

# Minimal Invasive Surgery for Pediatric Thoracic Pathologies

## Pediyatrik Toraks Patolojilerinde Minimal İnvaziv Cerrahi

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### ABSTRACT

**Objective:** The purpose of this study was to discuss minimal invasive surgical options for surgical thoracic pathologies in the pediatric age group.

**Material and Methods:** A retrospective analysis was performed for 45 patients who had undergone thoracoscopic surgery by a single surgeon. The underlying pathologies, surgical procedures and anesthetic aspects and postoperative outcomes were analyzed.

**Results:** Forty-five children underwent thoracoscopic surgery in a ten-year period. The conditions requiring thoracoscopic surgery were congenital diaphragmatic hernia (CDH), esophageal atresia (EA), congenital malformations, pulmonary and mediastinal masses, empyema, spontaneous pneumothorax, and interstitial lung diseases. There were 21 girls and 24 boys. The mean age of the children except the CDH and EA cases was 4.5 years (n=33, 2 months to 17 years). The mean age of the children with CDH and EA was 5.5 days (n=12, 1 day to 8 months). There were 6 conversions in total. The mean chest tube removal time was 6 days (1-24 days). The mean hospital stay was 9 days (3-34 days).

**Conclusion:** Thoracoscopy in the pediatric age group is safe and feasible in experienced hands. Each child and condition should be evaluated individually to avoid complications.

**Key Words:** Congenital lung malformations, Lobectomy, Minimal invasive lung surgery, Thoracoscopy

### ÖZ

**Amaç:** Çalışmanın amacı pediyatrik yaş gruplarında cerrahi toraksik patolojilerde minimal invaziv cerrahi seçenekleri göstermektir.

**Gereç ve Yöntemler:** Tek cerrah tarafından torakoskopik ameliyat edilen 45 hasta retrospektif incelendi. Altta yatan cerrahi patolojiler, cerrahi yaklaşım ve anestezi bakış açıları ve postoperatif sonuçlar analiz edildi.

**Bulgular:** On yıllık periyotta 45 çocuğa torakoskopik cerrahi yöntem uygulandı. Torakoskopik cerrahi yaklaşım, Konjenital Diyafragma Hernisi (KDH), Özofagus Atrezisi (ÖA), Konjenital Malformasyonlar, Pulmoner ve Mediastinal Kitleler, Ampiyem, Spontan Pnomotoraks ve İntertisyal Akciğer Hastalık tanısı olan hastalara uygulandı. Hastaların 21'i kız, 24'ü erkek cinsiyetteydi. KDH ve ÖA dışındaki çocukların ortalama yaşı 4,5 yaş'tır (n=33, 2ay-17yaş). KDH ve ÖA'li çocukların ortalama yaşı 5,5 gün'dür (n=12, 1gün- 8ay). Toplam 6 hastada açığa dönüldü. Ortalama göğüs tüpü çıkarılma süresi 6 gündür (1-24 gün). Hastanede yatma süresi ortalama 9 gündür (3-34 gün).

**Sonuç:** Torakoskopi, çocuk yaş grubunda deneyimli ellerde uygulanabilir ve güvenli bir yaklaşımdır. Komplikasyonları önlemek için her çocuk ayrı ayrı değerlendirilmelidir.

**Anahtar Sözcükler:** Konjenital Akciğer malformasyonları, Lobektomi, Minimal invaziv akciğer yaklaşımı, Torakoskopi

### INTRODUCTION

Thoracic pathologies in the pediatric age group have a wide range of presentation and prognosis. In this study, thoracic pathologies of children were evaluated from a surgical aspect.

Minimal invasive surgery has become the gold standard for many conditions in the last few decades (1). It is increasingly being performed due to its advantages over conventional surgery such as less blood loss, less tissue trauma, decreased

need for painkillers, shorter hospital stay, better cosmetic results and faster recovery (2). Success rates and safety of the procedures are correlated with the development of new devices, surgeons' learning curves, and anesthesia management (3). Thoracoscopic procedures have therefore replaced conventional thoracotomy for many diseases in the pediatric population. On the other hand, debates continue regarding some other disorders.

The purpose of this study was to discuss minimal invasive surgical options for surgical thoracic pathologies in the pediatric age group.

## MATERIAL and METHODS

A retrospective analysis of 45 patients who had undergone thoracoscopic surgery by single surgeon was performed. The underlying pathologies, surgical procedures and postoperative outcomes were analyzed. After a short overview, each condition was evaluated separately to determine individual advantages, difficulties and pitfalls.

## RESULTS

Forty-five children underwent thoracoscopic surgery in a ten-year period. The conditions requiring thoracoscopic surgery were congenital diaphragmatic hernia (CDH), esophageal atresia (EA), congenital malformations, pulmonary and mediastinal masses, empyema, spontaneous pneumothorax, and interstitial lung diseases. There were 21 girls and 24 boys. The mean age of the children except CDH and EA was 4.5 years (n=33, 2 months to 17 years). The mean age of the children with CDH and EA was 5.5 days (n=12, 1 day to 8 months). There were 6 conversions in total. The mean chest tube removal time was 6 days (1-24 days). The mean hospital stay was 9 days (3-34 days) (Table I).

## DISCUSSION

A thoracoscopic approach for selected cases is technically feasible and safe in children and infants under adequate conditions. As in all surgical procedures, the endoscopic approach to the thoracic cavity has its own advantages. On the other hand, each condition has individual pitfalls.

In general, thoracoscopic procedures have the following advantages over thoracotomy: less postoperative pain, early removal of chest drain, better cosmetic outcome, reduced wound infections and wound dehiscence which lead to a shorter hospital stay, and absence of thoracotomy specific complications such as shoulder girdle weakness and severe scoliosis (1). Despite these attractive benefits, a technically

demanding operation, small working area, and anesthesia worries in pediatric patients due to the difficulty of single lung ventilation make surgeons think twice before thoracoscopic surgery (4, 5).

Thoracic empyema, pleural effusion, spontaneous pneumothorax, and lung biopsy are indications of VATS. Early intervention for such conditions with parenteral antibiotic support has especially great benefits without much surgical trauma (4). Therefore, a major surgical procedure like thoracotomy can be avoided. Since 2006, all procedures for these conditions were performed thoracoscopically and there was no perioperative complication or conversion.

Maintaining successful single-lung ventilation in children is often difficult and the relatively small thoracic cavities and narrow intercostal spaces of children make it difficult to apply large-sized conventional endoscopic surgical devices that are designed for adult patients (6).

All procedures cannot be performed as easily as the ones above. Congenital cystic adenomatoid malformations, bronchopulmonary sequestration, bronchogenic cysts and congenital lobar emphysema are common pathologies that require surgical intervention in infantile age. Eight children with these conditions were treated with thoracoscopy without complications. Wedge resection or lobectomy is recommended at 6-12 months (7). The main surgical indications for these diseases are malignancy potential and recurrent respiratory tract infections. Lung-sparing surgery is especially important for reducing the surgical risks for these patients and it can be managed thoracoscopically (8).

Thoracoscopic excision of neuroblastoma and lymphoma is associated with shorter chest tube removal time, less blood loss, shorter operative time, shorter length of stay, smaller incisions, improved visualization, decreased pulmonary adhesions, decreased postoperative atelectasis, improved perception of body image, and earlier chemotherapy starting time. Limitations also exist when it comes to thoracoscopy. Tumors that are located deeply in the lung tissue are very difficult to reach. The size of the lesion, inability of single lung ventilation and the patients' general condition are among the potential difficulties. Thoracoscopy is a better choice in suitable cases as regards perioperative outcomes, body image, and chemotherapy starting time (9). In our study, conversion was performed in one of the cases due to the difficult dissection and no complication was encountered.

Congenital diaphragmatic hernia repair in newborns is still controversial among pediatric surgeons. The concern in thoracoscopic repair is hypercapnia and acidosis. Multiple studies have also shown a higher recurrence rate associated with thoracoscopic repair due to the learning curve, limited workspace and limited use of the patch as it is, in the current study (10). After three recurrences out of seven thoracoscopic hernia repairs in the current study, the thoracoscopic approach

was abandoned. Hospital stay time is also longer in the open group (11). For these reasons, the candidates for thoracoscopic surgery have to be chosen carefully. Thoracoscopic surgery can be thought as safe if the stomach and the liver are in the abdomen and the patient does not have pulmonary hypertension (12).

The thoracoscopic approach is beneficial and difficult in esophageal atresia. Inside the thoracic cavity, thoracoscopy requires a superior visualization of anatomy. However, esophageal atresia is definitely the most demanding thoracoscopic procedure in pediatric surgery. The anesthesia part of the procedure is also another limitation. Single lung ventilation is not likely possible in newborn patients and minimal interventions to trachea during surgery can cause major airway problems. The modified prone position is known as a beneficial position for anesthesia and the surgeon. However, the total prone position makes a real difference for maintaining a safer airway in newborns in our practice. It also makes the exposure better in the thoracic cavity (13). Even though conversion was performed in two out of five cases in the experience of the clinic, the thoracoscopic approach is thought to be more advantageous by many and should be attempted in every suitable case to reduce perioperative complications.

With recent advantages in endoscopic instruments and operative techniques, more technically demanding procedures such as thoracoscopic lobectomy are now safe and feasible. The advantages of thoracoscopic procedures over open thoracotomy include less postoperative pain, early removal of chest drain, shorter hospital stay and better cosmetic outcome. In addition, the thoracoscopic approach can reduce the incidence of musculoskeletal complications such as scoliosis and chest wall deformities seen in conventional surgery (14).

Prolonged chest tube removal times may be explained with the underlying disorder of the children. For example, it was necessary to keep the chest tube for 24 days in a child with interstitial lung disease, due to the malfunction of the normal lung tissue. The tubes also stayed longer in children with esophageal atresia and pulmonary mass because of esophageal leakage and intrathoracic chemotherapy, respectively. Such long tube durations are because of underlying pathologies, not technical issues, and may also be seen in open surgery.

In conclusion, thoracoscopy in the pediatric age group is safe and feasible in experienced hands. Preoperative imaging results and the general condition of the child should be evaluated by both pediatricians and pediatric surgeons, and surgical plans should be made carefully. In the operation room, conversion should be considered if necessary and not delayed. Each child and condition should be evaluated individually to avoid complications.

**Table 1:** Patients' detailed data.

Condition	n	Median Age	Surgical Technique	Operation Time	Conversion	Complication	Chest tube removal	Length of hospital stay
<b>Congenital Pulmonary Malformations</b>	8	3m (2m-4y)	Thoracoscopy	60min (45min-70min)	3	-	2.3d (2d-4d)	3.8d (3d-6d)
<b>Empyema, Pleural Effusion</b>	5	14y (2y-17y)	Thoracoscopy	60min (40min-70min)	-	1 patient has a solid lesion	8.6d (2d-15d)	10.8d (3d-23d)
<b>Interstitial Lung Disease</b>	4	14m (2m-10y)	Thoracoscopy	45min (30min-60min)	-	-	12.3d (2d-24d)	14.6d (3d-30d)
<b>Spontaneous Pneumothorax</b>	2	15y (15y)	Thoracoscopy	50min (40min-60min)	-	Relapse	9d (3d-15d)	10.5d (6d-15d)
<b>Esophageal Atresia</b>	5	10d (1d-8m)	Thoracoscopy	180min (140min-210min)	2	-	12.2d (5d-14d)	14d (10d-23d)
<b>Diaphragmatic Hernia</b>	7	1d (1d-3m)	Thoracoscopy	150min (100min-190min)	-	Relapse 3 patients	2.1d (2d-5d)	11.1d (5d-34d)
<b>Pulmonary Mass</b>	14	5y (2m-17y)	Thoracoscopy	180min (160min-190min)	1	Relapse 2 patients	5d (1d-13d)	8d (3-17d)

**D:** days, **M:** months, **Y:** years.

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