

## MINIMALLY INVASIVE REPAIR SURGERY FOR PECTUS CARINATUM; A ONE-YEAR EXPERIENCE

### Minimal İnvaziv Pektus Karinatum Onarımı; Bir Yıllık Deneyim

Tülin Durgun Yetim<sup>1</sup>, Sedat Koçal<sup>1</sup>, Kerem Karaarslan<sup>1</sup>

<sup>1</sup> Mustafa Kemal Üniversitesi Tıp Fakültesi Göğüs Cerrahisi Anabilim Dalı

#### ABSTRACT

**Objective:** Pectus carinatum, is the second most common congenital chest wall deformity after pectus excavatum. Etiology is controversial but positive family history of congenital chest wall deformity (25%) is supporting the genetic transition. In recent years, Minimally Invasive Repair of Pectus Carinatum (MIRPC), a modified type of Nuss procedure, has been preferred in many clinical centers due to the successful results achieved by Abramson. We have used the same method in our cases (14 men 6 women) and wanted to share our experiences. Quality of the patients' life was evaluated after the surgery.

**Material and Methods:** Psychosocial problems because of cosmetic appearance occurred in all cases. 17 (85%) patients have symmetrical deformity, and 3 (15%) have asymmetrical deformity. The most common anomaly is scoliosis. Correction was done with one pectus bar in all patients. All 20 patients in the series underwent control thorax CT and quality of life survey in the postoperative 3<sup>rd</sup> month

**Conclusion:** MIRPC is less invasive and leaves less scar tissue, should be preferred in appropriate patients.

**Key words:** Congenital chest wall deformity, pectus carinatum, minimally invasive surgery.

#### ÖZET

**Amaç:** Pektus karinatum (PC), pektus ekskavatum'dan (PE) sonra ikinci sıklıkla görülen doğumsal göğüs duvarı deformitesidir. PE için kesin bir etioloji saptanamamış olmakla birlikte, doğumsal göğüs duvarı deformitelerinde pozitif aile hikayesi (%25) olması genetik geçişi desteklemektedir. Son yıllarda PC onarımında Nuss prosedürünün modifiye bir şekli olan Minimal İnvaziv Pektus Karinatum Onarımı (MIRPC), Abramson tarafından başarılı sonuçlar alınması nedeniyle birçok merkez tarafından tercih edilmeye başlanmıştır. Biz de bu yöntemi kullandığımız 20 (14 erkek, 6 kadın) olgumuzu, tecrübelerimizi ve erken dönem sonuçlarımızı ile hastaların cerrahi sonrası yaşam kalitelerini literatür eşliğinde değerlendirmeyi amaçladık.

**Materyal ve Metod:** Olguların tamamında psikososyal sorun yaratan kozmetik görüntü bozukluğu ön planda ve 17 (%85) deformite simetrik, 3'ünde (%15) ise asimmetrik idi. En sık rastlanan ek anomali 6 (%15) olguyla skolyozdu. Pektus karinatum deformitesi nedeniyle MIRPC uygulanan bu 20 olgunun tamamında tek bar ile düzelme sağlandı. Tüm hastalar post operatif 3. Ayda bilgisayarlı toraks tomografisi ile ve yaşam kalitesi anketi değerlendirildi.

**Sonuç:** MIRPC az invaziv ve daha az doku hasarı nedeniyle uygun hastalarda tercih edilmelidir.

**Anahtar Kelimeler:** Konjenital göğüs duvarı deformiteleri, pektus karinatum, minimal invaziv cerrahi.

Gönderme tarihi / Received: 17.11.2015 Kabul tarihi / Accepted: 22.06.2016

İletişim: Tülin Durgun Yetim

Mustafa Kemal Üniversitesi Tıp Fakültesi Göğüs Cerrahi A. D.

Tel: 05416373031 E-posta: tulinyetim31@gmail.com

## INTRODUCTION

Following pectus excavatum (PE), pectus carinatum (PC) is the second most common congenital chest wall deformity (1). Although no exact etiology has been detected for pectus carinatum, high incidence of positive family history (25%) supports the genetic inheritance for the chest wall deformity (2,3). In recent years, Minimally Invasive Repair of Pectus Carinatum (MIRPC), a modified type of Nuss procedure, has been preferred in many clinical centers due to the successful results achieved by Abramson. We have used the same method in our cases and wanted to share our experiences.

## MATERIAL AND METHOD

This study was carried out at Mustafa Kemal University Medicine Faculty, Department of Chest surgery between 2010-September 2011 and ethics committee approval and patients consent was provided. MIRPC operation was applied which we have included in the study. MIRPC operation was applied which we have included in the study. Single-lumen intubation was performed to all patients under general anesthesia. Patients were laid in the supine position with both arms abducted with an angle of 70°. Hyperextension was avoided not to overstrain plexus brachialis. The highest point of the pectus and the right and left intercostal spaces where the bar would be placed were determined. Measurements with aluminum models were performed to determine the appropriate pectus bar to fit that region. The bar with the correct size was selected and brought into the shape that the chest front wall would take. The pectus bar in the same size as the model was bent according to the aluminum model which was shaped

with a table top or hand-held bender. Approximately 3-cm incisions were made on the mid axillary line of the right and left intercostal spaces corresponding to the highest point of the pectus. The parts of the ribs where the stabilizers would be attached were deperiosteated. The hook in the set was passed subperiosteally, then a thin (black) suction catheter was placed on its tip and the hook was withdrawn. For fixation; two No.5 steel wires twisted around one another were attached to the suction catheter and the steel wires were passed under the rib by withdrawing the catheter. This process was repeated 4 times and the fixation of carinatum stabilizers on the ribs with the twisted wires was achieved. The tunnel which the bar would be passed through was created underneath the pectoral muscles with the employment of long clamps through the incisions to the anterior. Thoracic drain CH 28 with trocar was passed through this tunnel. Then trocar was removed and the bar was inserted into the drain, then the drain was withdrawn through the tunnel together with the bar. The ends of the bar were positioned in the previously attached stabilizers, and the stabilizers were fixed with steel sutures. The muscle fibers on the ends of the bar and on the stabilizers were approximated with 2/0 Vicryl. The process was completed with 2/0 the continuous Vicryl subcutaneous closure and subcuticular 4/0 Vicryl skin closure. Pain control in early postoperative period was achieved with the controlled intravenous analgesia in all patients. Tramadol and an anti-inflammatory were preferred as analgesic agents and the patients were discharged with oral Tramadol and anti-inflammatory for the maintenance of analgesia.

Quality of the patients' life was evaluated 3 months after the surgery with quality of life survey and all 20 patients in the series underwent control thorax CT.

### RESULTS

Of the patients, 14 (70%) were male and 6 (30%) were female (Table 1). The age range was 10-18 with the mean age 14 years. Indications for surgery in all patients were the cosmetic impairment which leads to psychological problems and having heard that it can be repaired with surgery. The deformity was symmetric in 17 patients (85%) and asymmetric in 3 (15%) patients. In the series, the most common additional anomaly was scoliosis with 6 (15%) patients. It was followed by growth retardation in 1(5%) patient and bronchial asthma in 1(5%) patient (Table 3). Nine (45%) of the patients had family history of congenital chest wall deformity (PE or PC). The most frequent symptom in patients was shortness of breath with 10 (50%) patients. It was followed by chest pain in 7 (35%) patients and complaints of fatigue in 3 (15%) patients (Table 4). In all of these 20 patients who underwent MIRPC due to pectus carinatum deformity, the repair was achieved with a single bar and in all cases, the recently developed pectus carinatum bar and stabilizer was used (Biomed W.Lorenz, US). The operation period ranged from 45 minutes to 120 minutes with a mean period of 65 minutes . The hospitalization period ranged from 2 days to 8 days and the mean hospitalization period was 5 days. The most frequently observed postoperative complications were; one patient (%5) developed pneumothorax, but no tube thoracostomy was needed and the air was reabsorbed simultaneously, and 1(5%) patient

developed wound site infection in the late postoperative period. Following the wound site debridement, Septocoll (Biomed BioMaterials-Germany) was applied to this patient and full recovery was achieved. All 20 patients in the series underwent control thorax CT in the postoperative 3rd month and no problems were detected. In quality of life survey, patients compare the questions with preoperative and after 3 month of surgery. Although not statistically significant but we reached higher satisfaction scores in post operative 3. month in all questions.

**Table 1. Gender distribution of the patients.**

Gender	Number of patients (n)	Percentage
Male	14	70
Female	6	30

**Table 2. Types of deformity.**

Type of deformity	Number of patients (n)	Percentage
Symmetrical	17	87
Asymmetrical	3	15

**Table 3: Accompanying anomalies.**

Additional pathologies	Number of patients (n)	Percentage
Scoliosis	6	15
Growth retardation	1	5
Bronchial asthma	1	5

**Table 4. Symptoms.**

Symptoms	Number of patients (n)	Percentage
Shortness of breath	10	50
Chest pain	7	35
Quick tiredness	3	15
Wound site infection	1	5

**Figure 1: Preoperative image.**

## DISCUSSION

Pectus carinatum includes the anterior chest wall deformities characterized with the convex protrusion of the sternum and costal cartilages. These deformities are classified as condrogladiolar and condromanubrial, depending on the anatomical site of the highest prominence. Condrogladiolar deformity is the symmetrical or asymmetrical protrusion of gladiolus and inferior costal cartilages.

**Figure 2: Postoperative image.**

Unilateral overgrowth of costal cartilages in asymmetrical deformity leads to the rotational deformity of the sternum. However, condromanubrial PC is the protrusion of manubrium and superior costal cartilages, and this subtype constitutes less than 1% of the PC cases (4). Among our cases, there were 3 (15%) asymmetrical and 17 (85%) symmetrical deformities.

Although there is no exact etiology for pectus carinatum, high positive family history incidence (25%) supports the genetic inheritance for the chest wall deformity (2). Similarly, 9 (45%) patients in our series had family history.

Over the active linear growth in puberty, PC makes a progress that leads to significant cosmetic and psycho-social problems and becomes more evident. Only in less than 10% of the PC patients, an evident protrusion is observed under the age of 11. Typical PC deformity is identified in early adolescence and it progressively aggravates until the patient reaches the full skeletal maturity (5). Accordingly, the ages of our patients ranged

from 10 to 18, and most of the patients were unaware that their deformity could be repaired surgically.

Pectus carinatum is observed 5 times less than pectus excavatum and is 4 times more common in males than females(6). Fourteen (70%) of our cases were males and six (30%) were females. Pectus carinatum can be a deformity alone, or it can be observed together with other genetic deformities and syndromes such as trisomy 18, Marfansyndrome, homocystinuria, Morquio's syndrome and Ehler-Danlos syndrome, with congenital cardiovascular diseases, or with other connective tissue diseases(3). The most common musculoskeletal abnormality which accompanies PC is scoliosis (15%) (7). Similarly 6 (30%) patients in our series had scoliosis and it was the most common deformity in the group.

The most frequently observed symptoms in patients with pectus carinatum are shortness of breath, getting tired quickly and chest pain at the site of deformity (7). The most frequently observed symptom in our series was also shortness of breath with 10 (50%) patients. Chest pain was in the 2nd place with 7 (35%) patients and getting tired quickly was in the 3rd place with 3 (15%) patients.

Pneumonia, wound infection, pneumothorax and nickel allergy are among the complications that can develop in the early postoperative period. The infection rate in the series usually does not exceed 1% with a careful operation considering that a foreign body implantation is being performed and with a proper antibiotic prophylaxis (8). If any infection develops, the infection can be controlled with the help of wound drainage and antibiotherapy supported by a culture. There is no need for the

removal of the bar. In our series, one (5%) patient developed wound infection. The infection was controlled with Septacoll (Sebamed).

The standard surgical approach for PC had been Ravitch open surgery procedure until the minimally invasive technique was dintroducted by Abramson (9, 10). Minimal Invasive Repair of Pectus Carinatum (MIRPC), which is a modified type of Nuss, was first defined by Abramson in 2005 (11) and it has been preferred at many centers since then, because it is minimally invasive and yields successful results. We applied the same technique to the patients who were suitable for it. In the evaluation of the data obtained from life quality questionnaires applied to the patients, it was observed that the questionnaire scores of all patients increased in the postoperative 3<sup>rd</sup> month.

In open surgery, sternum or cartilaginous parts of the ribs may need to be cut or removed partially. Additionally, open surgery leaves a wide scar tissue although it is performed for aesthetic concern. Thus, Abramson method, which is less invasive and leaves less scar tissue, should be preferred in appropriate patients.

**REFERANSLAR**

1. Attila Kálmán, MD Initial results with minimally invasive repair of pectus carinatum. *J Thorac Cardiovasc Surg* 2009;138:434-8.
2. Golladay ES. Pectus carinatum and other deformities of the chest wall. In: Ziegler MM, Azizkhan RG, Weber TR, editors. *Operative Pediatric Surgery*. New York (NY) 7McGraw-Hill; 2003:269-77.
3. Shamberger RC, Welch KJ. Surgical correction of pectus carinatum. *J Pediatr Surg* 1987;22: 48–53
4. Shamberger RC, Welch KJ. Surgical correction of chondromanubrial deformity (Currarino Silverman syndrome). *J Pediatr Surg* 1988;23:319-22.
5. Fonkalsrud EW, Beanes S. Surgical management of pectus carinatum: 30 years experience. *World J Surg* 2001;25:898-903.
6. Pena A, Perez L, Nurka S, Dorenbaum D. Pectus carinatum and pectus excavatum: are they the same disease? *Am Surg* 1981;47:215–8
7. Fonkalsrud EW, Anselmo DM. Less extensive techniques for repair of pectus carinatum: the undertreated chest deformity. *J Am Coll Surg* 2004;198:898-905
8. Calkins CM, Shew SB, Sharp RJ, et al. Management of postoperative infections after the minimally invasive pectus repair. *J Pediatr Surg* 2005;40:1004-8.
9. Abramson H. A minimally invasive technique to repair pectus carinatum. Preliminary report. *Arch Bronconeumol* 2005;41:349-51.
10. Ravitch MM. The operative correction of pectus carinatum (pigeon breast). *Ann Surg* 1960;151:705-14.
11. Abramson H, D'Agostino J, Wuscovi S. A 5-year experience with a minimally invasive technique for pectus carinatum repair. *J Pediatr Surg* 2009;44:118-23.