Imaging of Anterior Mediastinal Masses in Adults

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Abstract

Imaging plays a major role in the diagnosis and management of mediastinal masses. Masses in the anterior mediastinum are more in number as compared with middle and posterior mediastinal masses. Imaging characteristics on conventional films, MDCT and other modalities are described in a pictorial fashion.

Keywords: Anterior mediastinum, Imaging, Different types of masses in the anterior mediastinum in adults. The four ‘T’s namely Thymic masses, Teratodermoids, Thyroids and Terrible lymphoma.
Introduction

Mediastinum is the anatomical space containing several structures and is located between two lungs invested with pleura. Its boundaries consist of anteriorly the sternum, posteriorly the spinous processes of the vertebrae, superiorly thoracic inlet and inferiorly diaphragm. This mediastinum is divided into compartments and is a creation of radiologists and the compartments include anterior, middle and posterior. Some authors add superior compartment of which the inferior boundary is the space between an imaginary line drawn from manibiosternal junction to the level of 6th dorsal vertebra. Superior to this line is superior compartment. However, in practice it is not very advantageous in considering mediastinal masses. The anterior mediastinum is located between sternum and a line drawn along the posterior wall of the trachea and extending along the posterior border of the heart towards diaphragm at the location of inferior vena cava (Tracheo cardiac line). The heart is considered to be in the anterior mediastinum, while aortic arch, descending aorta and pulmonary vessels are included in the middle mediastinum. Middle mediastinum comprises of the above tracheo cardiac line and another line parallel to this, cutting the anterior fourth of the vertebral column. Posterior to this line extending to the spinous process is the posterior mediastinum. Imaging plays a major role in identifying the masses in each compartment. It also helps in diagnosing the origin of these masses as certain masses occur commonly in specific compartments. Conventional radiology is the initial investigation. Further imaging such as MDCT, MRI, ultrasonography, angiography and pet scan supplement and confirm the initial diagnosis (Table 1). The mediastinal masses differ in children and adults, although some of them are common. This paper deals only with anterior mediastinal masses which statistically are more in number as compared with other compartments.

Fig. 1: FELSON’S CLASSIFICATION OF MEDIASTINAL COMPARTMENTS.

A - Anterior, M- middle and P – posterior.
Imaging Methods

Table 1:

- Conventional / Digital radiology
- Ultrasonography / Color doppler
- MDCT, CTA
- MRI
- PET CT.

Imaging Characteristics and Review of the Literature

Conventional radiography remains the primary radiologic examination in the evaluation of mediastinal masses. Postero anterior and lateral views of the chest radiographs are essential to localize and identify the mass in the mediastinal compartments. But they provide limited information about the morphology and extent of the lesion. MDCT with or without contrast remains the procedure of choice to further evaluate a mediastinal mass shown on chest radiography. It evaluates the size of the mass, determines its location within the mediastinum, defines its morphology and delineates its extent\(^3\), \(^4\), \(^5\), \(^6\), \(^7\). Ultrasonography is useful in differentiating a cystic from a solid mass\(^8\). Magnetic resonance imaging has the potential advantage of conclusive demonstration of cystic components and tissue differentiation\(^9\). Masses in the anterior mediastinum are listed in table 2.

Table 2. Masses in the anterior mediastinum:

- Thyroid – Substernal
- Teratodermoid
- Thymoma – Invasive, malignant
- Terible lymphoma
- Seminoma
- Mesenchymal tumors
- Pericardial cyst
- Hydatid cyst
- Lipomatosis
- Hernia through foramen of Morgagni
- Aneurysms of the ascending aorta
Imaging characteristics

Thyroid goiters: Intrathoracic goiters are classified into two subtypes. One is substernal or retrosternal and the second is retroesophageal which lies in the middle mediastinum. Substernal thyroid is an extension of the cervical thyroid. The substernal thyroid is seen retrosternally in the anterior mediastinum in a lateral view of the chest (Fig. 2ab). Depending upon the size it may deviate the trachea. Scintigraphy helps to identify the thyroid mass.

*Fig. 2ab: Retrosternal goiter; a – PA chest, b – lateral view. (↩)*

Teratodermoids contain elements of all germinal layers. A dermoid cyst is a teratoma of a cystic nature that contains an array of developmentally mature, solid tissues. It frequently consists of skin, hair follicles, and sweat glands. Mature teratoma contains mature tissues. Mature teratoma is a well defined, cystic containing fluid, fat and calcifications. Benign teratomas constitute 60 – 75 % of mediastinal germ cell tumors (Fig. 3 a,b,c,d)\(^{10}\). Imaging characteristics of teratodermoid are listed Table 3.

Table 3: TERATODERMOID – IMAGING CHARACTERISTICS

- Curvilinear/nodular calcifications
- Rudimentary tooth
- Fat fluid level
Malignant teratomas are also called immature teratomas and contain malignant tissues. They are poorly defined and contain fat with and compression or invasion of mediastinal structures. Malignant mediastinal teratomas occur most often in young men in their 20s or 30s. The malignant nature of the teratoma in the thorax is expressed by involvement of the nerves and cardio vascular structures in the mediastinum. The involvement of the phrenic nerve produces paralysis of the left dome of the diaphragm (Fig. 4 ab). It is often difficult to differentiate from aggressive thymomas.
Thymic masses generally are located in the anterior mediastinum and may extend to the middle mediastinum. The different types of thymic masses are listed in Table 4.

Table 4:

- Thymic cyst
- Thymoma – Benign, Invassive, Malignant
- Thymolipoma
- Thymic lymphoma
- Thymic carcinoid

Thymic cysts: A firm diagnosis is made by ultrasonography or CT. CECT confirms the diagnosis and the benign nature of the cysts (Fig. 5ab). The presence of Hassall's corpuscles in the cyst wall is diagnostic especially in congenital lesions. They may be congenital or acquired. Thymic cyst can be a simple cyst or it can lie within thymoma. It may also follow irradiation for Hodgkin’s lymphoma.

Thymomas – Aggressive/Malignant: Thymomas are the most common neoplasms of the anterior mediastinum, originate within the epithelial cells of the thymus. A thymoma can appear at any age, but most common in patients over the age of 40. They are slow-growing lesions and usually behave in a benign fashion (Fig. 6ab). A subgroup of these tumors have an aggressive nature and are called invasive thymomas (30 %) (Fig 7). Invasive thymomas typically invade locally and spread along pleural and pericardial surfaces, but they can exhibit extrathoracic metastasis.
Malignant thymomas: These are highly aggressive and large. Areas of necrosis with haemorrhages are common but calcification and cyst formation is rare. These invade contiguous mediastinal structures and may produce extra thoracic metastasis. MDCT, CECT and PET SCAN are useful to study these patients. CECT helps to know the invasion of the vessels (Fig. 8ab).

Thymolipomas: They contain both thymic tissue and mature lipomatous tissue. A thymolipoma can grow to a very large size. On CT thymolipomas typically appears almost entirely fatty with some areas of inhomogeneous soft tissue density that represent thymic tissue (Fig. 9a,b,c).
Thymic lymphoma and Thymic carcinoids: These tumors are quite uncommon and there are no typical imaging characteristics for a definitive diagnosis.

Terrible lymphomas: These constitute about fifteen percent of all primary mediastinal masses and these are common in younger age group. Approximately sixty percent belong to Hodgkin lymphoma. B cell and T cell lymphomas are also not uncommon in this group. Histologically, three types are noted: 1. Nodular sclerosing Hodgkin lymphoma, 2. Primary mediastinal large B-cell lymphoma, 3. Lymphoblastic lymphoma. However, it is not possible to differentiate these three by imaging methodology. Although, most of the bulk of these lymphomas occupy the anterior mediastinum, some of them extend to middle and posterior compartments (Fig. 10 ab).

![Fig. 10 ab, Rapidly growing lymphoma.](image)

Germ cell tumors: Although, extragonadal germ cell tumors are uncommon, mediastinum is the most common place. About 5-10 % of all germ cell tumors are noted in the mediastinum. Generally, benign germ cell tumors are called as terato dermoids\(^{11,12}\). These have been dealt with already. Primary malignant germ cell tumor in the mediastinum is rare. The clinical symptoms are usually due to the result of compression of the adjacent structures, such as trachea, esophagus and vessels. Radiologically, a diffuse mass is noted in the anterior mediastinum as noted in the chest films (Fig. 11a, b). On CT a homogenous soft tissue mass is seen compressing the neighbouring structures (Fig. 11 c, d). No specific imaging characters are noted to make a histological diagnosis.

![a](image), ![b](image)
Mesenchymal tumors include hemangiomas and lymphangiomas. Cystic lymphangiomas, also known as cystic hygromas are a heterogenous group of benign vascular malformations of the lymphatic system, composed of cystically dilated lymphatics. Most cystic lymphangiomas are found in the cervical region (75%) and axillary region (20%), the majority of them are detected before the age of 2 years. Of cervical lymphangiomas only 2–3% may be associated with an intrathoracic extension. An isolated mediastinal lymphangioma without a cervical component is an uncommon occurrence which account for less than 1%. The majority of mediastinal cystic hygromas are located in the superior and anterior compartments. It may extend to the middle mediastinum. Posterior location is exceptional. Mediastinal cystic lesions are mostly asymptomatic. The diagnosis cannot be made on chest films only. It has to be confirmed by CT. The characteristic appearance is a multilocular predominantly cystic mass containing septa of variable thickness and solid components (Fig. 12a, b). Ultrasonography is helpful in noting the cystic nature of the mass.
**Pericardial cysts:** Among the cysts of the anterior mediastinum, pericardial cysts are most common. The frequent location is at the right cardiophrenic angle. These are also called coelomic cysts, pleuropericardial or clear water cysts. The chest films taken in PA and lateral views demonstrate the rounded or oval opaque shadow with uniform density (Fig. 13a, b). No calcification is noted. Ultrasonography and CT establish the cystic nature (Fig. 13 c, d, e). Intrapericardial teratoma contains calcifications, fat etc.

![Fig. 13ab, Pericardial cyst; a – PA chest, b – lateral.](image)

![Fig. 13c, d, e: Pleuropericardial cyst; c – PA chest, d – ultrasonography, e – CT.](image)
Hydatid cysts or echinococcal cysts: In tropical countries and sheep growing places, hydatid cysts are common. They can occur anywhere in the body from brain to foot. In the chest involving the lungs, pleura and mediastinum are the second common sites in the body. The cystic nature is not definitely established on chest films (Fig. 14 a, b). It can occur in any part of the mediastinum. Ultrasonography establishes the multilocular nature. Calcification is quite rare.

![Hydatid cyst, a – PA chest, b – lateral.](image)

**Fig. 14ab: Hydatid cyst, a – PA chest, b – lateral.**

Mediastinal Lipomatosis is a disorder where there is a deposition of a large amount of mature adipose tissue in the mediastinum. It is not a common benign cause of mediastinal widening. It may be idiopathic or part of a generalised obesity. It may be seen as a result of steroid therapy or in cushing disease. Radiologically, there is mediastinal widening, particularly in the superior and anterior compartments in the chest films. They might also rarely show a clear peripheral zone present around the tumour which is called Huer's sign. CT is the imaging choice in confirming the diagnosis (Fig. 15 ab).

![Mediastinal lipomatosis; a – Conventional, b – CT](image)

**Fig. 15ab: Mediastinal lipomatosis; a – Conventional, b – CT**
Hernias through foramen of Morgagni: Out of the three abnormal openings of the diaphragm, costosternal hiatus is one of the rarer ones. Herniation of the abdominal contents can occur through this hiatus. Generally, the contents consist of mesenteric fat and vessels, but in large herniations, the colon and small bowel are also included. On chest films, a homogenous opacity is noted in the right cardiophrenic angle which cannot be easily distinguished from pericardial cyst. Whereas, if gaseous contents are noted a definite diagnosis can be made. However, CT establishes the nature of the contents (Fig. 16 abcd). This hernia is usually described as Morgagni hernia.

![Fig. 16ab: Morgagni hernia; a – PA chest, b – CECT.](image)

![Fig. 16cd: Morgagni hernia; c – PA chest, d – CT showing mesentry.](image)

Aneurysms of the ascending aorta: In older age groups, aneurysms of the ascending aorta are not uncommon. Ascending aortic aneurysms may be true or false. Ascending aortic aneurysms are defined as permanent dilatation of the ascending aorta with a diameter equaling or exceeding 1.5 times the expected normal diameter or an ascending aortic diameter equal to or greater than 5 cm. In younger age group, Marfan syndrome is one of the causes of this type of aneurysm. It may be simple dilatation, post stenotic dilatation in aortic valve stenosis or of dissecting aneurysm (Fig. 17abc). CECT and MRI are essential to study the details of the aneurysm\(^\text{16}\).
**Fig. 17 abc, Aneurysms of the ascending aorta: a – PA chest poststenotic, b – CT Marfans, c – CECT dissecting.**

**Conclusion**

The mediastinum is divided into three major compartments which division helps radiologically to identify and analyse mediastinal masses. In this article, the anterior mediastinal masses are only considered, that too in adults. Most of the masses are identified by conventional radiology. However, ultrasonography and MDCT with or without contrast are helpful in identifying the morphology of the contents of these masses. The common and unusual mediastinal masses are described with their specific imaging features.

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