall reconstruction after resection of tumours. Enthusiasm towards the use of titanium is based on the resistance to corrosion and infection, non interference with imaging and compatibility with long term implantation. The aim of this article is to present two cases of spontaneous titanium plate fracture.

Two case reports

Case 1: A 34 year old male underwent a posterior resection for a desmoid tumour (4th to 6th rib – 10cm greater length of excision) and reconstruction with two titanium plates (2mm Matrix Mandible®) and an underlying PTFE dualmesh.
Case 2: A 31 year old male, with a single rib pheochromocytoma metastasis underwent segmental resection (16cm) of the 8th rib and reconstruction with a polyglactin mesh and one titanium plate (2mm Matrix Mandible®).
In both cases, the postoperative period was uneventful but, unexpectedly, routine x-ray one year after revealed fracture of the implanted plates.

Titanium presents one of the highest strength to weight ratio amongst all metals but in these two cases the plates fractured. This complication jeopardizes the main purpose of their use: chest wall stability and maintenance of respiratory dynamics. Keeping in mind the great forces the implants are subject to, the surgeon must aim to maximize the rigidity of the implant and avoid stress factors like excessive contouring and incorrect screwing.



OPEN PECTUS REPAIR UTILIZING ABSORBABLE STERNAL BARS

Short Oral Communication

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Open pectus repair is the preferred method of choice for correction for severe pectus defects in adults. In the majority of patients metal bars or struts are used to solidify the repair and prevent early sternal depression. Unfortunately the patient has to undergo a second procedure for bar removal. Recently, an absorbable bar has been developed. The advantage of the absorbable bar is that it remains structurally intact for at least 24 months and does not require removal.

We respectively reviewed the medical records of all patients (> 18 years) who underwent open repair of pectus defects between January 2009 and December 2016.

Sixty patients underwent open repair. Median age was 31 years old (range, 18 - 72). Fifteen patients (25%) had a open repair previously at a median of 15 years (range, 3 - 24). Median pectus

index was 4.7 (range 4.0 - 7.1); 40 patients (67%) had an asymmetric defect. All 60 patients underwent posterior sternal support with absorbable bars; 31 had a single doublet, 22 had a single triplet, and 7 had two doublets anchored to the ribs bilaterally. Median hospital stay was 4 days (3 - 7). Complications occurred in 10 patients (17%). Median follow-up was 42 months (range, 4 - 84). None of the patients required reoperation for a pectus recurrence. Patient satisfaction was excellent in 93% and good in 7%.

Pectus repair with placement of an absorbable bar(s) for posterior sternal support provides a safe alternative to a metal bar. Utilization of absorbable bars should be used for all open pectus repairs to prevent early recurrence and to eliminate requirement of a second procedure for bar removal.

HEPATIC VEIN DOPPLER IN ADULT PECTUS EXCAVATUM PATIENTS: NORMALIZATION OF FLOW AFTER SURGICAL REPAIR

Short Oral Communication

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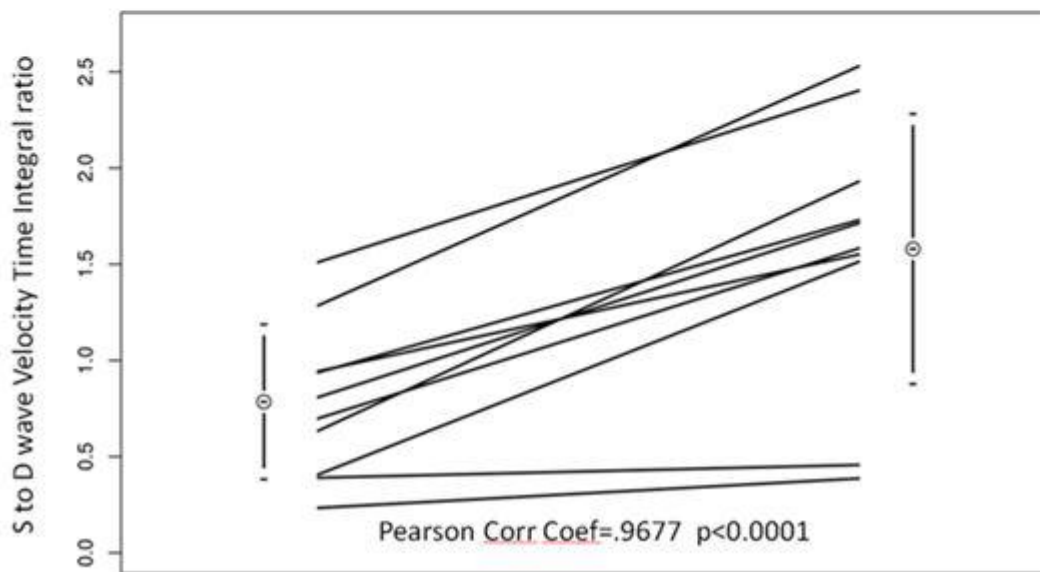
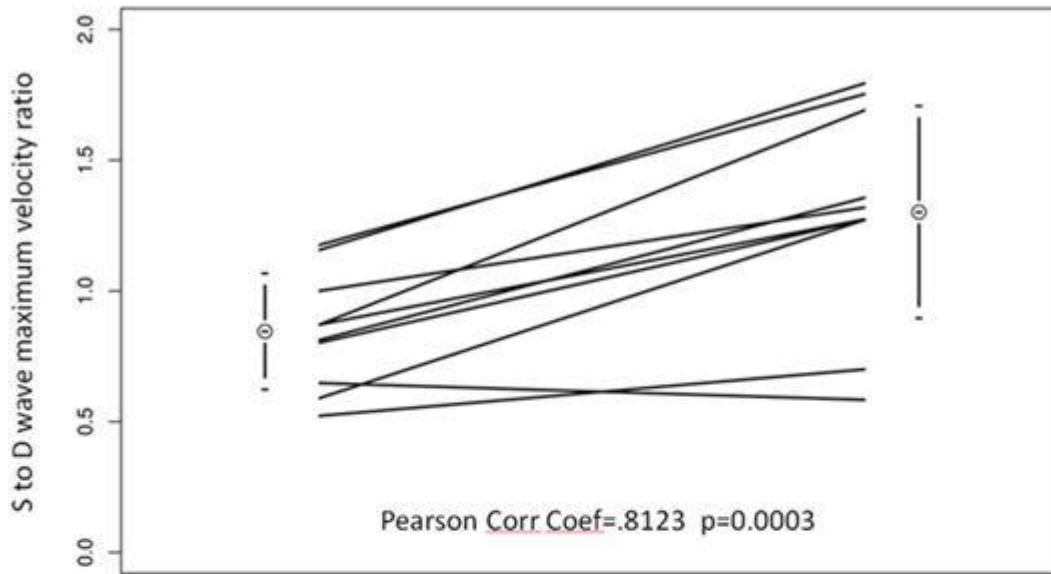
Background: Pectus Excavatum (PE) may produce cardiac compression by inward chest wall displacement. The cardiopulmonary effects of the cardiac compression are debated. Hepatic vein Doppler echocardiography is used to assess right heart filling to detect normal and abnormal right heart physiology and hemodynamics. We report the effects of PE on hepatic vein flow patterns before and after modified Nuss repair.

Methods: A prospective cohort study of hepatic vein Doppler tracings obtained via transesophageal echocardiography (TEE) was performed in adult PE patients (≥ 16 years) immediately before and after modified Nuss repair. Intraoperative TEE parameters pre- and post-operatively were recorded and analyzed.

Results: Ten patients were analyzed before and after surgery. The mean demographics were age 27 years ± 9.6 ; Haller Index 6.8 ± 5.1 ; and Ejection Fraction 56 ± 1.9 . Eighty percent were male. Hepatic venous maximum diastolic (D) and systolic (S) velocity and velocity time integral ratio analysis demonstrated a statistically significant change in right atrial filling from an abnormal to more normal filling pattern (see graph 1a and 1b) with an increase in the systolic-to-diastolic wave ratios post-operatively .

Conclusion: An increase in systolic-to-diastolic wave ratios was observed in 9 out of 10 of our severe PE patient cohort prior to surgical correction. These findings imply these patients who underwent PE correction reverted to a more normal right heart filling pattern with improved systolic-to-diastolic wave ratio.

Pulse wave hepatic vein Doppler



Pre (n=10)

Post (n=10)

CHEST WALL DEFORMITY AFTER CHEST WALL MALIGNANT TUMOR MULTIMODAL TREATMENT

Short Oral Communication

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Pediatric Surgery - University Hospital of Padova ~ Padova ~ Italy

Chest Wall (CW) Malignant Tumors are rare in children and are treated with a multidisciplinary approach including Chemotherapy, Surgery and Radiotherapy. Some cases involve ribs and the excision of the tumor causes a certain demolition of the osteo-muscular chest wall. We report our experience with three cases who developed CW Deformity after multimodal treatment of a malignant tumor.

Three patients (2 M, 1 F) aged 3, 8 and 13 years presented with huge right thoracic mass, in 2 cases associated to pleural effusion. Initial tru-cut biopsy allowed the diagnosis of Ewing Sarcoma t(11;22)-positive (ES) in 2 cases and Undifferentiated Sarcoma (US) in 1 case (affected by Neurofibromatosis-type-1). All the patients received neoadjuvant CT and pre-operative RT and after about 6 months underwent surgical excision of the tumor.

The 2 patients with ES received the excision of the tumor together with 2 ribs (3rd-4th and 5th-6th); the thoracic wall was reconstructed with a titanium prosthesis in 1 case and with a biocompatible patch in 1 case. The patient with US underwent excision of the soft-tissues without affecting ribs. All the patients developed post-op reduced pulmonary expansion: treatments including FKT and surgery in 1 case were useless. One patient developed heart failure due to post-actinic cardiomyopathy and died; 2 patients are AWD at 16 and 18 months of follow-up. Both have evidence of persistent CW asymmetry due to reduced expansion of the ipsilateral rib cage.

Multimodal treatment for Soft Tissue Sarcomas has determined an improvement in Overall Survival, but toxicity due to local treatment seems to increase. The described patients received different surgeries; nonetheless, they developed similar post-op complications. We guess that pre-op RT contributed to the tissues scarring retraction. In literature, there are no clear indications concerning the opportunity and modality of restricted ribcage enlargement to improve lung function and appearance.

OUR CURRENT TREATMENT METHOD IN PECTUS ARCUATUM SURGERY: LESSONS LEARNED

Short Oral Communication

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We reviewed clinical experience with our approach for pectus arcuatum repair.

Thirty-two patients underwent pectus arcuatum repair at our department with modifications of Ravitch sternochondroplasty. In all patients, the initial part of the operation begins with standard wedge osteotomies to the anterior aspect of the sternum. Since March 2012, we discovered the usage of titanium plates for stabilization of sternum instead of using absorbable plates. Fourteen patients were operated by using titanium plates. Since April 2016, 7 patients' sternum were

supported with a short retrosternal steel bar in addition to titanium plate implantation.

Average age was 26.57. The mean operation duration was 162 minutes and mean hospitalization duration was 4,6 days. Patients who underwent correction using titanium plates only, had unfavorable results. Two out of 7 developed pectus excavatum deformity in the lower part of the sternum. Therefore we decided to place an additional retrosternal steel bar for the required retrosternal support. In one year follow-up period, we did not experience any complaints. The bar was removed at the end of the planned duration in one patient.

Open repair methods are surgically challenging. There are various Ravitch modifications and they are still evolving. In our opinion, the best results seem to be achieved by both titanium plates and supportive retrosternal bar.

TRANSESOPHAGEAL ECHOCARDIOGRAPHY DURING SURGICAL CORRECTION OF PEDIATRIC PECTUS EXCAVATUM: PRELIMINARY ASSESSMENT OF INTRAOPERATIVE CARDIOLOGIC CHANGES.

Short Oral Communication

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Cardiac compression in relation to pectus excavatum is difficult to evaluate by preoperative transthoracic echocardiographic examinations at rest and is still a matter of debate. There are very few studies regarding findings in intraoperative transesophageal echocardiography. None of these include children population. We hereby describe our first three cases of pectus excavatum correction associated to intraoperative transesophageal echocardiography and our preliminary findings.

We prospectively studied right heart changes during surgical correction of pectus excavatum by transesophageal echocardiography, which was performed under general anesthesia before the correction, during the elevation of the sternum and after placement of the Nuss bars or Pectus-up devices. We measured diameters of right ventricle (diastole (RVD)), right atrium (RA) and tricuspid annulus (TA). In two cases we associated 4D echo.

3 patients were included between december 2016 and march 2017 (1 girl, 2 boys) of mean age of 13 (range 12-14), with mean preoperative Haller Index of 5.5 (range 4-8) and mean Correction Index of 46% (Range 40,37-47,2). Preoperative transthoracic echocardiography at rest did not show compression of right heart chambers in any of the cases. 2 cases were corrected by insertion of 2 pectus bars each, 1 case by Pectus-up technique. Transesophageal echocardiography showed in all cases compression of the right heart and deformation of the TA before the correction. During the elevation of the sternum RVD, RA and TA improved in all: mean augmentation of RVD was 7mm (Range 3-7,5), RA 6mm (Range 0-13) and TA 8,9mm (Range 7-9). Morphology of the TA also normalized with the correction.

Preoperative transthoracic echocardiography at rest may underestimate right chamber compression in pediatric patients with pectus excavatum. With the surgical correction the

diameters of DTD, RA and TA seem to improve immediately intraoperatively. Long term follow-up and higher numbers of patients are needed to confirm these findings.

EARLY OUTCOME OF SURGERY FOR THORACIC OUTLET SYNDROME

Short Oral Communication

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The aim of this study is to evaluate the functional prognosis after Thoracic Outlet Syndrome (TOS) surgery and report the early outcome of surgery for TOS.

From November 2015 to August 2016, 10 patients with thoracic outlet syndrome underwent surgery at single institute. In order to measure clinical and functional improvement, the application of Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was used. We retrospectively analyzed the result of operation, score of DASH questionnaire. The DASH questionnaire was administered pre- and postoperatively.

There were 8 males and 2 female, with the median age was 21 years (range, 19-44). The anterior and middle scalene muscle was sectioned and the first rib was resected in all the cases by means of a supraclavicular approach. Pectoralis minor tenotomy was performed in 7 patients. After operation, median length of stay for admissions was 8 days (range, 6-15). No serious complication was observed, except one case of chyle leakage. Mean preoperative score of DASH questionnaire was 49.68 (SD ± 17.38) and mean postoperative score of DASH questionnaire was 25.0 (SD ± 22.31) (p = 0.04).

Our study demonstrated that surgically decompression of thoracic outlet leads to significant benefit in TOS patients. Surgical treatment of thoracic outlet syndrome could be a good option.

LESS INVASIVE OPEN SURGICAL REPAIR FOR PECTUS EXCAVATUM

Video Communication

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^[1]Nagoya Tokushukai General Hospital ~ Kasugai, Japan ~ Japan, ^[2]Shonankamakura General Hospital ~ Kamakura ~ Japan

Nuss developed a novel novel method for pectus excavatum correction, and gaining popularity. But the method has been associated with relatively high morbidity and limitation of patients' age. We review and appraise our experiences of open repair procedure with low incidence of complications and high patients satisfaction. We present a movie of the procedure.

Until 2016, 377 patients (3-56, 15.1+/-9.6 yo) underwent surgical repair of pectus excavatum. Sterno-costal elevation (SCE) was adopted for 366 patients. Sternal turnover was employed for 11 patients and replaced by modified SCE. In our recent standard method of SCE modification 3, a section of the third or fourth to the seventh costal cartilages as well as the lower tip of the sternum were resected. All of the cartilage stumps were drawn and resutured to the sternum. The secured ribs generate tension, pulling the sternum bilaterally. The resultant force raises the concavity and correct irregularities.

In all cases the deformities were corrected satisfactorily. The length of the vertical wound in male was 3.7 +/- 0.7 cm in patients under 7 yo, and 7.1 +/- 2.1 cm in adult patients. In female patients, inframammary curved incision was used. None of the patients required mechanical ventilation after emergence from anesthesia. No patient needed blood transfusion. None of them developed pneumonia, deep wound infection, instability of the chest wall, and any life-threatening complications. No patient reported residual pain beyond 7th post-operative day. No reoperations were required for any reasons. Patients resumed daily activities of all types, including contact sports, within three months after surgery. No recurrence was reported.

Modified SCE provided satisfactory results without major complication for wide range of patients' age groups. Although modified SCE includes resection of the cartilages, we believe that our techniques represent a less invasive procedure for the repair of pectus excavatum.

EARLY RESULTS OF SANDWICH METHOD: COMBINATION OF NUSS AND ABRAMSON PROCEDURES

Video Communication

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Marmara University Thoracic Surgery Department ~ Istanbul ~ Turkey

Because of the various presentations of the anterior chest wall deformities, the surgeons have to act like architectures for adequate correction. Therefore, many different techniques were defined. In this article, we reviewed our prospectively collected pectus database to retrieve 30 mixed type deformity (pectus excavatum and carinatum combination) patients.

In between October 2013 and October 2016, 30 consecutive mixed type deformity patients treated with sandwich technique. The operation steps started as regular carinatum bar insertion and then the deepest point of the sternum supported retrosternally by using a second bar under the visualization of videothoracoscopy. Compression from both side of the sternum provides better correction.

Average age of the patients were 17,29 (14-27). Twenty nine of the cohort were males. One of the patients' deformity was symmetrical, while 29 had asymmetrical deformity. Mean operation duration was 93,6 minutes (60-180). In postoperative period all patients received intravenous patient controlled analgesics for three days. Then oral analgesics used for pain management. Mean length of hospitalization was 4,1 (3-6) days. Only one patient's stabilizer was displaced. So, on postoperative day one, a revision performed and the stabilizer repositioned by using cables. Two of the patients bar removed because of unbearable pain at the end of the first month. Two patients' bars removed at the end of the planned duration without any further complications and satisfying final appearance.

There are many different presentations of anterior chest wall deformities. So, there has to be multiple possible ways to achieve improved cosmetic results. The sandwich method is a good combination of Nuss and Abramson procedures. It can be used in the certain specific subgroups of the pectus patients, named as mixed type deformities. Minimal invasive repair is possible, safe, effective even in the complex presentations of congenital anterior chest wall anomalies.

A NUSS MODIFICATION: INDICATIONS OF THE CROSSED BARS IN MINIMAL INVASIVE REPAIR OF PECTUS EXCAVATUM

Video Communication

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Marmara University Thoracic Surgery Department ~ Istanbul ~ Turkey

The presentation of pectus excavatum patients are diversified. Various repair methods has been described. In this article we report the indications of crossed bars.

From 742 pectus excavatum patients operated in Marmara University Hospital Department of Thoracic Surgery Clinic in between August 2005 and February 2017, nineteen consecutive patients treated by crossed bar technique retrieved. The data belongs to single-institution's large experience. It is collected prospectively. None of the patients were excluded during the study period. By means of operative technique, the steps were quite similar with regular minimal invasive repair of pectus excavatum. Patients had rib flare, short length sternum, one deep point of pectus excavatum instead of grand canyon deformity were selected for crossed bar insertion. The additional forceful effect of the double bar can provide better elevation even in the strong, rigid chest walls.

Average age of the patients were 21,1 (15-38). Cohort was unsurprisingly male dominant: 16 males out of 19 patients. Two of the patients' deformity was asymmetrical, while seventeen had symmetrical deformity. Mean operation duration was 86,84 minutes (60-180). In postoperative period all patients received intravenous patient controlled analgesics for three days. After that, oral analgesics used for pain management. Mean length of hospitalization was 3,94 (2-6) days. There was not any morbidity or mortality neither in preoperative nor in postoperative period. Yet, none of the patients' bar was removed. Postoperative follow-up is still ongoing in all of the patients (1-14 months).

The crossed bar technique is effective, simple, easy to reproduce, safe, facilitates repairing of the deformity and provides improved cosmetic results in selected specific pectus excavatum patients. Physical examination itself renders the judgement: Rib flare, short length sternum, one deep point of pectus excavatum may be selected for crossed bar insertion.

MINIMALLY INVASIVE TREATMENT OF PIGEON BREAST

Video Communication

Menna C.*, Ibrahim M., D'Andrilli A., Ciccone A.M., Maurizi G., Cassiano F., Poggi C., Rendina E.A., Andreotti C.

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Pigeon Breast is a congenital chest wall deformity characterized by a protrusion of the sternum and adjacent costal cartilages. Pigeon Breast is rarer than Pectus Excavatum, occurring in only about 20% of patients with pectus deformity.

We report a case of a 16-years old patient affected by Pigeon Breast treated by our innovative and hybrid surgical technique consisting of chondrectomy of deformed cartilages, sternal wedge osteothomies and retrosternal placement of a small metallic bar.

After a preoperative CT scan evaluation, through a 4-cm “half-moon” shaped skin incision, performed at the deepest point of the chest, after detaching pectoralis muscles, all the deformed cartilages were isolated preserving the perichondrium. We performed three sternal osteothomies, one at the edge of the sternal protrusion, one superiorly and one inferiorly, preserving the posterior surface of the sternum. This procedure allows the surgeon to mobilize the sternum easily. The cartilages were reduced into 1 mm cylindrical fragments during the back table surgery. Pectoralis muscles were prepared and an 8 inches metallic bar was placed deep to the sternum. After performing two small incisions at the level of the theoretical exit points of the bar, we performed a submuscular retrosternal communication through a transthoracic tunnellizator. We placed the re-shaped cartilages on the perichondrial layer to build the new structure of the chest wall.

The metallic bar was removed 8 months after surgery after obtaining a CT scan. The patient did not show recurrence of the deformity 1 year after surgery.



3D VIDEO PRESENTATION OF MIRPE

Ghionzoli M.

Florence ~ Italy

THE VIDEO- THORACOSCOPIC STABILIZATION OF THE FLAIL CHEST, ALTERNATIVE FOR THE MANAGEMENT OF THE TRAUMA PATIENT.

Video Communication

Perez--Alonso D.*, Cano J.R., Torrent G., López L., Quevedo S., Hernandez F., Amador V.

Hospital Universitario Insular de Gran Canaria ~ Las Palmas de Gran Canaria ~ Spain

Flail chest after blunt thoracic trauma is a life-threatening injury which continues to result in high mortality due to complications associated with pulmonary contusion and prolonged mechanical ventilation. Current evidence suggests that surgical fixation of the flail segment may provide substantial benefits. However, given that the outcome of traditional fixation with clips is unpredictable in patients who present with multiple and greatly displaced or comminuted rib fractures, new techniques are needed to improve current chest wall stabilization procedures.

We report our experience with a novel minimally invasive method for internal fixation of unilateral flail chest by using a pectus bar. We propose a biportal approach for the unilateral intrapleural implantation of the bar with pre-sternal support and fixation, relevant and differentiating technical aspects which have not been described before. We present a video which describes the most relevant steps of the surgical procedure.

The minimally invasive fixation of the flail chest is less time-consuming than traditional open reduction and costal osteosynthesis methods, requires minimal dissection, is associated with minimal blood loss and provides immediate effective stabilization and quick recovery.

We recommend this less invasive surgical approach for those flail chest cases where thoracotomy is not required to treat internal lesions, especially if surgeons are experienced in the treatment of congenital deformities of the thoracic wall.

GIANT OSTEOSARCOMA ORIGINATING FROM CHEST WALL

Video Communication

Sayan B.*^[1], Yamansavci Sirzai E.^[1], Çetinkaya Ç.^[1], Saçak B.^[2], Yüksel M.^[1]

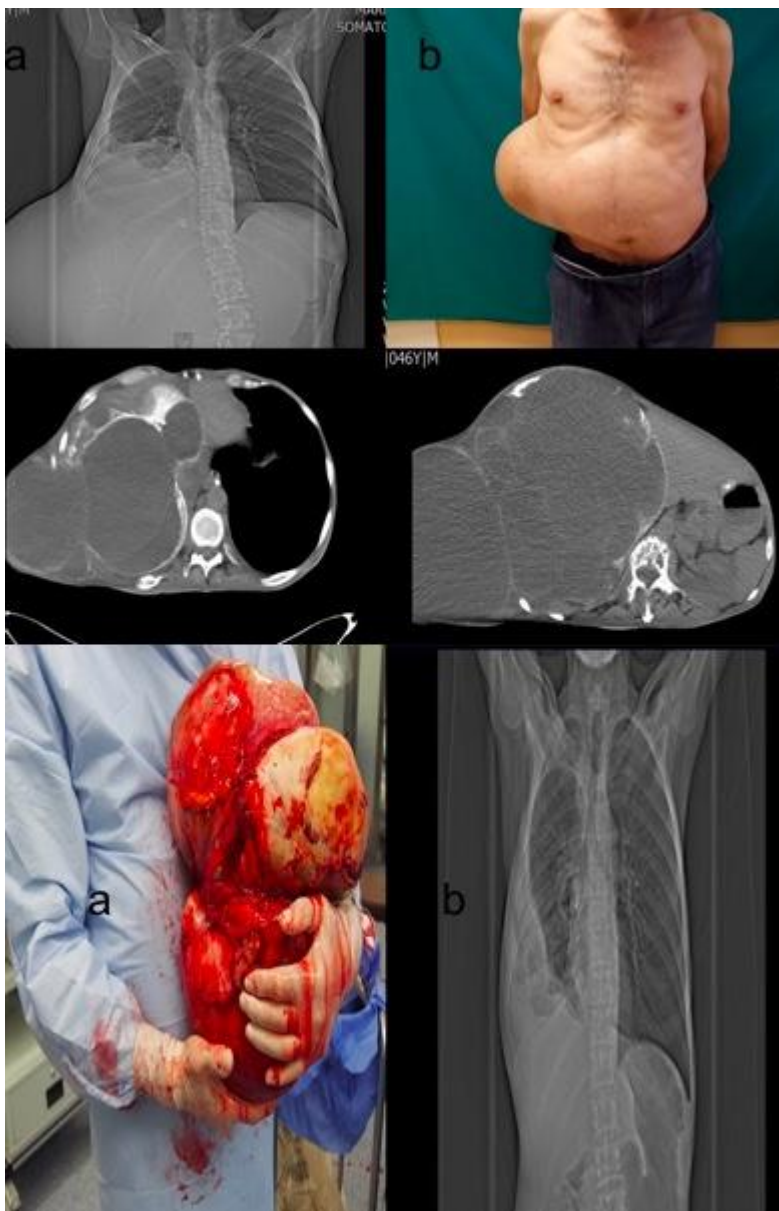
^[1]*Marmara University Thoracic Surgery Department ~ Istanbul ~ Turkey,* ^[2]*Marmara University Plastic Reconstructive Surgery Department ~ Istanbul ~ Turkey*

Osteosarcoma is the most common malignant bone tumor. It is quite unusual to see a giant mass growing massively without having any metastasis.

Forty-six year old male was diagnosed as osteosarcoma four years ago after palpating a 3*4 cm chest wall mass. Patient denied the operation by his own will. After four years, with having dyspnea and difficulty in movement, patient consulted to the outpatient clinic. Two sessions of chemotherapy were not effective.

With a thoracoabdominal incision, 8., 9. and 10th ribs were partially resected. Diaphragm were partially resected and reconstructed by using a prolene mesh. The mass weighted 15 kg. There was no invasion to the lungs or any abdominal organs. The patient was discharged on postoperative day 7. Pathological examination was reported as osteoblastic osteosarcoma with necrosis. The surgical margins were tumor-free. The patient was seen that he gained 20 kg on postoperative third month. He is still under follow-up with having radiotherapy regimen.

Nonsurgical options for the treatment of osteosarcoma showed no significant effect on this patient. Complete surgical resection seems to be the most effective treatment.



DEVELOPMENT OF A PROGRAM FOR SCHOOLS TO MANAGE THE HEALTH OF CHILDREN UNDERGOING THE NUSS PROCEDURE

Poster Communication

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^[1]Kawasaki University of Medical Welfare ~ Kurashiki.Okayama ~ Japan, ^[2]Kawasaki Medical School ~ Kurashiki.Okayama ~ Japan

Over the past 20 years since its adoption in 1998, the Nuss procedure has been generalized as a method to repair chest deformities in Japan, and 1 in every 6 nurse-teachers currently deals with such children during the pre- and postoperative periods. Schools, where children spend a lot of time, markedly influence their QOL. Aiming to enable children undergoing the Nuss procedure to lead their daily lives with a sense of security, a school health management support program was developed through literature analysis.

Nineteen research papers were collected using the Ichushi Web (<http://demo.jamas.or.jp/>) and Scholarly and Academic Information Navigator (<http://ci.nii.ac.jp/>), with the following keywords: 'Nuss procedure', 'schools', and 'QOL'. Through analysis of their contents, difficulties and challenging issues faced by children, their parents, and school staff were extracted to consider program items.

A school health management support program, consisting of the following items, was developed: [during the preoperative period]: <the significance of identifying chest deformities in the early stages>, <information regarding specialized medical institutions>, and <the process from admission to discharge> as points to be understood by school staff; [during hospitalization]: <daily life in hospital>, <surgery>, and <discharge guidance>; and [during the postoperative period]: <complication prevention>, <exercise and activities>, <emergency care>, <mental care>, <self-care>, <peer support>, <methods to contact medical institutions>, and <removal surgery>.

With the items extracted through literature analysis and chronologically classified from the preoperative period to removal surgery, a school health management support program was developed. In future studies, the program will be evaluated to improve its contents, and ensure its effective use by school staff through collaboration with doctors and nurses (this study is a part of a research project supported by Grants-in-Aid for Scientific Research from the Ministry of Education,

THE ROMAN ARCH: WHAT IS THE IDEAL SHAPE OF THE PECTUS BAR OR WHY THE SHORT BAR FAILS

Poster Communication

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^[1]University of Pretoria ~ Pretoria ~ South Africa, ^[2]Private Practice ~ Johannesburg ~ South Africa

I am presenting a complication of the use of the "Short bar technique. " Why the short bar fails."

The first case returned after 6 years complaining of a depression of the left hand side. The second returned after one year with the same complaint. In both cases the patients were very happy after the initial operations but less so after a few months. Both cases had the procedure repeated with longer bars being inserted. The mathematics of why the short bar fails is discussed.

The Roman arch has stood the test of time. The mathematics shows that the strength of the bridge is transmitted to the supports on the sides. It also indicates the weakness of an asymmetric arch.

The formula: $f/2 = fx/x+x = fx/2x = f/2$. Normal Roman arch.

Short bar: Long side: $R1 = fy/x+y < f/2$
 Short Side: $R2 = fx/x+y > f/2$
 Rotational Force: $M = R2^* w$

f= Force at apex of Roman arch
 x= distance from midpoint of arch to lateral end.
 Y= distance from midpoint of arch on short side.
 M= rotational force.
 W=difference of x-y.

The ideal shape of the pectus bar is similar to a Roman Arch. Both sides offer greater strength if they are of equal size. The short bar procedure is not without complications and can lead to one sided weakness if the ribs are not strong enough to support the arch.

A VERY RARE BENIGN NEOPLASM IN THE CHEST WALL: NONOSSIFYING FIBROMA

Poster Communication

Kanbur S., Dogruyol T., Tezel C., Alpay L., Evman S.*, Kiral H., Baysungur V.

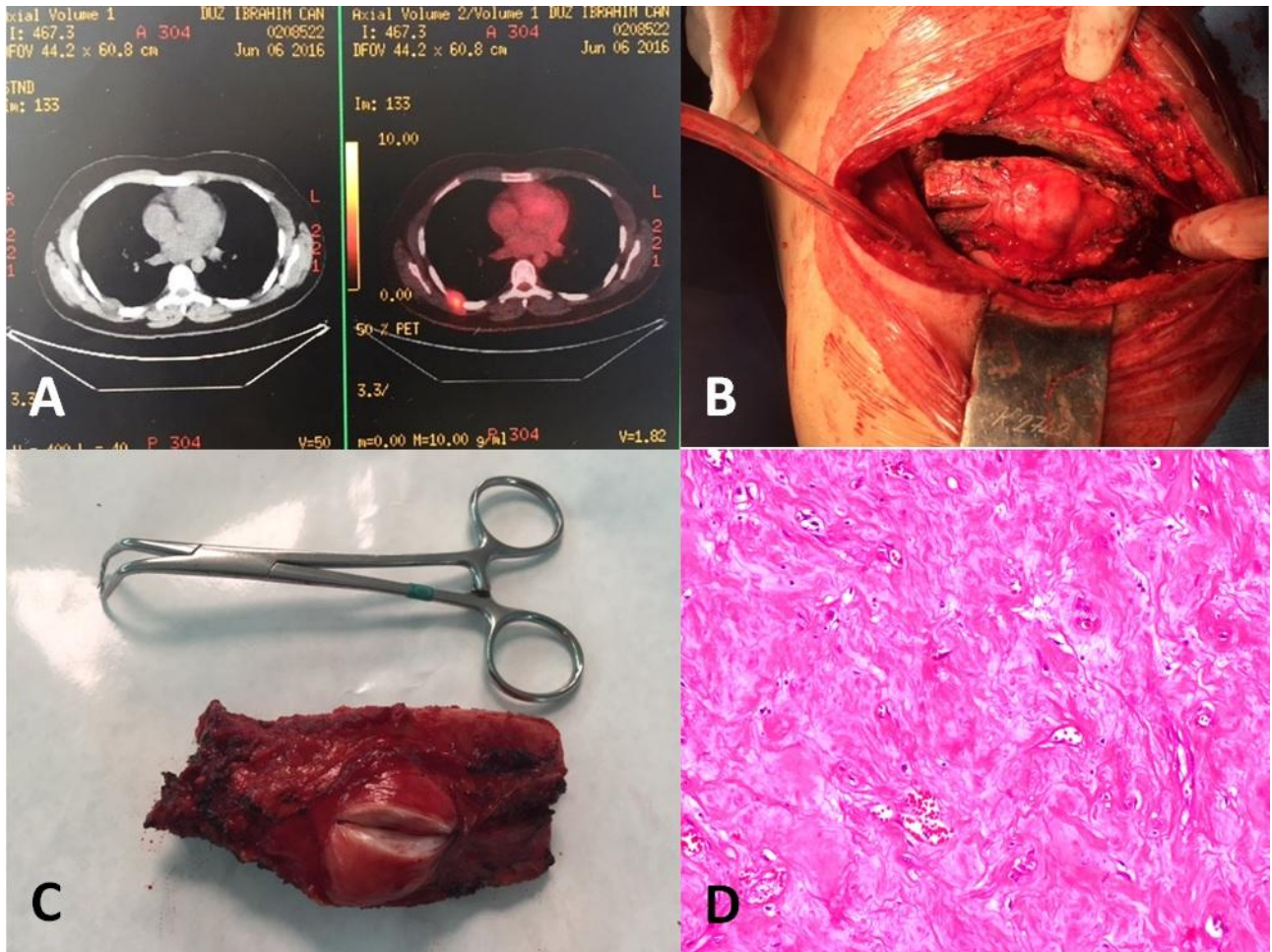
Sureyyapasa Chest Disease and Thoracic Surgery Training and Research Hospital, Department of Thoracic Surgery ~ Istanbul ~ Turkey

Twenty-three year-old male patient with no complaints were referred to our clinic with an incidentally found lesion on the chest x-ray. Thorax computed tomography showed a 3x3x2cm diameter lesion on the 6th and 7th ribs in the right hemithorax with uptake in bone scintigraphy.

Operation was undertaken as the maximum standardized uptake value was 5.6 in positron emission tomography (Figure 1-A). A 3x3cm mass on the 6th and 7th ribs was explored in the operation which had no invasion to the lung (Figure 1-B). Both ribs were resected with clean surgical margins (Figure 1-C). Postoperative course was uneventful and the patient was discharged on the 3rd postoperative day. Pathology was reported as Non-Ossifying Fibroma (Figure 1-D).

It is a benign bone tumor which is seen especially in children and two times more in men than women. This tumor originates from fibrous tissue and is generally incidentally found in x-ray as it doesn't cause symptom or distant metastasis. It is more common in femur or tibia and is rarely encountered in thorax.

We present this case as we have never experienced this pathology in our clinic before and it must be brought into notice especially in young male patients with lesions on the costae.



LEARNING CURVE IN MINIMALLY INVASIVE REPAIR OF PECTUS EXCAVATUM: A SINGLE CENTER EXPERIENCE

Poster Communication

Evman S.*, Dogruyol T., Alpay L., Kiral H., Misirlioglu A., Kanbur S., Tezel C., Baysungur V., Yalcinkaya I.

Süreyyapasa Chest Diseases Training and Research Hospital ~ Istanbul ~ Turkey

Pectus excavatum is the most common congenital chest wall deformity. Aim of this study was to share our initial outcomes with minimally invasive repair of pectus excavatum (MIRPE), which has recently been gaining popularity worldwide.

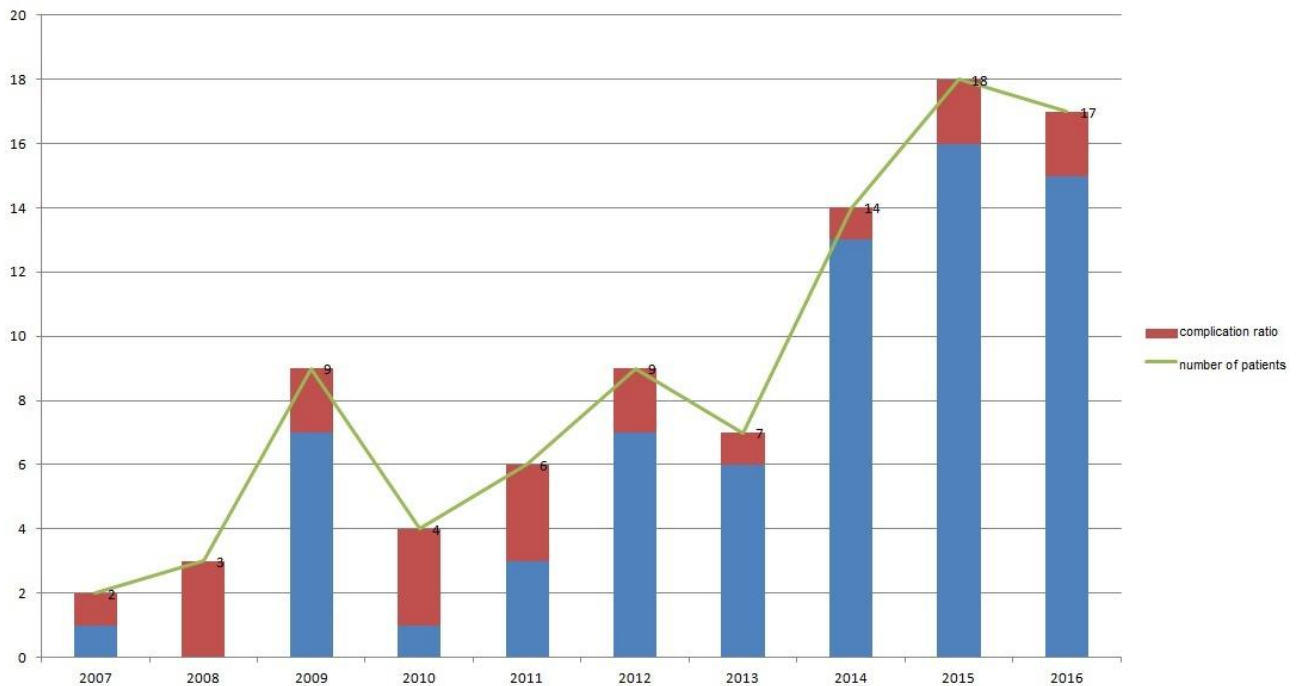
Medical files of all patients undergoing MIRPE between August 2007 and December 2016 were reviewed retrospectively in terms of patient demographics and postoperative complications.

Total of 79 patients (21 female, 58 male), with a mean age of 17.1 (range: 9 to 35) underwent 89 operations. One patient underwent exploratory video-thoracoscopy for bleeding, originating from an intercostal artery. Three patients required longer bar re-placement after 8, 13 and 14 months of the first operation, respectively. Seven (8.9%) patients necessitated revision due to bar flipping/dislocation.

Minor complications include 8 pneumothorax patients necessitating small-bore (8ch) pleural catheter. Pneumonia (n=1) and bulla formation on the incision due to late hypersensitivity allergy (n=2) were the other complications.

When looked at the complication trend, only 1 pneumothorax requiring drainage, 2 bar allergies and 2 (4%) bar malpositions out of last 49 patients within last 3 years were noted. No mortality was seen in the group (figure 1).

Despite relatively high re-do (11%) and complication rates (23%), the trend have shown great improvement, especially in the last few years. In conclusion, we believe that the learning-curve has been passed through the first 25-30 patients with reasonable results, and will surely obtain better clinical outcomes with gained experience.



MINIMALLY INVASIVE REPAIR OF PECTUS DEFORMITIES: SELCUK UNIVERSITY EXPERIENCE

Poster Communication

Oncel M.*, Sunam G.S., Yildiran H.

Selcuk University Medical Faculty ~ Konya ~ Turkey

Dr. Nuss explained a new procedure for repair of pectus deformities in teenagers in 1988 and this procedure performed via videoassisted surgery which inserted transthoracic and elevated the sternum. This minimally invasive method was primarily used and acceptance in recent years. We aimed in this study to present the our clinic experience on pectus surgery.

From 2011 to 2017 98 patients were evaluated for chest wall deformity at Selcuk University Medical Faculty Thoracic Surgery, Minimally Invasive Division, Konya Turkey. All patients underwent follow 3-6 months period after operations. All patients performed CT scans and cardiopulmonary works up. The effects of surgical operation on cardiac functions of people with pectus excavatum (PE) who have right ventricular pressure were evaluated with echocardiography.

All of these patients, 74 had pectus excavatum and 24 had pectus carinatum (Table 1). There were 59 (79,7 %) boys and 15 (20,3%) girls for a sex ratio of pectus excavatum patients. 2 (8,3 %) girls and 22 (91,6 %) boys had pectus carinatum. The mean Haller index was 3,72 (2,21-12,8). The pectus bars were removed for 42 of PE and 12 of PC patients.

It was turning point since we encountered the MIRPE. We believe that minimally invasive repair is safer via thoracoscopy. You have a good exposure. One of the problems with MIRPE is the bar rotation in the postoperative period. It is preventable stronger fixation and using the stabilizer.

Table 1. Characteristics of 74 patients who underwent repair of pectus excavatum	
Gender	Male: 59 (79,7 %) Female: 15 (20,3 %)
Symmetry	Symmetric 37 (50%) Asymmetric 37 (50%)
Associated anomaly or disease	2 Marfan's Syndrome (2,7 %) 1 Scoliosis (1,3 %)
Haller Index > 3,25	33 (44,5 %)
Age at operation (mean-range) years	16,36 (6-36)
Haller Index (mean-range)	3,72 (2,21-12,8)
Postoperative hospital stay (days)	4,42 (2-8)

SIMULTANEOUS MINIMALLY INVASIVE SURGERY FOR PECTUS EXCAVATUM AND VIDEOTHORACOSCOPIC LOBECTOMY

Poster Communication

Oncel M.*, Sunam G.S., Yildiran H.

Selcuk University Medical Faculty ~ Konya ~ Turkey

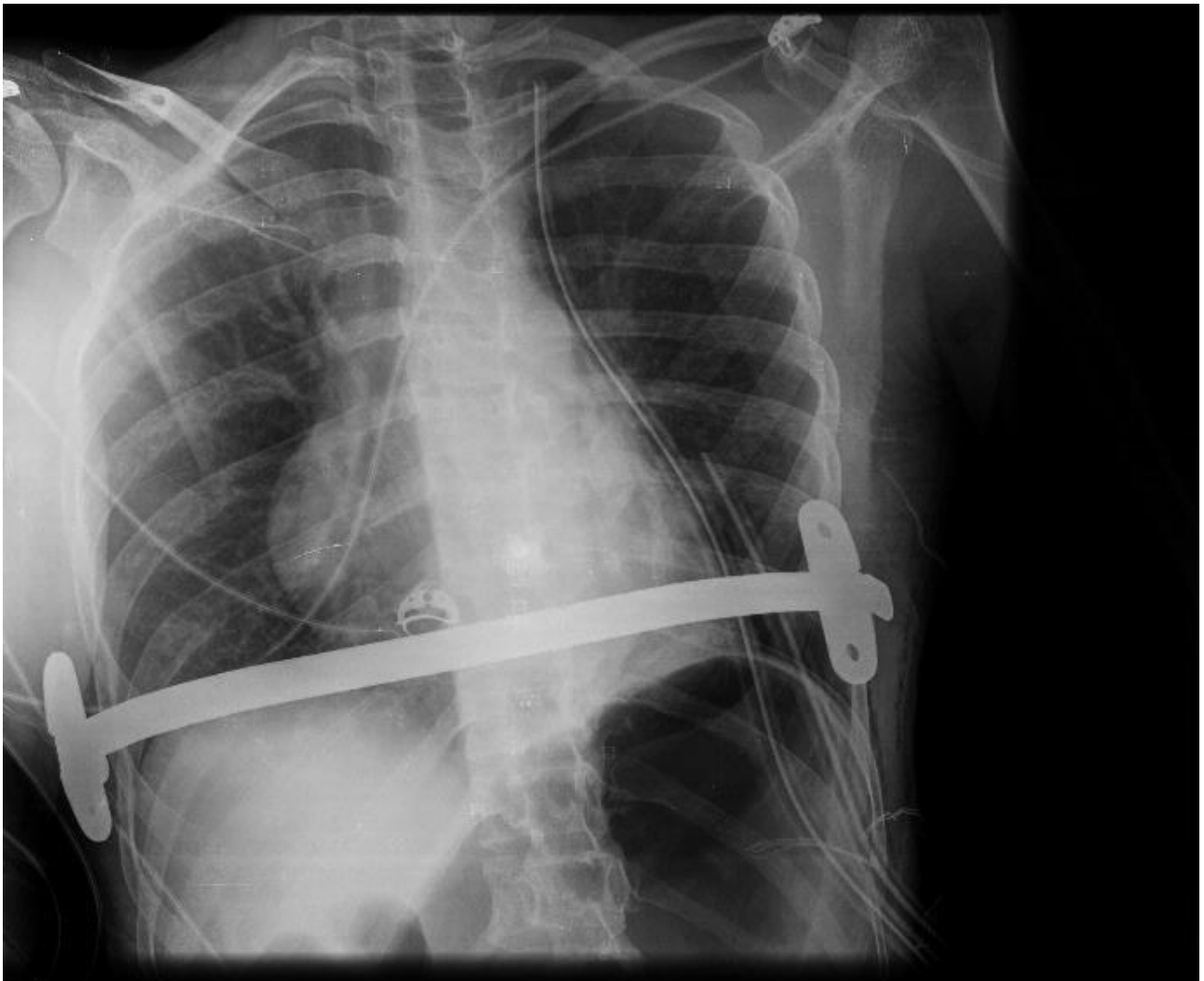
Pectus excavatum with congenital cystic adenoid malformation is very rare. The surgeries for pectus excavatum and cardiac procedures were reported in the literature several times. However, lung resections are rarely performed with MIRPE (minimally invasive repair of pectus excavatum). Our aim is to present an interesting case which was performed two minimally invasive surgeries at the same time.

CASE:23 year-old female patient admitted to our clinic with dyspnea and cough. The detailed history revealed that she had admitted to hospital many times with same complaints and she had been diagnosed as asthma and given medicines. In physical examination, she had asymmetric pectus excavatum deformity and there was ronchus on the left lower lobe. Infiltration in left lower lobe was seen on the chest X-ray. Computed thorax tomography was taken and destroyed left lower lobe with cystic bronchiectasis and severe pectus excavatum deformity were determined. Haller index was 3,8. Surgical treatment was planned. Firstly, videothoracoscopic left lower

lobectomy was performed. Then a Nuss bar was placed under the deformity and it was stabilized with bilateral stabilizers. The patient was discharged after 6 days postoperatively. The pathology of lobectomy specimen was reported as congenital cystic adenoid malformation type 2. She has been followed up with no problem.

The pathology of lobectomy specimen was reported as congenital cystic adenoid malformation type 2. She has been followed up with no problem.

By the development of thoracic surgery with minimally invasive methods and thoracoscopy, the surgical treatments together can be performed in the same period safely.



SIMULTANEOUS BAR REMOVAL AFTER MINIMALLY INVASIVE SURGERY FOR PECTUS CARINATUM AND VIDEOTHORACOSCOPIC THORACAL SYMPATHECTOMY

Poster Communication

Oncel M.*, Sunam G.S., Yildiran H.

Selcuk University Medical Faculty ~ Konya ~ Turkey

Pectus carinatum is seen commonly as a second-leading disease in all thoracic wall deformities. The treatment is performed for aesthetic and postural problems generally. The surgical treatments include Ravitch and Abramson procedures. Palmar hyperhidrosis is a clinical situation with excessive sweating in the hand without any systemic disease. The treatments are local pomads, botulinum toxin injection, iontophoresis and surgery. The gold standard one is thoracal sympathectomy via videothoracoscopy. Our aim is to present an interesting case which was performed this two minimally invasive surgeries at the same time.

CASE: 16 year-old female patient admitted to our clinic with discomfort with her chest. She had severe pectus carinatum deformity. After her examination, the surgery was planned. The MIRPC (minimal invasive reconstruction for pectus carinatum) was performed. 1 year after first surgery, the bar removal surgery was planned. The patient complained for sweating in her hands. Thoracal sympathectomy was planned at the same time with bar removal surgery. The operations were performed succesfully and the patient was discharged after 1 day.

The thoracic surgery has a great development using thoracoscopy and minimally invasive methods.

Two or more surgeries can be performed with less pain, less incisions, and less hospitalization time than open (classical) surgeries.



LUNG AND MEDIASTINUM HERNIATION THROUGH SURGICAL CHEST WALL DEFECT

Poster Communication

Sunam G.S., Oncel M., Yildiran H.*

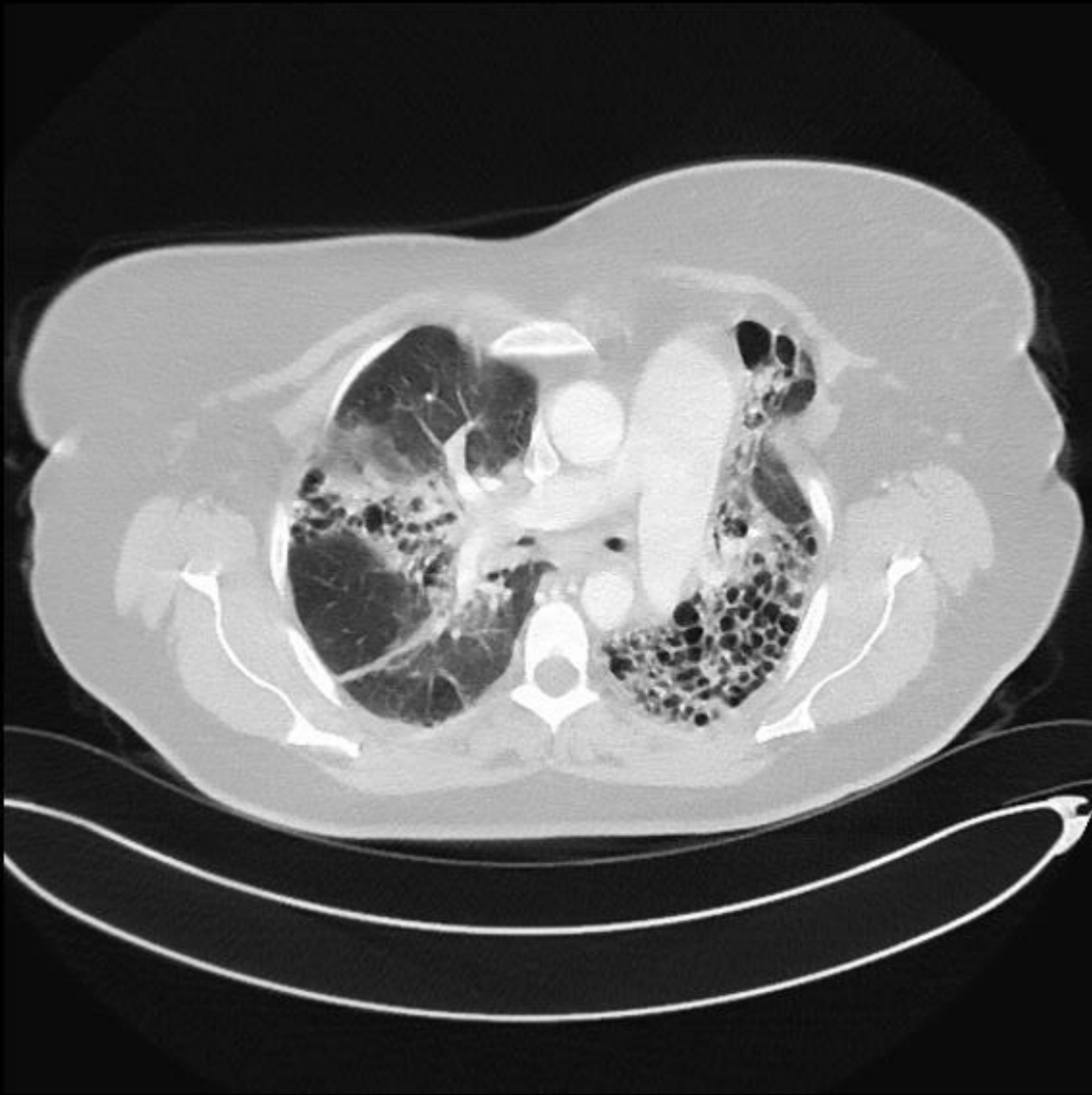
Selcuk University Medical Faculty ~ Konya ~ Turkey

Thoracic hernias are seen generally after thoracic surgeries. Failed closure of intercostal area facilitates herniation of lung through the subcutaneous tissue. Sometimes respiratory problems can be occurred. It is aimed to present this interesting case.

CASE: 51 year-old female patient admitted to chest disease clinics with cough attack with swelling of the left anterior chest wall. Her complaints started about 5 years ago and it worsened year by year. She had sarcoidosis diagnosed with a lymphadenectomy biopsy via left anterior mediastinotomy 25 years ago. CT (computed tomography) evaluation showed the herniation of lung with mediastinum and pulmonary inflammatory infiltrations.

The surgery was planned, and the defect of the thoracic wall was repaired with synthetic graft. The patient was discharged at the 4th postoperative day.

The chest wall defects cause herniation of lung and surgical treatment have to be performed when it is diagnosed.



CYST HYDATID LOCATED ON CHEST WALL

Poster Communication

Oncel M.*, Sunam G.S., Yildiran H.

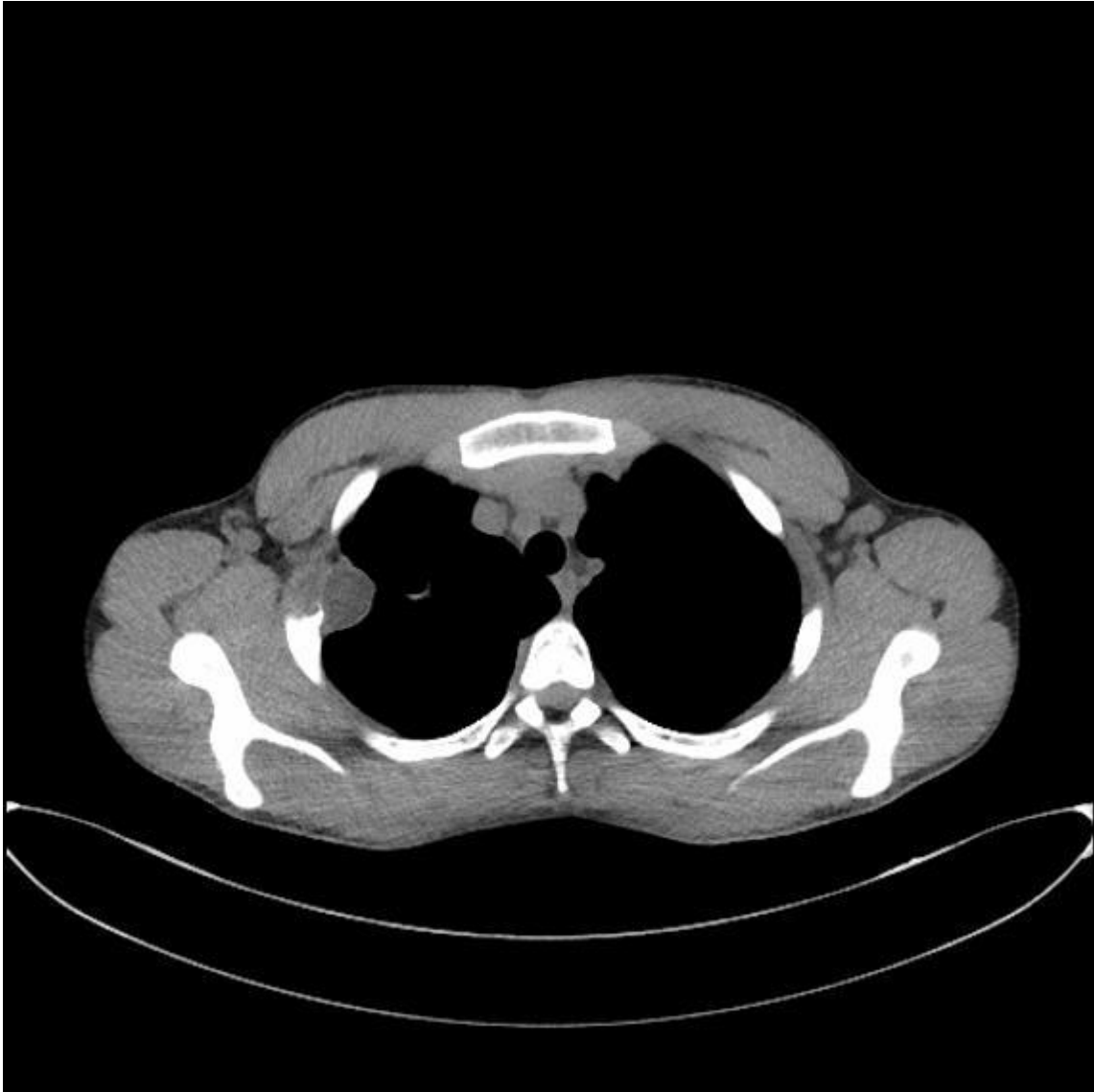
Selcuk University Medical Faculty ~ Konya ~ Turkey

Hydatid cyst is a parasitic disease which infects the liver and the lung commonly. The pathogen organism is generally *Echinococcus granulosus*. Hydatid cysts are rarely located on thoracic wall and we aimed to present this case.

CASE: 15 year-old male patient who was operated for hydatid cyst located in left upper lobe of lung 2 years ago admitted to our clinic. In admission of him, he did not have any complains and he had not taken albendazole for 1 and half year. On the chest X-ray, there was a smooth-lined nodular lesion located by 3rd rib in the upper zone. The computed thorax tomography was applied and it was seen on the right lateral chest wall, a nodular lesion which destructed the 3rd rib and it had homogenous fluid dansity with smooth margine. The nodule had about 3-cm diameter. For the evaluation of liver abdominal ultrasound was applied and there was not any cyst in liver. The operation was planned. The cystic lesion was excised through the incision opened axillary. The germinative membrane of *Echinococcus granulosus* was seen and the albendazole 10 mg/kg/day was started. The patient discharged at postoperative 3rd day.

The hydatid cyst located lung is usually treated surgically.

It is very important to prevent the reccurence of the disease with usage of albendazole enough time. Generally we suggest using albendazole at least 2 years postoperatively if there is giant or multiple cysts.



THORACIC WALL DEFECT BY GUNSHOT INJURY

Poster Communication

Sunam G.S., Oncel M.*, Yildiran H.

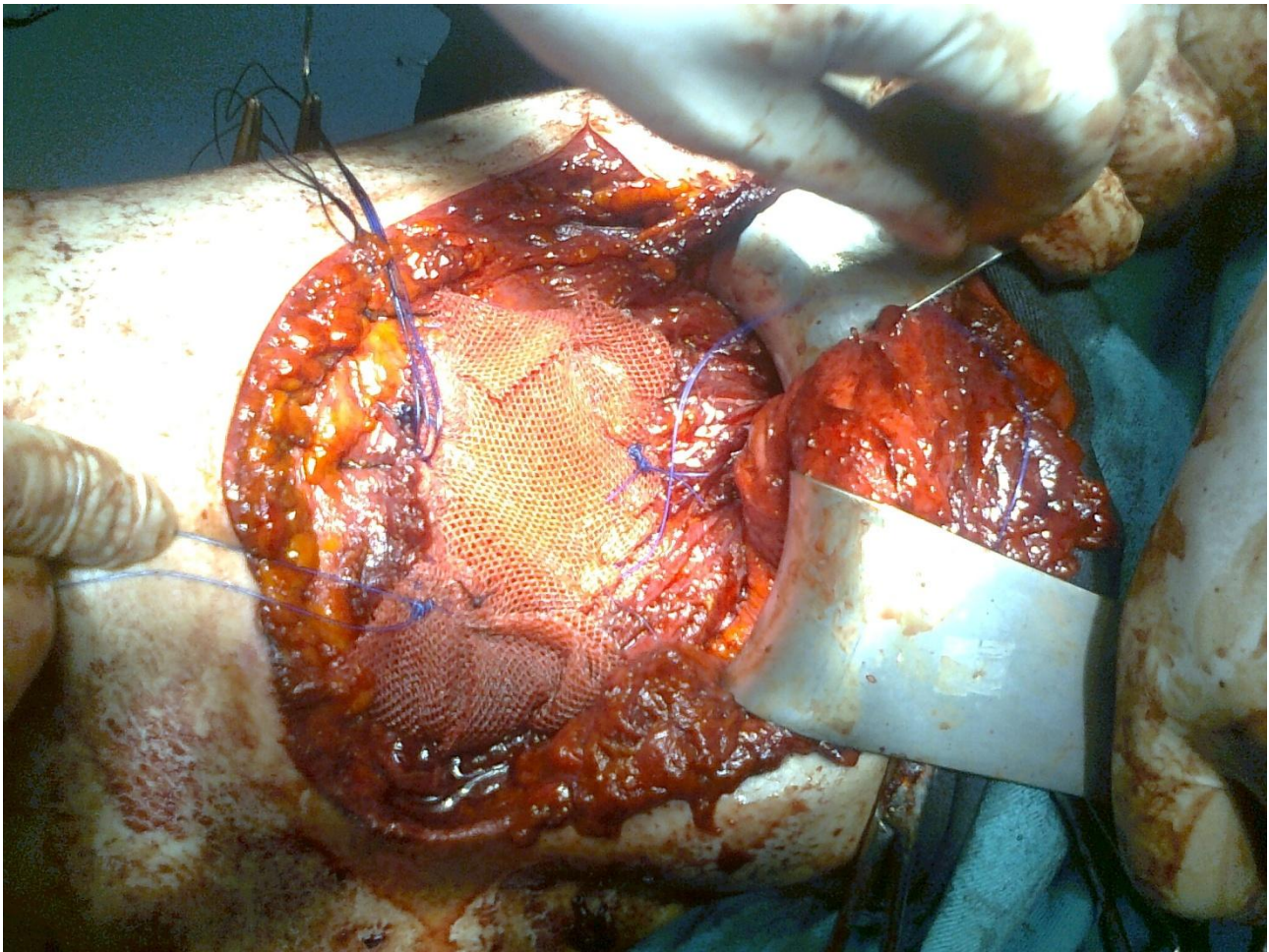
Selcuk University Medical Faculty ~ Konya ~ Turkey

Thoracic gunshot traumas are life-threatening clinical situations that should be evaluated carefully and immediately. It is aimed to present a reconstruction of chest wall due to a gunshot injury.

CASE: 19 year-old female patient was admitted to emergency department with gunshot injury due to suicide. At the time the patient admitted to the hospital, the TA:100/80 mmHg, hearth rate:120/min, there were a 3-cm wound in length at the anterior chest wall on the right side of the xyphoid of sternum at the level of 3rd and 4th intercostal area. Right breast had tissue defect. The heamothorax and open pneumothorax with open 3rd and 4th rib fracture were seen. An urgent surgery was performed. The middle segment of middle lobe was hurt by small shots and there was bleeding from parenchyma. Contusion was seen in the lower lobe. The heamothorax in pleural cavity was aspirated and cleaned. The hearth and major vessels had no injuries. Medial segmentectomy of the right middle lobe was performed to stop bleeding. There was not any fracture of anterior porsion of the 3rd rib and 4th rib. The defect of chest wall was repaired by prolene mesh. During the follow-up there weren't any respiratory problems. She was consulted to plastic, reconstructive and aesthetic surgery because of complain from asymmetry of breast tissue.

The thoracic penetrating traumas are very important having risk for trauma related death. When the penetrating injury to the chest occures, generally urgent thoracotomy is needed because of open pneumothorax and heamothorax.

Early diagnosis and management of thoracic trauma help to apply appropriate treatment strategies and prevent complications.



ANALYSIS OF THE ORTHOTIC MANAGEMENT OF PECTUS CARINATUM WITH DYNAMIC BRACING AT THE ROYAL HOSPITAL FOR CHILDREN, GLASGOW, SCOTLAND

Poster Communication

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^[1]Senior Paediatric Orthotist, RHC Glasgow ~ Glasgow ~ United Kingdom, ^[2]Cardiothoracic Surgeon, RHC Glasgow ~ Glasgow ~ United Kingdom

The RHC, Glasgow has treated PC with dynamic bracing (DB) since mid 2010 and recently (October 2016) received National Service status to develop DB as part of a comprehensive Paediatric Anterior Chest Wall Deformity Service. This study reviewed the effectiveness of this mode of treatment to date.

Clinical data has been collected for all patients orthotically assessed for treatment with DB. Patient compliance with PCO use for the “completed treatment” cohort was self-reported. The outcome measure for brace effectiveness was subjectively assessed by the Orthotist assisted by clinical photographs before and after treatment.

Figure 1 shows outcomes for the study population. This includes those currently undergoing DB and those who have completed treatment. Of the 10 patients who ceased DB and opted for surgery, the mean age at start of treatment was 15 years (9:1 male:female ratio), 70% were classed as severe at initial consultation. Those who discontinued DB but did not opt for surgery had a mean age of 10 years, (1:1 male:female ratio) and were classified mild-moderate at initial

consultation.

This data demonstrate that correction of PC with DB is an effective treatment for patients with a flexible chest wall. National Service designation will allow us to promote DB. We hope earlier referrals will increase the success rate of DB and reduce the numbers requiring surgery. Our multi-disciplinary approach allows patients to be seen by the surgeon and Orthotist on the same day and reduces time from assessment to starting treatment. Future developments include alternative orthosis shape capture methods, more accurate assessments of effectiveness and compliance as well as more efficient orthosis production.

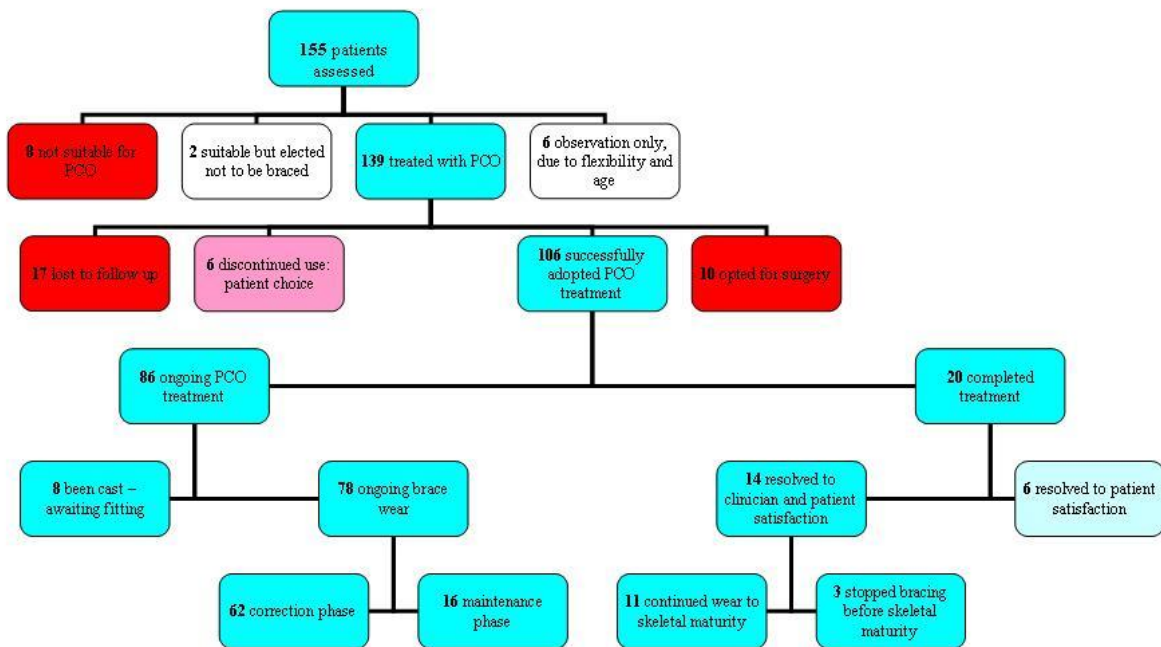


Figure 1: Flowchart illustrating the breakdown of the data set. Data accurate to date of writing (10/03/17).

POLAND'S SYNDROME: ANALYSIS OUR CASES.

Poster Communication

Gradica F.^[1], Lisha L.^[2], Argjiri D.^[1], Cani A.^[1], Gradica F.^[3], Vata Y.^[1], Buba S.^[4], Bollano E.^[5]

^[1]University Hospital "Shefqet Ndroqi" ~ Tirane ~ Albania, ^[2]~ Albania, ^[3]~ Tirane ~ Albania, ^[4]Infantil surgery ~ Albania, ^[5]Visceral surgery ~ Albania

Poland's Syndrome is a rare congenital condition. First described by the 19th-century British anatomist Sir Alfred Poland, Poland syndrome is a unique pattern of one-sided malformations that are present at birth. It is classically characterised by absence of unilateral chest wall muscles and sometimes ipsilateral symbrachydactyly (abnormally short and webbed fingers). The condition typically presents with unilateral absence of the sternal or breast bone portion of the pectoralis major muscle which may or may not be associated with the absence of nearby musculoskeletal structures. Experts currently are reporting an incidence of one in 10,000 to one in 100,000 live births. For reasons unknown, boys are more likely than girls to have Poland syndrome.

During 2004-2017 we are consulting in our service and treated 13 patients with the syndrome Poland. Age of patients from 4 to 27 years old. 4 female patient and 9 male patient. Only two of female patients has been presented in the age of 4 and all other patients are presented to us over the age of 16 years. Unilateral total lack of pectoral muscle in 9 patients and partially in 3 patients. Bilateral total lack of pectoral muscle in 2 two patients. Without clinical signs and symptom, most of them had psychological complaints, stress, anxiety and recurrent respiratory infections. All patients were supplemented with the necessary examinations and medically treated. They are treated anti stress procedures, respiratory exercises, sports, swimming, and antibiotic therapy in case of pulmonary infections.

The patients are under medical treatment and monitoring of recurrent. In three patients. Hemoptisi in 1 patient. Patient with partial absence of pectoral muscle have no complaints related diseases.

Medical and conservative treatment patients with Poland syndrome is safe alternative to maintaining and improving the quality of life of these patients

CHEST WALL ERNIA DUE TO GIANT THORACOABDOMINAL HYDATID CYST

Poster Communication

Montinaro F.^[1], Giusti A.^[2], Giacconi G.^[1], Falli F.^[1], Silvestri V.^[1], Gavagni M.^[2], Luzi K.^[1], Adriani B.^[1], Romoli L.^[1], Zalla T.^[1], Scatizzi M.^[1]

^[1]Nuovo Ospedale Santo Stefano ~ Prato ~ Italy, ^[2]Università degli Studi di Firenze ~ Florence ~ Italy

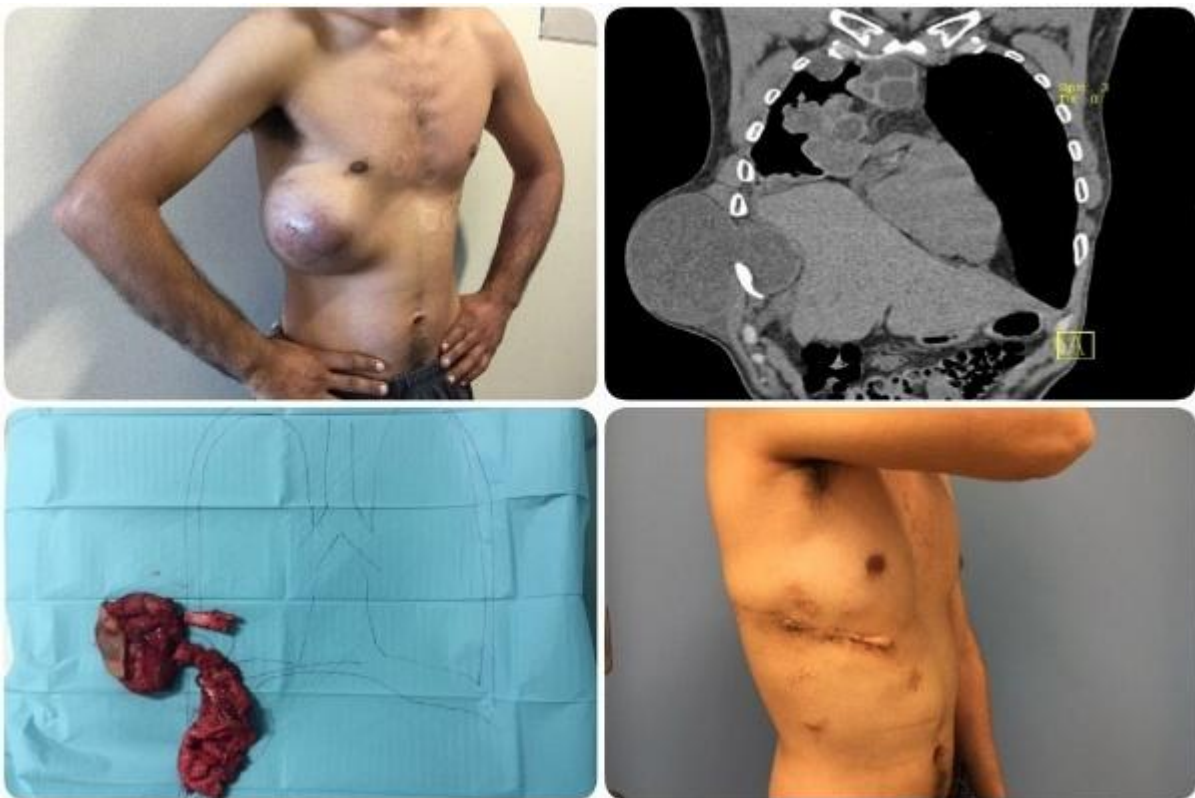
Echinococcosis is a parasitic disease caused by ingestion of Echinococcus eggs in contaminated food, water or soil, or through direct contact with animal hosts. In endemic regions (South America, East Africa and Central Asia), human incidence rates for cystic echinococcosis can reach greater than 50 per 100,000 person/years. Male, 33 years old from Morocco with a huge thoracic tumefaction wider than 15 cm in diameter that appearing tense, painless and partially erythematous. He underwent right thoracotomy for

hydatid cyst in 2008 in Morocco. Serology test for echinococcus was positive. Thoracoabdominal CT showed disseminated hydatid disease with cysts in mediastinum, right paramediastinum, in paravertebral zone, in the right lung, in the liver; It also showed a huge right thoracoabdominal cyst developing in chest wall and insinuating between 7th and 8th rib.

The patient was treated with anthelmintic Albendazole and then we carried out a two-stage surgical approach. The first stage involved a cyst drainage under local anesthesia using 14 Fr pig-tail and obtaining 1200ml of purulent fluid. The second stage, three days later, involved a partial redo anterolateral thoracotomy, radical cyst excision plus 7th partial rib resection.

There wasn't any post operative complication and CT scan control showed no residual thoracoabdominal ernia but confirmed disseminated hydatid disease. At the moment the patient is still treated with Albendanzole.

Cooperation of more physicians is required for a correct diagnosis and treatment of echinococcus disease. Surgery is often the best treatment but in disseminated disease, as our clinical case, a long term chemotherapy is also needed.



HOW DOES THE PECTUS BAR AFFECT THORACIC CAGE DYNAMICS DURING RESPIRATORY MOVEMENTS?

Poster Communication

Park H.J.^[1], Cho S.*^[2], Moon M.^[1], Kim K.S.^[1], Moon Y.K.^[1], Hong S.B.^[1], Namkoong M.^[1], An H.C.^[1]

The impact of pectus bars to respiratory thoracic cage dynamics has not been discovered. The aim of this study is to reveal how pectus bars attribute to hinder the chest wall movements during the respiratory cycle.

We analyzed full inspiration and expiration chest x-rays (postero-anterior and lateral projections), which were obtained from pectus deformity clinic visitors. From September 2016 to February 2017, 506 sets of chest x-rays were collected. We measured thoracic dimensions in three different directions: 1) transverse dimension (TD), 2) anteroposterior dimension (APD) - representing chest wall recoil, and 3) lung height (LH) - reflecting diaphragm movements. These parameters were analyzed among three different phases: before bar insertion; bar in place; and after bar removal.

Chest wall movements were decreased after bar insertion: TD 4.38 to 2.41 % ($p < 0.01$) and APD 12.40 to 6.59 % ($p < 0.01$), whereas diaphragm movements were preserved (LH: 18.60 to 21.09 %, $p = 0.14$). Multiple bars in adults seemed to be more restrictive than single bars in children: TD 3.30 vs. 4.65 % ($p = 0.03$); APD 6.33 vs. 7.08 % ($p = 0.70$). However, LH was higher in multiple bar patients than single bar patients (14.50 vs. 9.35%, $p < 0.01$). After bar removal, all of the thoracic dimensions were returned to the preoperative levels: TD 4.81 to 5.52 % ($p = 0.33$); APD 10.83 to 9.44% ($p = 0.32$); LH 10.77 to 12.20 % ($p = 0.30$).

Our study revealed that pectus bars restrained chest wall movements in some degree to the antero-posterior and lateral directions, but compensated by increased movement of the diaphragm in multiple bar patients. In addition, restrained movements were restored after bar removal. The compensatory diaphragm dynamics contribute to the regulation of the respiratory mechanism during in possession of the pectus bar.

HYBRID APPROACH FOR TREATMENT OF PECTUS EXCAVATUM AND CARINATUM: THE MINI-INVASIVE HALF MOON INCISION FOR THE RAVITCH TECHNIQUE

Poster Communication

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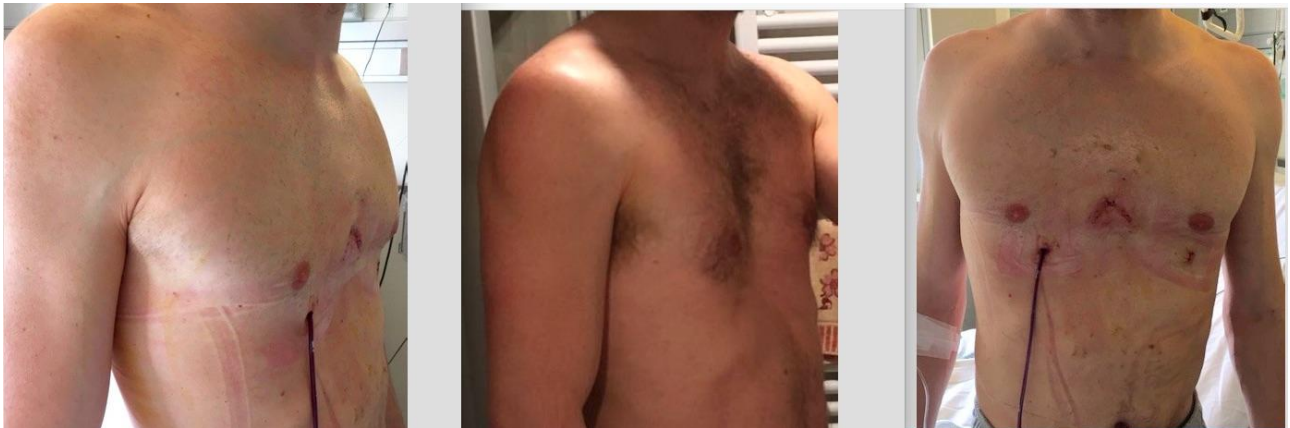
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Pectus excavatum (PE) and carinatum (PC) are the most common chest wall deformities. Ravitch and Nuss techniques are the procedures most commonly used for the treatment of PE, while PC is usually treated by Ravitch technique. The aim of the study was to evaluate the results of patients affected by PE and PC all treated through a modified Ravitch technique in terms of self-esteem and satisfaction.

Between January 2012 and June 2016, $n = 78$ patients underwent to surgical repair of chest wall deformity ($n = 53$ PE/ $n = 25$ PC; $n = 72$ male, $n = 19$ female; mean age = 27.8 years, range: 14-46 years). The hybrid mini-invasive approach was performed through an half-moon shaped skin incision (4 cm) in correspondence with the deepest depressed point of the chondro-sternal deformity for the PE and the most salient point for the PC, a chondrectomy of deformed cartilages, one or more sternal wedge osteotomies and a retrosternal placement of a small bar using the instruments of the Nuss technique, remodelling pectoralis muscles. Patient satisfaction was assessed with a single- step questionnaire.

Median length of hospital stay was 4 days. Mean operative time was 135.6±12.4 minutes for PE and 155.7±13.5 for PC. N=1 patient (1.3%) reported an intraoperative bleeding from mammary artery, n=1 (1.3%) patient developed a pericardial effusion after 6 months from bar placement and n=2 patients (2.6%) had a seroma at the level of the wound site. In all patients the metallic bar was removed after 7 months. There was a significant improvement in self-esteem (p=0.001) and high level of overall satisfaction (median score 85, range: 80-91).

The association of a half-moon incision and the use of the Nuss instruments provided an optimal surgical exposure with a minimally invasive anterior access, showing excellent correction results and high patients' satisfaction.



PRELIMINARY RESULTS OF BRACE FOR PECTUS CARINATUM: BASED ON 3D SCANNING OF CHEST WALL

Poster Communication

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Since non-surgical approaches for pectus carinatum have been developed, many bracing devices have been available and shown good outcomes in patients with pectus carinatum. However, to get effective results, it is important to increase the compliance of patients during wearing the brace. The best solution to get over the noncompliance could be determined by fitness of brace which could decrease chest pain, and have external appearance and decrease comfortableness even after wearing brace. Herein, we want to introduce the brace using scanning of chest wall with portable 3D scanner.

From January 2014 to February 2017, 27 patients with pectus carinatum were treated with a compressive brace. The brace was individually made after scanning of chest wall with portable 3D scanner as fig 1. In first 2 weeks, patients were recommended to wear the brace at least 12 hours a day and reduced to 6-8 hours a day during follow-up. The regular follow-up was performed at 3, 6, 12 months. After 6 months application, the durations of brace wearing time were gradually reduced to wean off. Satisfaction was assessed subjectively after 6 months application.

Of 27 patients, the mean age of patients was 11 (range, 3—16 years). There are 26 male and 1 female patients. 25 patients (93%) were satisfied after removal of brace. 3 patients were recurred in 6 months after removing it and were recorrected by rewearing the brace. Skin color change was occurred in 2 patients, but recovered without any treatment.

The brace using scanning of chest wall with portable 3D scanner could be one of feasible techniques for patients with pectus carinatum to increase compliance in adolescent and minimize chest discomfort during inspiration.



CROSS BAR TECHNIQUE FOR PECTUS EXCAVATUM

Poster Communication

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Since the Nuss procedure was started, surgical techniques and devices have developed according to variability of patients. We report a single-institution experience about technical modifications to correct broad and deep chest wall deformities

We retrospectively reviewed medical records of pectus excavatum patients who underwent cross bar technique from December, 2016, through March, 2017 at this center. Seven patients have been corrected. The technique involved crossing 2 bars at the deepest portion of lesion and fixed by bridge plates at the each ends of the bars.

The mean age was 16 years (range, 6-25 years). All patients were male. Mean height was 161.92 cm (range, 114.2 - 176.2), mean body weight was 49.17 kg (range, 15 - 70.3), mean BMI was 17.88 kg/m² (range, 11.5 - 22.64). Mean length of bar was 12.85 inches (range, 9 - 15), mean op time was 69.14 minutes (range, 47 - 87). Mean pre op-Haller Index was 4.08 (range, 3.44 - 5.28), mean post op-Haller Index was 2.23 (range, 1.97 - 2.87). The median postoperative stay was 3 days. There was no patients experienced complications.

A "cross bar technique" designed to connect 2 crossing bars using plates and screws was demonstrated as a method to make better quality of surgical outcomes. This approach was easy to implement without using sutures or invasive devices.

CHEST WALL RECONSTRUCTION WITH PECTUS BARS AND PTFE AFTER TUMOR RESECTION

Poster Communication

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After resection of chest wall tumors, reconstruction is needed to obliterate dead space as well as to preserve breathing biomechanics. However, restorage of chest wall stability in cases of huge full-thickness defects is one of the major challenges facing surgeons.

Case report: A 82-year-old woman presented with progressive right chest wall swelling eight months prior to admission; no pain, respiratory symptoms or loss of weight or appetite were referred. Clinically, she had a hard right lateral chest wall tumor fixed to the underlying rib cage. On contrast-enhanced CT, the thorax showed a large, solid right antero-lateral chest wall mass measuring 119x121x159 mm with invasion of pectoral muscles, ribs and pulmonary tissue. The biopsy revealed primary sarcoma.

We performed an "en block" surgical resection of the tumor by removal of a wide portion of the second to 6th right ribs, the pectoralis major and minor muscle and a segment of the right superior lobe. To provide chest wall stability, two pectus bars were modelled mimicking the ribs, and were fixed on the sectioned ribs with wires and on the sternal surface with plates and screws. In order

to provide flexibility and watertight, a 2 mm polytetrafluoroethylene (PTFE) coverage was sutured as tight as possible around or through adjacent ribs and was covered by surrounding healthy tissue. After careful hemostasis and placement of pleural drainages, skin incision was closed by planes.

The combination of pectus bars and PTFE for reconstruction of huge chest wall defects allows for an adequate restorage of the chest contour and offers enough rigidity to prevent paradoxical motion as well as flexibility to minimize respiratory compromise.

SURGICAL TREATMENT IN SOLITARY PLASMACYTOMA: PALLIATIVE OR CURATIVE?

Poster Communication

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Solitary plasmacytoma is a rare plasma cell neoplasm. Bone involvement in multiple myelomas is termed as plasmacytoma, which frequently involves ribs. However, solitary plasmacytomas, which are not accompanied by multiple myelomas and are characterized by malign plasma cell proliferation in the bone, is rarely seen. We aimed to collect a surgical data of this rarely seen chest wall tumor.

Between 2011 and 2016 we retrospectively investigated the demographic characteristics, metastasis development during follow-up and survival of patients with solitary plasmacytoma, who were operated for diagnostic or treatment purposes in our clinic.

Of the 6 patients that were included in the study, 3 were male and the mean age was 55.6 years (32-74). All patients had preoperative PET-CT. While one patient did not have FDG uptake at the solitary lesion, remaining 5 patients had FDG uptake at malignancy level (SUVmax: 3.1-11.9). Two of the 6 patients underwent Tru-cut biopsy before surgery but only one was diagnosed. Two patients underwent surgery for diagnosis and remaining 4 underwent resection and reconstruction. Rib resection, partial sternum removal, and mesh placement were performed in the patient with both rib and sternum involvement. During the 14.1 months average follow-up period, two patients died and these patients were those who had metastasis preoperatively. The median survival of all patients was 14.1 months.(Table1)

Solitary plasmacytoma is rarely seen among primary malign tumors of the chest wall. A multidisciplinary approach is important in these cases. Surgical treatment in solitary plasmacytoma has fewer local and systemic side effects compared to radiotherapy and chemotherapy. Therefore, the place of surgery in the treatment of solitary plasmacytoma should be revised. Surgery should be considered as not only a palliative treatment but also a curative one in solitary plasmacytomas.

n	AGE	SEX	COMPLAINT	LOCALIZATION	PREOPERATIVE DIAGNOSIS	OPERATION	PET-CT (FDG)	METASTAS	LIFE STATUS	SURVEY (MOUNTH)
1	60	M	PAIN	COSTA	NEGATIVE	BIOPSY	POSITIVE	BONE METASTASIS	EX	23
2	74	F	DYSPLNEA	COSTA	NEGATIVE	BIOPSY	POSITIVE	PLEURAL EFFUSION	EX	3
3	61	M	PAIN	COSTA	NEGATIVE	COSTA RESECTION + RECONSTRUCTION	NEGATIVE	NEGATIVE	ALIVE	41
4	57	F	PAIN	COSTA	NEGATIVE	COSTA RESECTION + RECONSTRUCTION	POSITIVE	NEGATIVE	ALIVE	10
5	50	M	PAIN	COSTA + STERNUM	NEGATIVE	STERNUM RESECTION + RECONSTRUCTION	POSITIVE	NEGATIVE	ALIVE	6
6	32	F	PAIN	COSTA	NEGATIVE	COSTA RESECTION	POSITIVE	NEGATIVE	ALIVE	2

CHEST WALL NECROSIS DUE TO INTRATUMORAL HEMORRHAGE IN NEUROFIBROMATOSIS TYPE 2

Poster Communication

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Neurofibromatosis type 2 (NF2) is an autosomal dominant disorder characterized by bilateral vestibular schwannoma. Surgical procedures for it are challenging because of the brittleness of the bloody vessels and soft tissues.

We present clinical and pathological findings of 45 year-old man with NF2 was admitted because of a subacute enlargement of chest wall mass with 9 x 14 cm-sized skin necrosis on the right back area. PET CT demonstrated huge mass with mild FDG uptake, suggestive malignant transformation. Preoperative angiography demonstrated hypervascularity of the chest wall mass. The treatment plan was embolization and surgical resection.

Right lateral thoracic artery embolization was performed for reducing tumor bleeding. The tumor covered the chest wall too widely, it was impossible to complete resection. It was resected as possible as widely to perform the primary chest wall closure. It was diagnosed as diffuse neurofibroma with skin ulceration and hemorrhage.

Neurofibromatosis with an intratumoral hemorrhage and chest wall necrosis is rare. Preoperative embolization could reduce intraoperative bleeding especially debulking surgery. It was difficult to differential diagnosis neurofibroma from malignant transformation at accompanying intratumoral hemorrhage.

BLOOD METAL LEVELS IN PECTUS EXCAVATUM PATIENTS AT BAR REMOVAL

Poster Communication

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Pectus excavatum is the most common chest wall deformity. The gold standard for the surgical correction is the placement of a stainless steel retrosternal bar with minimally invasive technique; the bar has to be kept in situ for 3 years. This kind of bar contains some metals which can settle in blood and tissues. Literature lacks of studies about the blood and tissues deposition of metals in these patients. The aim of the study is to measure serum and tissue metal levels in patients at the time of bar removal, after 3 years from the implantation

A prospective study was conducted in Gaslini Children's Hospital since 2017. For each patient undergoing bar removal, metal levels were measured in blood sample and tissues around the bar. Samples were analysed using inductively coupled plasma mass spectrometry (ICP-MS) at the Quality Control Laboratories and Chemical Risk of University Hospital Paolo Giaccone of Palermo.

13 patients were included and in 12 cases chromium, molybdenum and nickel blood levels resulted higher than in the general population, while other metals resulted in the expected ranges.

these preliminary results on a small sample of patients are suggestive of a possible metal deposition and deserve further investigations.

“Educational intervention and Physioterapist role in management of adolescents undergoing surgery for pectus excavatum: a retrospective 6-months experience of Meyer Children Hospital”

Poster Communication

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Several post-surgical protocols for adolescents undergoing surgery for pectus excavatum (PE) are reported in literature. None of them implied the role of respiratory physiotherapy (RPT) as a primary outcome for surgery success. Our centre protocol recently had included RPT educative intervention the day before surgery, respiratory physiotherapy and very early active mobilization post-surgery; the aim of the study was to point out our experience with a “RPT-centered” protocol for the management of adolescents undergoing surgery for PE.

A retrospective six-months review of patients undergoing correction of PE was performed. Pre and post-operative measurements of respiratory performance, physical and psychosocial quality of life changes that were administered by RPTs and surgical outcomes were collected. A descriptive statistical analysis was performed along with a correlation analysis between index of routine activity (HAES), physical activity and Haller index.

Data from 17 patients, 13 males, aged 15(2) years, were collected. Mean Haller was 5,7(1,8) and mean vital capacity was 96,4(13,7)%, forced vital capacity 93,7%(15,9). Maximal inspiratory volume capacity decreased after surgery with a mean loss of 853(15,9) ml. Average duration of hospitalization was 7 days, with a median of 2 days for achieving standing position. Pain intensity using visual-analogue scale(VAS) showed a decrease from 24 hours after surgery (median VAS of 6) to the discharge (median VAS of 3); radiographic signs of pneumothorax were reported in 10 patients (59%). 10 adolescents (59%) did physical activity before surgery which wasn't correlated with better recover but showed an higher score at HAES index (8/17). There wasn't a correlation between Haller and Haes Indexes (p-value=0.07). No adverse events related to uncontrollable pain or displacement of the bars were reported.

Although no correlation was found, physiotherapist seems to play an important role in the management of PE patients. Further studies are necessary to better assess and compare the cost-effectiveness of PT's intervention in PE after-surgery management.