

Clinical presentations, diagnosis and management of primary mediastinal cysts: A retrospective study

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Abstract

Introduction: Primary Cystic lesions of mediastinum are usually seen in the three compartments of mediastinum, and they may arise from any organ in the mediastinum. The most of these cystic lesions are benign and may be asymptomatic. But large cysts may produce symptoms related to compression of adjacent structures. The two most common histological variants of PMCs are bronchogenic and thymic cysts. CXR, Computed tomography and magnetic resonance are routinely used for diagnosis of these lesions. Although computed tomography offers superior than others, magnetic resonance is useful in differentiating cysts that contain watery material from solid component. Cysts lesion may arise from solid lesions, such as thymoma or teratoma. Primary cystic lesion may arise in three compartments of anterior, middle and posterior mediastinum. In this paper we want to show our experience the clinical presentations, diagnosis, management and complications after treatment of PMCs

Methods: The medical records of all patients with PMCs, who underwent surgical resection from April 2014 to July 2022, were reviewed and 68 patients were included. Clinical characteristics, imaging features, and surgical approach and outcomes were analyzed. Follow-up data were successfully obtained from 58 of PMCs patients by telephone or in the thoracic clinic every six month. The latest follow-up was October 2023.

Results: The 40 of patients were male and 28 were female. the age of patients were between 10 to 58 years, the tools of diagnosis were CXR, CT –scan and MRI. The approaches for resection were AT, PL thoracotomy and median sternotomy. The mean operation time were 120 ± 58 minutes and intraoperative bleeding were 324 ± 108 mL. The intraoperative complications rates were in eight patients and 12 postoperative. Seven patients with bronchogenic and four thymus cysts showed severe cyst adhesion to vital mediastinal structures and partial resection was performed. Our analysis shows that a maximal cyst diameter greater than 10 cm was associated with increased risks of operation time, intraoperative blood loss and phrenic nerve or great vessels damages. A total of 58 patients had follow-up data. The median follow-up time was 70 months (range 24 to 72 months). recurrence was not occurred.

Conclusions: CT-scan is best imaging for diagnosis. Location of cysts are important in guiding for a differential diagnosis. Although the content of most these cysts is simple fluid, Furthermore, the presence of solid component may suggest cystic degeneration or cystic component of a solid neoplasm. Surgical resection with thoracotomy is recommended in our situation and the results are acceptable but in recent years, VATS recommended for primary therapeutic strategy in PMCs. Cysts with a maximum diameter greater than ten cm or cysts adjacent to vital mediastinal structures can increase the surgical difficulties and complications.

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Keywords: Mediastinum; Cysts; Thoracotomy; VATS; CT-Scan; MRI

1. Introduction

Primary mediastinal cysts (PMCs) are congenital abnormalities of the foregut, pericardium or pleura (1, 2, 30). They are rare benign lesions, accounting for 12% to 18% of all mediastinal masses, and include a wide variety of pathologic types, such as bronchogenic cyst (fi=A, B), thymic cyst (fi=C, D, E, F), pericardial cyst (fi=G), esophageal duplication cyst (fi=H), and others as Cystic Teratoma (fi=I, K, L, M, N, O, P, Q), Neu enteric Cyst, Intrathoracic Meningocele, Lymphangioma and Thoracic Duct Cyst (1, 2, 3, 4, 5, 6). Pericardial cysts are congenital and most commonly unilocular (1, 2) The most common location for pericardial cysts is the right anterior cardio phrenic angle (^{1,3}) Most patients with PMCs are mainly asymptomatic (10). Usually finding by the radiological procedures in patients for routine medical examinations (1, 2, 3). Mediastinal thymic cysts are representing only 1%-3% of mediastinal masses (1, 9 10)). These cysts' location is most commonly in the anterior mediastinum (^{4,6,7}). They are usually unilocular, thin-walled, and filled with clear fluid (^{4,6,7}). Teratomas are most commonly seen in the anterior mediastinum (1, 2, 3). Most patients with dermoid cysts are symptomatic and these lesions are usually filled with sebaceous material, but it may also contain macroscopic fat, bone, hair, or other tissues (1, 2, 3) (Fig1, 2, 3). Bronchogenic cysts usually located in the middle mediastinum (1, 2, 11, 12). They are occasionally associated with other congenital pulmonary malformations (1, 2, 3, 5). At histopathology, they contain cartilage, smooth muscle, and respiratory epithelium (1, 5, 8, 11, 12). Esophageal duplication cysts are usually asymptomatic, but they can cause dysphagia or pain (1, 2, 3) They rarely communicate with the esophageal lumen (1, 2, 3, 6, 9,). At histology, they have submucosal, and muscular layers similar to gastrointestinal (1, 9, 10). Diagnosis tools are CT –scan MRI (1, 2, 3, 5, 6, 7) Surgical resection indicated for confirm the pathological diagnosis, relieve the compression effect of the cysts, and prevent complications as infection and rupture (2, 3, 8, 9, 10) Resection is preform by thoracotomy or Video-assisted thoracic surgery (VATS) (11, 12, 13) Here, we summarize our experience more than 17-year duration and to show diagnostic and surgical therapeutic recommendations.

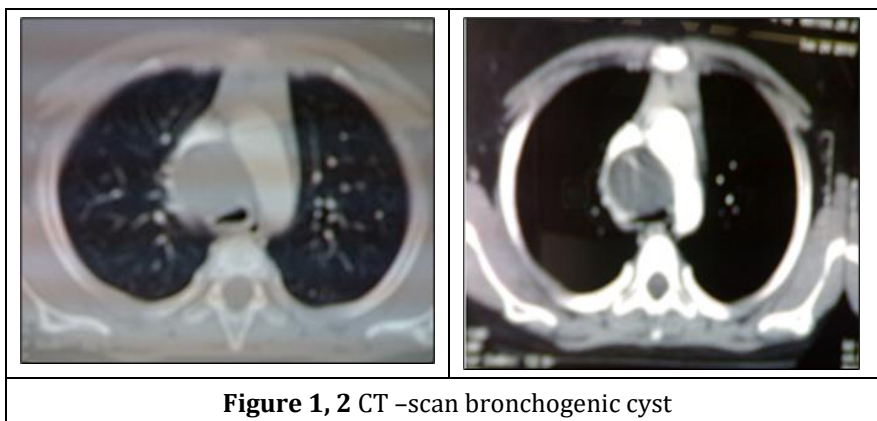


Figure 1, 2 CT –scan bronchogenic cyst

2. Methods

In a retrospective study the medical records of 68 patients with diagnosis of PMC who underwent surgical resection at Razi teaching hospital Guilan University and Arya private Hospital from October 2014 to July 2021 were reviewed. Inclusion criteria: Cystic lesions of mediastinum for which gross features, microscopic features were available. exclusion criteria are hematoma, cystic thymic carcinomas, cystic germ cell tumors or cystic lymphomas The indication for surgical resection of PMC were: (1) patient with symptoms caused by a mediastinal cyst; (2) the cyst grew more during the clinical observation; (3) malignancy could not be ruled out by the preoperative CT-scan and MRI, (4) PMC showed severe compression of the pulmonary artery or main bronchus. All patients were undergoing CXR, chest computed tomography (CT) and MRI prior to surgery. Preoperative examinations included complete blood test, echocardiography and pulmonary function test. Our approach was total part of cysts should be removed completely, if possible, with a maximum effort to avoid cyst fluid leakage and damage to vital strictures, in thymic cyst thymectomy should be performed; and if severe cyst adhesions to vital mediastinal structures might lead to incomplete resection. Thoracotomy in 56 and VATS in 12 patients. At the end of surgery, a chest drainage tube was routinely inserted. Histopathologic examinations confirmed by pathologist. The data of demographic characteristics, operative exploration and complications, hospital stay morbidity mortality and follow-up data were analyzed. Patients were followed-up by telephone interview or thoracic clinic visit every six months for two years. The latest follow-up was completed in July 2022.

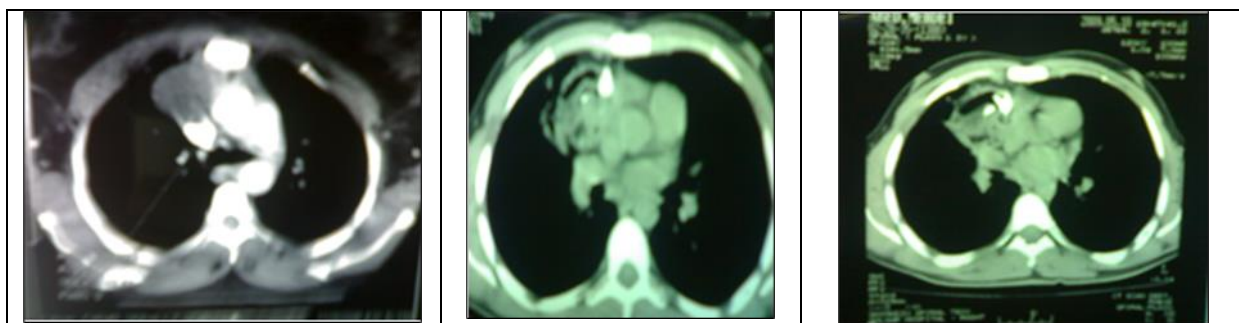


Figure 3, 4, 5 Dermoid cyst with bone material

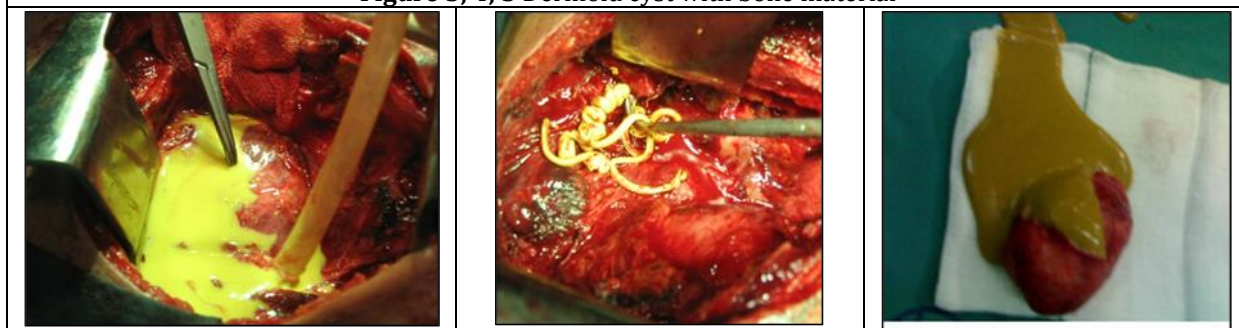


Figure 6, 7, 8 Content of dermoid cyst with sebaceous materials

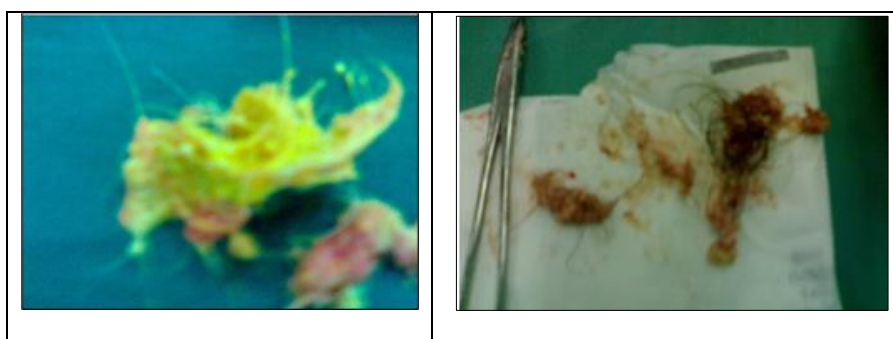


Figure 9, 10 content of dermoid cyst with sebaceous materials

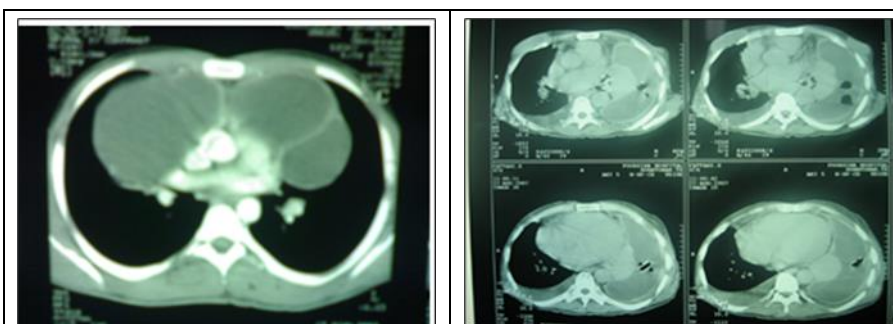


Figure 11, 12 CT –scan bilateral thymic cyst and pleural effusion

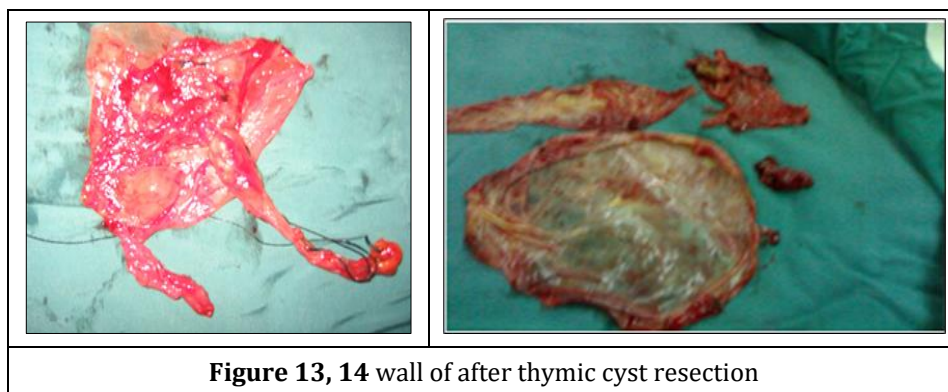


Figure 13, 14 wall of after thymic cyst resection

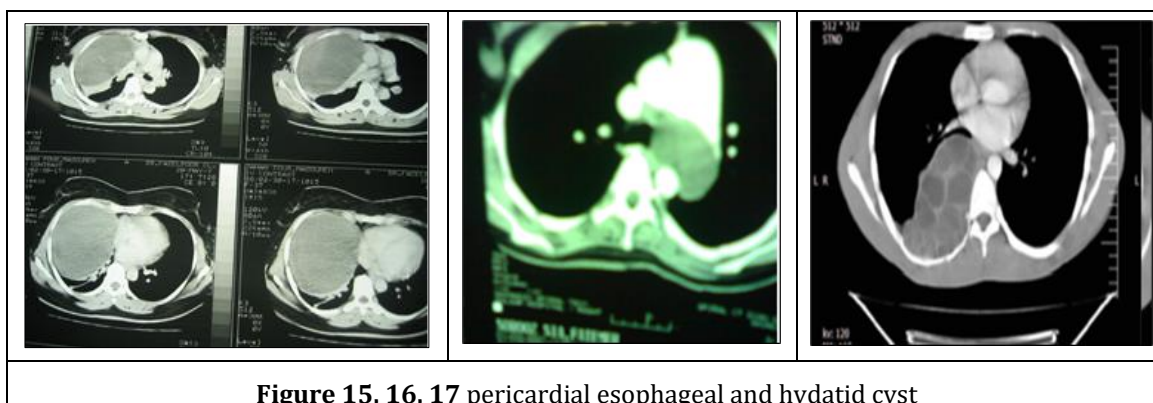


Figure 15, 16, 17 pericardial esophageal and hydatid cyst



Figure 18 CT scan Bilateral Thymic Cyst and Pleural Effusion

3. Results

A total of 68 patients (35% women and 65% men) were included in this study. the age of patients was between 10 to 58 years Fifty-eight of these patients were presented with symptom. These most common symptom was cough (35%), dyspnea (22%), chest pain (18%) hemoptysis (3%), fever (4%) and dysphagia (3%) Symptoms developed in 14 patients during a median one to three years follow-up time PMC. According to the location of the cysts, the patients divided into three groups: Group I (patients with anterior mediastinal cysts), Group II (patients with middle mediastinal cysts) and Group III (patients with posterior mediastinal cysts) The location of 32 patients had cysts in the anterior, 22 middle 14 in posterior mediastinum. Chest CT -scan were correctly diagnosed in 92% MRI in 8%. The mean size of the mediastinal cysts was (14 ± 4 cm). The CT value of bronchogenic cysts was higher than other types of mediastinal cysts. The demographics and clinical characteristics of the three groups are shown in Table 1

Table 1 Demographic characteristics of patients

	G I	G II	G III
Age (median)	32 (10–52) (years)	22 (12– 48) (years)	14 (18–58) (years)
Sex (male/female)	20/12=NO	12/10=NO	8/6=NO
Symptom developed during 1to2 year	6=NO	6=NO	2=NO
Diagnosed by: CT MRI	88% (2%)	94% (4%)	92% (2%)
Cyst size (mean range)	14 ± 8 cm	10 ± 6 cm	8 ± 6cm

Table 2 Clinical symptoms

		G 1	G11	G111
		NO%	NO%	NO%
1	cough (35%)	15	14	6
2	dyspnea (22%)	10	8	4
3	Dysphagia (4%)	1		3
4	chest pain (18%)	10	6	2
5	hemoptysis (2%)	2		
6	fever (4%).	2	1	1
7	Palpitation (18%)	8	6	4
8	Asymptomatic (incidentally (18%)	2	12	4

Table 3 The Demographic Profile of Different Cyst Types

Postoperative Pathology	G I=NO	G II =NO	G=NO III
Thymic cyst	18	-	
Bronchogenic cyst	-	20	
Pericardial cyst	2	4	
Hydatid cyst	-		2
Lymphangioma cyst	6	2	
Dermoid cysts	10		
esophageal duplication cyst			4

Complete cyst resection was achieved in 56 patients, because of severe cyst adhesions to the mediastinal structure or a giant cyst in the esophagus sever adhesion to heart. However, incomplete cyst resection was seen in three patients with bronchogenic cysts because of severe cyst adhesion to tracheal membranous wall and pulmonary artery wall, and all the cysts were in the middle mediastinum. The mean operation time was $120 \pm$ minutes and intraoperative bleeding were and 524 ± 118 mL. The median duration of chest-tube drainage was four days (range, 3–8 days), and the median hospital stays was four days (range 4–8 days). The incidence rate of overall intra operative complication was 12 patients. Esophageal injury, Tracheal injury and Carina injury were the most common complications There was significant difference of complications among the three groups. Complications in bronchogenic cysts were more than others (Table 2). Of the 68 patients 58 had follow-up data. The follow-up duration was between 90 months to 210 months with a

median of 70 months. . Postoperative complication occurred in 11 patients and recurrence was not observed in the 68 patients. No mortality occurred in this study.

Table 4 Surgery-related complications

	G1=NO	G11=NO	G111=NO
<i>Esophageal injury</i>		1	2
<i>Carina injury</i>		2	
<i>Tracheal injury</i>	1	3	
Pericardial injury	2	1	
Incomplete excision of the cyst wall	1	3	1
Left side recurrent laryngeal damage	2		
Phrenic nerve damage	2	2	
Chylothorax	1	2	1

Table 5 Postoperative complications

	G1=NO	G11=NO	G111=NO
Arrhythmia	4	2	1
Pneumonia	2	1	
Atelectasis	3	2	1
Hemothorax	2	1	
Prolonged air leakage (≥7 days)		3	1
Chylothorax		1	2

4. Discussion

Our retrospective study contained 68 mediastinal cysts that were completely resected. Six of these cysts because of severe adhesion to vital organs underwent incomplete resection. Three of these cysts were bronchogenic, one thymic cyst and two esophageal duplication cysts, as others study bronchogenic cysts were most common than others cysts (1) (Fig A, B). In our study two cysts in posterior mediastinum were hydatid cyst which is very rare, one of these cysts was distraction of spinal Column (Fig 4, 5 (17)). Eighteen of PMCs are thymic cysts and twenty are bronchogenic cysts and eight are lymphangioma cyst. location of 32 cysts were anterior mediastinal (G 1), 22 cysts were middle mediastinal (G 11) and 14 cysts were posterior mediastinal (G 111) as others studies (1, 3, 5). Cough, chest pain and dyspnea were the most common presentations as other study (1, 3, 3, 5). in our study hemoptysis and expectorant of teeth, hair and cartilage and sebaceous were more than another search (1, 2, 3, 5). incidental diagnoses were in ten patients and was more than another search (1, 2, 10). The preoperative diagnosis of a PMC mainly is CXR. Chest CT and MRI. Chest CT is commonly used to show the size and shape and location of cysts and show the relationships between PMC and vital mediastinal structures (1, 4, 5, 6, 7). The chest CT show PMCs in mediastinum with fluid attenuation, shape and wall cyst. homogeneous and weak or no enhancement on IV contrast (8, 9, 14). In our series, chest CT showed only 92% of the patient's characteristic in PMCs. In one series chest CT show only 50. 7% characteristic presentations of cysts (1). Previous studies have showed that about 50% of PMCs patients demonstrated soft-tissue attenuation on chest CT (1, 5, 6). Therefore, the most common challenging is to distinguish between mediastinal cysts from solid neoplasm cystic lesion because of protein-rich fluid in this cystic neoplasm. (7, 9). McAdams *et al* (7), reported a series of 20 patients with bronchogenic cysts who underwent both chest CT and chest MRI, and they find that in nine patients the MRI demonstrated a fluid-like signal on the cystic lesion but others eleven cases chest CT show as soft-tissue-like mass. In a study by Tomiyama *et al* (10) they showed the rates of accurate diagnosis based on chest CT is 46. 0% and on MRI is 71. 0% for thymic cysts and they recommended that MRI might show more diagnostic information than CT. But in our study diagnostic rate in bronchogenic cysts in chest CT was 70% and in thymic cyst was 66%.

Most surgeons recommended that symptomatic patients, or progressively growing cysts should be treated with surgery after diagnosis (11, 12). But resection in asymptomatic patients remains controversial. (1, 2, 11, 12). But in our series symptomatic or asymptomatic patients after diagnosis underwent surgical resection, because most of our patients come from remote area and cannot do the program of follow-up. In our study, only two patients with preoperative diagnosis of dermoid cyst was malignant in histopathology. In a review by record of 683 PMC patients from 23 papers were analyzed during 22 Years observation only 0. 7% of patients developed malignant transformation in the asymptomatic patients (11). conservative treatment could be an alternative therapeutic method, but these patients should be under observation by followed-up routinely with imaging examination (11, 12). In our study all PMCs after diagnosis underwent resection. Definitive diagnosis usually was based on the microscopic examination after resection (1, 2, 3). In bronchogenic cysts the diagnosis is challenging especially with a diffuse ulcerated epithelium (1, 7). But in our study diagnosis in four patients of bronchogenic cysts was challenging.

Bronchogenic cysts are the most common cysts reported in different studies (1, 8, 9, 10). Bronchogenic cysts belong to the foregut cysts group (1). Bronchogenic cysts account for 50 to 60% of the mediastinal cysts (4, 11). As in our series. this cyst can be diagnosed at any age but are mainly common in young adults and adolescents (1, 2, 3). The most of these patients are usually asymptomatic or present with symptoms due to the compression of the mediastinal organs (7, 8). They are unilocular and rarely multinodular (7, 10, 11). As our study Most of BC are located in the middle mediastinum (1, 2, 7) The cyst wall is very thin, and smooth muscle cells and covered in respiratory epithelium (1, 9). In a study, the most characteristic feature was the respiratory epithelium observed in 26 cases (1, 7, 11). As our patients in pathology report. The presence of bronchial glands and cartilage helps to assess the diagnosis (1, 7, 10, 11). A transformation into an adenocarcinoma has been rarely reported in the literature (3). We not have any malignancy in our patients.

Incidence of Esophageal and gastroenteric cysts are less than bronchogenic cysts (1, 2, 3). In a study, 2 cysts were located and connected with the esophagus wall but pathology examination show a bronchogenic cyst (1, 3). Usually, Esophageal duplication cysts develop in the esophageal muscle layer (4, 8, 11). The localization of this cysts is in the posterior mediastinum (1, 4). The frequent complications include perforation, hemorrhage or infection (1, 4). In the imaging They are usually spherical, unilocular and in the pathology they covered with a squamous epithelium and (1, 8). Esophageal cysts are differentiated from bronchogenic cysts by their location, the absence of cartilage and presence of muscle layer of esophagus (1, 3). The incidence of Gastroenteric cysts is rare and usually observed in the posterior mediastinum and connect with a fibrous band to the vertebrae (1, 3). cervical and thoracic malformations may see in these cysts (1). Gastric epithelium presents in these cysts (4, 8). Ulceration, perforation and adenocarcinomas have been reported in these cysts (1, 2, 3). In this study we have not complication or malignancy in our cases.

Mediastinal thymic cysts are represented only 1%-3% of mediastinal masses (1, 4, 8, 18). They are may be congenital or acquired and are most commonly find in the anterior mediastinum (18). They are usually unilocular, thin-walled, and filled with clear fluid (18). They are generally asymptomatic (1, 4, 7, 11). In pathology evaluation, the presence of thymic parenchyma is the key of the diagnosis (1, 3, 10). Rarely in the thymic cysts squamous cell carcinoma may develop and have been reported (1, 3, 10). In our study we did not have malignancy in thymic cysts. The treatment of the foregut cysts if possible is complete surgical excision (1, 2, 3, 4, 8). Initially, only symptomatic cysts were resected, but in asymptomatic cysts because of 25% complications, resection indicated in some studies (4). In our study we resect all cysts when diagnosed by chest CT or MRI. In our study, only six pericardial cyst was observed and pericardial cysts account 22 to 38% of mediastinal cysts (4). They may adhere to the pericardium and usually are asymptomatic (4). Pericardial cysts are located into the right cardio-phrenic angle. They are unilocular with a thin wall (1, 2, 3, 4). The thickness of the cystic wall and the absence of adhesions induce a relatively easy surgical excision (1, 2, 4). We resected all pericardial cysts in our study. Some authors recommended the surgical excision even in asymptomatic cysts because of the difficult for closed follow-up (4, 11, 18). Previous studies have shown that about 45% of asymptomatic patients might produce symptoms during follow-up period (11). Complications of some cysts include: rupture can produce pleural effusion (Fig678), infection or hemorrhage in the pleural space, serious complications such as superior vena cava syndrome, dyspnea, and arrhythmia (10, 12, 18). In our study two patients with thymic cysts and one with bronchogenic cyst present with pleural effusion. In imaging some atypical cases of PMCs, malignant transformation cannot be ruled out (11, 19). Some cysts produce serious inflammation adhesion to the adjacent mediastinal structures and these conditions make surgical treatment difficult (1, 2, 4), in such PMCs are challenging and increase the risk of perioperative complications (20). Some recommended surgery can prevention in asymptomatic PMCs for develop symptoms or clinical complications in the future (1, 2, 8, 11). Surgical approach depended to the locations of cysts postero, antero-lateral thoracotomy, sternotomy or mini-invasive surgery (VATS) (1, 15, 16).

A large growing cyst can produce dense adhesion to the mediastinal organs and complete resection of these cysts are very difficult. (1, 2, 5, 21). Fievet *et al.* (12) reported the outcomes of 36 patients with mediastinal bronchogenic cysts and show that surgical resection of small cysts can reduce inflammatory process and decrease the rate of operative

complications when inflammatory process developed. In our study we resection all of PMCs above than 4 Cm. In a series the analysis showed that cysts with greater than 5 cm increased operative time and risk of blood loss (1, 2, 3) . inflammation and adhesion of cysts increase the surgical difficulties (1, 3). In a center, some criteria is used for indication of surgical resection in PMCs: (a) Symptomatic patients, (b) the cyst grew progressively during clinical follow-up, (c) malignancy cannot be ruled by imaging and (d) cysts showed severe compression pulmonary artery or main bronchus (1, 2). Thoracotomy was the best approach for resection of PMCs but in recent years VATS was use in the world (1, 15, 16). Moureaux *et al* (22) reported the first resection of PMCs by VATS in 1991. But in this time, VATS has been used to resection for various mediastinal cysts. (3, 21, 23). Guo and colleagues (24). compared VATS versus thoracotomy in PMCs resection and they find VATS reduce the operative time, blood loss, no increasing the risks of incomplete resection and operative complications. In our series, VATS was initially performed for 12 patients. Only one patient was converted to thoracotomy because of severe cyst adhesions. Therefore, in this time VATS could be a primary therapeutic approach for resection of PMCs (15, 16).

The standard surgical treatment of PMCs are total cystectomy and resection of the radically all cysts wall if possible (1, 4, 9) . However, there are several problems for surgery, which include: in anterior mediastinal, when thymic cystic present and we can cannot excluded these cysts from malignant tumors by chest imaging, in such case thymectomy is recommended (1, 2, 3). In middle mediastinal cysts present, with severe adhesion to the membranous wall of trachea, the esophageal wall or the great vessels in such situation complete resection of the PMCs usually impossible, some research recommend using electrocautery or chemical agents as alcohol or iodine can destroy the residual cyst wall (1, 7, 9, 12). In our study we not have such PMCs

5. Conclusion

CT-scan is best imaging for diagnosis. Location of cysts are important in guiding for a differential diagnosis. Although the content of most these cysts is simple fluid, Furthermore, the presence of solid component may suggest cystic degeneration or cystic component of a solid neoplasm. Surgical resection with thoracotomy is recommended in our situation and the results are acceptable but in recent years, VATS recommended for primary therapeutic strategy in PMCs. Cysts with a maximum diameter greater than ten cm or cysts adjacent to vital mediastinal structures can increase the surgical difficulties and complications.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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