

Approaching the Patient with an Anterior Mediastinal Mass: A Guide for Radiologists

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Abstract: Mediastinal masses are relatively uncommon, yet include a large variety of entities. Some tumors can be diagnosed with confidence based on imaging alone; others when a typical appearance is combined with the right clinical presentation. A structured approach for radiologists is presented to facilitate evaluation of patients with anterior mediastinal tumors. The approach focuses first on the more common tumors and on imaging features that strongly suggest a particular diagnosis. Discussion with the clinician can be very helpful in formulating a presumptive diagnosis. This article also discusses that confirmatory imaging or biopsy tests are most beneficial in particular situations.

Key Words: Mediastinum, Anterior, CT, MRI, PET.

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Mediastinal masses are relatively uncommon. Furthermore, because there is such a wide variety of pathologic entities that can occur in this region, the average radiologist or clinician will encounter many of these specific lesions only infrequently. Imaging is a critical part of establishing a presumptive diagnosis, which will guide whether and what type of confirmatory testing is needed. When classic features are present, a presumptive diagnosis can be made with a high degree of confidence based on imaging alone. However, the appearance of anterior mediastinal lesions is often less specific. Nevertheless, when combined with a typical clinical presentation, a particular entity can be strongly suggested.

Developing an appropriate differential diagnosis for a particular patient can be very useful in avoiding unnecessary and sometimes misleading biopsies or additional tests. A framework to guide the image interpretation and additional testing improves the efficiency of the evaluation. This is particularly pertinent since incidental anterior mediastinal

abnormalities are discovered with increasing frequency due to increased imaging of asymptomatic patients, either for screening or staging of extrathoracic primary malignancies.¹ To address this need, the International Thymic Malignancy Interest Group (ITMIG) began an initiative to develop such a structured approach. This article represents the output of this project primarily addressed to radiologists; a companion paper focused on the clinician has also been produced.²

METHODS

The algorithm outlined in this document represents a consensus among radiologists and clinicians with a particular interest in anterior mediastinal diseases. The ITMIG Education Committee assembled a core workgroup (E.M.M., B.W.C., F.D., and M.O.) to review the existing literature as well as standards for imaging and clinical investigation of patients with an anterior mediastinal mass. This group drafted a proposed approach to the patient presenting with an anterior mediastinal mass. The document was then refined by an extended workgroup (Ami Rubinowitz, Wentao Fang, Jeanne B. Ackman, and Stephen Cassivi).

GENERAL CONSIDERATIONS

Slightly more than half of all mediastinal masses are located in the anterior mediastinum. One-fourth of mediastinal masses are discovered in the middle mediastinum, and another one-fourth of masses are found in the posterior mediastinum.^{3–11} Assignment of lesions to particular mediastinal compartments has been quite useful in narrowing the differential diagnosis. In the past, this classification was based on varying definitions based on the lateral chest radiograph. A modern, computed tomography (CT)-based definition of mediastinal compartments has been developed by ITMIG¹² building upon work done by radiologists associated with the Japanese Association for Research in the Thymus.¹³

INCIDENCE

The most common tumors of the anterior mediastinum include thymic malignancies and lymphoma, but the prevalence of the different abnormalities varies markedly according to both age and gender. Thymoma is the most common anterior mediastinal mass and primary tumor of the anterior mediastinum, with the highest incidence in middle aged patients. Other tumors of the anterior mediastinum include benign teratomas and malignant germ cell tumors such as seminomas and nonseminomatous germ cell tumors (NSGCTs).

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Malignant teratomas, which are residual lesions after treatment of NSGCTs, are typically grouped in the same category as NSGCTs. Thymic cysts and benign cystic lesions (usually acquired, often related to surgery and radiation therapy) are among the most common nonneoplastic lesions of the anterior mediastinum. Additional nonneoplastic masses include vascular abnormalities, substernal extension of thyroid goiters, other cystic lesions such as pericardial or bronchogenic cysts, and lesions related to infection such as tuberculosis.

The true incidence of anterior mediastinal masses is difficult to ascertain from the existing literature for numerous reasons. One of the most important of these is that different clinical and/or radiologic classification schemes have been used to define the mediastinal compartments. Additionally, the inclusion of nonneoplastic lesions such as thymic and pericardial cysts differs between series. Finally, there is variability in the inclusion of lymphomas in different series. More detail on the relative incidence of anterior mediastinal tumors is provided elsewhere.²

ROLE OF IMAGING

A large anterior mediastinal mass is readily identified by chest radiography as it typically manifests as an extra soft tissue mass or opacity. The use of the *silhouette sign*, which describes the loss of normal borders of intrathoracic structures, increases the sensitivity of detecting mediastinal abnormalities. The borders of the anterior mediastinum, that is, the ascending aorta, right and left heart border, are visualized by radiography because they are delineated by natural contrast: the air containing lung (Figure 1A). The density of soft tissue masses is similar to the anterior mediastinal structures and the image produced by the X-rays cannot differentiate between the abnormal mass and the normal mediastinal structure. However, since the mass displaces the air-containing lung from the normal mediastinal structure, the border of the

normal mediastinal structure is lost. This loss of normal border is termed the *silhouette sign* (Figure 1B). However, the identification of a small mediastinal mass requires a more methodical approach. The presence of the anterior junction line, representing the point of contact between the anterior lungs and their pleural surfaces anterior to the cardiovascular structures, can help exclude the presence of an anterior mediastinal mass. This line is seen in 20% of normal chest radiographs (Figure 2A). Thickening of this line indicates an anterior mediastinal mass (Figure 2B).

Once an abnormality is identified by chest radiography, cross-sectional imaging is used to characterize the lesion, generate a differential diagnosis, assess for other abnormalities, and guide further management. CT with intravenous (IV) contrast has traditionally been the imaging modality of choice in the evaluation and characterization of an anterior mediastinal mass. One study analyzing 127 anterior mediastinal masses of various etiologies demonstrated that CT was equal or superior to magnetic resonance imaging (MRI) in the diagnosis of anterior mediastinal masses except for thymic cysts.¹⁴ Indeed, when a cystic mass is suspected or is to be investigated, MRI is the most useful imaging modality, because MRI is superior to CT in distinguishing cystic from solid masses (e.g., thymic cysts from thymic neoplasms), discerning cystic/necrotic components within solid masses, and discerning thymic hyperplasia from thymic tumors.¹⁵ For patients unable to undergo contrast-enhanced CT due to renal failure or allergy to IV contrast, non-contrast MRI may be performed to characterize the lesion and evaluate for involvement of vascular structures. Chemical shift techniques used in MRI can also be used to differentiate thymic hyperplasia from thymoma in adult patients.^{16,17} ¹⁸F-FDG positron emission tomography (PET)/CT is not routinely performed to evaluate or characterize an anterior mediastinal mass, but may be used to stage patients with specific malignant lesions and monitor response

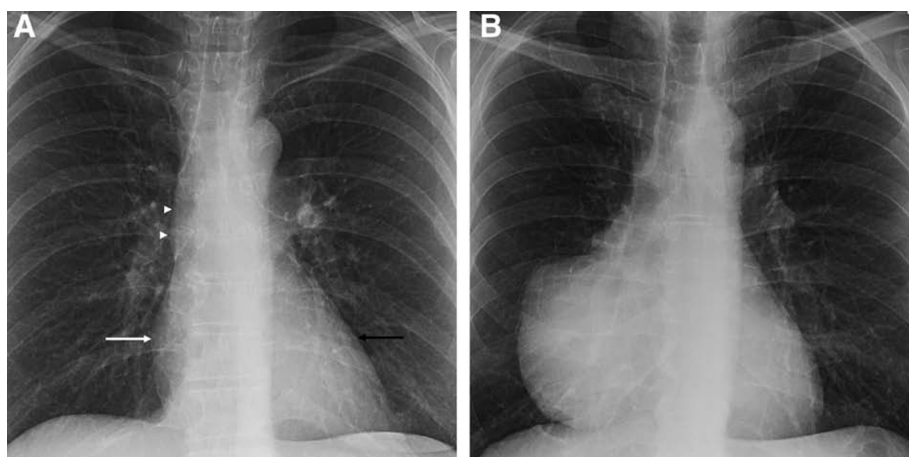


FIGURE 1. Normal anatomy and the silhouette sign. *A*, Coned-down posteroanterior chest radiograph demonstrates the normal boundaries of the anterior mediastinum: the right heart border (white arrow), left heart border (black arrow), and ascending aorta (arrowheads). These structures are normally visible on chest radiography because they are delineated by air-filled lung. *B*, Coned-down posteroanterior chest radiograph of a different patient demonstrates obscuration of the right heart border and ascending aorta by a large right anterior mediastinal mass found to represent lymphoma at the time of surgery. This loss of normal boundaries and structures, known as the silhouette sign, may be used to localize an abnormality to a specific mediastinal compartment such as the anterior mediastinum in this case.

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