Clinical Spectrum of Mediastinal Cysts

Shin-ichi Takeda, Shinichiro Miyoshi, Masato Minami, Mitsunori Ohta, Akira Masaoka and Hikaru Matsuda

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Clinical Spectrum of Mediastinal Cysts*

Shin-ichi Takeda, MD, PhD, FCCP; Shinichiro Miyoshi, MD; Masato Minami, MD; Mitsunori Ohta, MD; Akira Masaoka, MD; and Hikaru Matsuda, MD

Objectives: **Congenital cysts of the mediastinum are an uncommon but important diagnostic group, representing 12 to 30% of all mediastinal masses. The purpose of this study was to review our institutional experience with congenital cysts of the mediastinum, emphasizing the clinical spectrum of the disease.**
Design: **Retrospective study.**
Objectives: **University hospital unit of general thoracic surgery.**
Methods: **We retrospectively reviewed the records of 105 patients with cysts of the mediastinum (50 male and 55 female patients) who comprised 13.0% of mediastinal masses over the past 50 years.**
Results: **There were 10 pediatric patients (< 15 years old) and 95 adult patients. The prevalence of cysts in the adult populations was higher than that in children (14.1% vs 7.7%, $p < 0.05$). There were 47 bronchogenic cysts, 30 thymic cysts, 12 pericardial cysts, 7 pleural cysts, 4 esophageal duplications, 2 meningoceles, 1 thoracic duct cyst, and 2 others. MRI has become a useful tool for providing supplemental data in combination with CT. Overall, 38 patients (36.2%) with mediastinal cysts were symptomatic, including 39.2% with bronchogenic/esophageal cysts, 40% with thymic cysts, and 15.8% with pericardial/pleural cysts. One hundred patients had complete resection of their masses, 3 patients with pericardial diverticulum received a thoracoscopic fenestration without mortality, and 2 patients refused surgery.**
Conclusion: **Early recognition of these relatively rare lesions would lead to immediate and appropriate surgical intervention. Early surgical intervention is also important because definitive histologic diagnosis can only be established by means of surgical extirpation.**
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Key words: bronchogenic cysts; foregut cysts; mediastinal cysts; mesothelial cysts; symptomatology, Japanese experience

Abbreviation: VATS = video-assisted thoracic surgery

Cysts of the mediastinum, which are benign masses, constitute a small but important diagnostic group, representing 12 to 18% of all primary mediastinal tumors[1,2]; however, the individual physician has little chance to know the clinical characteristics and total disease entities because of their relative rarity. There are few reports that review the entire range of mediastinal cysts.[3,4] The classification of mediastinal cysts is based on their etiology, encompassing bronchogenic, esophageal duplication cysts of foregut origin, mesothelial derived pericardial/pleural cysts, thymic cysts, and other miscellaneous cysts. Foregut cysts are believed to result from

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abnormal budding or division of the primitive foregut,[3–5] a very similar embryogenesis to congenital cystic lesions of the lung parenchyma.[5,6] In a broad sense, these disease entities are categorized into bronchopulmonary foregut malformations, such as pulmonary sequestration, congenital cystic adenomatoid malformation, congenital lobar emphysema, and

*From the Department of Surgery Course of Interventional Medicine (E1), Osaka University Graduate School of Medicine, Osaka, Japan.
Dr. Takeda is presently at the Department of Thoracic Surgery Toneyama National Hospital, Toyonaka City, Osaka, Japan.
Dr. Miyoshi is presently at the Department of Thoracic Surgery, Dokkyo Medical College, Tochigi, Japan.
Dr. Masaoka is presently at Osaka Central Hospital, Osaka, Japan.
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Correspondence to: Shin-ichi Takeda, MD, PhD, FCCP, Toneyama National Hospital Toneyama, 5-1-1 Toyonaka 560-8552, Japan; e-mail: stakeda@toneyama.hosp.go.jp

bronchogenic pulmonary cysts. Neuroenteric cysts may develop by abnormal septation of the embryogenic germ cell layer, which closely associate with the vertebral column.[3] In addition, mesothelial cysts, including pericardial and pleural cysts, and thymic cysts also occur in the mediastinum, as well as other rare cysts. This report is a retrospective study from a single Japanese institution reviewing the clinical characteristics and diagnostic and therapeutic modalities for the entire spectrum of cystic lesions of the mediastinum.

Materials and Methods

A retrospective review of the medical records of patients with mediastinal cysts treated at Osaka University Hospital between 1951 and 2000 was performed. Complete records were available in all patients with mediastinal cysts. χ^2 testing was utilized for categorical values.

Results

Between 1951 and 2000, 806 patients (451 male and 355 female) were referred to our institution for treatment of mediastinal tumors. There were 105 mediastinal cysts (50 male and 55 female patients), comprising 13.0% of total mediastinal tumors. There were 10 pediatric patients < 15 years of age and 95 adult patients (age range, 6 months to 74 years; average age, 37.3 years). The prevalence of cysts in all mediastinal tumors of the adult population was slightly higher than that in the pediatric population (14.1% vs 7.7%, $p < 0.05$). The details of mediastinal cysts are listed in Table 1.

There were 47 bronchogenic cysts (44.8%), 30 thymic cysts (28.6%), 12 pericardial cysts (11.4%), 7 pleural cysts (6.7%), 4 esophageal duplication cysts (3.8%), 2 meningoceles, 1 thoracic duct cyst, and 2 others. The mean ages of patients with bronchogenic/esophageal cysts, thymic cysts, and pericardial/pleural cysts were 34.7, 43.9, and 37.5 years, respectively. Fifty-one of 105 mediastinal cysts (48.6%) were located in the middle mediastinum, followed by 35 cysts (33.3%) in the anterior and 19 cysts (18.1%) posterior mediastinum. In the current series, we used the term *bronchogenic cyst in the mediastinum*; therefore, bronchogenic cysts in the lung parenchyma seen in 13 patients were excluded from this study.

Regarding bronchogenic cysts, the classification of Maier[7] was used to describe location. There were 12 right paratracheal, 4 left paratracheal, 11 right hilar, 5 left hilar, 7 subcarinal, 3 right paraesophageal, and 5 left paraesophageal bronchogenic cysts, as shown in Table 2.

Table 1—*Primary Mediastinal Cysts in Osaka University Hospital

Variables	Adults	Children	Total	Average Age, yr
Mediastinal tumors	676	130	806	35.5
Male	386	65	451	
Female	290	65	355	
Mediastinal cysts	95	10	105	37.3
Male	46	4	50	
Female	49	6	55	
% of tumors	14.1	7.7	13.0	
Location				
Anterior	34	1	35 (33.3)	
Middle	45	6	51 (48.6)	
Posterior	16	3	19 (18.1)	
Malignancy	0 (0)	0 (0)	0 (0)	
Bronchogenic cyst	41	6	47	35.3
Thymic cyst	29	1	30	43.9
Pericardial cyst	12	0	12	39.4
Pleural cyst	5	2	7	34.7
Esophageal cyst	3	1	4	28.3
Meningocele	2	0	2	43.0
Others	3	0	3	38.7

*Data are presented as No. or No. (%).

Imaging and Diagnosis

Diagnostic evaluations in all cases began with conventional chest radiographs. Standard chest radiographs identified the mediastinal cysts in 94 patients (89.5%). Small subcarinal or hilar bronchogenic cysts, and small thymic cysts were found as homogenous water density masses on chest CT. Barium swallow studies and/or esophagoscopy were performed mainly for patients for suspected esophageal and bronchogenic cysts. CT was performed in patients after 1980, which revealed round, well-circumscribed masses of water density or a little higher. In the early series when CT was not available, induced pneumomediastinum was a diagnostic tool used to demonstrate the size, shape, and extent

Table 2—*Anatomic Location of Mediastinal Bronchogenic Cysts

Locations	Adults, n = 41	Pediatric (0 to 15 yr), n = 6	Total, n = 47†
Right paratracheal	11	1	12
Left paratracheal	3	1	4
Right hilar	9	2	11
Left hilar	4	1	5
Subcarinal	7	0	7
Right paraesophageal	3	0	3
Left paraesophageal	4	1	5

*According to the classification of Maier.[7] Data are presented as No.
†Of the total of 47 cysts, 26 were right sided (55.3%), 14 were left sided (29.8%), and 7 were subcarinal (14.9%).

of the mediastinal masses. MRI was recently performed in 29 patients. Compared to the low signal intensity in T1-weighted images, the bright signal intensity in T2-weighted images indicated the cystic content of the mediastinal mass, which was a characteristic sign that differentiated a solid mediastinal mass. In this sense, MRI has provided specific diagnostic confirmation in regard to mediastinal cysts (Fig 1, 2). For example, in 1970, we performed an axillary thoracotomy with a preoperative diagnosis of neurogenic tumor in the posterior mediastinum for a patient with von Recklinghausen disease, which was found to be a meningocele at surgery. In 1997, we encountered another patient with a meningocele whose MRI showed the anatomy of that cyst clearly (Fig 3),[8] and thus a definite preoperative diagnosis was obtained. However, we failed to diagnose small thymic cysts because of a lack of their characteristic signs in MRI. For one particular patient with thoracic duct cyst, a lymphangiogram was performed to obtain a definite preoperative diagnosis. With recent advancements in radiologic techniques, needle aspiration was rarely performed after establishing the clinical diagnosis.

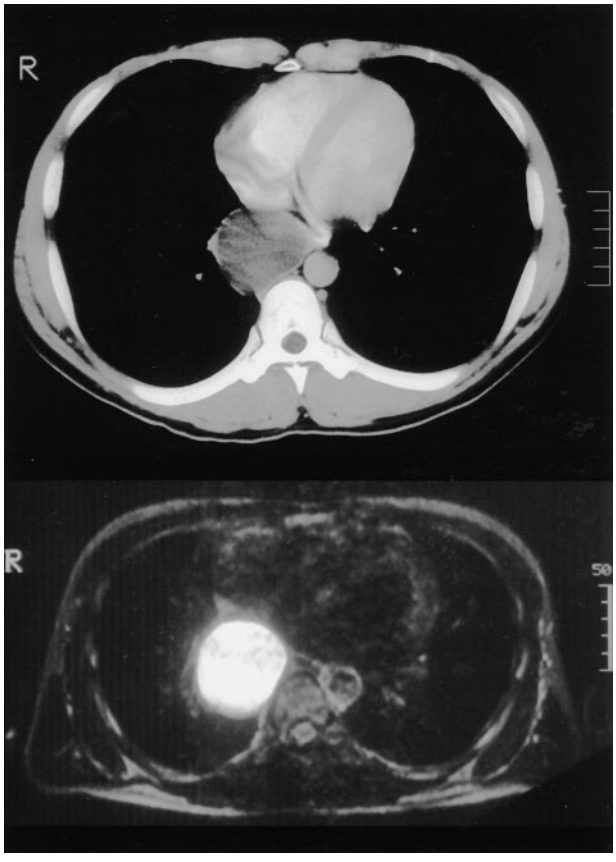

FIGURE 1. Chest CT scan (*top*) and MRI (*bottom*) of the subcarinal bronchogenic cyst.

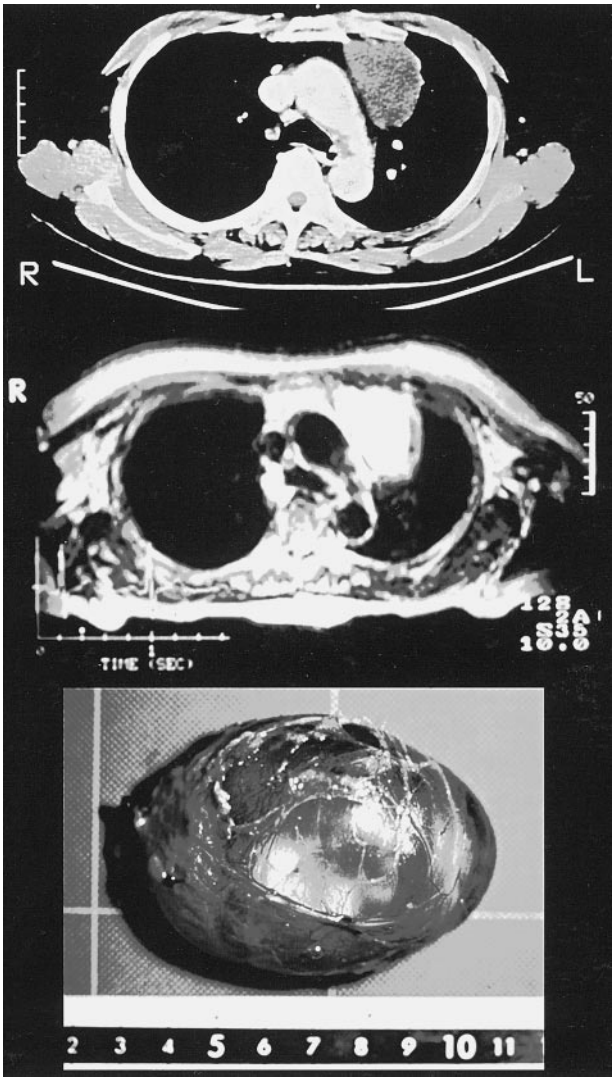

FIGURE 2. Chest CT (*top*) reveals an anterior mediastinal mass. It was found to be a cystic mass by T2-weighted images in MRI (*middle*). A resected specimen reveals a thymic cyst containing serous fluid (*bottom*).

Symptoms

The clinical characteristics of mediastinal cysts are shown in Table 3. Overall, 38 patients (36.2%) with mediastinal cysts were symptomatic: 39.2% of bronchogenic/esophageal foregut cysts, 40% of thymic cysts, and 15.8% of pericardial/pleural cysts. These symptoms usually appeared in progressive fashion in most patients. Overall common symptoms were retrosternal chest pain (14.3%), followed by dyspnea (7.6%), cough (6.7%), fever (5.7%), and hoarseness (4.8%). Of particular interest, 4 of 30 patients with benign thymic cysts presented with hoarseness despite the benign nature of this disease. Two patients with meningoceles in the posterior mediastinum were associated with cutaneous neurofibromatosis (von Recklinghausen disease). We also found acute

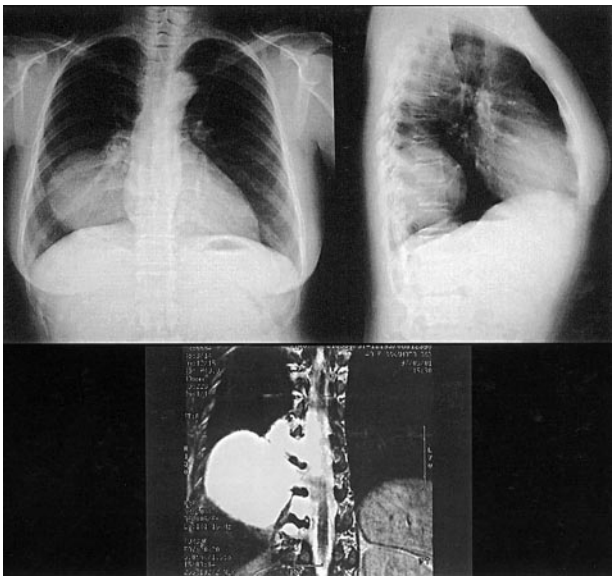

FIGURE 3. Chest radiograph on hospital admission shows a round, well-circumscribed shadow 10 cm in diameter in the in the lower right chest (*top left*). A right lateral view shows a mass in the posterior mediastinum (*top right*). MRI (*bottom*) clearly demonstrated paravertebral cysts communicating with the vertebral canal.

symptoms of fever and chest pain due to abrupt enlargement and rupturing into the mediastinum in one patient with an esophageal duplication cyst.[9] One patient with a thoracic duct cyst was referred to us with recurrent retrosternal chest pain. A 6-month-old boy with a huge pleural cyst was transferred to our clinic with severe respiratory distress and cyanosis, and an emergency operation was performed (Fig 4). Surgical excision eliminated these symptoms, including vocal cord paralysis.

Surgical Treatment

In these diseases, surgical excision is definitely diagnostic and therapeutic. Surgical removal was performed via an axillary thoracotomy or median sternotomy, which was chosen with regard to the tumor size, location, and extension in the early series. Since 1993, when video-assisted thoracic surgery (VATS) was introduced, 19 of 28 patients with mediastinal cysts received VATS resection in the current study for up to 12 cm in size of thymic cyst. Though the cysts were often histologically benign, they may present difficult surgical problems because of the vital structures involved. Three patients with bronchogenic cysts were converted to standard thoracotomy because of severe adhesions around the cysts, particularly into the esophageal muscle layers. Three patients with pericardial cysts had a communication with the pericardial cavity, which were found during surgery, thoracoscopic fenestration was performed. One female patient with a thymic cyst had a concurrent neurogenic tumor in the posterior mediastinum; therefore, the thymic tumor was resected via a median sternotomy as an initial diagnosis of thymoma, and a neurogenic tumor was removed via a posterolateral approach concurrently.

Specimens were available for pathologic examination in all patients, which revealed typical features of bronchogenic, esophageal, thymic, and thoracic duct cysts or meningoceles. Some patients with the entire cystic mass in the thymus, found to be cystic thymoma, were excluded from this study. There were no major morbidity or mortality in the surgical treatment of mediastinal cysts, and all patients had uneventful recovery.

DISCUSSION

Mediastinal cysts are relatively uncommon but easily diagnosed by routine radiographic imaging procedures. These cysts comprise 12 to 30% of all primary mediastinal masses.[1–3] Mediastinal cysts were further classified into foregut-derived cysts,[3]

Table 3—*Clinical Characteristics in Cysts in the Mediastinum (Symptoms and Signs)**

Characteristics	Bronchogenic, n = 47	Esophageal, n = 4	Thymic, n = 30	Pericardial, n = 12	Pleural, n = 7	Others, n = 5	Total, n = 105
Asymptomatic	28	3	18	10	6	2	67 (63.8)
Chest pain	6	0	6	2	0	1†	15 (14.3)
Dyspnea	3	1	3	0	1	0	8 (7.6)
Cough	5	0	2	0	0	0	7 (6.7)
Fever	5	0	1	0	0	0	6 (5.7)
Hoarseness	1	0	4	0	0	0	5 (4.8)
Sputum	3	0	0	0	0	0	3 (2.9)
Dysphagia	1	1	1	0	0	0	3 (2.9)
Cyanosis	0	0	0	0	1	0	1
Hemoptysis	1	0	0	0	0	0	1
Others	1	0	1	0	0	2‡	4

*Data are presented as No. or No. (%).

†Chest pain associated with thoracic duct cyst.

‡Neurofibromatosis associated with meningocele.

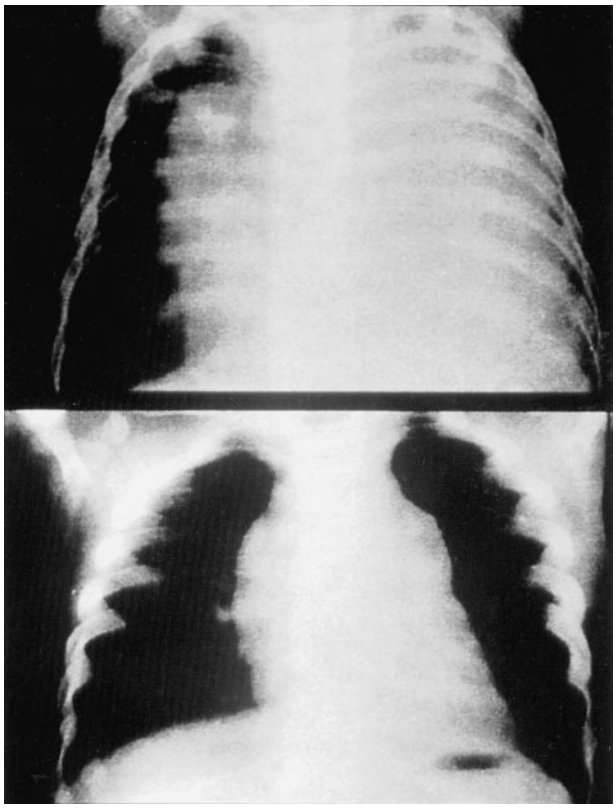

FIGURE 4. Preoperative chest radiograph of a 6-month-old with a huge pleural cyst (*top*). Postoperative course was quite uneventful (*bottom*).

which represented more than half of cystic lesions of the mediastinum, mesothelial cysts including pericardial pleural cysts, thymic cysts, and other rare anomalies such as thoracic duct cysts or meningoceles. We herein reviewed our experience with 105 mediastinal cysts, including some rare mediastinal cysts.

Incidence and Embryogenesis

Foregut cysts, including bronchogenic and esophageal cysts, represented 48.6% (51 of 105 cysts) of all cysts in the mediastinum. Bronchogenic cysts were more common than esophageal cysts.[10,11] The prevalence of bronchogenic cysts was reported to be 1:42,00 and 1:68,000 of admissions to two hospitals[12]; however, it is difficult to appreciate the prevalence of the cysts exactly, since some aged patients have lesions that remain forever silent.[12]

Bronchogenic and esophageal cysts originate from the ventral primitive foregut as an anomalous budding of the laryngotracheal groove[3,11,12] during embryonic development around the time when cleavage occurs between the respiratory tract and digestive tube.[12] Both organs have columnar and ciliated mucosa at the time, and thereafter the squamous epithelium spreads in the esophagus. Gerle et al[13] first proposed the term *bronchopulmonary foregut malformation* to encompass the entire spectrum of developmental anomalies of the primitive foregut. In a broad sense, congenital cystic lesions of the lung and mediastinum may result from compromised interaction between embryologic mesodermal and ectodermal lung components during development. Bronchopulmonary foregut malformations encompassed pulmonary sequestration, congenital cystic adenomatoid malformation, congenital lobar emphysema, and bronchogenic pulmonary cyst.[14] During the same period of our 105 mediastinal cysts, we also observed 26 cases of congenital cystic disease of the lung including 13 bronchogenic pulmonary cysts, which were previously reported.[5] The stage of embryonic development and error may determine the bronchial vs pulmonary parenchymal location of bronchogenic cysts.[5,12,15] When they form early, they are located in the mediastinum by the trachea or esophagus, having ciliated epithelium derived from either the respiratory tract or alimentary tract. In contrast, when the later anomaly develops, they are located in the lung parenchyma and with lined respiratory epithelium.[5,12,15] In this sense, bronchogenic cysts and esophageal cysts (duplications) share a similar developmental background, namely foregut budding errors, rather than being separate disease entities.[16,17] A distinction is made between bronchogenic and esophageal cysts when cartilage is present, which suggests the cyst is bronchogenic in origin. However, Nobuhara et al[11] advocated naming both types as "foregut cysts" because of their common embryological origin, anatomic proximity and histologic similarities.

Mesothelial cysts, including pericardial and pleural cysts, are estimated to occur in approximately 1 in 100,000 persons.[17] Ochsner and Ochsner[4] reported 33% mesothelial cysts among 42 cysts in the mediastinum. These cysts accounted for 18.1% in our series. These anomalies are formed by the parietal recess persisting during development, namely aberrant recess fusion; therefore, the pericardial diverticulum, having a communication with the pericardial cavity, is regarded as an incomplete form of pericardial cyst in terms of its embryogenesis.

Thymic cysts used to be regarded as a rare anomaly[1,18]; however, reports[19] described a higher incidence of thymic cysts. In the current series, thymic cysts represented the second most common type: 28.6% of the mediastinal cysts and 3.7% of the mediastinal tumors. Thymic cysts may occur at any anatomic level, from the base of the neck to the diaphragm.[19] There has been some controversy as to the causes of thymic cysts.[18–20] Bieger and

McAdams[18] reported that thymic cysts derived from the thyropharengeal duct, that is, they are congenital in origin. Graeber et al[20] divided cystic lesions of the thymus into three major categories: congenital, neoplastic, and degenerative. The latter two mechanisms in pathogenesis were cystic degeneration of thymomas and cystic masses after chemotherapy for Hodgkin disease.[20] In any case, local disruption of thymic tissue can induce the formation or growth of cysts. In the current series, they mainly encompassed thymic cysts of congenital origin, and we excluded the cystic masses of neoplastic origin such as cystic thymomas or degeneration after surgery.[20] Of note, Suster and Rosai[19] reported 18 cases of multiocular thymic cysts, in addition to uniocular cysts.

We experienced two cases of meningocele in the posterior mediastinum.[7] Although the etiology of intrathoracic meningocele is unknown, it is frequently associated with von Recklinghausen disease (neurofibromatosis type 1). Due to its rarity, intrathoracic meningocele is seldom considered in the differential diagnosis of a mediastinal cyst. A meningocele may be defined as a saccular protrusion of the spinal meninges through an intravertebral foramen.[21] As reviewed by Erkulvrawatr et al,[22] 20% of the cases were associated with neurologic impairments such as weakness, sensory disorder, hyperactive reflexes, and occasional headache, probably due to low cerebrospinal fluid pressure. We also encountered an extremely rare case of a thoracic duct cyst in 1976; pathologically, the cyst was unilocular with an associated connection to the thoracic duct. As Tsuchiya et al[23] later described another case, we made a preoperative diagnosis of thoracic duct cyst by lymphangiogram. They can have a distinct connection with the thoracic duct. Regarding pathogenesis, thoracic duct cysts occur secondary to a congenital weakness and degenerative wall changes, which result in aneurysm-like dilatation and subsequent cyst formation.[24]

Symptomatology and Diagnosis

The clinical characteristics in mediastinal cysts are outlined in Table 3. Overall, 38 patients (36.2%) with mediastinal cysts were symptomatic. Symptomatic patients were seen in 39.2% with bronchogenic/esophageal cysts, 40% with thymic cysts, and 15.8% with pericardial/pleural cysts, respectively. Asymptomatic patients were most common in patients with mesothelial cysts compared to other type of cysts ($p = 0.06$).

In the current study, the prevalence of symptomatic patients with bronchogenic/esophageal foregut cysts was lower than that reported previously, ranging from 50 to 80%.[6,11,12] In addition, symptoms of infection such as fevers in the current series were low (9.8%) in patients with bronchogenic or esophageal cysts in the mediastinum compared to previous reports.[6,11] In our experience,[5] 10 of 13 patients (79%) with parenchymal bronchogenic cysts had symptoms of infection, including 1 patient with a tuberculosis infection in the cyst, and this incidence was consistent with previous reports.[6,12] St-Georges and coworkers[6] reported that 90% of parenchymal bronchogenic cysts had symptoms of infection compared to mediastinal bronchogenic cysts with 36.4%. In addition, two pediatric patients with parenchymal bronchogenic cysts had symptoms of respiratory distress associated with acute mediastinal shift due to a ballooning of the cyst, and emergency left lower lobectomy was performed.[5] We only encountered the following acute symptoms in two patients with mediastinal bronchogenic cysts: one patient appeared with empyema due to cyst rupture, and the another patient referred to us with abrupt onset of hoarseness due to ballooning of a right paratracheal cyst (this hoarseness was reversible by surgery). According to Ribet and colleagues,[12] bronchogenic cysts in the subcarinal or paratracheal locations were more apt to provoke compression symptoms. Children with narrow or soft airways are easily vulnerable to compression by expanding cysts; therefore, patients with bronchogenic cysts in the pediatric group were seen as life-threatening emergencies,[14] but this was also seen in adult patients.[3] St-Georges et al[6] reviewed 86 bronchogenic cysts and found major complications such as fistulization with airway, and ulcerations or hemorrhage in mediastinal cysts that were observed with parenchymal cysts. In addition, other potential complications including arrhythmia or superior vena cava syndrome may occur. Another important issue is that malignancy is associated with bronchogenic cysts.[25]

As for esophageal cysts, by reviewing previous reports,[10,11] approximately one half of the patients with esophageal cysts were asymptomatic and discovered incidentally. Three of four patients with this disease were asymptomatic at presentation in our experience. We encountered one patient with an esophageal duplication cyst who visited us complaining of fever and chest pain due to acute enlargement and rupturing into the mediastinum.[9]

Thymic cysts were regarded to be usually asymptomatic, located in the anterior mediastinum, and were incidentally discovered on a chest radiograph.[18] Graeber et al[20] reported that only 6 of 46 patients (13%) had symptoms. Unusual presentations such as respiratory distress[19] and Horner syndrome[26] have been reported. In our series, thymic cysts represented 28.6% of mediastinal cysts and 3.7% of total

mediastinal tumors. As shown in Table 3, 40% of patients were symptomatic, a similar prevalence to those with bronchogenic cysts in the current study. Such cases presented with relatively large masses of 7 to 13 cm in size. Notably, hoarseness was the second most common symptom in our series. However, patients with cystic masses in the thymus have been reported to be asymptomatic.[19,20]

In our experience, patients with pericardial/pleural cysts had lower incidences of symptoms than other mediastinal cysts; however, one patient with an expanding pleural cyst who presented with cyanosis and respiratory distress needed an emergency operation. The two patients with meningoceles appeared without respiratory symptoms. Recurrent chest pain was associated with the thoracic duct cyst similar to the previous report.[24]

As for the diagnostic modality, chest radiograph was once the most cost- and time-efficient method of diagnosing surgical lesions, and was the only diagnostic tool in our early series. Before the introduction of CT scan, pneumomediastinum used to be a diagnostic tool for mediastinal mass. Currently, mediastinal cysts can be accurately diagnosed with imaging modalities such as CT, MRI, and ultrasonography. The appropriate diagnostic test allows for efficient treatment, avoiding complications. The plain chest radiograph serves as the starting point for diagnostic evaluation, and MRI is an ultimately useful tool for providing supplemental data in combination with CT. In addition, asymptomatic cystic lesions were sometimes found during examination or follow-up for other diseases.

Surgery and Outcome

Short-term results after extirpation of mediastinal cysts are excellent, and operative morbidity is acceptable as well as eliminating symptoms. We concluded that the diagnosis of a symptomatic mediastinal cyst is an indication for complete extirpation in all patients. In this sense, surgical excision is definitely diagnostic and therapeutic; therefore, watchful waiting is discouraged. The options for treatment of foregut cysts or thymic cysts including mediastinoscopic aspiration in symptomatic patients have been reported,[27] but these methods should be exceptionally preferred as temporary procedures in selected cases. There were some concerns about the indications of surgery for asymptomatic patients with mediastinal cysts after establishing the diagnosis due to their benign nature.[25] Ribet and colleagues[12] followed up two patients with bronchogenic cysts who refused surgery for 15 years and found that one patient remained free of symptoms and the other died of a malignancy of unknown origin. As for thymic and mesothelial cysts, watchful observation data were not available in our experience. An accurate imaging diagnosis may allow these lesions to leave alone. Many patients with mediastinal cysts were initially asymptomatic, later with occasional severe outcomes. In our series, 60% of patients were actually asymptomatic but they accepted an offer of surgery. We believe that preventive resection should be preferred, even in asymptomatic patients because of the unpredictability of clinical behavior. VATS may be an acceptable surgical procedure for patients with mediastinal cysts, which are rarely malignant.[28,29] Ribet et al[12] analyzed the operative records and found that the VATS approach was hazardous in 11 to 30% patients with bronchogenic cysts because of pericystic adhesions or communication of the cysts with tracheobronchial or esophageal structures. The need for conversions should not be delayed. These technical difficulties were less frequently encountered in other types of cysts.

In summary, we reviewed our experience with cysts of the mediastinum, emphasizing the clinical spectrum of the disease, diagnosis and treatment, and some case presentations with unusual clinical manifestations. Early recognition of these relatively rare lesions would lead to immediate and appropriate surgical intervention. Early surgical intervention is also important, because a definitive histologic diagnosis can only be established by means of surgical extirpation.

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