Thymic Cyst

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Thymic cysts are rare lesions that account for 3–5% of all mediastinal masses and represent approximately 1–2% of anterior mediastinal tumors.

2.1 Classification

The thymic cysts may be congenital or acquired. The congenital thymic cysts originate from embryonic remnants and may be found along the thymopharyngeal duct, which extends from the upper neck to the anterior mediastinum. The congenital thymic cysts occur rarely in the posterior mediastinum or near the diaphragm. The congenital thymic cysts are typically unilocular and contain clear fluid within the thin wall. They are mostly asymptomatic and are discovered incidentally during the first two decades of life. In contrast, the acquired thymic cysts (also known as multilocular thymic cysts) are usually multilocular and contain turbid fluid or gelatinous material due to the hemorrhage or infection. The acquired thymic cysts have been reported to be associated with radiation therapy for Hodgkin's disease, thymic tumor, thymic hyperplasia, thoracostomy or chest trauma, and human immunodeficiency virus (HIV) infection.

2.2 Clinical Features

Thymic cysts can occur in the neck and mediastinum, and are more common in the upper mediastinum. Cervical thymic cysts are most common at the age of 10–20 years, and mediastinal thymic cysts are more common at the age of 30–60 years. Clinically, it can also be ectopic, such as in the middle posterior mediastinum and anterior inferior mediastinum. Usually, small thymic cyst causes no clinical symptoms and often be found in physical examination. It was reported that 13–40% of the patients have clinical symptoms because of the adjacent mediastinum structure were oppressed by the accumulation of fluid and the increasing volume of cyst. In a study performed by Suster and Rosai on 18 patients, seven patients presented with chest pain or discomfort. Symptoms may be due to the enlargement of the cysts secondary to fluid accumulation. Dysphagia may occur if the esophagus is compressed; chest tightness, cough, and dyspnea may occur if the trachea is compressed; and palpitation may occur if the heart is compressed. If the cyst breaks into the pericardium, it may cause cardiac tamponade. Some cases may cause acute symptoms due to the rapid increase of cyst due to the increase of osmotic pressure or intracystic hemorrhage caused by degeneration. Unlike thymic solid tumors, thymic cysts are rarely associated with myasthenia gravis.

2.3 Histopathology

The pathological changes of thymic cysts are serous fluid or hemorrhage in the cysts, without malignant tendency. Microscopically, a unilocular cyst is characterized by a unique cavity lined by flattened epithelial cells surrounded by a thymic parenchyma. In case of multilocular thymic cysts, several cystic spaces are separated by thick walls containing dense lymphoid tissue. The cyst wall has thymic tissue, which is the basis for the diagnosis of thymic cysts.

2.4 Radiographic Features

The diagnostic methods of thymic cysts include chest X-rays, ultrasound, CT, and magnetic resonance imaging (MRI). Chest radiography can find asymptomatic lesions and can

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initially determine the scope of the lesion. Thyroid scan can determine the relationship between the lesion and the thyroid gland. Ultrasound diagnosis can find the cyst wall and cyst fluid. Chest CT scan can clearly identify the cystic characteristics of the mass and determine the size and extent of the lesion, unilocular or multilocular, intracapsular density, etc., and the relationship between the mass and adjacent mediastinal structures and whether it is associated with thymic hyperplasia can be clarified. MRI is particularly advantageous in showing the relationship between thymic cysts and surrounding tissues, and can be used as a supplement to CT examinations.

Thymic cysts generally appear as unilocular or multilocular cystic lesions with smooth and well-circumscribed border, round or round-like (Fig. 2.1), and some have mass effect. The lesions are often located at the midline structure, and there may be no obvious thymic tissues around them. Some huge individuals can extend to both sides of the thorax (Fig. 2.2).

On CT imaging, these lesions have no solid components, demonstrate thin, barely perceptible walls, which can be deformed with the change of mediastinal morphology during deep breathing (Fig. 2.3). The density (or signal) of the contents inside the capsule is uniform, which equals the water sample (0–20 HU). There is a fat gap between the adjacent mediastinal structure and cyst and do not enhance with intravenous contrast administration (Fig. 2.4). Occasionally, internal septations or mural calcifications could be seen, and the internal contents of the cyst may be proteinaceous or hemorrhagic, which causes

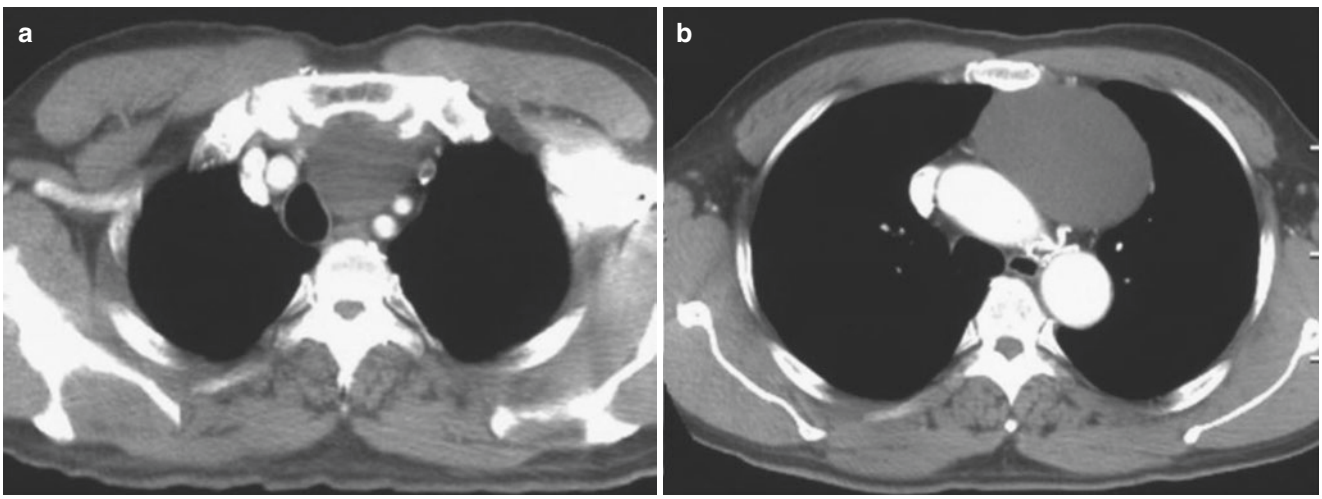

Fig. 2.1 A 52-year-old man found a round, well-defined thymic cyst in the left anterior superior mediastinum

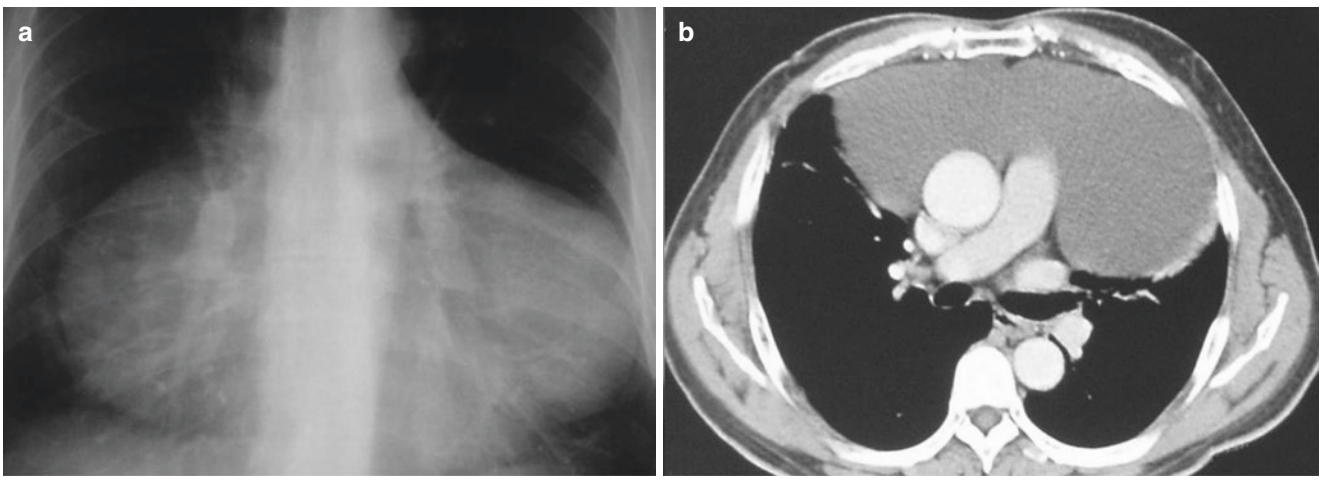

Fig. 2.2 A 54-year-old man found a giant anterior mediastinal cyst. Surgery showed that the cyst was close to the pericardium and pulmonary artery and extended to both sides of the thoracic cavity. The size was 40 × 30 × 20 cm, the capsule was intact and severely adhered to the surrounding pleura. The cyst contained 2400 ml of watery transparent liquid. Postoperative pathological diagnosis was thymic cyst

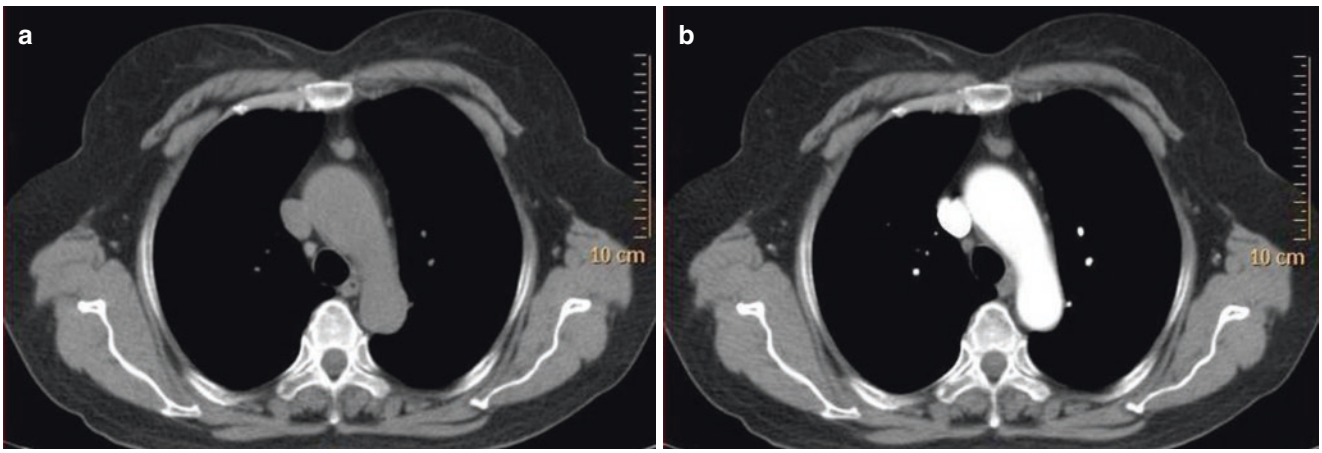

Fig. 2.3 A 59-year-old woman with a thymic cyst showed a thin cystic wall on the chest CT. Differences in inspiratory amplitudes can cause changes in the shape of the cyst. This is a characteristic of some thymic cysts

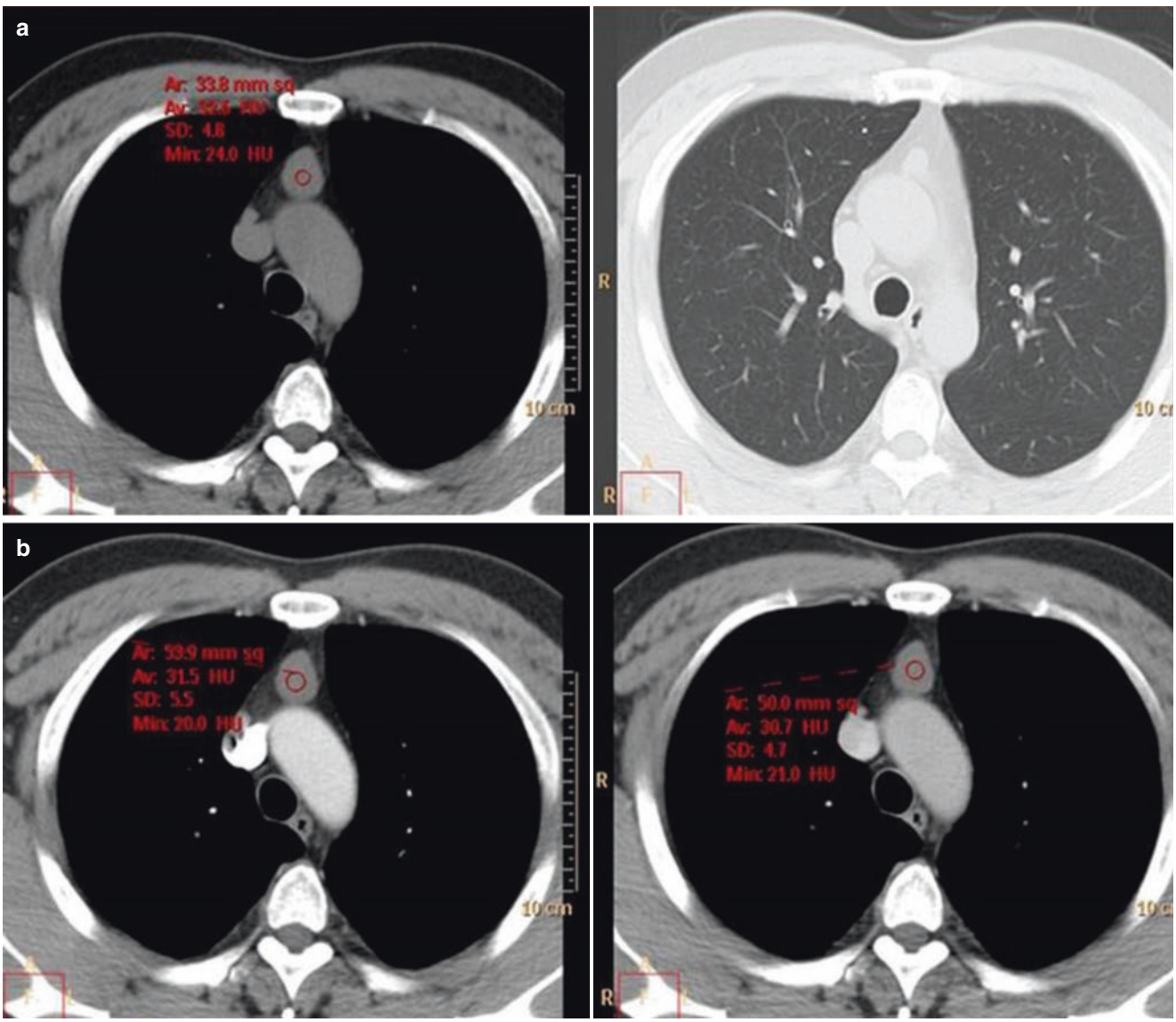

Fig. 2.4 A 51-year-old man with a thymic cyst. The CT attenuations of the three-phase dynamic scan were 32.6, 31.5, and 30.7 HU, respectively

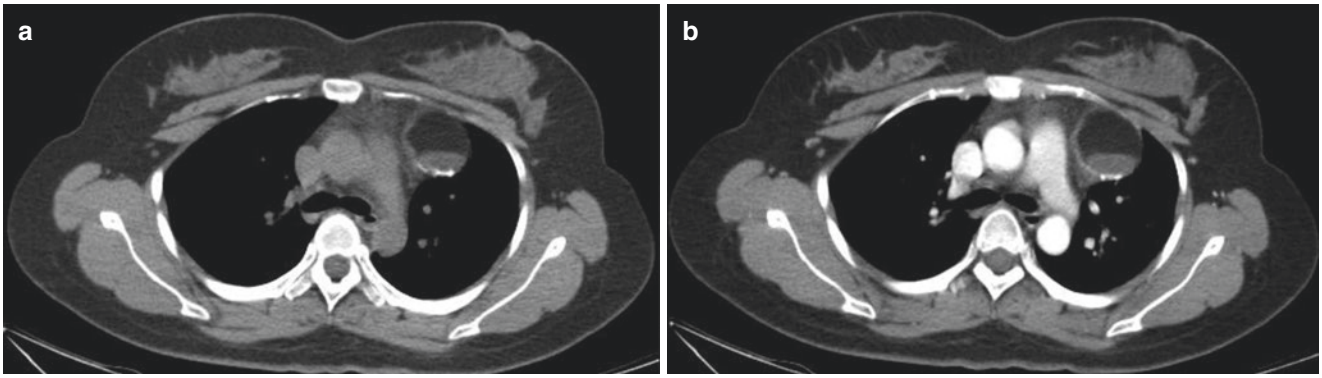

Fig. 2.5 A 30-year-old woman found cystic lesions in the left anterior mediastinum. Calcification was seen at the lower edge of the cyst wall, and no enhancement was seen in the enhanced scan. Gross specimens of the operation showed a single cyst with a size of 7 × 5 × 3.5 cm. The capsule contains sebaceous material and the thickness of the capsule wall is 0.3–1 cm. The pathological diagnosis was thymic cyst, and a large amount of residual thymic tissue was seen around the cyst wall

the attenuation of the soft tissue mass and results in a diagnostic dilemma. The negative CT attenuation in the cyst is one of the characteristics, which is related to the residual thymic tissue (containing fat) in the cyst and the degenerative thymic cyst surrounding the mediastinal adipose tissue (Fig. 2.5). The CT attenuation of the cystic fluid will increase while the cyst is accompanied by bleeding or high protein content. It can be occasionally misdiagnosed as a solid mass (Fig. 2.6). CT features of idiopathic multilocular thymic cyst were investigated by Choi et al. in eight patients [1]. They reported that typical appearance of multilocular thymic cysts is heterogeneous, unilocular, or multilocular cystic mass, and often with a soft-tissue attenuation component, and well-defined wall sometimes with calcifications. Their conclusion was that CT was not helpful to distinguish neoplastic from nonneoplastic soft tissue components. Araki et al. reported that 18 patients with pathologically confirmed intrathymic cysts who underwent thymectomy and had preoperative chest CT available for review [2]. Among the 11 patients with contrast-enhanced chest CT, the mean CT attenuation of the cysts was 38 HU (range 6–62 HU), while in 7 patients with unenhanced CT the value was 45 HU (range 26–64 HU). In 15 out of 18 patients (83%), the CT attenuation was >20 HU, the threshold usually used to differentiate fluid from soft tissue. Ackman et al. reported that true thymic cysts ranged in attenuation from −20 to 58 HU, with a mean attenuation of 23 HU [3].

2.5 Differential Diagnosis

High-density small thymic cyst and smaller thymoma are indeed difficult to distinguish in terms of morphology and density during CT scan, but enhanced scan can provide a differential diagnosis method. Thymoma can be mildly and evenly enhanced. Scan for thymic masse should be routinely enhanced to reduce misdiagnosis. In general, a small lesion that occurs in the thymus area is more likely to be cyst than thymoma.

Thymic cyst must also be distinguished from cystic teratoma. Cystic teratoma can contain fatty components, calcifications, or even tooth-like structures. Other cystic masses that may appear in the anterior superior mediastinum are cystic lymphangioma, bronchial cyst, and pericardial cyst. Preoperative identification is often difficult, especially in those cases where the normal thymus has completely deteriorated.

2.6 Treatment

Small mediastinal cysts, including also the thymic cysts, are without any clinical manifestations, do not require any treatment. The bigger cysts in the mediastinum, with compressed structures around, give different clinical manifestations, and need therapeutic treatment like puncture or extirpation of the cyst.

There has not been a consensus about the surgical therapeutic approach for the treatment of mediastinal cysts. The puncture of a bigger cyst can release symptoms, but the persistence of the epithelium that produces fluids can fulfill the cyst again. In addition, there is also the possibility of infection of the cyst and serious problems with mediastinal infection. The treatment of thymic cysts is based on surgical resection and must be as complete as possible. In Suster and Rosai's study of 18 cases, two patients presented a recurrence of the cyst due to incomplete surgical resection. For smaller mediastinal cysts, a video-assisted surgical approach may be appropriate as minimally inva-

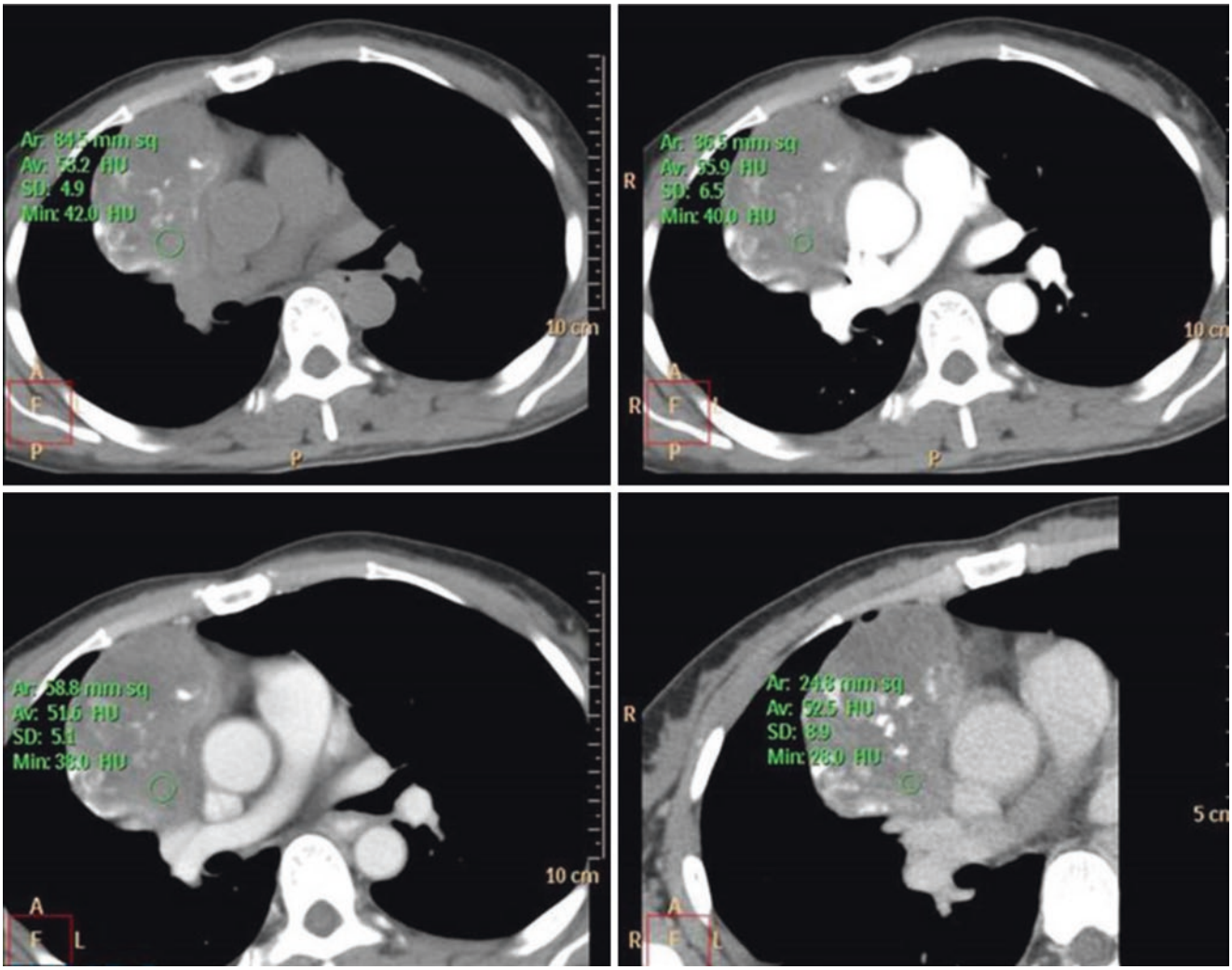

Fig. 2.6 A 48-year-old woman found a solid mass in the right anterior mediastinum with obvious calcification and no enhancement on multipoint enhanced scans (four-phase dynamic scan were 58.2, 55.9, 51.6, and 52.5 HU, respectively). The pathological diagnosis was thymic cyst

sive. The whole pathologic substrate with minimally invasive surgery can be removed. Surgical excision, via median sternotomy, thoracotomy, or video-assisted techniques is necessary for definitive diagnosis, treatment, and elimination of recurrence.

2.7 Case Analysis

2.7.1 Case 1

A 16-year-old man found a mediastinal mass for 5 days on physical examination.

Chest CT: A oval cystic mass with clear borders occupied the left anterior superior mediastinum (Fig. 2.7a–d).

[**Diagnosis**] Thymic cyst

[**Diagnosis basis**] This is an oval-shaped low-density mass in the left anterior mediastinum, which is close to the density of water samples. It is considered as a cystic lesion and the cyst wall is thin. Linear and speckled calcification (red arrow) can be seen. No enhancement is seen in the enhanced scan. Thymic cysts are considered. The patient underwent resection of the left anterior mediastinal tumor. Postoperative pathology showed that residual thymic tissue was visible in the cyst wall of the submitted tissue. The cyst cavity contained eosinophils with calcification, consistent with thymic cyst.

[**Analysis**] Mediastinal cystic mass is well-marginated, round, epithelium-lined lesions that contain fluid. Cysts account for 15–20% of all mediastinal masses and occur in all compartments of the mediastinum. The most common cystic lesions include bronchogenic cysts, pericardial and neurenteric cysts, esophageal duplication cysts, thymic cysts, meningocele, cystic teratoma, and lymphangioma. Thymic cysts need to be distinguished from cystic teratomas, foregut cysts, and pericardial cysts.

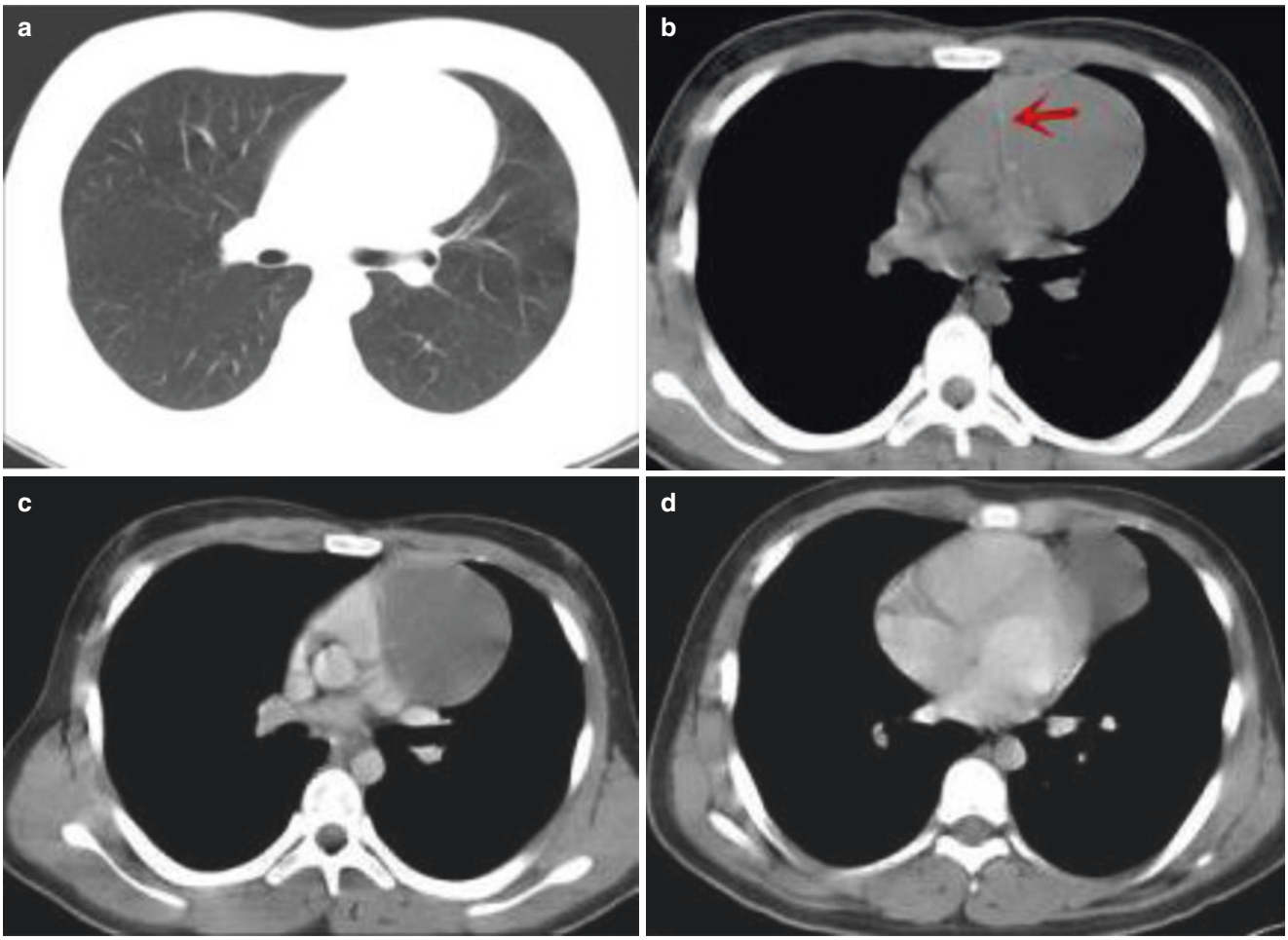

Fig. 2.7 (**a**–**d**) Chest CT of a 16-year-old man found a mediastinal mass on physical examination

Thymic cysts with mural calcification are easily misdiagnosed as cystic teratomas. Teratomas occur in the anterior superior mediastinum, and can also be a thin-walled cyst. However, the cyst wall of teratomas is generally thicker than that of thymic cysts. Teratomas may contain fat components, soft tissue components, liquid components, calcifications, or tooth-like structures.

The mediastinal foregut cysts originate from the embryonic foregut and are the most common type of mediastinal cysts (Fig. 2.8a–d). They are divided into bronchogenic cysts, esophageal cysts, and gastrointestinal cysts based on the components of the cyst wall and the lining cells. Bronchogenic cysts are congenital lesions, which originated from abnormal budding of the embryonic foregut. Most bronchogenic cysts occur in the lungs and mediastinum and rarely derive from the diaphragm. The location of occurrence of bronchogenic cysts depends on their timing of development during embryogenesis. Mediastinal bronchogenic cysts are divided into paratracheal, carinal, paraesophageal, hilar, and miscellaneous subtypes. Its common location is the posterior mediastinum and the subcarinal region. It may be attached to the carina, but does not communicate with the tracheobronchial tree. Typically, the lining of the cyst is composed of respiratory epithelium, sometimes with squamous metaplasia. The most reliable criterion for bronchogenic cyst is the presence of cartilage in the wall. The water-attenuation and soft tissue-attenuation represent two different radiologic patterns of bronchogenic cysts. Esophageal cysts are mostly located near the esophagus. Most patients are asymptomatic, and a few have difficulty swallowing due to compression of the esophagus, and some patients may be misdiagnosed with asthma or chronic bronchitis due to chronic cough. Gastrointestinal cysts are composed of gastric epithelium alone or together with intestinal mucosa, whereas entirely intestinal mucosa-lined cysts are extremely rare. Among them, gastric mucosal epithelial cells can have secretory functions, leading to peptic ulcers. The imaging characteristics of gastrointestinal cysts are basically consistent with bronchogenic cysts, but gastrointestinal cysts are rarely calcified.

Pericardial cysts were first described in 1837 as diverticula extending from the pericardium. These lesions are uni-

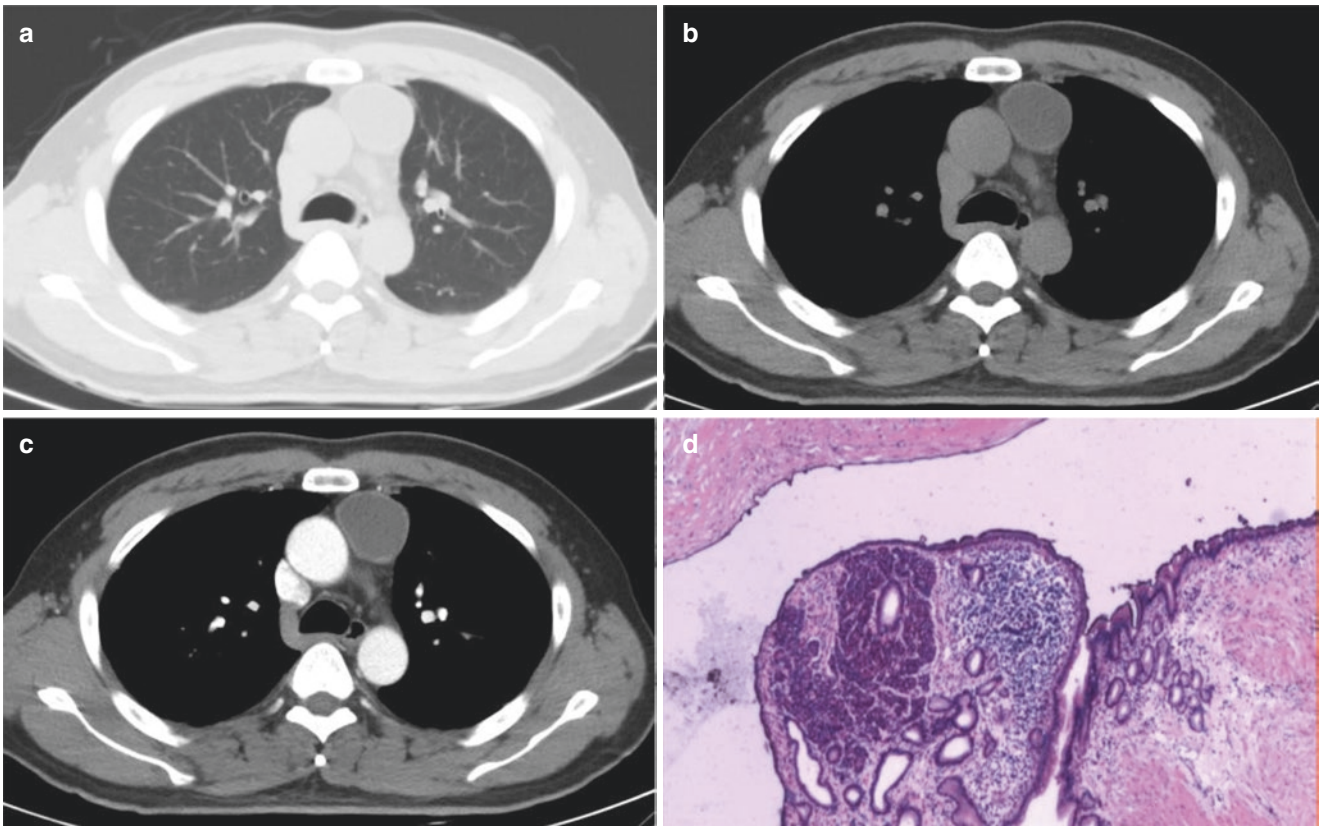

Fig. 2.8 (**a**–**d**) A 38-year-old man complained of intermittent chest tightness and chest pain for more than 2 years, and found a mediastinal mass for 1 year. Chest CT showed a uniform cystic mass in the anterior superior mediastinum and no enhancement. Pathology showed that the cyst wall was lined with gastric epithelium, intestinal epithelium, and pancreatic duct epithelium. A small amount of pancreatic tissue was found in the cyst wall fibrous tissue, and a small amount of atrophic thymus tissue was outside the cyst wall. The pathological diagnosis was foregut cyst

locular and contain transparent water-like fluid, with the occasional addition of blood and necrotic cystic content; the cyst wall is composed of connective tissue lined by mesothelial cells. Classically, pericardial cysts are located in the right cardiophrenic angle (51–70%), compared to that in the left cardiophrenic angle (28–38%) and rarely in other mediastinal sites. They are rare and often asymptomatic. Symptoms may be similar to more common causes of chest pain or dyspnea such as acute coronary syndrome or pulmonary embolism. Emergency physicians should consider mediastinal masses in the differential diagnosis of chest pain. In this case, pericardial cysts should be considered because of the risk of tamponade, sudden cardiac death, or other life-threatening complications. When the thymic cysts are large in size, they grow into strips or casts squeezed by adjacent tissues, and drop to a lower position due to gravity, even at the cardiophrenic angle (Fig. 2.9). Pericardial cysts can be similar to thymic cysts in CT or MRI, but the upper part is not connected to the thymus, and mural calcification is less common, and they are not all round, and can take different shapes at different periods.

2.7.2 Case 2

A 59-year-old man was examined and found a mediastinal mass.

Chest CT: Irregular cystic masses were seen in the left anterior superior mediastinum with clear borders and uniform density. The four-phase attenuations were 32.1, 24.1, 42.0, and 42.3HU (Fig. 2.10).

[**Diagnosis**] Thymic cyst

[**Diagnosis basis**] Anterior mediastinal cystic lesions with full margins and space-occupying effects are possible for thymoma and cysts. Insufficient tension, straight edges, or even partial depression, support the diagnosis of thymic cysts. In view of the mild enhancement of the enhanced scan in this case, the possibility of thymoma needs to be ruled out. Because the cyst of the thymic cyst is thin and the shape of the lesion can change with respiration. Examination of the expiratory phase showed that the lesion was full, the volume increased, and the CT attenuation also changed (Fig. 2.11). The diagnosis of thymic cyst was clear.

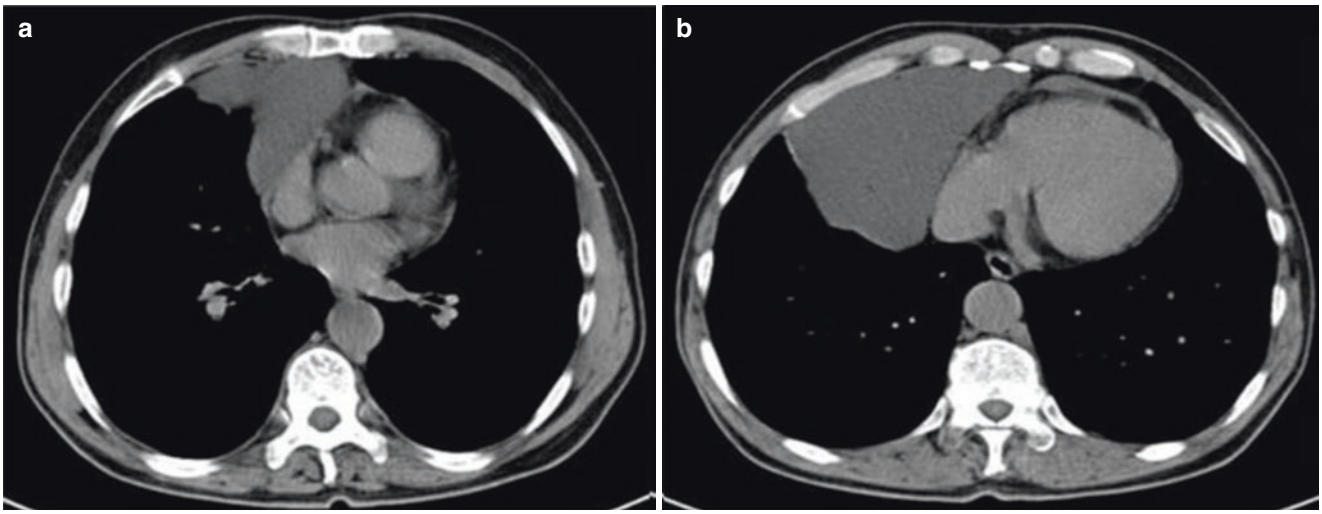

Fig. 2.9 A 69-year-old man with thymic cyst. Chest CT scan showed a low attenuation of the pericardial cystic soft tissue mass adjacent to the anterior mediastinum and anterior chest wall

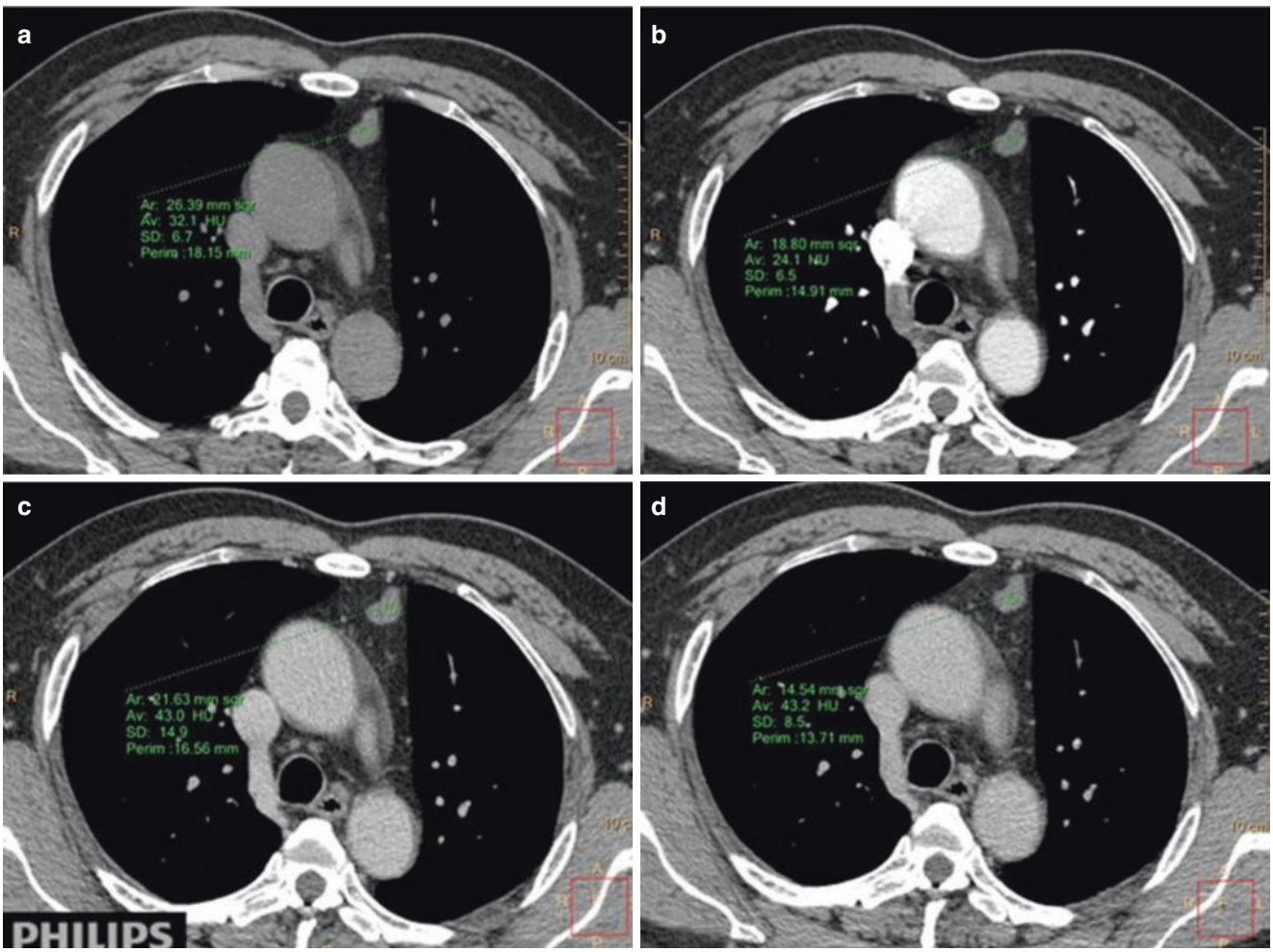

Fig. 2.10 Chest CT images of a 59-year-old man

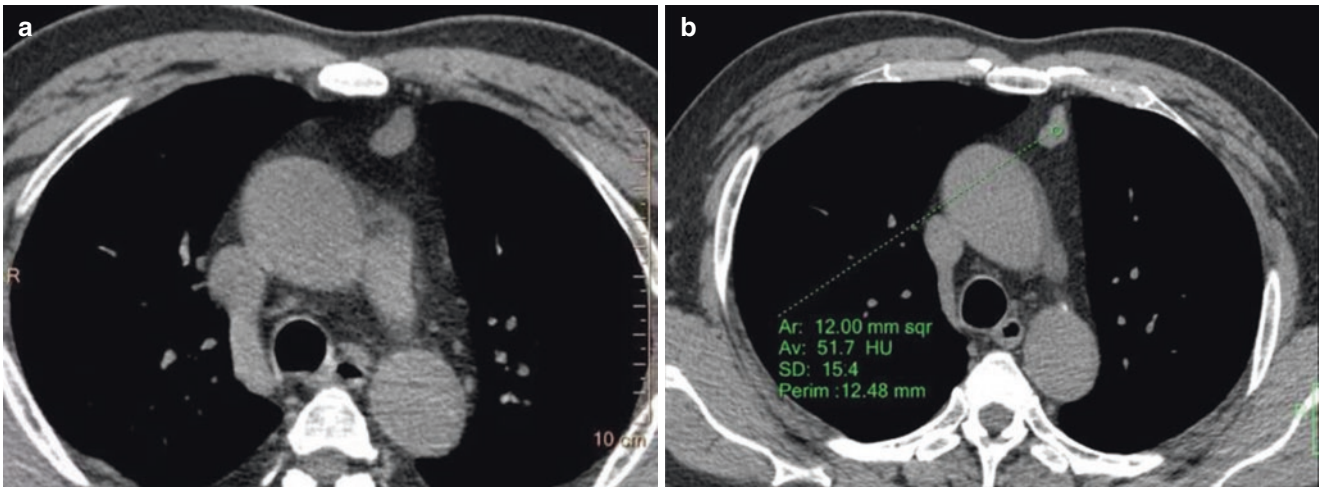

Fig. 2.11 The exhalation phase CT showed that the lesion was full, the volume increased, and the CT attenuation also changed

[**Analysis**] Locations of Oval shape, smooth contour, midline without visible adjacent thymic tissue, calcification, mass effect, or septa are the most frequent qualitative imaging features of intrathymic cyst. McErlean et al. retrospectively reviewed preoperative CT imaging for 66 patients, who had undergone thymectomy for benign thymic lesions or early-stage malignant thymic neoplasms [4]. Twenty-eight benign thymic lesions were studied, including 10 benign thymic cysts. They concluded that intralesional fat, midline location, and triangular thymic shape were more frequently found in "benign thymic lesions." The midline location was one of the most common findings of intrathymic cyst in the present cohort, accounting for 61% of the cases. Triangular shape or intralesional fat was not found in the present cohort, probably because these were the findings associated with other benign entities, such as thymolipoma, thymic hyperplasia, or benign thymus rather than cyst. Therefore, these CT features alone are difficult to distinguish between intrathymic cysts and thymic tumors, especially low-grade thymoma.

There are several methods to identify thymic cysts. If the CT attenuation of the enhanced scan does not change, it can be diagnosed as a cyst. However, the CT attenuation of small lesions is occasionally slightly enhanced, which is often difficult to distinguish. Thymoma is a solid tumor with a tendency to swell outward, and the edges are mostly swollen. Thymic cysts have thin walls, and sometimes due to inhalation, the cysts are compressed, deformed, and shrink in volume. If the normal scan and the enhanced scan have different inspiratory amplitudes, the lesion's morphology changes after two examinations, which can be diagnosed as a cyst. In addition, the inspiratory phase and the expiratory phase are scanned respectively. Due to the thin wall of the cyst, the morphology of the two scans will almost change, and the density and cyst position may sometimes change, which cues cyst.

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