

## CT-Pathologic Correlation in Anterior Mediastinal Masses

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### Abstrak

Telah dilakukan analisis retrospektif terhadap gambaran CT scan 16 pasien dengan massa mediastinum anterior yang telah menjalani pembedahan. Usia penderita berkisar antara 17-60 tahun. Limapuluh persen pasien memperlihatkan tanda-tanda timoma, 25 % teratoma dan tumor sel germinoma, serta masing-masing 12,5 % tumor tiroid dan limfoma malignum. Penampilan timoma pada pemeriksaan CT scan berupa massa bulat, lonjong, berpermukaan licin atau berbenjol dan terletak pada daerah perbatasan antara jantung dan pembuluh darah besar. Timoma benigna atau invasif memperlihatkan kalsifikasi punktala atau berupa garis lengkung. Timoma invasif dijumpai telah mengenai lemak mediastinum, vena kava, aorta dan menjalar ke perikardium serta pleura. Teratoma benigna kistika tampil sebagai massa berbatas tegas, bulat atau berbenjol. Tampil pula adanya kalsifikasi perifer atau gigi. Limfoma ganas memperlihatkan sifat umum seperti massa berbenjol atau massa soliter dengan permukaan yang licin. Massa pada kelenjar tiroid akan menekan trakea dan mengakibatkan penyempitan. Sedangkan goiter intratorakal dapat menekan vena brakiosefalik. Setelah dilakukan torakotomi dilakukan pemotongan transversal pada sediaan. Terdapat korelasi penampilan histopatologi dari lesi dengan gambaran CT prabedah.

### Abstract

Computed tomography (CT) images of sixteen patients with anterior mediastinal masses undergoing surgical treatment were retrospectively analyzed. Fifty percent of the cases were thymomas, 25 % teratomas and germ cell tumors, 12,5 % thyroid tumors and 12,5 % malignant lymphomas. The age ranged from 17-60 years. The CT findings of thymoma consisted of a roundish, oval, smoothly bordered or lobulated mass situated at the junction of the heart and major vessels. Punctate or curvilinear calcification is seen in benign and invasive thymoma. Invasive thymoma were found to invade the mediastinal fat, V. cava, aorta spreading the pericardium and pleura. Benign cystic teratoma produced a well-defined rounded or lobulated mass. Peripheral calcification or teeth were visible on CT. Malignant lymphomas showed gross characteristics of a lobulated mass or a smooth solitary mass. Thyroid masses displaced and narrowed the trachea. Intrathoracic goiter compressed the brachiocephalic veins. After explorative thoracotomy, specimens were sliced transversely. The gross pathology and histology were correlated with the appearance of the lesion on preoperative thin section CT images.

**Keywords :** Anterior Mediastinal Masses, CT-Pathologic Correlation

### INTRODUCTION

Computed tomography has emerged as the main technique used to evaluate the anterior mediastinum after plain radiologic studies. A major advantage of CT over plain films is better contrast discrimination, which permits distinction between solid, fatty, cystic, calcified, and vascular structures. CT is better at localiz-

ing and revealing the exact extent of anterior mediastinal abnormalities than is the plain film. CT is usually better at differentiating benign from malignant processes and can preclude the use of more invasive diagnostic procedures. Comparison of thin section CT images with pathologic data suggests that the demonstration of the anterior mediastinal tumor interface and the

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tumor's internal texture, increased the accuracy of CT in diagnosing a tumor mass.

## MATERIALS AND METHODS

Sixteen patients with anterior mediastinal masses who were admitted to the Persahabatan Hospital between March 1990-March 1992 were studied. There were 14 males and 2 females. The age ranged from 10-60 years. Transthoracic biopsy was carried out in 12 patients during bronchoscopy, and transbronchial biopsy was performed in 4 cases. All patients underwent chest radiography (posteroanterior and lateral view) and thoracic computed tomographic scanning. All CT studies were performed with a Siemens DR-2 scanner (4 s scanning time), KV 125, Mass 350, gantry 0, Contiguous 8 mm thick sections were obtained from the lung apices caudally to the level of the liver or adrenal glands, during suspended respiration. All CT studies were performed with intravenous contrast enhancement obtained after a rapid bolus injection of 75 cc angiografin. Scans were viewed using window levels appropriate for the mediastinum. The window width was 4000 HU at the level 500 HU. All of these patients underwent explorative thoracotomy. The specimens were sliced transversely.

## RESULTS

Sixteen patients with primary anterior mediastinal tumors, comprising 14 males and 2 females, with an age range from 17-60 years were included in this study (Figure 1).

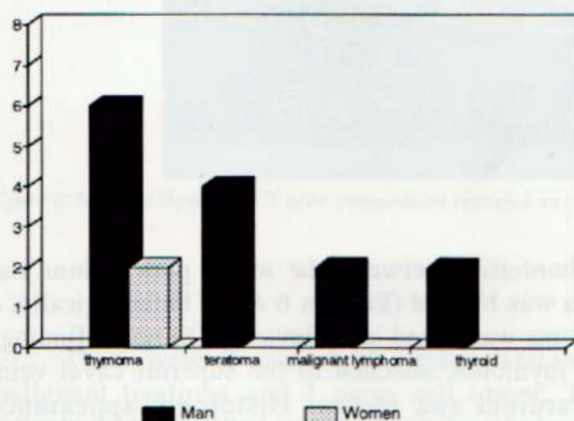


Figure 1. Histologic distribution of tumor age and sex of patients with anterior superior mediastinal mass

The anterior mediastinum was defined as that part of the mediastinum lying posterior to the sternum and anterior to the great vessels and pericardium. The anterior mediastinum extends from the diaphragms inferiorly to the thoracic inlet superiorly.

The chest roentgenogram (PA & lateral view) and CT-Scan findings were as follow : thymoma 50 %, teratoma and germ cell tumor 25 %, thyroid tumor 12.5 % and malignant lymphoma 12.5 % (Figure 2). Among the thymomas there were 6 males and 2 females. Three

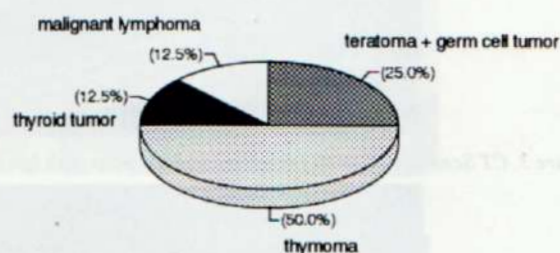


Figure 2. CT of anterior superior mediastinal mass histologic distribution

patients were admitted with chest pain, one had shoulder pain, two came for general check up and the other two with a history of diplopia and muscle weakness (myasthenia gravis). The CT findings of thymomas were roundish, oval, smoothly bordered or lobate masses situated at the junction of the heart and the major vessels. Punctate or curvilinear calcification was seen in benign and invasive thymomas. CT demonstrated the water density of the cyst. Invasive thymomas invaded the mediastinal fat, vena cava, aorta and spread to the pericardium and pleura. A 48-year-old woman was admitted to the hospital with chest pain. Posteroanterior chest radiograph showed enlargement and slight lobulation of left hilar margin. The lateral view showed the mass in anterior superior mediastinum. CT findings revealed an anterior superior encapsulated mediastinal mass. This thymoma was located in front of the aorta and pulmonary cone. Contrast CT-Scan showed the mass with low attenuation and density similar to that of water indicating a benign thymoma. Diagnosis was confirmed surgically (Figures 3 & 4). Histological appearance showed a capsule, fibrous bands (septa), large epithelioid cells, lymphocytic component and fibrous tissue (Figure 5).

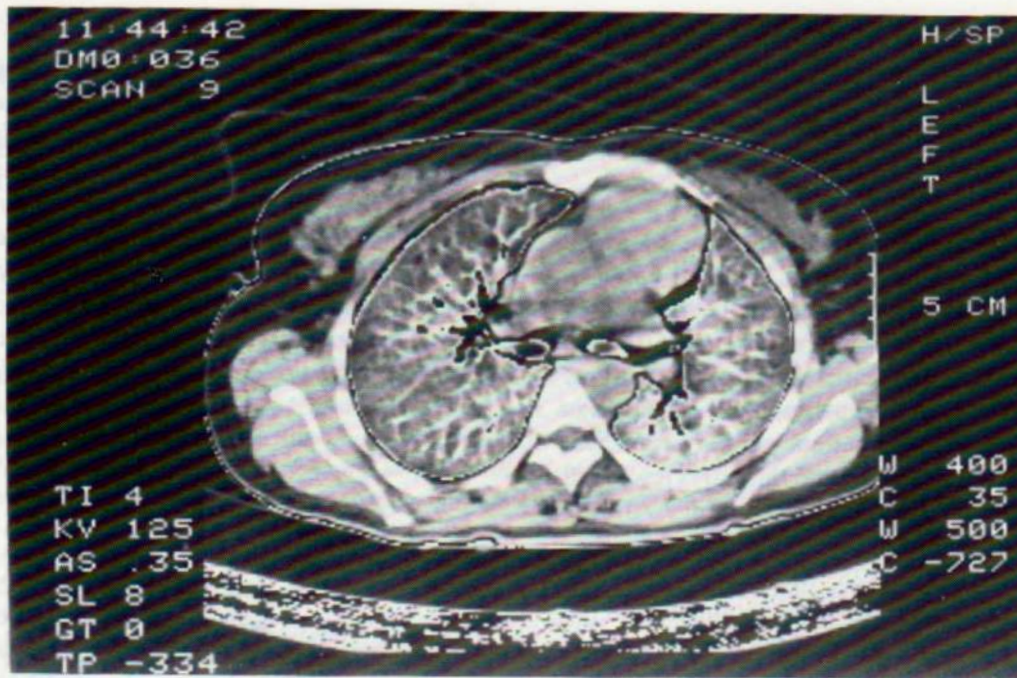


Figure 3. CT Scan of benign thymoma showed the mass with low attenuation and density similar to that of water

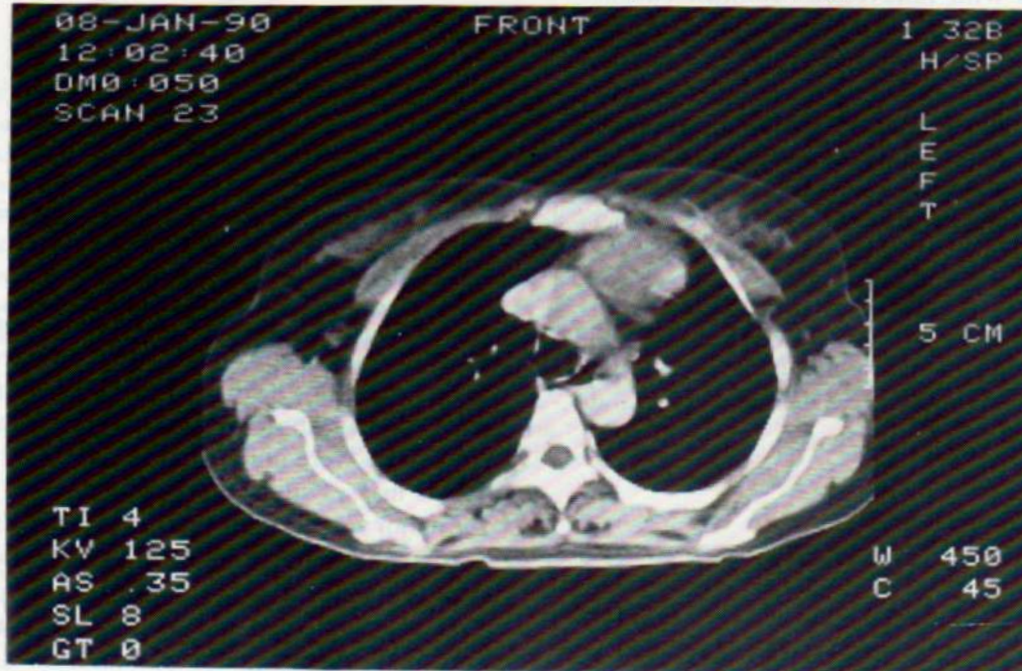


Figure 4. Same patient as above after injection of contrast

Another patient was a 42-year-old man admitted to the hospital with dyspnea and superior caval vein syndrome. Chest radiography showed enlargement of a mediastinal mass. CT revealed an oval, smoothly lobulated mass situated at the junction of the heart and superior caval vein and in front of the aorta. The borderline between caval vein and the tumor was not clear. Contrast enhanced CT-Scan showed discrete opacity within the mass and also a cystic/necrotic area.

The borderline between the mass, pericardium and pleura was blurred (Figures 6 & 7). Pathologically, a thymoma was found to be invasive. Surgical findings were thymoma, attached to the superior caval vein, pericardium and pleura. Histologic appearance revealed fibrosis, necrosis, cytologic atypia, undifferentiated lymphoepithelioma-like, squamous and basaloid elements (Figure 8).

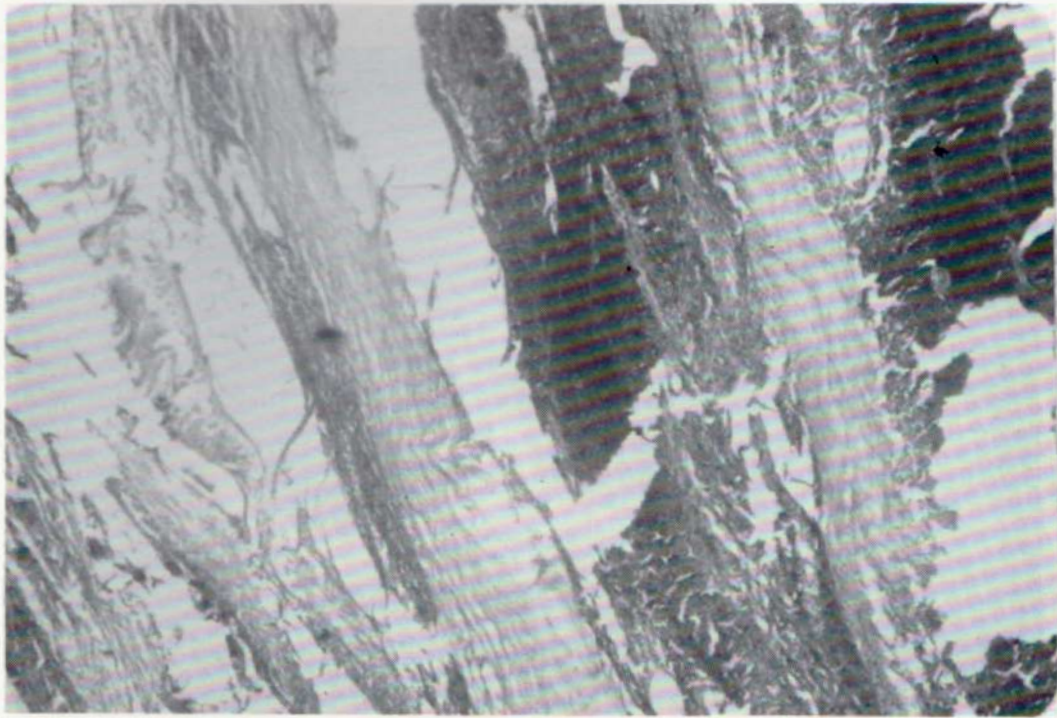


Figure 5. Histopathological appearance of the patient showed above

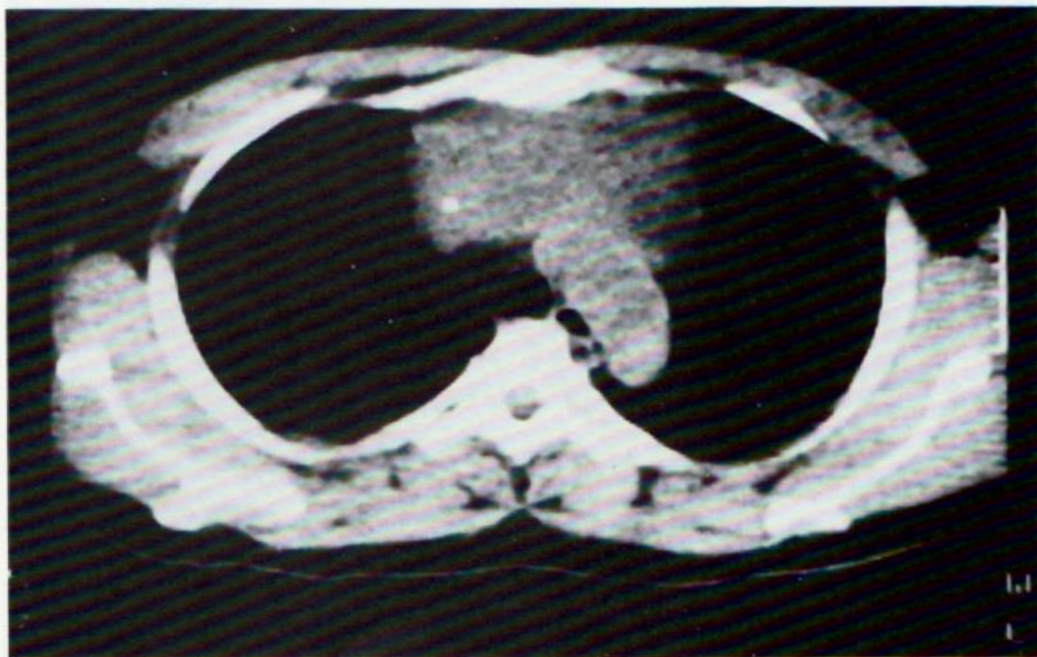


Figure 6. Invasive thymoma. CT scan examination revealed an oval, smoothly lobulated mass at the junction of the heart and superior caval vein.

There were 2 cases with benign teratoma, 1 malignant teratoma and 1 germ cell tumor. These patients were admitted to the hospital with dyspnea, cough and chest pain. The CT findings of benign teratoma were cystic, smoothly bordered and roundish masses. Calcifications and lipoid components were found. The CT imaging of malignant teratoma showed lobulate contours and a solid mass. The solid tissue

displaced the aorta and pulmonary trunk. Peripheral calcification, teeth and fat were visible on CT. A 22-year-old man had dyspnea. Posteroanterior film showed a soft tissue mass with calcification or teeth in it at the left hilum. On lateral view the mass was located at the anterior superior mediastinum with calcification. CT findings were as follows : Mass in the anterior superior mediastinum attached to the left upper lobe.

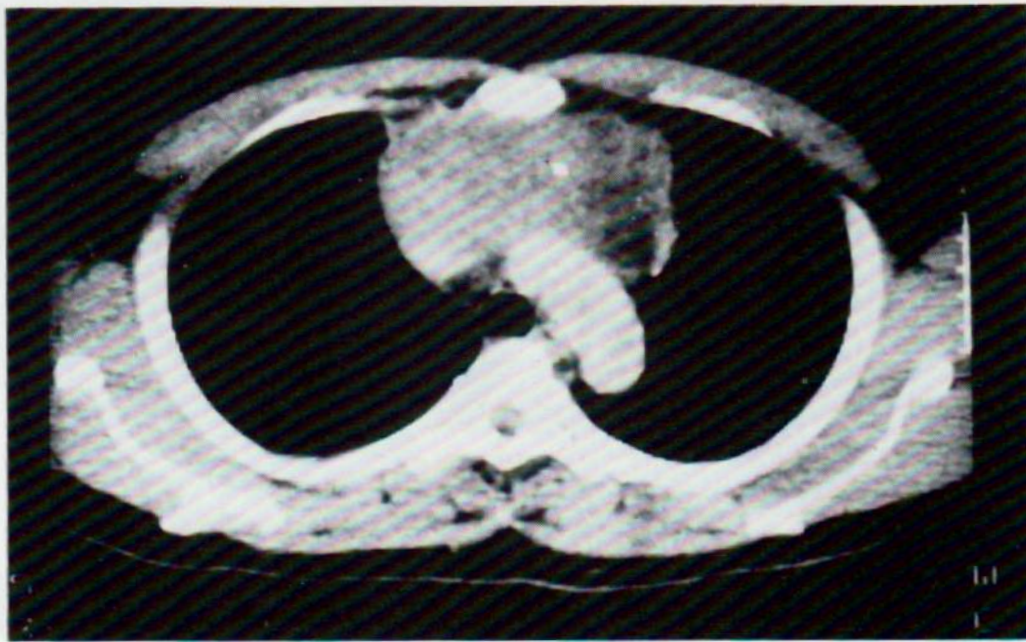


Figure 7. Same patient as above after injection of contrast.

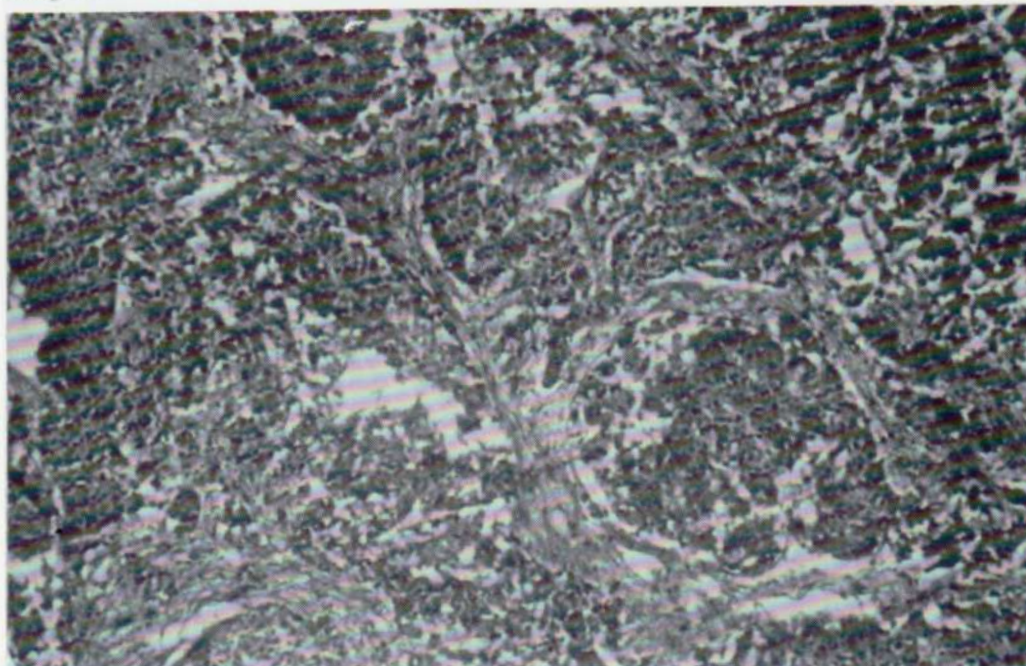


Figure 8. Histopathologic examination of the mass on figure 6 and figure 7.

This benign cystic teratoma produced a well-defined rounded mass (Figures 9 & 10). Histologic appearance consisted of mature tissue components, such as skin, cylindrical epithelial cells, cartilage and fibrous tissue (Figure 11). Two patients with NHL (non Hodgkin lymphoma) had chief complaints of fever, night sweats, fatigue, anorexia, showing gross characteristics of a lobulated mass or a smooth solitary mass. Lymphoma was not enhanced by the contrast

The boundary between the mass, pericardium and media. CT-Scan showed enlargement of lymph nodes in a patient with high-grade large cell lymphoma. The large lymph node masses compressed the right brachio-cephalic vein and superior vena cava. Multiple fluid density areas of necrosis were noted.

A 23-year-old man was admitted to the hospital with chest pain and dyspnea. Postero-anterior chest radiograph showed massive lobulated mass at the right and left paratracheal sides. Pleural reaction at the right

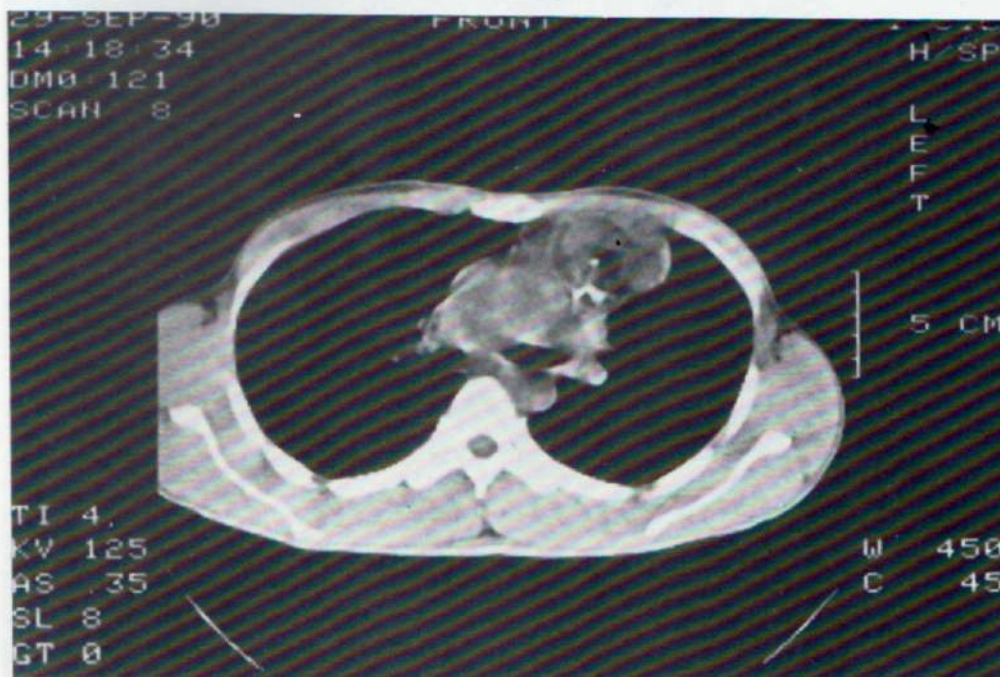


Figure 9. CT appearance of benign cystic teratoma. There is a mass in the anterior superior mediastinum attached to the left upper lobe.



Figure 10. The same patient as figure 9, after contrast injection.

chest was noted. The border of the upper part of the tumor is A. brachio cephalica and the lower part carina. The tumor pressed the trachea posteriorly. CT-Scan showed a mass with necrotic lesion at the center (Figure 12). Diagnosis was confirmed surgically. Three months after radiotherapy the patient died. Histologic appearance revealed diffuse malignant small lymphocytic cells, well differentiated and diffuse dense tissue (Figure 13).

There were two patients with thyroid adenoma. CT showed retrosternal thyroid with focal calcifications, multinodular goiter, cystic areas or necrosis. The multinodular goiter was a markedly enlarged gland surrounded by fibrous capsule. The mass displaced and narrowed the trachea.

A 36-year-old man entered the hospital with a soft tissue mass at the neck. The face and the neck were

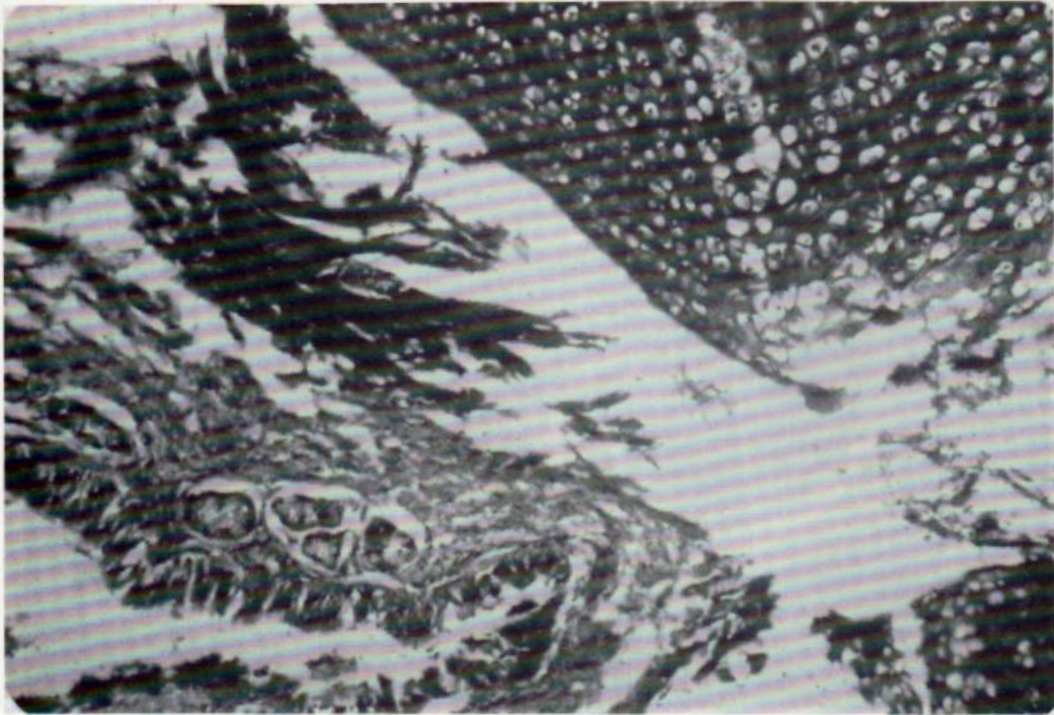


Figure 11. Histopathological appearance of the specimen confirmed the diagnosis benign cystic teratoma.

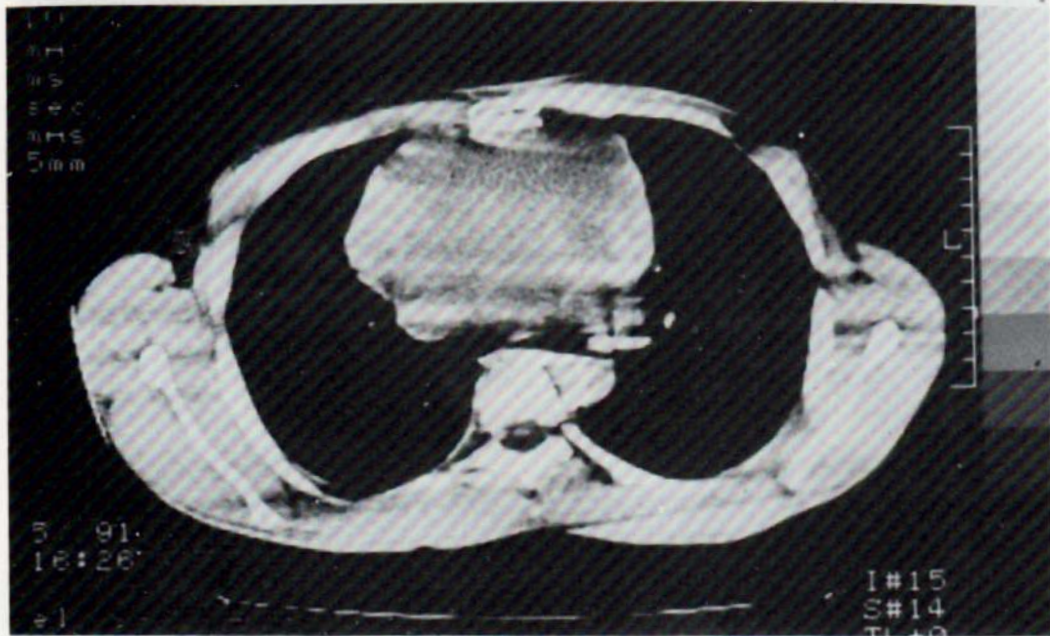


Figure 12. CT scan examination of a patient with a massive lobulated mass surrounding the trachea with necrotic lesion at the center.

swollen, and a postero anterior or chest radiograph showed a large mass at the right paratracheal side which pushed the trachea to the left. The mass located in the anterior superior mediastinum on lateral view. CT- Scan showed appearance of thyroid gland enlarged by multiple adenoma. Trachea, carotic artery, left brachio cephalic vein and a subclavia were pushed to the left. Diagnosis was confirmed pathologically and surgically (Figure 14). Histologic appearance were

thyroid tissue with variable follicles and diffuse fibrosis (Figure 15).

#### DISCUSSION

Benign thymoma is often found in patients over the age of 40, in which 70 % are benign. Fifty percents of patients with thymoma have myasthenia gravis (15%

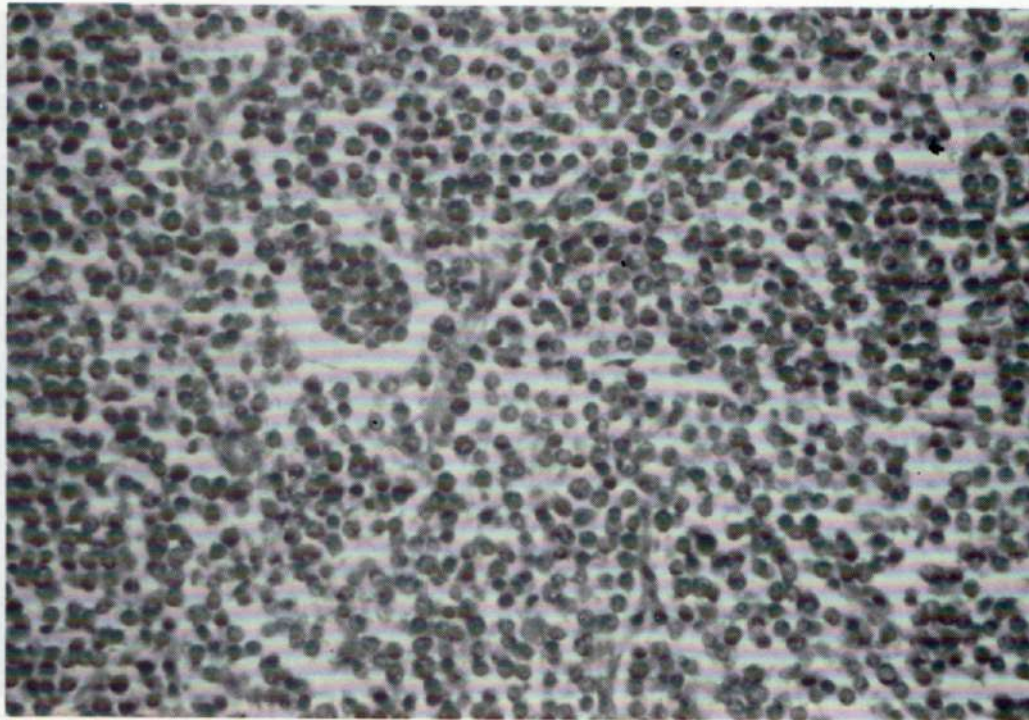


Figure 13. Histopathologic examination revealed a Non Hodgkin Lymphoma.

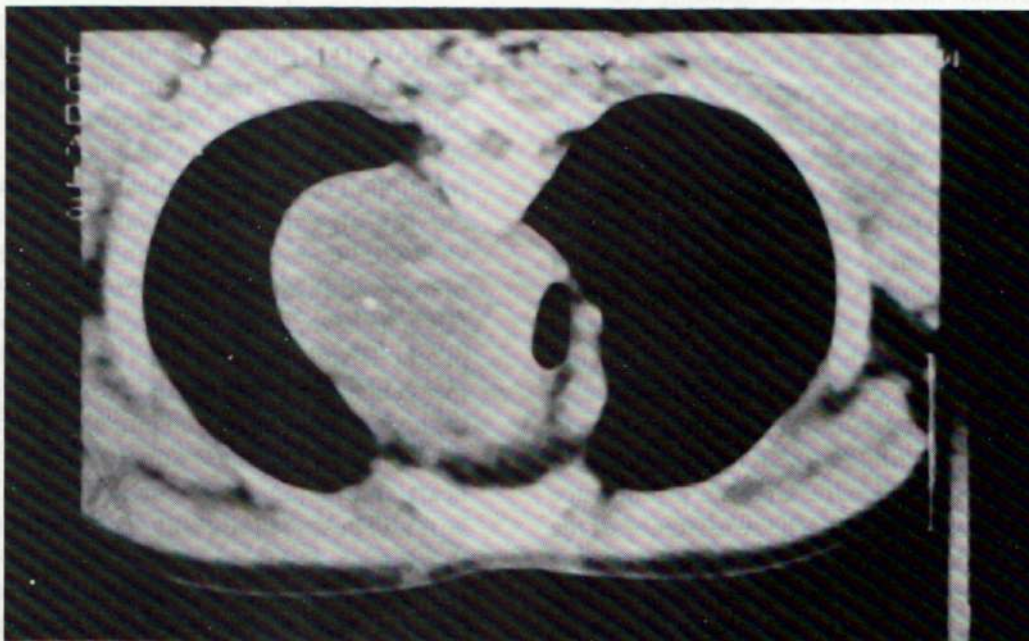


Figure 14. Retrosternal thyroid with focal calcifications. The mass displaced and narrowed the trachea.

of patients with myasthenia gravis have thymomas).<sup>2</sup> In all eight patients with myasthenia gravis and surgically proven thymomas the CT-Scans showed a round or ovoid soft tissue density mass in the anterior mediastinum.<sup>1</sup> One hundred sixty five patients with surgically treated thymoma were followed over 28 years (73 % had myasthenia gravis at presentation),<sup>4</sup> whereas 25 % of our cases had myasthenia gravis. The mean age was 45 years.

Large masses projecting to the right or left of the cardiac margin are easily mistaken for the heart. The presence of subtle lobulation and increased density of the heart in that area, along with a normal cardiac configuration on the opposite side helps to identify the abnormality as a mass rather than an abnormal cardiac contour.<sup>1</sup>

The tumor density varies markedly, from the low density of fat to soft tissue density. Calcification is





Figure 15. Histopathologic appearance of patient above showed thyroid tissue with variable follicles.

often visible and a cystic component may be present, which can be enhanced by contrast material. Certain CT findings strongly suggest that a thymoma is malignant, e.g. definite extension of the tumor into the mediastinum or lung parenchyma indicate malignant spread.<sup>5,6,7,8</sup>

Most of the thymomas are lobulated by fibrous bands resulting in a nodular surface and in a lobulated cut surface, which is one of the most characteristic, but nevertheless nonspecific gross feature of thymomas. The color of the tumor tissue ranges from white to yellow the shade depending on the relative amount of epithelial cells and lymphocytes and the prominence of the connective tissue stroma. The consistency of the tumors varies from soft to very firm. Within the tumors small areas of necrosis can be found, but these are less common than cysts. Smaller cysts might be filled with a clear fluid, larger ones with a thick, brown bloodlike fluid.<sup>9</sup> CT-Scan might be useful in suggesting or excluding a diagnosis of thymoma and in differentiating thymic hyperplasia from thymoma in patients with myasthenia gravis, in differentiating benign cysts from solid tumors, and in defining the extent of a thymic neoplasm. Occasionally, CT may suggest the histologic nature of a thymic lesion.<sup>3</sup>

Characteristically, thymomas are found at the base of the heart, may be calcified, and are cystic in 5% of cases. Malignant thymoma spreads locally, often into the pleura space.<sup>2</sup> A CT diagnosis of a cystic neoplasm is based on finding an inhomogenous, rela-

tively low density mass with thick walls.<sup>10</sup> In our eight patients, CT findings of thymoma were roundish, oval, smoothly bordered or lobulate mass situated at the junction of the heart and the major vessels. Punctate or curvilinear calcification was seen in benign and invasive thymoma. CT demonstrated the water density of the cyst. Invasive thymoma invaded the mediastinal fat, vena cava, aorta and spread to the pericardium and pleura. Histological findings of an anterior mediastinal mass such as fibrous bands, prominence of connective tissue, necrosis, cysts and punctate calcification can be seen on CT. The mass situated at the junction of the heart and major vessels or in front of the ascending aorta. These results suggest that this tumor is a thymoma.

A teratoma is a neoplasma derived from more than one embryonic germ layer. Mediastinal teratomas are believed to develop in aberrant cell rests. Benign teratomas are found in patients of all ages, but particularly in adolescents and in young adults, with females slightly outnumbering males.<sup>11</sup> Teratomas are often found in patients under the age of 40.<sup>2</sup> We found a teratoma in 4 patients, all of them males. The age ranged from 17-23 years (mean 20 years). Mediastinal teratoma exists in a spectrum from benign to malignant forms. The benign variety occurs in males and females with about equal frequency and can often be diagnosed on radiographs by virtue of the identification of bone, teeth, or fat within them. Peripheral calcification can also be present.<sup>12</sup> When malignant, the masses are

often solid and grow rapidly. Other germ cell tumors, such as seminoma and choriocarcinoma, should also be considered.<sup>2</sup>

Benign cystic teratomas usually produce a well-defined, rounded or lobulated mass in the mediastinum. The scans demonstrated a mass within the thymus with a well-defined wall: soft tissue septations separating areas of water density calcification and fat densities were noted internally.<sup>1,3,11</sup> Histopathologic variants include teratoma, seminoma, embryonal cell carcinoma, yolk sac tumor, choriocarcinoma and mixed types. Teratomas account for most mediastinal germ cell tumors. Teratoma can be further subdivided into mature solid, cystic, immature, malignant/teratocarcinoma and mixed.<sup>1</sup> They usually contain ectodermal elements such as sebaceous material, hair, calcification and large cystic component.<sup>9</sup> The CT findings of benign teratomas in our cases were cystic, smoothly bordered and roundish masses. Calcifications and lipid components were found. The CT of malignant teratomas showed lobulate contours, solid mass, fat and teeth. The solid tissue displaced the aorta and pulmonary trunk. Anterior mediastinal mass contains of skin, teeth, fat, fibrous tissue, on histologic examination, can be seen on CT teratomatous tumors produce posterior and lateral displacement of the trachea and esophagus. Teratomas are localized at the origin of the major vessels of the heart. CT by virtue of its great sensitivity, can be useful in detecting malignant lymphoma. Subtle mediastinal nodal enlargement not appreciated on conventional radiographs or enlarged hilar nodes obscured by bulky mediastinal masses. Infiltration of tumor into the lungs from mediastinal disease. Anterior and posterior extra pleural spread from mediastinal adenopathy. Pulmonary nodules, pleural effusion and chest wall invasion.<sup>6,11</sup>

The radiodensity of lymphomas is within or slightly below the range of that of soft tissue. Cystic or necrotic areas must be regarded as a particular pathological constellation. Enhancement following the rapid injection of contrast medium is very limited because of the poor vascularity of the lymphomas.<sup>1,7</sup> Non-Hodgkin's lymphoma is usually associated with enlarged nodes elsewhere.<sup>2</sup> Malignant lymphomas are the most common malignant tumors of the anterior mediastinum. They can affect the regional lymph nodes and the thymus.<sup>9</sup> CT findings of our patients are as follows. The border of the upper part of the tumor is A brachio cephalica and the lower part carina. The tumor pressed trachea posteriorly. CT-Scan showed a cystic mass with necrotic lesion in it. Histologic appearance of diffuse dense tissue, cystic and necrotic areas can be seen on CT.

Most mediastinal thyroid masses are cervicomediastinal goiters extending from the neck into the anterior superior mediastinum. About 75-80 % of mediastinal goiters are situated anteriorly and 20-25 % posteriorly, in the anterior mediastinum.<sup>1,6,11,13</sup> Multinodular or adenomatous goiters are characterized by a markedly enlarged gland distorted by multiple nodules and surrounded by a fibrous capsule. Areas of hemorrhage, calcification, and cystic degeneration within the mass are common. On plain films the mass is in the anterior superior mediastinum, causing smooth displacement and often narrowing of the trachea. Areas of calcification frequently are present.<sup>1</sup> CT is capable of specifically diagnosing mediastinal thyroid. With CT, most of these masses have a suggestive appearance, probably because as goiters they show inhomogenous densities, with small, cystic appearing areas, curvilinear calcium deposits, and areas of high density presumably due to the iodine content of the gland and prolonged enhancement after contrast administration.

CT findings of our patient showed retrosternal thyroid with focal calcifications, multinodular goiter, cystic areas or necrosis. The multinodular goiter was a markedly enlarged gland surrounded by a fibrous capsule. The mass displaced and narrowed the trachea.

Histologic appearance of thyroid tissue, fibrous capsule, calcifications and diffuse fibrous can be seen on CT. The gross pathology and histology were correlated with the appearance of the lesion on preoperative thin section CT images.

## CONCLUSIONS

1. CT is usually the best diagnostic procedure to delineate the anatomy, location and tissue characteristics of an anterior mediastinal mass.
2. The gross pathology and histology correlated with the appearance of the lesions on preoperative thin section CT images.

## REFERENCES

1. Brown LR, Aughenbaugh GL. Masses of the anterior mediastinum: CT and MR imaging. *AJR* 1991; 157: 1171-80.
2. Ravin CE, Cooper C. Review of radiology by the faculty of Duke University Medical Center Department of Radiology. Philadelphia: Saunders 1990; 5-7.
3. Baron RL, Lee JKT, Sagel SS, Levitt RG. Computed tomography of the abnormal thymus. *Radiology* 1982; 142: 127-31.

4. Maggi G, Giaccone G, Donadio M. et al. Thymomas. A review of 169 cases, with particular reference to results of surgical treatment. *Cancer* 1986; 58 : 765-76.

5. Ellis K, Austin JHM, Jaretzki A. Radiologic detection of thymoma in patients with myasthenia gravis. *AJR* 1988; 151: 873-81.

6. Moss AA, Gamsu G, Gennant HR. Computed tomography of the body. Philadelphia : Saunders, 1983; 147-250, 258-63.

7. Wegener OH. Whole body computerized tomography. London Berlex Imaging Division of Berlex Laboratories Inc. 1983: 61-20/31, 61- 45.

8. Zerhouni EA, Scott Ww Jr, Baker RR, Wharam MD, Siegelman SS. Invasive thymomas : Diagnosis and evaluation by

computed tomography. *J Computed Assist Tomography* 1982; 6: 92.

9. Martini N, Vogt Moykopf I. Thoracic surgery frontiers and uncommon neoplasms. St. Louis : Mosby, 1989; 157-73.

10. Glazer GM, Axel L, Moss AA. CT diagnosis of mediastinal thyroid. *AJR* 1982; 138: 495-8.

11. Armstrong P, Wilson AG, Dee P. Imaging of diseases of the chest. Chicago : Year Book Medical, 1990; 703-20.

12. Heitzman ER. The mediastinum. Radiologic correlations with anatomy and pathology. Berlin : Springer-Verlag, 1988; 103-7.

13. Naidich DP, Zerhouni EA, Siegelman SS. Computed tomography of the thorax. New York : Raven Press, 1984; 72.