Abstract
Esophageal duplications and bronchogenic cysts are aberrations of primitive foregut development. Duplications can be found along the entire length of the esophagus with varying presentation depending on its location and pressure effects on neighboring structures. Although duplications can remain asymptomatic, they may get discovered incidentally during unrelated investigations. The complicated duplications can present with life-threatening symptoms.

Differential diagnosis of posterior mediastinal rounded opacity on radiological investigation should include esophageal duplication cyst. Investigations such as an upper gastrointestinal contrast study and computed tomography of the chest are not diagnostic but can suggest duplication cyst. Once identified and investigated, the duplications should be resected.

Thoracoscopic surgery is recommended for resection of all uncomplicated and some complicated cysts. Thoracoscopic surgery reduces the hospital stay, postoperative analgesia requirement, and morbidity compared to open surgery. Although thoracotomy can achieve resection, it should be reserved for the complicated cysts. The outcome after complete resection is excellent. Surgical complications can be avoided by optical magnification and careful dissection close to the cyst. Incomplete resection results in recurrence. Surgical complications are related to inadvertent accidental injury to the surrounding vessels, nerves, thoracic duct, esophagus, and neighboring trachea. This chapter attempts to give an overview of the esophageal duplication and its current management.

Keywords
Esophageal duplications • Mediastinal cysts • Thoracoscopic surgery • Neuroenteric cyst

Contents
Introduction ............................................ 2
Embryology ............................................ 2
Relevant Anatomy ..................................... 3
Pathology ............................................. 3
Clinical Features and Presentation .......... 3
Antenatal ............................................. 3
Incidental ........................................... 5
Symptomatic ......................................... 5
Malignancy ........................................... 6
Investigations ....................................... 6
Introduction

Esophageal duplications and bronchogenic cysts come under the spectrum of foregut duplications, as both take their origins from the primitive foregut (Ponsky and Rothenberg 2009). Esophageal duplications account for up to 20% of benign esophageal lesions and may be associated with other duplications of the intestinal tract and vertebral anomalies (Stringer et al. 1995). Furthermore, one in five cases of alimentary tract duplications is esophageal in origin (Holcomb et al. 1989; Beardmore and Wiglesworth 1958). Esophageal duplications are situated close to and in contact with the esophagus but rarely communicate with it. They are generally isolated congenital malformations in the posterior mediastinum and are occasionally seen with esophageal atresia (Hemalatha et al. 1980; Snyder et al. 1996). Esophageal duplications seen in association with cysts within the vertebral column are called Neuroenteric cysts.

Esophageal duplication cysts were first described by Blasius in 1711. They were further defined by Roth in 1881 who described esophageal duplications as a simple epithelial lined cysts and cysts covered by muscle coat. Often asymptomatic in nature, their true incidence is difficult to establish but is estimated at a frequency of 1:8200 from autopsy studies (Arbona et al. 1984).

Embryology

During week 4 of gestation, the primitive gut develops an anterior diverticulum which eventually becomes the trachea and respiratory system. At the same time, a posterior bud appears which goes on to become the esophagus. With time, these two systems are separated by the tracheoesophageal septum. As development continues, epithelium obliterates the esophagus before it re-cannulizes. Simple cysts are duplications of the epithelium alone. Several embryological theories have attempted to explain the origins of mediastinal duplications. The esophageal duplication cysts may develop from an accessory diverticulum that may or may not communicate with the esophageal lumen or the failure of appropriate canalization of the gastrointestinal tract. Though these theories may be attractive, neither is able to explain the entity known as Neuroenteric cysts where there is associated vertebral anomaly and a connection between esophageal duplication cysts and cyst within the spinal canal. The split notochord theory attempts to address this by describing a time in embryogenesis where there is persistence of endodermal-ectodermal tract leading to an endomesenchymal tract between amnion and yolk sac (Veeneklass 1952). The postulation in this theory is an incomplete separation of the notochord from the endoderm, and the traction from the developing primitive gut forms a tract between the vertebral column and the duplication. This is described as Neuroenteric cyst. During development, the communication may be lost developing into two distinct cysts: one inside the vertebral column and one close to the alimentary tract. Those cysts not associated with vertebral column anomalies or cysts within the vertebral column may arise during separation of primitive foregut and may give rise to both simple esophageal duplications and bronchogenic
cysts. These can explain a variety of epithelia observed during histological examination.

**Relevant Anatomy**

Esophageal duplication cysts can occur anywhere along the length of the esophagus but most commonly occur in the lower esophagus (66%). In the superior mediastinum, duplications can be found on either side of esophagus or in between the trachea and the esophagus. Distally the duplications are situated in the posterior mediastinum and mainly on the right side. They therefore lie in close proximity to the vagus and phrenic nerves, thoracic duct, trachea, and pulmonary vessels. Neuroenteric cysts are associated with vertebral anomalies, in particular hemivertebra, cranial to its location in the mediastinum. The intravertebral and esophageal components may or may not communicate with each other. The recurrent laryngeal nerve should be identified and preserved in cases of an esophageal cyst in the upper and cervical esophagus.

**Pathology**

Esophageal duplication cysts are described as being Neuroenteric, cystic, or tubular. They are either encased with a thin layer of muscle or embedded within the esophageal wall itself (Snyder et al. 1996). Esophageal duplications usually replicate histology of the gastrointestinal tract with two layers of muscularis surrounding the luminal epithelial lining and enteric nervous system but do not contain cartilage (Whitaker et al. 1980). Esophageal duplication endothelial lining can be either squamous, gastric, pseudostratified, cuboidal, columnar, ciliated respiratory, pancreatic, or mixed epithelial. The presence of cartilage within its wall indicates bronchogenic origin. Cysts contain either clear mucoid or brown or blood-stained serous fluid. The spinal component of a Neuroenteric cyst has a thin fibrous wall and is lined by single cuboidal layer or pseudostratified epithelium.

Sudden increase in cyst size may occur related to intraluminal bleeding by eroding peptic ulcers related to heterotopic gastric mucosa or infection. These complications can cause retrosternal pain. Erosion or fistulation into the tracheobronchial tree or esophagus can be life-threatening and may present as recurrent pneumonia or hemoptysis (Rhaney and Barclay 1959; Parikh and Samuel 2005). Malignant transformation has been reported in the esophageal duplications as either well-differentiated adenocarcinoma or as squamous cell carcinoma arising in the cyst. The malignant change is rare (Olsen et al. 1991; Chuang et al. 1981; Tapia and White 1985).

Esophageal duplications occasionally share a common muscular wall with the native esophagus. Rarely duplications may be tubular along the entire length of the esophagus and have abdominal extension with duplication of the stomach (Cocker et al. 2006; Shepherd 1965).

**Clinical Features and Presentation**

Esophageal duplications may remain asymptomatic and present as an incidental finding. Symptoms are known to develop once secretions accumulate within its cavity thus producing a pressure effect on the surrounding organs and esophagus. A sudden increase in the size of the esophageal cyst either as a result of infection or intra-cystic hemorrhage, perforation results in its acute presentation (Nakhara et al. 1990).

Routine antenatal scans detect with increasing accuracy intrathoracic cystic lesions. The postnatal investigation may distinguish some to be duplications or Neuroenteric cyst.

**Antenatal**

Parikh and Singh describe up to 5% of antenatally diagnosed cystic thoracic lesions as being
Fig. 1 (a) Antenatal MRI scan: Antenatal US and subsequent MRI showed a tubular paraspinal cystic mass with vertebral anomaly (arrow). Antenatal scan also showed intraspinal component of Neuroenteric cyst. (b) Postnatal MRI scan confirmed the diagnosis (Acknowledgment for Copyright permission: Parikh D, Singh M. Esophageal Duplication Cysts in Prem Puri (ed) Newborn Surgery 3rd Edition; Hodder Arnold 2011; 406–412. Fig. 41.1)

Fig. 2 (a) A 12-year-old child with blunt chest trauma: (arrow) on chest AP and lateral x-ray showing rounded posterior mediastinal opacity. There were no symptoms related to this esophageal duplication. (b) Contrast study and CT and subsequent thoracoscopic resection confirmed esophageal duplication
esophageal duplication cysts, with sudden infant death being reported in those cysts in close proximity of tracheobronchial tree (Parikh and Singh 2011; Fig. 1a, b).

**Incidental**

A large number of cysts are asymptomatic from birth. Radiological investigations for unrelated symptoms or blunt chest trauma may therefore reveal a previously unknown duplication cyst (Fig. 2a, b).

**Symptomatic**

Symptoms are related to pressure effect from an enlarged esophageal cyst against visceral mediastinum causing stridor, breathlessness, wheezing, lobe. Thoracoscopic esophageal duplication was carried out. (c) An infant presented with recurrent infections; chest x-ray showed emphysematous right upper lobe. (d) CT scan showed duplication cyst compressing right upper lobe bronchus causing emphysema.

---

![Fig. 3](image-url) : Esophageal duplications presented with complication. (a) A 10-year-old girl presented acutely with hematemesis requiring blood transfusion. Chest x-ray showed a cavitatory lesion on the right side. (b) CT scan showed a cavitatory lesion with fluid levels in posterior mediastinum with collapse consolidation of the right lower lobe. Thoracoscopic esophageal duplication was carried out. (c) An infant presented with recurrent infections; chest x-ray showed emphysematous right upper lobe. (d) CT scan showed duplication cyst compressing right upper lobe bronchus causing emphysema.
or dysphagia (Kawashima et al. 2016). Anemia in 10 of 25 cases, melena in 8/25, vomiting in 8/25, pain in 5/25, and failure to thrive in 4/25 patients were observed by Pokorny and Goldstein 1984. Younger infants are more likely to present with respiratory symptoms. The gastric epithelium may cause peptic ulceration, intra-cystic hemorrhage, and fistulation into the tracheobronchial tree resulting in hemoptysis and pneumonia (Fig. 3a, b). Fistulation into the esophageal lumen leads to hematemesis and melena. The Neuroenteric cysts with an intravertebral component may present with meningitis or neurological symptoms (Piramoon and Abbassioun 1974).

Malignancy

Adenocarcinoma and squamous cell carcinoma have both been described in adults arising from esophageal duplication cysts (Olsen et al. 1991; Chuang et al. 1981; Tapia and White 1985).

Investigations

The order of the radiological imaging is generally guided by the clinical suspicion and presenting symptoms. Antenatally detected cystic lesions should undergo a CT scan of the chest with

Fig. 4 (a) Intra-abdominal duplication near gastroesophageal junction discovered after a routine ultrasound of abdomen in a child with thoracic esophageal duplication. (b) Contrast study showing a filling defect near the fundus of the stomach (arrow). (c) CT scan confirmed a cyst at gastroesophageal junction (arrow). (d) Laparoscopic view of the duplication near gastroesophageal junction (arrow) resected successfully.
intravenous contrast. If the postnatal CT identifies a posterior mediastinal cyst/ duplication in the chest, an additional abdominal ultrasound, although not specific, may help diagnose associated other gastrointestinal duplications (Fig. 4a).

**Chest X-ray** A well-circumscribed or a tubular smooth shadow/opacity may suggest a mediastinal mass. Recurrent infections from a communicating cyst to either tracheobronchial tree or esophagus may show as a cavitatory lesion or pneumonic shadow in the lung (Fig. 3a). Partial compression of bronchus may result in emphysema of the lobe or a tracheal narrowing (Fig. 3c). Chronic compression may result in recurrent infection of the lobe and bronchiectasis seen as chronic collapse.

**Contrast Swallow** A focal smooth compression or displacement may be visible in association with the contrast passing through the esophagus (Fig. 5a–c). Occasionally displacement of esophagus is seen by a posterior mediastinal space occupying lesion. Contrast studies cannot differentiate between the type of lesion causing the external compression and an intramural lesion. Thinly lined contrast on the compressing lesion side (Fig. 5c) may suggest a common mucosal wall and should warn operator to be vigilant as during surgery as it may result in esophageal mucosal injury and leak after resection.

**Computed Tomography of the Chest with Intravenous (IV) Contrast** If an intrathoracic mass is suspected from preliminary investigations or presenting symptoms, a CT scan is indicated. This will allow the definition, location, and relationship of the mass to be identified, which is important for the surgeon before resection (Figs. 3b, d and 6).
Duplication cysts on CT scan show as homogeneous, smooth bordered, and of low attenuation. In adults, a necrotic paraesophageal posterior mediastinal mass or an abscess is difficult to differentiate by the CT scan alone.

MRI Scan Some radiologists recommend MRI to better delineate posterior mediastinal soft tissue masses. MRI showing low T1- and T2-weighted images of the wall and high-intensity T1-weighted images of the contents of the paraesophageal soft tissue mass as cyst in nature. The only drawback of MRI is the need for sedation or general anesthesia in infants and children. It is, however, vital if a Neuroenteric cyst is suspected to define the spinal component (Fig. 1b).

Endoscopy Flexible endoscopy is not routinely indicated for the diagnosis of the esophageal duplication cysts. Endoscopy carried out while investigating dysphagia may demonstrate external compression; however, intramural swelling such as leiomyoma may be seen causing obstruction. Intraoperative endoscopy, while performing resection aids complete resection, helps reduce esophageal mucosal injury and diagnose accidental mucosal injury.
**Transesophageal ultrasound** can diagnose duplication cysts in adults as compressing cystic lesion containing echogenic material. This investigation is generally not indicated in children.

**Management**

Esophageal duplications should be resected in symptomatic patients and also in asymptomatic cases to prevent potential life-threatening complications (Holcomb et al. 1989; Dresler et al. 1990; Benedict et al. 2016). Although malignancy is rare, its late presentation causes a significant diagnostic dilemma in adults. Once the diagnosis has been made and location confirmed, complete excision should be undertaken as incomplete resection results in its recurrence. Operative resection can be open or thoracoscopic depending on position of cyst and surgical expertise.

Antenatally diagnosed as well as symptomatic cases in most instances are suitable for thoracoscopic resection with the exception of infected cases with fistulations. Thoracoscopic resection is gaining popularity and has the advantage of less time for recovery and hospital stay, reduced requirement for chest tube drainage, opioid analgesia, and less disfiguring than open operations (Michel et al. 1998; Bratu et al. 2005; Merry et al. 1999).

Two types of esophageal duplications can be encountered; both require slightly different technique during resection. The esophageal duplication with its own separate muscle wall attached with the native esophagus with loose connective tissue. A second variety is rare but may pose a surgical challenge during its resection. This duplication on the side of the native esophagus is not covered by the muscle coat and attached to each other by their mucosa.

Thoracoscopic approach is ideally suited for the resection of esophageal duplications as it is associated with low morbidities (Bratu et al. 2005; Merry et al. 1999). Many including our center have stopped placing a postoperative chest drain in uncomplicated resections. Infradiaphragmatic duplications are resected laparoscopically.

Thoracotomy is advised for complicated duplications involving fistulation into the tracheobronchial tree. Previous inadequate resection with recurrence may require an open approach for a complete resection. Cervical duplication will require a cervical incision for its resection.

**Thoracoscopic Surgery**

Thoracoscopy is carried out with 3 or 5 mm instruments under general anesthesia in a lateral position. Central endotracheal intubation is used in most cases with the exception of older children where single lung anesthesia is possible. Bronchial blockers are rarely necessary in younger children to allow single lung ventilation. The first port is generally placed in the mid-axillary line followed by two or three other ports under thoracoscopic vision for the best possible manipulation. Resection in infants can easily be carried out using 3 mm instruments. The carbon dioxide is set at a pressure of 5–7 mmHg and insufflated at flow rates of 1.5 L/min to collapse the ipsilateral lung and expose the posterior mediastinal cyst. Thoracoscopic surgery in complicated cysts can be performed but requires expertise, experience, and advanced skills (Sundararajan and Parikh 2007; Partrick and Rothenberg 2001).

**Thoracotomy**

Open operations are indicated for recurrence and infected cysts. Lateral thoracotomy, preferably muscle sparing through the bed of the fifth or sixth rib, is ideally suited for an open approach. Adhesions, either inflammatory or from previous attempted resections, may cause difficulty during dissection and bleeding. The posterior mediastinum and duplication cyst is exposed by dissecting lung parenchyma and retracting it anteriorly. Meticulous dissection of lung parenchyma from adhesions avoids bleeding and air leaks.
Complicated duplications can cause particular difficulty while dissecting from the surrounding normal structures. The infective fistula between the tracheobronchial tree and the cyst should be dissected out and sutured securely. A test for air leak should be performed after closure of the fistula. Surgery for infected esophageal cysts is associated with more postoperative morbidity and often requires placement of chest drains. Phrenic nerve injury with eventration of the diaphragm, chylothorax, Horner’s syndrome, and esophageal leak are notable complications.

**Surgical Management of Various Types of Esophageal Duplication Cysts**

**Cervical and Suprasternal Cyst**

Duplication cysts within the superior mediastinum may appear in the suprasternal or anterior triangle of the neck, particularly when the child cries. Cervical esophageal duplications are rare but are encountered (Fig. 6a). These are within the deep cervical fascia adjacent to the esophagus and cause compression on the trachea and esophagus. These are invariably symptomatic with visible neck swelling, significant stridor, and dysphagia. Cervical excision is achieved in supine position with neck extension. The carotid and internal jugular and sternomastoid muscle are retracted laterally. The surface of the esophageal duplication cyst is reached and dissection is continued, staying close to its surface. The recurrent laryngeal nerve in particular is at risk of injury as it travels along the tracheoesophageal groove. The recurrent laryngeal nerve is known to travel on the surface of the esophageal duplication. The nerve should be carefully dissected off the duplication and preserved. The cervical incision is then closed keeping a small suction drain in the space, in layers. The drain is kept for approximately 48 h or until drainage stops. Postoperative analgesia can be achieved by local anesthetic infiltration in the wound and if necessary narcotic and anti-inflammatory medications. Invariably patient can be discharged on day 3 after surgery.

**Left-Sided Thoracic Inlet Duplication Cyst**

Surgery of a cyst in this area is challenging because of its location in the superior mediastinum in close proximity to major vessels (left subclavian, carotid, arch of the aorta, and left pulmonary artery), the phrenic and left recurrent laryngeal nerves, and the thoracic duct. The cyst in this position causes pressure symptoms, namely, stridor, breathlessness on exertion, wheezing, and dysphagia (Figs. 5b and 6a). Thoracoscopic dissection is carried out by identifying and protecting vital structures, dividing the overlying parietal pleura, and exposing the left lateral cyst wall. The dissection is gradually carried out staying close to the cyst wall under thoracoscopic vision. The dissection may require sharp and electrocoagulation. The vessels and nerves are protected during dissection. Care should be taken while dissecting the cyst from the esophagus. If they share a common wall, the native esophagus and its mucosa should be protected. Diathermy should be used sparingly as its excessive use may cause conduction or thermal injury to the nerves.

Hemostasis is checked, and carbon dioxide is evacuated from the thoracic cavity after removal of the cyst from one of the port sites. In most instances, postoperative chest drain placement is not required. The child is allowed to feed and analgesia is administered as required. An erect chest x-ray is usually performed the following day to confirm full expansion of the lung and no collection within the pleural cavity. A residual postoperative pneumothorax generally gets reabsorbed spontaneously and does not require drainage. A fluid collection may indicate chylothorax, blood, or leaking saliva. If the child is symptomatic from increasing pleural fluid accumulation, intervention and investigation are required to identify the cause. Chest x-ray also delineates the position of the left diaphragm as eventration would suggest left phrenic nerve injury.

**Right-Sided Thoracic Duplication Cyst**

A right-sided thoracic cyst can be at the apex, near the carina, or inferior to carina (Figs. 3c, d, 5a, c,
and 6b–d). Depending on its position, it may cause symptoms and complications. The posterior mediastinal pleura near the cyst is incised either with scissors or a diathermy hook. The separation of the duplication with the esophagus can easily be carried out by either diathermy scissors or ultrasonic harmonic device. Care should be taken during dissection, and structures such as the vagus nerve, azygous vein, and trachea should be protected. The right inferior pulmonary vein, thoracic duct, and azygous vein are at the risk of injury during right-sided lower esophageal duplications.

Intraoperative endoscopy during resection is advisable and may help avoid inadvertent resection of mucosa and the wall of the native esophagus. The duplication cyst should be resected completely preferably keeping the native esophageal mucosa intact. Leaving the duplication cyst mucosa usually results in recurrence. The esophageal muscle after resection of the cyst is sutured with absorbable sutures. Injury to esophageal mucosa can be detected by an intraoperative endoscopy, by keeping saline in the thoracic cavity and blowing air through an endoscope. The specimen is decompressed by aspiration and delivered by expanding one of the anterior ports.

Most esophageal duplications following resection do not require postoperative chest drains. A chest drain is placed only if the esophageal mucosa is breached during the resection (Piramoon and Abbassioun 1974). Postoperative pain is managed by intravenous paracetamol and oral anti-inflammatory drugs. The majority of thoracoscopically resected cases can be discharged the following day after a normal chest x ray.

**Intra-abdominal Esophageal Duplication Cyst**

Intra-abdominal infradiaphragmatic esophageal duplication lying near the gastroesophageal junction can cause dysphagia and invariably contain heterotopic gastric mucosa. The cyst may lie posterior to the esophagus and stomach and can be difficult to separate from the gastroesophageal junction (Fig. 4a–d). The continuation of an intrathoracic duplication’s tail is found located on the right side and parallel to the esophagus and seen coming out of the diaphragmatic crus. This cyst can be dissected laparoscopically using a similar principle to the one described above. A separate intra-abdominal cyst is successfully resected either at the same sitting or at a subsequent laparoscopic resection (Dresler et al. 1990).

**Neuroenteric Cyst**

Neuroenteric cysts are associated with vertebral anomalies (Figs. 1b and 6d) and may or may not communicate with the intraspinal component. These cysts are ideally investigated by MRI scan (Fig. 1b). The esophageal component can be resected thoracoscopically as described above. The communication entering in through the spinal foramina can be ligated at its entrance into the spinal canal. The intraspinal component can either be resected at the same time or subsequently by posterior laminectomy. Rarely anterior spinal approach is required for its resection. Infected intraspinal components are difficult to resect, and at times the wall of the cyst left behind in fear of damaging the spinal cord inevitably results in recurrence. Specific complications are related to incomplete resection and neuronal injury during resection. Late sequel of scoliosis is related to vertebral column anomaly.

**Surgical Complications**

Postoperative-specific morbidities are secondary to esophageal cyst location and surgical approach:

1. Recurrence is inevitable after an incomplete resection. Often, there is the need for further surgery.
2. Unrecognized injury to the native esophagus may occur following either an open or thoracoscopic surgery. This often occurs following the repair of an esophagus after the resection of an esophageal duplication sharing a common wall. An unrecognized leak can result in a postoperative pyrexia, mediastinitis, and/or
empyema. A minor leak can be managed conservatively with a period of parenteral nutrition, antibiotics, and chest drainage. However, significant esophageal injury resulting in significant leak will result in significant infection and will require thoracotomy, esophageal repair, and chest drainage (Michel et al. 1998; Bratu et al. 2005). Esophageal injury in most instances results in stricture formation that may respond to dilation. Late esophageal pseudo-diverticulums can be a consequence of inappropriate esophageal repair and incoordination (Parikh and Singh 2011). Rarely motility disorder of the esophagus and swallowing difficulties are noted in some cases after resection and improve with time. After resection of a cervical duplication, a pharyngeal pouch can be a long-term consequence as a result of tight cricopharyngeus (Fig. 7a).

3. Tracheobronchial injury results in a persistent air leak and continuous postoperative bubbling through intercostal drains. This invariably will require thoracotomy and formal repair of the bronchus or trachea (Bratu et al. 2005). Complicated esophageal duplications are more likely to cause postoperative air leak either from lung parenchyma or from a tracheobronchial injury.

4. Postoperative bleeding is generally anticipated in complicated cysts from the dissection of vascular adhesions or from the lung parenchyma. In cases when postoperative chest blood drainage is excessive and continuous, emergency thoracotomy may identify a source of bleeding and achieve hemostasis. A retrospective series recorded two deaths related to exsanguinating bleeding and related to bleeding from a gastric epithelial-lined cyst bleeding into the esophagus. Two other postoperative deaths have been accounted secondary to septic complications, one from an esophageal leak and the other from an intraparenchymal abscess.

5. Injury to the vagus nerve, recurrent laryngeal nerve, and phrenic nerve in the cervical and the left apical duplication can be avoided by careful dissection and staying close to the cyst wall. Judicious use of the monopolar diathermy...
during dissection is recommended. Hemorrhage should be controlled with the use of a bipolar diathermy or LigaSure. There is a higher risk of major nerve or thoracic duct injury during surgery for an infected or recurrent cyst because of adhesions and bleeding (Fig. 7b).

Conclusions and Future Directions

Esophageal duplications, once identified, should be electively resected due to their potential to cause complications: related peptic ulcers from heterotopic gastric mucosa, bleeding, and perforation, pressure symptoms on airway causing stridor, and infection causing recurrent pneumonia and mediastinitis. Neuroenteric cysts may result in meningitis and spinal cord compression if left untreated, causing neurological deficit. There is also the potential long-term risk of malignancy. Thoracoscopic excision in an asymptomatic patient has a lower complication rate than surgery for a symptomatic cyst. Incomplete excision results in a recurrence and will require further surgery.

As minimally invasive technique becomes widely available and practiced in future, most surgeons will be able to offer thoracoscopic surgery to children presenting with esophageal duplication cyst.

Cross-References

- Duplications of the Alimentary Tract
- Embryology of Congenital Malformations
- Fetal Counseling for Congenital Malformations
- Prenatal Diagnosis of Congenital Malformations
- Principles of Minimal Invasive Surgery

References

Arbona JL, Fazzi JG, Mayoral J. Congenital esophageal cysts: case report and review of literature. Am J Gastroenterol. 1984;79:177–82.

Beardmore HE, Wiglesworth FW. Vertebral anomalies and alimentary duplications: clinical and embryological aspects. Pediatr Clin N Am. 1958;457–74.

Benedict LA, Bairdain S, Paulus JK, Jackson CC, Chen C, Kelleher C. Esophageal duplication cysts and closure of the muscle layer. J Surg Res. 2016;206(1):231–4.

Brau I, et al. Foregut duplications: is there an advantage to thoroscopic resection? J Pediatr Surg. 2005;40(1):138–41.

Carachi R, Azmy A. Foregut duplications. Pediatr Surg Int. 2002;18(5–6):371–4.

Chuang MT, Barba FA, Kaneko M, Trirstein AS. Adenocarcinoma arising in an intrathoracic duplication cyst of foregut origin. Cancer. 1981;47:1887.

Cocker DM, Parikh D, Brown R. Multiple antenatally diagnosed foregut duplication cysts excised and the value of thoracoscopy in diagnosing small concurrent cysts. Ann R Coll Surg Engl. 2006;88(6):8–10.

Dresler CM, Patterson GA, Taylor BR, Moote DJ. Complete foregut duplication. Ann Thorac Surg. 1990;50:306.

Hemalatha V, Betcup G, Breton RJ, Spitz L. Intrathoracic foregut cyst (foregut duplication) associated with esophageal atresia. J Pediatr Surg. 1980;15:17.

Holcomb III GW, Gheissari A, O’Neill JA. Surgical management of alimentary tract duplications. Ann Surg. 1989;209(2):167–74.

Kawashima S, Segawa O, Kimura S. A case of cervical esophageal duplication cyst in a newborn infant. Surg Case Rep. 2016;2(1):30.

Merry C, Spurbeck W, Lobe TE. Resection of foregut-derived duplications by minimal-access surgery. Pediatr Surg Int. 1999;15(3–4):224–6.

Michel JL, et al. Thoracoscopic treatment of mediastinal cysts in children. J Pediatr Surg. 1998;33(12):1745–8.

Nakhrara K, Fujii Y, Miyoshi S, et al. Acute symptoms due to huge duplication cysts ruptured into the esophagus. Ann Thorac Surg. 1990;50:309–11.

Olsen JW, Clemmensen O, Anderson K. Adenocarcinoma arising in a foregut cyst of the mediastinum. Ann Thorac Surg. 1996;51:497.

Parikh D, Samuel M. Congenital lung lesions: is surgical resection necessary. Pediatr Pulmonol. 2005;40:533–7.

Parikh D, Singh M. Esophageal duplication cysts. In: Puri P, editor. Newborn surgery, 3rd ed. Hodder Arnold; 2011. p. 406–12.

Partrick DA, Rothenberg SS. Thoracoscopic resection of mediastinal masses in infants and children: an evaluation of technique and results. J Pediatr Surg. 2001;36(8):1165–7.

Piramoon AM, Abbassioun K. Mediastinal enterogenic cyst with spinal cord compression. J Pediatr Surg. 1974;9:543.

Pokorny WJ, Goldstein IR. Enteric thoracoabdominal duplications in children. J Thorac Cardiovasc Surg. 1984;87:821.

Ponsky TA, Rothenberg SS. Foregut duplication cysts. In: Parikh DH, Crabbe DCG, Auldist AW, Rothenberg SS, editors. Pediatric thoracic surgery. London: Springer; 2009. p. 383–90.
Rhaney K, Barclay GPT. Enterogenous cysts and congenital diverticula of the alimentary canal with abnormalities of the vertebral column and spinal cord. J Pathol Bacteriol. 1959;77:457.

Shepherd MP. Thoracic, thoraco-abdominal and abdominal duplication. Thorax. 1965;20:82.

Snyder CL, Bickler SW, Gittes GK, Ramachandran V, Ashcraft KW. Esophageal duplication cyst with esophageal Web and tracheoesophageal fistula. J Pediatr Surg. 1996;31(7):968–9.

Stringer MD, et al. Management of alimentary tract duplication in children. Br J Surg. 1995;82(1):74–8.

Sundararajan L, Parikh DH. Evolving experience with video-assisted thoracic surgery in congenital cystic lung lesions in a British pediatric center. J Pediatr Surg. 2007;42(7):1243–50.

Tapia RH, White VA. Squamous cell carcinoma arising in a duplication cyst of the esophagus. Am J Gastroenterol. 1985;80(5):325–9.

Veeneklass GMH. Pathogenesis of intrathoracic gastrogenic cysts. Am J Dis Child. 1952;83:500.

Whitaker JA, Deffenbaugh LD, Cooke AR. Esophageal duplication cyst. Am J Gastroenterol. 1980;73:329.