Lesions of the anterior mediastinum: radiologic appearance and histologic diagnostic correlation after percutaneous needle biopsy

Poster No.: C-2511
Congress: ECR 2013
Type: Educational Exhibit
Authors: R. D. T. Mesquita¹, P. Ananias¹, P. M. M. Lopes², J. A. Sousa Pereira¹, S. Foreid¹, I. Bravio¹, N. Costa¹, H. M. R. Marques¹, L. Figueiredo¹; ᵃ¹Lisbon/PT, ᵃ²Paranhos - Porto/PT
Keywords: Mediastinum, Thorax, CT, CT-Angiography, Diagnostic procedure, Biopsy, Neoplasia
DOI: 10.1594/ecr2013/C-2511

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

- To characterize the typical imaging findings of anterior mediastinal lesions.
- To assess the efficacy and safety of CT guided transthoracic biopsy.
- To correlate the imaging findings with the final diagnosis.
Background

Focal mediastinal lesions are common diagnostic challenges for the radiologist. Anterior mediastinal masses comprise a number of neoplasms and noneoplastic conditions that arise in the anterior mediastinum, and accounts for about 50% of all mediastinal masses. The representative tumors in the anterior mediastinum comprise thymic neoplasms, germ cell neoplasm, lymphoma, thyroid masses, ectopic parathyroid masses and mesenchymal tumors.

Multi detector computed tomography (MDCT) is generally the choice modality of diagnostic imaging in assessment of mediastinal tumors. CT has the ability to better characterize and localize masses seen on chest radiographs, aids in detection of sites of involvement, and allows precise evaluation of anatomical relationship with adjacent structures that can alter the disease staging, prognosis and therapy. It is also used in guidance of transthoracic biopsy, and has the capacity to monitor response to therapy and detection of relapse.

In this work we describe the clinical features, pathological findings, and imaging findings of CT of mediastinal tumors with a focus on thymic hyperplasia, thymoma, germ cell tumors and lymphoma, the cases for which we had a final diagnosis made after percutaneous transthoracic needle biopsy, performed in our department in a 2-year period.

Normal thymus and thymic hyperplasia

The normal thymus is located in the superior mediastinum and varies widely in size and shape depending on age. The widely accepted CT measurement of the thymus is the thickness of the lobes measured perpendicular to their long axis. On CT, the normal maximal thickness of thymus is 18mm in younger than 20 years, and 13mm in older patients.

Two distinct histologic types of thymic hyperplasia are recognized: true thymic hyperplasia and lymphoid hyperplasia. True thymic hyperplasia is defined as an increase in size of the thymus with normal gross and histologic examination. This entity occurs primarily in children recovering from recent "stress" including chemotherapy, treatment of hypercortisolism, radiotherapy and thermal burns. In contrast to most cases of true thymic hyperplasia, lymphoid hyperplasia does not produce thymic enlargement, and refers to an increased number of lymphoid follicles and is most commonly seen in patients with myasthenia gravis, being present in up to 65% of cases.

When rebound thymic hyperplasia occurs in patients who previously underwent chemotherapy for malignancy, distinction of thymic rebound from recurrent neoplasm...
may be difficult. Clinically, thymic rebound is most problematic when it is seen in patients with malignant lymphoma who have undergone chemotherapy.

**Thymoma**

Thymoma is the most common primary neoplasm of the anterior mediastinum.

The masses of the thymus are traditionally classified into thymomas, which are histologically benign but may be either non invasive (encapsulated) or invasive, and thymic carcinomas, in which the epithelial component shows signs of frank malignancy. Tumors that are encapsulated and are amenable to complete resection have a good prognosis, whereas invasive and unresectable tumors have a poor prognosis regardless of their histologic characteristics.

The average age at diagnosis of thymoma is 45 to 50; these lesions are rare in patients under the age of 20. The tumor affects men and woman with approximately equal frequency.

Approximately 20-50% of thymomas are discovered incidentally in asymptomatic individuals. In a minority of cases, patients present with signs and symptoms related to compression or invasion of adjacent mediastinal structures. Compression of the recurrent laryngeal nerve, trachea or the esophagus may produce hoarseness, cough, dyspnea, chest pain, respiratory infection, or dysphagia.

The relationship of thymoma with myasthenia gravis is well established. Between 30% and 50% of patients with a thymoma have myasthenia gravis, whereas 10%-15% of patients with myasthenia gravis have a thymoma, but the two conditions do not necessarily occur synchronously. The most common associated thymic abnormality is follicular thymic hyperplasia, seen in approximately 65% of patients with myasthenia gravis. While most often associated with myasthenia gravis, thymoma has also been associated with other autoimmune and paraneoplastic phenomena such as hypogammaglobulinemia, red cell aplasia, systemic lupus erythematosus, polymyositis, and myocarditis.

Thymomas are composed of neoplastic epithelial cells and nonneolastic lymphocytes and exhibit marked histologic variability.

The World Health Organization (WHO) has recently reclassified these neoplasms based upon the morphology of the epithelial component and the ratio of epithelial cells to lymphocytes. The classification system divides these neoplasms into types A, AB, B1, B2, B3, and C, with a spectrum of histologic changes. Today, histologic classification primarily distinguishes thymic carcinoma from the different types of thymoma.
Several WHO subtypes can often coexist in the same tumor, which makes classification challenging, particularly at needle biopsy, which may not yield a sample of the predominant tumor subtype.

Most thymomas are slow-growing neoplasms but they may exhibit aggressive behavior such as invasion of adjacent structures and involvement of the pleura and pericardium. Contiguity of a thymoma with the adjacent chest wall, the pleura or mediastinal structures cannot be used as a reliable evidence of invasion of these structures, because encapsulated thymomas may have these fibrous adhesions but invasion must always be confirmed with histologic evidence of invasion.

Extrathoracic metastases are rare, although transdiaphragmatic spread has been described. For this reason, it is important to image the entire thorax and upper abdomen in any patient with suspected invasive disease.

The main role of imaging is to initially diagnose and properly stage thymoma, with emphasis on the detection of local invasion and distant spread of disease, to identify candidates for preoperative neoadjuvant.

**Lymphoma**

Either Hodgkin lymphoma (HL) or non-Hodgkin lymphoma (NHL) can present as an anterior mediastinal mass.

Malignant lymphoma accounts for nearly 20% of all mediastinum neoplasms in adults. Lymphoma involving the mediastinum secondary to generalized disease is more common but mediastinal primary lesion can also occur. Hodgkin's disease is the most common primary mediastinal lymphoma. In addition to intrathoracic nodal disease, thymic involvement is also common. Clinically, most malignant lymphomas of the mediastinum affect individuals younger than those with thymoma. Involvement of other lymph nodes in the mediastinum or hila makes lymphoma more likely. Presence of discrete thick-walled cysts within a mass and lung invasion by tumor, are additional helpful findings in the diagnosis of lymphoma.

Hodgkin lymphoma affects both men and women, usually between 20-30 years or over the age of 50 years. Hodgkin disease involves the thorax in 85% of patients at the time of presentation. The large majority of patients with intrathoracic involvement have mediastinal lymph node enlargement, that most commonly involves the anterior mediastinal and hilar nodal groups. The anterior mediastinum is the most frequent site for a localized nodal mass in patients with HL, particularly those with the nodular sclerosing type. Involvement of multiple lymph node groups in the thorax is more common in HL than in NHL, with the exception of paracardiac and posterior mediastinal locations. HL has a predilection for thymic involvement, in association with lymphadenopathy.
Of the various subtypes of Non-Hodgkin lymphoma that present with mediastinal masses, lymphoblastic lymphoma and diffuse large B-cell lymphoma are the most common, with mean age of presentation of 28 and 30 years, respectively. Symptoms are common and include constitutional symptoms and chest or back pain, cough, dyspnea. Adults may experience rapid onset of symptoms, associated with compression of mediastinal structures by the lymphomatous mass. NHL involves the thorax in approximately 40% of patients at presentation.

**Germ Cell Tumors**

Germ cell tumors account for 10-25% of anterior mediastinal masses in adults and are thought to arise from mediastinal remnants of multipotential primitive germ cells left behind after embryonal cell migration. These primitive cells give rise to a variety of neoplasms. Generally, germ cells tumors consist of three categories: Teratoma, seminoma and nonseminomatous malignant germ cells.

The anterior mediastinum is the most common extragonadal site for germ cell tumors. Most germ cell tumors of the mediastinum present during the second to fourth decades of life. More than 80% of germ cell tumors are benign, with a large majority of mature teratomas. While benign tumors have a slight female predominance, malignant tumors are seen almost exclusively in men. Benign tumors are usually asymptomatic, while malignant tumors are more likely to cause symptoms. Malignant germ cell tumors can occasionally secrete tumor markers and these can be used in making a diagnosis and monitoring response to therapy.

Since they are histologically indistinguishable from germ cell tumors arising in the testes and ovaries, to make a diagnosis of primary mediastinal germ cell tumors, gonadal tumors should be excluded as a source of mediastinal metastases. A key in distinguishing a primary from metastatic mediastinal germ cell neoplasm is the presence of retroperitoneal lymph node involvement in metastatic gonadal tumors.

**Teratoma**

Teratoma is the most common mediastinal germ cell neoplasm, comprising 60 -70% of mediastinal germ cell neoplasms. Teratomas usually contain elements of all three germinal layers: ectoderm, mesoderm and endoderm, and they are histologically classified as mature teratoma, immature teratoma and teratoma with malignant transformation. Mature teratoma is the most common histologic type of mediastinal germ cell tumor, followed by seminoma. They are slow-growing neoplasms, generally with benign course that usually arise near the thymus or within the thymic parenchyma. Posterior mediastinal teratomas are rare, and represent 3-8% of all cases.
The appearance of mediastinal teratoma varies, depending on its content. Mature teratomas are spherical, lobulated, well-encapsulated tumors that are typically cystic and usually multilocular, but unilocular cystic tumors also occur. Solid elements are frequently present in association with the cysts, and in rare cases the tumors are predominantly solid; solid teratomas are usually malignant.

Mature teratomas are often asymptomatic, and the tumor is discovered incidentally on chest radiographs or CT obtained for other reasons. Large tumors may produce symptoms like dyspnea, cough, and chest pain due to local compression of mediastinal structures, rupture, or associated infection.

The treatment of mature teratoma consists of complete surgical excision of the mass. The prognosis is very good, in contrast to the prognosis of immature teratomas that have a more malignant and aggressive behavior, and have a poor prognosis in the adult.

**Seminoma**

The remainder of the mediastinal germ cell tumors is malignant. Seminoma is the second most common mediastinal tumor and the most common malignant germ cell neoplasm, accounting for approximately 30% of these tumors. Seminomas occur almost exclusively in males during the period from the second to fourth decades of life. Approximately 20-30% of patients are asymptomatic at presentation, but may experience symptoms related to invasion of the adjacent airways and vessels, such as substernal chest pain or respiratory symptoms. They present as large solid masses that may project into one or both sides of the anterior mediastinum.

Metastatic mediastinal seminomas most frequently involve regional lymph nodes, lung, bone, and liver.

**Nonseminomatous Malignant Germ Cell Tumors**

Embryonal carcinoma, endodermal sinus (yolk sac) tumor, choriocarcinoma, and combinations of any of the histologic types (mixed germ cell tumors) are the rest of the mediastinal germ cell tumors. These are rare highly malignant tumors that usually occur in young adults and are much more common in men. The vast majority of patients are symptomatic, and symptoms include chest pain, cough, fever and dyspnea. Elevated serum levels of #-fetoprotein or human gonadotropin are helpful in the diagnosis of suspected malignant mediastinal germ cell neoplasm, while clinical and CT evidence of gynecomastia is an additional clue. Levels of #-fetoprotein are elevated in about 80% of patients and can be used also as a useful indicator of tumor recurrence or remission with therapy.
Normal thymus and thymic hiperplasia

On CT, the thymus shows soft-tissue attenuation similar to muscle in infants and young children. With age, the gland involutes and its attenuation decreases after puberty due to fatty infiltration. In persons older than 25 years the thymus is no longer recognizable as a soft tissue structure, and it commonly appears to be entirely replaced by fat, with complete thymic involution after age 40 years.

Besides the measurement of the size and CT attenuation, the shape of the thymus is also an important indicator of its abnormality. The shape is variable and has been described as resembling an arrowhead or bilobar in the majority of the patients. Focal contour abnormality of the thymus, especially those associated with displacement of adjacent structures, is suggestive of underlying mass.

Fig. 1: Unenhanced CT of a normal thymus in a 9-year-old male child.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Most patients with thymic hyperplasia have normal or diffusely and symmetrically enlarged glands, but usually with preservation of normal shape. Occasionally, thymic hyperplasia will present as a mass that is radiographically indistinguishable from thymoma. The thymus can regrow more than 50% after chemotherapy, but it actually represents a transient overgrowth that resolves with time. Most cases can be resolved by noting a decrease in size in follow-up studies, thereby obviating the need for biopsy.
Fig. 2: 8-year-old female with systemic lupus erythematosus. Unenhanced CT showed an enlarged thymus, initially thought to possibly be a thymoma. Biopsy proved to be a thymic hyperplasia.

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

**Thymoma**

Because the normal thymus is located in the junction of the great vessels and the pericardium, most thymomas are closely related to these structures.

Tipically, thymoma manifests as a 1-10cm usually round or ovoid masses, and tumor surface may be smooth or lobulated, that characteristically arises from one lobe of the thymus. Most thymomas are solid neoplasms that are encapsulated and localized to the thymus. As a result of their firm consistency, thymomas characteristically maintain their shape where they contact the sternum anteriorly or heart and great vessels posteriorly.

On CT scans, thymomas are generally seen as homogeneous, soft-tissue masses usually with smooth borders, but may be bosselated or lobulated. The mass may be partially or completely outlined by fat or may completely replace the anterior mediastinal fat. The mass usually projects to one side of the mediastinum.

Homogeneous enhancement is characteristic, although heterogeneity can be seen in about one-third of thymomas due to necrosis, cystic change or hemorrhage. While benign thymoma generally has homogeneous attenuation, invasive thymoma may have more heterogeneous attenuation. Calcifications can occur and be easily detected with CT, and may be punctate, linear along the capsule, or coarse and within the tumor.
Fig. 3: B1-type thymoma in an 84-year-old female. Axial, sagittal and coronal reformatted contrast-enhanced CT shows a 9cm mediastinal solid mass with areas of low contrast enhancement, probably necrotic, and no evidence of enlarged lymph nodes. The surgical specimen weighed 236g.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Thymomas may result in vascular invasion, pleural involvement or pericardial dissemination. Approximately one-third invade the tumor capsule and the surrounding structures, but in the majority of these patients, this determination cannot be made by CT or MR and may even be difficult on examination of the resected specimen. The presence of irregular borders between the mass and the adjacent lung, suggest invasion.
Direct signs of vascular involvement include an irregular vessel lumen contour, vascular encasement or obliteration, and endoluminal soft tissue, which may extend into cardiac chambers. Pleural dissemination ("drop metastases") manifests at CT as one or more pleural nodules or masses, which can be smooth, nodular, or diffuse and are almost always ipsilateral to the anterior mediastinal tumor. Pleural effusion is uncommon, even in the presence of extensive pleural metastases.

**Fig. 4:** B2-type thymoma in a 76-year-old woman with myasthenia gravis. Axial contrast-enhanced CT images show a heterogeneous mass, with small hypodensifying areas representing necrosis/cystic degeneration. It is also evident thrombosis of the superior vena cava and the left innominate vein.

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Higher-grade thymomas, particularly types B3 and C, tend to show larger size, more irregular margins, heterogeneous enhancement, regions of necrosis, mediastinal nodal metastases, and calcification.
Fig. 5: B3-type thymoma in a 29-year-old male. Axial, sagittal and coronal reformatted contrast-enhanced CT showed an anterior 6cm mass with invasion and thrombosis of the superior vena cava and left innominate vein. Note the stent in the superior vena cava both on the chest ray and CT exams.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 6: a) 52-year-old male with a B3-type Thymoma of the anterior mediastinum, diagnosed via transthoracic biopsy. Pre surgical chemotherapy didn't help to reduce the mass, which involved the pericardium. Surgery was still possible and the patient is currently under vigilance.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 7: b) B3-type thymoma. Photomicrographs (original magnification, x100 and x400, H-E stain) show tumor organized into lobules (red arrows) separated by fibrous septa (black arrows, without intraepithelial lymphocytes). Tumor cells are polygonal, with round and elongated nucleus (inset, lower right). There is a predominance of epithelial cells over lymphocytes.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Lymphoma

At CT, the nodes in both HL and NHL, appear enlarged and demonstrate homogeneous attenuation with little if any enhancement. The appearance of nodal involvement in lymphoma varies: most commonly, discrete enlarged solid lymph nodes or conglomerate masses of nodes are seen.

On CT, involved thymus and nodes in Hodgkin lymphoma tipically show homogeneous soft-tissue attenuation with limited cystic and necrotic changes and gradually increasing mild to moderate contrast enhancement. Areas of low attenuation, suggesting cystic degeneration or necrosis, are seen in 20%-50% of patients, but have no prognostic significance. HL characteristically spreads by means of contiguous lymph node groups,
and anterior mediastinal HL tends to spread into mediastinal compartments. After such extension, pleural, pericardial, or chest wall invasion may be seen. Associated intrathoracic findings in HL include pleural effusion, sternal erosion, and invasion of the anterior chest wall.

**Fig. 8:** a) Nodular sclerosis type classical Hodgkin lymphoma in a 27-year-old woman with constitutional symptoms. PA chest x-ray shows widening of the right mediastinum by a peri-hilar mass. Axial and reformatted coronal contrast-enhanced CT scan images show a bulky soft tissue mass in the anterior mediastinum, with a moderate enhancement after contrast. Compression of the innominate vein and superior vena cava is seen. Note the presence of right pre-tracheal and latero-aortic lymphadenopathy.

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 9: b) Nodular sclerosis type classical Hodgkin lymphoma. Left photomicrograph (original magnification, x20, H-E stain) shows thymic structure (*) in a background of fibrosis (#). Right photomicrograph (original magnification, x400) shows atypical polymorphic infiltration of small B \( \rightarrow \) and polymorphonuclear \( \rightarrow \) lymphocytes. Clusters of large, pleomorphic cells, some of them multinucleated, with Hodgkin \( \rightarrow \) and Reed-Sternberg \( \rightarrow \) morphology are also observed.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

While NHL cannot be definitively distinguished from HL by imaging findings, specific patterns of distribution at CT are suggestive. In contrast to HL, only 50% of patients with NHL and intrathoracic disease have mediastinal nodal involvement. NHL predominantly involves the middle mediastinum when mediastinal disease is present; in 90% of cases, disease can also be identified outside the mediastinum. Juxtaphrenic and posterior mediastinal nodal involvement is uncommon but is seen almost exclusively in NHL.
Fig. 10: a) Mediastinal large B-cell lymphoma in an 18-year-old woman. Axial contrast-enhanced CT scan images show a heterogeneous mass with ill-defined margins, involving the anterior mediastinum and extending to the medium and posterior mediastinum. Note the presence of a nodular area of low attenuation representing an area of necrosis. Is also evident encasement of the great thoracic vessels, atelectasis of the middle lobe and right pleural effusion.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 11: b) Mediastinal large B-cell lymphoma. Photomicrograph (H-E stain) show large neoplastic cells with vesicular nuclei. Immunohistochemical stains showed that the lymphoma cells were positive for CD20, MUM1 and BCL2 (variable). The neoplasm has a high proliferation rate, approximately 80% of neoplastic cells (ki67).

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Nodal calcification in untreated lymphoma is extremely uncommon in the absence of previous mediastinal radiation or systemic chemotherapy, and its presence within an anterior mediastinal mass should suggest another diagnosis.

**Germ Cell Tumors**

**Teratoma**

On CT, teratoma usually appears as a well-defined multilocular cystic lesion containing fluid, soft tissue and fat attenuation. Fat-fluid levels are virtually diagnostic of teratoma but are seen less frequently.

Calcifications of various morphological configurations (central, curvilinear, or peripheral) may also be present in up to 50%. It may represent calcification in the wall of the tumor or in the tumor substance, ossification in mature bone, or calcification in a tooth within the tumor. The visualization of teeth is pathognomonic of teratoma.

In 15% of cases, mature teratomas appear as nonspecific cystic lesions without fat or calcium; however, the capsule of a teratoma is characteristically thickened, whereas that of other cystic lesions in the mediastinum is usually thin.

The combination of fluid, soft tissue, calcification, and/or fat attenuation in an anterior mediastinal mass is a highly specific finding for the prospective diagnosis of mature teratoma.

Benign lesions are often round or oval and smooth in contour with a thick capsulated wall that may enhance; an irregular or ill-defined margin suggests malignancy.

Obliteration of fat planes that separate mediastinal vascular structures may reflect malignancy; however, benign tumors may also obliterate fat planes owing to fibrous adherence of the mass to adjacent structures.

Septations are not unusual, and enhancement of tissue septa or rim enhancement may be seen after intravenous administration of contrast.

CT is also useful in the evaluation of adjacent structures. Complications of teratoma that may be visualized on CT include atelectasis due to airway compression, pneumonitis due to rupture into the lung and effusion due to rupture into the pleural space or pericardium.
Nearly 30% of mature teratomas have been reported to rupture into these adjacent structures.

**Seminoma**

The radiographic findings are nonspecific. CT typically shows a large lobulated soft tissue mass, with sharply demarcated margins and homogeneous internal attenuation, and show minimal enhancement after administration of contrast material. Areas of degeneration due to hemorrhage and necrosis may be present but are usually limited. Calcification and chest wall invasion are distinctly uncommon.

**Fig. 12**: a) Seminoma in an asymptomatic 35-year-old man. Axial and reformatted coronal and sagittal contrast-enhanced CT images show an 18 cm heterogeneous mass occupying both sides of the mediastinum. There is invasion of the great thoracic vessels and heart, small volume of pericardial and left pleural effusion.
**Fig. 13:** b) Seminoma. Photomicrograph (H-E stain) shows that the tumor is composed by clusters of rounded, clear cells (red arrows) separated by fibrous septa (black arrows), which include lymphocytes.

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

**Nonseminomatous Malignant Germ Cell Tumors**

On CT scans, these tumors are typically large, and show inhomogeneous soft-tissue density with areas of low attenuation representing cystic necrosis and hemorrhage. Obliteration of the adjacent fat planes is typical and invasion of adjacent structures may be seen. Metastases to the regional lymph nodes and distant sites are also common.
Fig. 14: a) Mixed germ cell tumor in a 30-year-old woman. Axial contrast-enhanced CT scan images demonstrate a heterogeneous mass in the superior anterior mediastinum showing areas of coarse calcification and fluid attenuation.  

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 15: b) Gross specimens show a lobulated mass and invasion of the superior vena cava by the tumor, proven at surgery. Cut specimen of the resected tumor shows a cystic area (black arrows) and a solid mass with a bright aspect (red arrows).

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Fig. 16: c) Nonseminomatous malignant germ cell tumor. Photomicrographs (original magnification, x100 and x400, H-E stain) of the same specimen seen in fig. shows that the tumor is composed of: residual mature teratoma component adjacent to the cystic lesion (*) lined by bronchial epithelium (black arrow), somatic malignant component - mucinous adenocarcinoma (red arrows) and germinal nonseminomatous component - yolk sac tumor (inset, lower right). Residual thymus is also noted (#).

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Other Conditions

Hematoma
Fig. 17: 76-year-old female under oral anticoagulation and no history of trauma. Axial and sagittal reformatted unenhanced and contrast-enhanced CT showed spontaneous hyperdense collections in the anterior mediastinum, with no significant contrast enhancement. Bilateral pleural effusion can also be seen. Biopsy confirmed to be a hematoma, and a 6 month CT control scan illustrated only a markedly reduced para-aortic collection, and the complete pleural effusion resolution. 76-year-old female under oral anticoagulation and no history of trauma. Axial and sagittal reformatted unenhanced and contrast-enhanced CT showed spontaneous hyperdense collections in the anterior mediastinum, with no significant contrast enhancement. Bilateral pleural effusion can also be seen. Biopsy confirmed to be a hematoma, and a 6 month CT control scan illustrated only a markedly reduced para-aortic collection, and the complete pleural effusion resolution.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Metastasis
Fig. 18: 50-year-old male, former smoker, with enlargement of the anterior mediastinum on the chest ray. Axial and coronal reformatted contrast-enhanced CT shows a large infiltrative mass of the mediastinum, with encasing of the supra-aortic branches, pulmonary arteries and superior vena cava. Exuberant collateral circulation can also be seen. Biopsy proved to be a necrosed small cell carcinoma.

References: Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Many studies have reported that anterior mediastinal tumors have typical CT findings. Some of these findings can help in providing specific diagnosis, such as the presence of fat attenuation that is highly suggestive of germ cell tumor or mediastinal
lymphadenopathy elsewhere associated with an anterior mediastinal mass that is presumptive of lymphoma.

Nevertheless, the diagnostic accuracy of CT for anterior medastinal tumors in most reports is not superior to 80% for the diseases considered in our work (the most common ones in anterior mediastinum). Also, of most importance, it is well documented that CT is equal or superior to MRI in the diagnosis of anterior mediastinal masses (except for thymic cyst) and the final differentiation between these entities is usually accomplished by histology.

So, although variables such as attenuation, calcification, contrast enhancement, relationship to adjacent mediastinal structures, and associated intrathoracic findings may be suggestive of a specific diagnosis in an appropriate clinical setting, the final diagnosis is given by histologic confirmation.

CT-guided biopsy of mediastinal masses is a minimally invasive and safe procedure and a very important diagnostic technique. It is a commonly used interventional procedure in our department to determine the diagnosis of several pathologies and has a high diagnostic rate.

Regarding this study, we had a high diagnostic percentage of mediastinal masses biopsies:

---

**Fig. 19**

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Most of the mediastinal masses in our department over a 2 year period, in a total of thirty eight procedures, were either Lymphomas or Thymomas, but other pathologies were also diagnosed:
### Results

<table>
<thead>
<tr>
<th>Biopsy</th>
<th>Lymphoma</th>
<th>Thymoma</th>
<th>Germ Cell</th>
<th>Others</th>
<th>Total</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>17</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>34</td>
<td>89%</td>
</tr>
<tr>
<td>Non Diagnostic</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>11%</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>9</td>
<td>3</td>
<td>8</td>
<td>38</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Fig. 20**

*References:* Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Of the Lymphomas, we add a prevalence of Non-Hodgkin (61%), comparing with Hodgkin Lymphomas (39%).
The B3 Thymoma is the most recurrent one of our study (50%).

**Fig. 21**

**References:** Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Regarding other kinds of diagnosis, we had 3 germ cell tumors, one being a seminoma, other a mixed germ cell tumor and another undetermined one.

But we also found some Carcinomas amongst our sample, as well as a thymic hyperplasia and a hematoma, thought to be a thymoma in the imaging studies.

<table>
<thead>
<tr>
<th>Others</th>
<th>Thymic Hyperplasia</th>
<th>Hematoma</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Total %</td>
<td>13%</td>
<td>13%</td>
<td>75%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Finally, we found no significant gender prevalence amongst any pathology, probably due to a small sample:

<table>
<thead>
<tr>
<th></th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lymphoma</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
</tr>
<tr>
<td>Male</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>18</td>
</tr>
</tbody>
</table>

In the sample of biopsies of the anterior mediastinum during these two years (38 cases), we had little to none complications, and never with the need of therapeutic actions. Pneumothorax or vascular lesions such as damage to the mammary arteries were by no means an issue in our practice, thus confirming the safe nature of this procedure.

So we were able to conclude that the idea of a possible complication in these kind of biopsies should be present, but it poses only a minor role in the intervention decision.
Images for this section:

**Fig. 1:** Unenhanced CT of a normal thymus in a 9-year-old male child.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

**Fig. 2:** 8-year-old female with systemic lupus erythematosus. Unenhanced CT showed an enlarged thymus, initially thought to possibly be a thymoma. Biopsy proved to be a thymic hyperplasia.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
**Fig. 3:** B1-type thymoma in an 84-year-old female. Axial, sagittal and coronal reformatted contrast-enhanced CT shows a 9cm mediastinal solid mass with areas of low contrast enhancement, probably necrotic, and no evidence of enlarged lymph nodes. The surgical specimen weighed 236g.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 4: B2-type thymoma in a 76-year-old woman with myasthenia gravis. Axial contrast-enhanced CT images show a heterogeneous mass, with small hypoattenuating areas representing necrosis/cystic degeneration. It is also evident thrombosis of the superior vena cava and the left innominate vein.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 5: B3-type thymoma in a 29-year-old male. Axial, sagittal and coronal reformatted contrast-enhanced CT showed an anterior 6cm mass with invasion and thrombosis of the superior vena cava and left innominate vein. Note the stent in the superior vena cava both on the chest ray and CT exams.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 6: a) 52-year-old male with a B3-type Thymoma of the anterior mediastinum, diagnosed via transthoracic biopsy. Pre surgical chemotherapy didn't help to reduce the mass, which involved the pericardium. Surgery was still possible and the patient is currently under vigilance.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 7: b) B3-type thymoma. Photomicrographs (original magnification, x100 and x400, H-E stain) show tumor organized into lobules (red arrows) separated by fibrous septa (black arrows, without intraepithelial lymphocytes). Tumor cells are polygonal, with round and elongated nucleus (inset, lower right). There is a predominance of epithelial cells over lymphocytes.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 8: a) Nodular sclerosis type classical Hodgkin lymphoma in a 27-year-old woman with constitutional symptoms. PA chest x-ray shows widening of the right mediastinum by a peri-hilar mass. Axial and reformatted coronal contrast-enhanced CT scan images show a bulky soft tissue mass in the anterior mediastinum, with a moderate enhancement after contrast. Compression of the inominated vein and superior vena cava is seen. Note the presence of right pre-tracheal and latero-aortic lymphadenophaty.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
**Fig. 9:** b) Nodular sclerosis type classical Hodgkin lymphoma. Left photomicrograph (original magnification, x20, H-E stain) shows thymic structure (*) in a background of fibrosis (#). Right photomicrograph (original magnification, x400) shows atypical polymorphic infiltration of small B (#) and polymorphonuclear (#) lymphocytes. Clusters of large, pleomorphic cells, some of them multinucleated, with Hodgkin (#) and Reed-Sternberg (#) morphology are also observed.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

**Fig. 10:** a) Mediastinal large B-cell lymphoma in an 18-year-old woman. Axial contrast-enhanced CT scan images show a heterogeneous mass with ill-defined margins,
involving the anterior mediastinum and extending to the medium and posterior mediastinum. Note the presence of a nodular area of low attenuation representing an area of necrosis. Is also evident encasement of the great thoracic vessels, atelectasis of the middle lobe and right pleural effusion.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

**Fig. 11:** b) Mediastinal large B-cell lymphoma. Photomicrograph (H-E stain) show large neoplastic cells with vesicular nuclei. Immunohistochemical stains showed that the lymphoma cells were positive for CD20, MUM1 and BCL2 (variable). The neoplasm has a high proliferation rate, approximately 80% of neoplastic cells (ki67).

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 12: a) Seminoma in an asymptomatic 35-year-old man. Axial and reformatted coronal and sagittal contrast-enhanced CT images show an 18 cm heterogeneous mass occupying both sides of the mediastinum. There is invasion of the great thoracic vessels and heart, small volume of pericardial and left pleural effusion.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 13: b) Seminoma. Photomicrograph (H-E stain) shows that the tumor is composed by clusters of rounded, clear cells (red arrows) separated by fibrous septa (black arrows), which include lymphocytes.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 14: a) Mixed germ cell tumor in a 30-year-old woman. Axial contrast-enhanced CT scan images demonstrate a heterogeneous mass in the superior anterior mediastinum showing areas of coarse calcification and fluid attenuation.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Fig. 15: b) Gross specimens show a lobulated mass and invasion of the superior vena cava by the tumor, proven at surgery. Cut specimen of the resected tumor shows a cystic area (black arrows) and a solid mass with a bright aspect (red arrows).

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 16: c) Nonseminomatous malignant germ cell tumor. Photomicrographs (original magnification, x100 and x400, H-E stain) of the same specimen seen in fig. shows that the tumor is composed of: residual mature teratoma component adjacent to the cystic lesion (*) lined by bronchial epithelium (black arrow), somatic malignant component - mucinous adenocarcinoma (red arrows) and germinal nonseminomatous component - yolk sac tumor (inset, lower right). Residual thymus is also noted (#).

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 17: 76-year-old female under oral anticoagulation and no history of trauma. Axial and sagittal reformatted unenhanced and contrast-enhanced CT showed spontaneous hyperdense collections in the anterior mediastinum, with no significant contrast enhancement. Bilateral pleural effusion can also be seen. Biopsy confirmed to be a hematoma, and a 6 month CT control scan illustrated only a markedly reduced para-aortic collection, and the complete pleural effusion resolution. 76-year-old female under oral anticoagulation and no history of trauma. Axial and sagittal reformatted unenhanced and contrast-enhanced CT showed spontaneous hyperdense collections in the anterior mediastinum, with no significant contrast enhancement. Bilateral pleural effusion can also be seen. Biopsy confirmed to be a hematoma, and a 6 month CT control scan illustrated only a markedly reduced para-aortic collection, and the complete pleural effusion resolution.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
**Fig. 18:** 50-year-old male, former smoker, with enlargement of the anterior mediastinum on the chest ray. Axial and coronal reformatted contrast-enhanced CT shows a large infiltrative mass of the mediastinum, with encasing of the supra-aortic branches, pulmonary arteries and superior vena cava. Exuberant collateral circulation can also be seen. Biopsy proved to be a necrosed small cell carcinoma.

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 19

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT

Fig. 20
Fig. 21

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Fig. 22

© Radiologia, Centro Hospitalar Lisboa Central, Hospital de Santa Marta - Lisbon/PT
Conclusion

Although the location, size and the densitometric characteristics of the lesion, as well as the enhancement pattern allows the differential diagnosis in some cases, the pathological correlation is often necessary.

CT is an important tool not only for staging and following up anterior mediastinal disease but also for guiding biopsy of anterior mediastinal masses.

CT-guided mediastinal biopsy is a minimally invasive and safe procedure and has a high diagnostic rate.
References

3. Brant WE, Helms CA; Fundamentals of Diagnostic Radiology, 2006; Lippincott W & W.