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The Radiologic Evaluation of Mediastinal and Hilar Abnormality: Tomography Using a Compensating Filter, and/or CT Following Pneumomediastinography

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Abstract By conventional tomography using a compensating filter, and by these procedures and/or CT following pneumomediastinography in the evaluation of hilar and mediastinal abnormality, it was confirmed that the wall and lumen of trachea, main bronchus, tracheal bifurcation, upper lobe bronchus, a part of upper segmental bronchus and blood vessels in hilar and mediastinal region were demonstrated clearly and in detail. Consequently, the mediastinal and hilar informations were evaluated more accurately : the lymph node involvement (swelling), the extension, origination of mediastinal and hilar lesion and/or the presence and extent of adhesion or cancerous lesion.

Key words: mediastinal and hilar lesion, tomography using a compensating filter, CT, pneumomediastinography

Introduction

It is already well-known that the radiologic evaluation of mediastinal abnormality is very difficult in a routin chest radiography.

It is also difficult to make the optimal density for all area of hilus, mediastinum and lung field on a sheet of film, because there is too much difference in density between both regions in conventional tomography.

Using a density compensating filter is advantageous in many ways such as modifying over density area to proper density with Aluminum and plexiglass. etc. In regards to the above, there have been many reports published. So far, however, there have been only a few reports on the use of compensating filters in hilus tomography[1].

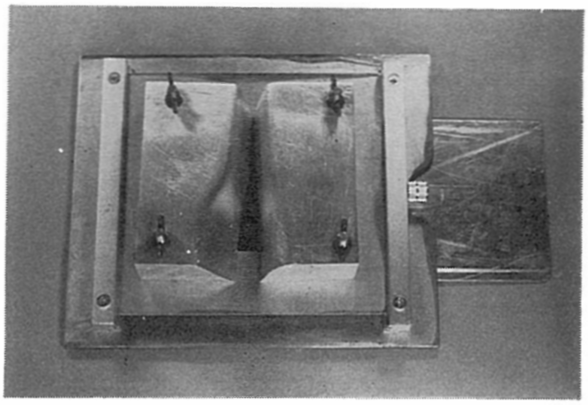
We attempted to evaluate exactly and in detail the structures of mediastinal and hilar regions by tomography using a compensating filter, and also to apply this procedure and/or CT following pneumomediastinography on the present study.

Subjects and Methods

Tomography using a compensating filter was employed in over 1200 cases for evaluating the abnormality of hilus and mediastinum in our department. 60 of these cases were analysed in a study of conventional tomography using a compensating filter. In addition to the above, 68 cases in tomography using a compensating filter and 34 cases in computed tomography following pneumomediastinography were also analyzed. The Aluminum compensating filter was made in our department and the filter was attached to the front of a multi-leaf shutter as shown in Fig. 1-A, B. Pneumomediastinography was done by transsternal method and oxygen gas volume was from 500 to 800ml[2]. Intravenously injected contrast medium was sometimes added to the computed tomography.

Results

Fig. 2 shows a filtered and unfiltered tomogram. Fig. 2-B is an unfiltered tomogram. Fig. 2-C, a filtered tomogram. The evaluation of tracheobronchial wall and the vascular shadow as demonstrated by a filtered tomography was shown in Fig. 3-A,B,C respectively. The numbers indicate the percentage of cases demonstrated clearly. From these results it was confirmed that the wall and lumen of trachea, main bronchus, tracheal bifurcation, both upper lobe bronchus, a part of upper segmental bronchus and lower lobe bronchus, and pulmonary vessels were visualized clearly and sirially.: A bronchial tree from trachea to the proximal portion of the lower lobe bronchus in over 95% of the cases examined was also visualized except for unfavorable cases due to overlapping lesion. Both a filtered tomogram and bronchofiberscopic image of the same patient were revealed in Fig. 4-A,B and Fig. 5-A, B respectively. These findings were compared and accorded largely. On a filtered tomography and CT following pneumomediastinography, Fig. 6-A,B,C showed the schematic presentation of mediastinal structure demonstrated by the filtered tomography



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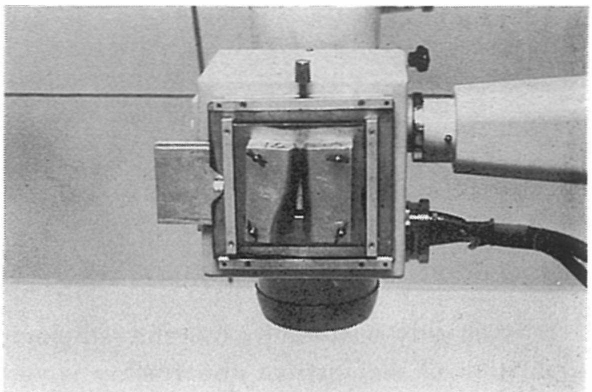
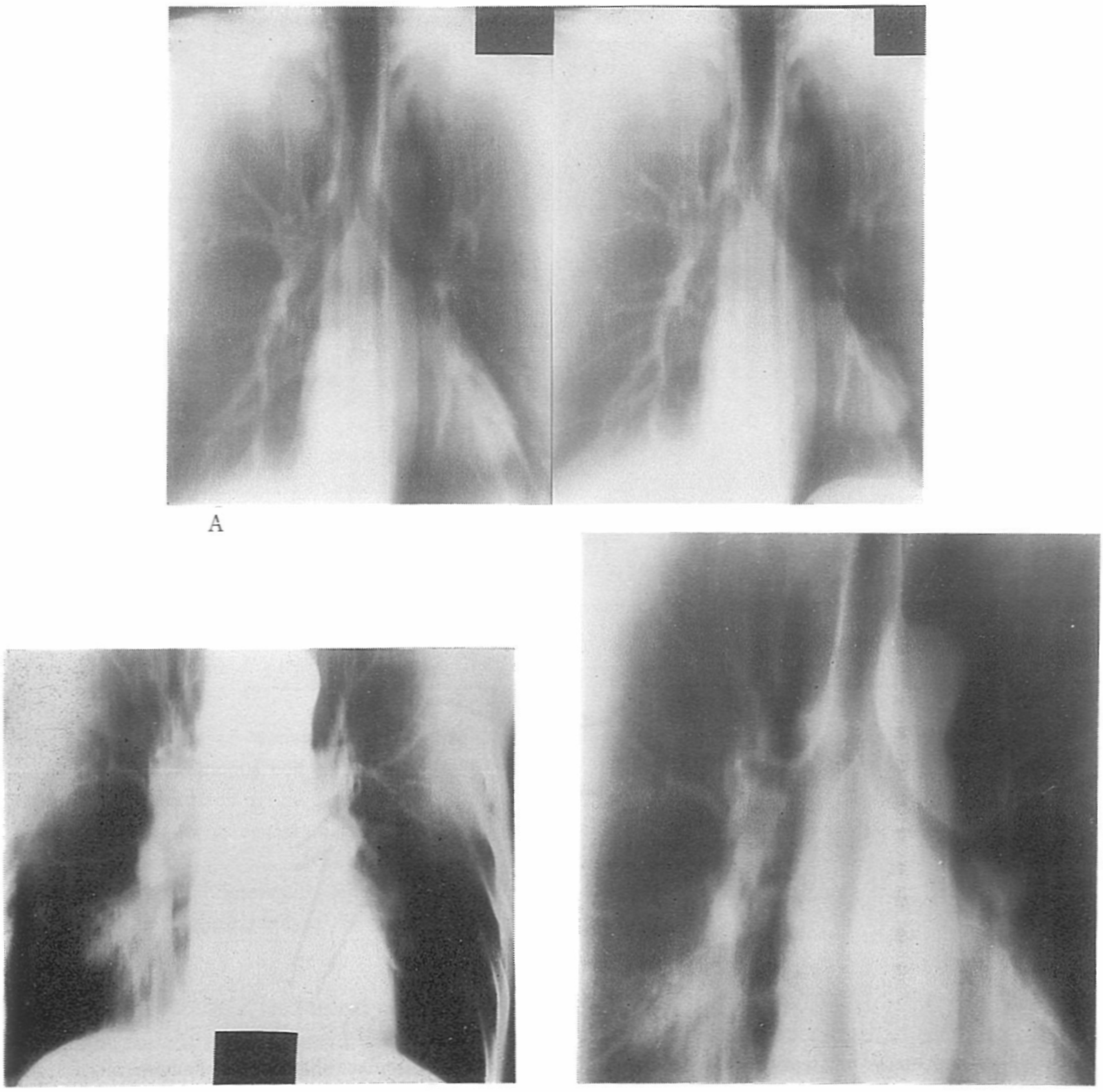


B

Fig. 1 A compensating filter

A. A filter made of Aluminum devise

B, A filter attached to the front of a multi-leaf shutter.



A

B C

Fig. 2 A filtered and unfiltered tomogram
A, A filtered tomogram of normal subject
B, C, An unfiltered versus filtered tomograms of the same patient. Note the better visualization of the obstruction of right intermediate bronchus because of endobronchial metastasis due to rectal cancer.

following pneumomediastinography.

In this method, paratracheal, periazygos, periaortic, pericardiac area, A-P window, vascular and tracheobronchial shadow were surrounded by band-like translucency and their correlation among each image was visualized clearly in the anterior and middle mediastinum. Cross hatching corresponded to band-like translucency. Band-like translucency was demonstrated over all area of mediastinum in normal individuals, but not demonstrated in affected areas. The involvement and swelling of left tracheobronchial lymph nodes was demonstrated clearly in Fig. 7-A,

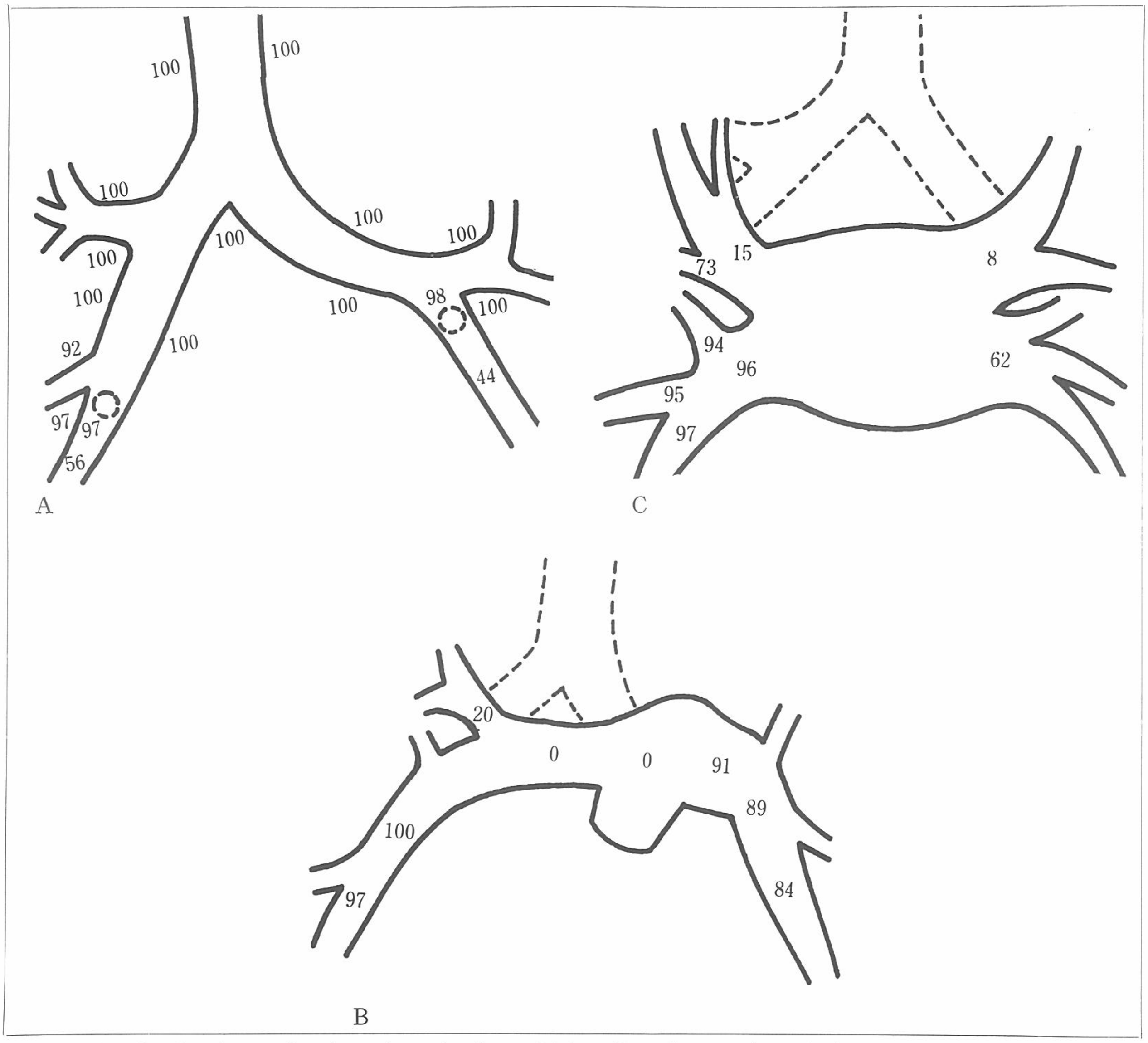


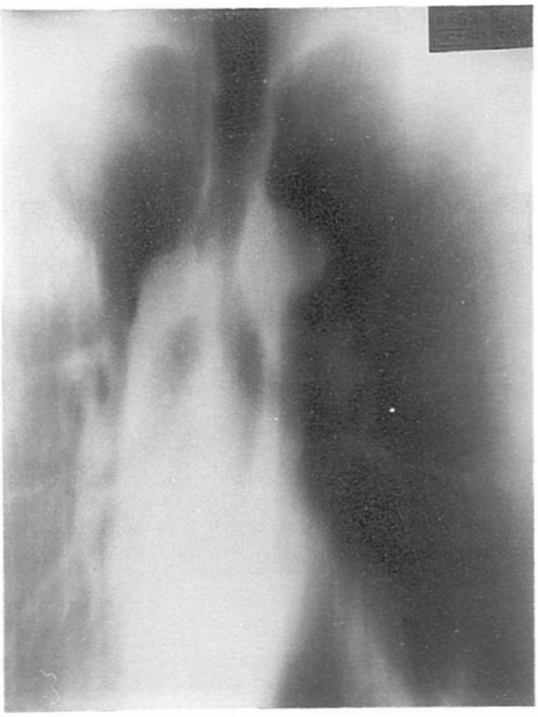
Fig. 3 On the evaluation of tracheobronchial wall and vascular shadow as demonstrated by tomography using a compensajing filter. (%) Number shows the percentage of cases demonstrated clearly, respectively.
A, Tracheobronchial wall
B, Pulmonary artery
C, Pulmonary vein

B,C.

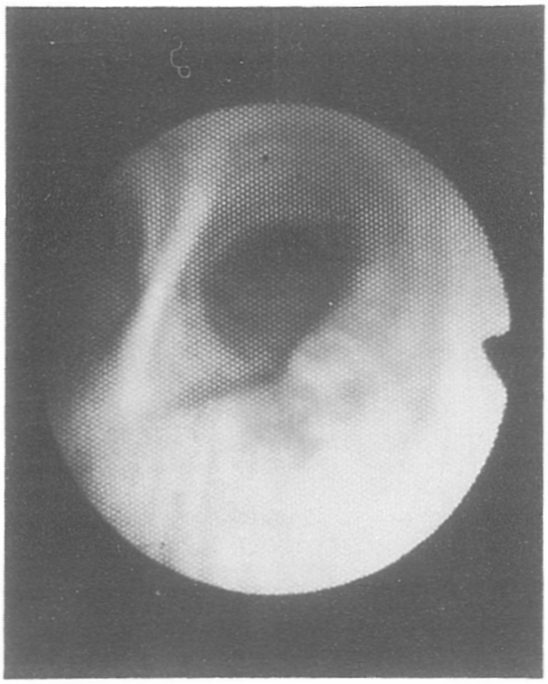
Computed tomography is a valid diagnostic method to assess the mediastinum-related lesion. However, we often find some difficulty in indentifying small aggregates of thymus tissue, the presence and extent of adhesion or cancerous lesion and small lymph node swelling. Computed tomography following administration of mediastinal gas reveals these findings more clearly. Computed tomograms following pneumomediastinography as shown in Fig. 7-B,C and Fig. 8-A,B revealed the lymph node swelling and the tumor originating at the thymus without adhesion.

Discussion

Evaluation of mediastinal and hilar abnormality is more difficult. Information from



A



B

Fig. 4 Filtered tomogram versus bronchofiberscopic image. A 73-year-old man with lung cancer (squamous cell carcinoma)

A, Filtered tomogram indicates an enlargement of mediastinal lymph node and a tumor shadow with irregular margin between the right wall of lower trachea and right main bronchus.

B, Bronchofiberscopic image indicates the endotracheobronchial mass with irregular surface corresponded to the tomogram.

ordinary anteroposterior, lateral and ordinary tomogram in chest radiography is less accurate in evaluating the mediastinum, hilus and lung field in a sheet of film, because there is too much difference between both regions in conventional tomography.

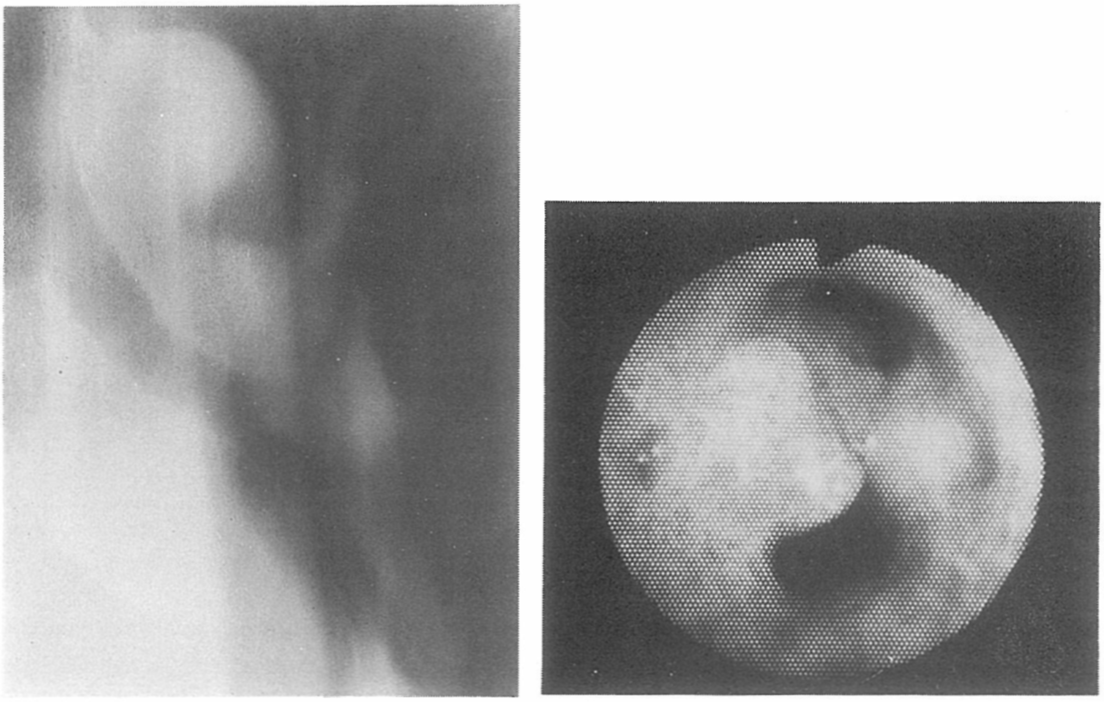
Using a density compensating filter is advantageous in many ways, such as modifying over density area to proper density with Aluminum and plexiglass, etc.

Regarding the above, there have been many reports published. So far, however, there have been only a few reports on the use of a compensating filter in hilus tomography[1].

Recently, xerotomography[3] and Fuji computed tomography[4)5] have been reported to be helpful in the evaluation of the mediastinum and hilus.

The xerotomograms reveal the tracheobronchial tree and blood vessels in the mediastinum and hilus more clearly than film tomogram by its edge enhancement effect. Because the tracheobronchial wall and lumen was demonstrated clearly by xerotomography was sometimes able to determine whether the lymph node metastases stayed within the lymph nodes or infiltrated into the bronchial wall.

However, xerotomography has some disadvantages. One is that it uses a special film-developing system different from that of film tomography. The other disadvantage is that xerotomography requires high voltage and



A B

Fig. 5 Filtered tomogram versus bronchofiberscopic image. A 73-year-old man with lung cancer (sqúamous cell carcinoma)

A, Filtered tomogram indicates strictured shadow from the distal part of left main bronchus to the entrance of left upper and lower lobe bronchus.

B, Bronchofiberscopic image indicates the protruded mass corresponded to the tomogram.

amperage, so a single radiation exposure is neccessary. But, considering its advantage, we hope that it should be used after careful consideration is given to its suitability for diagnostic purposes.

Xerotomograms can also be obtained in an ordinary printed form, which eliminates the neccessity of a radiography reading system, and since reading radiographs over a period of time does not tire the examiner's eyes, it is easier to grasp delicate chages in the lesions. In principle, however, it should be used only for a further examination.

It is generally acknowledged that the greatest value of computed tomography of thorax is in the evaluation of the medastinum. The cross-sectional CT images display the fine anatomic detail of this area with great precision, and often yield unique and useful diagnostic information directly affecting the management or prognosis of patients. Compared with conventional radiographic techniques, the transverse anatomic plane CT sections provide an unparalleled view of the superimposed structure of the mediastinum.

However, CT diagnosis is not the first diagnostic choice for the mediastinum, but conventional radiographic technique (plain film and tomography) is required in a initial diagnostic step.

The wide variation of tissue density in the thorax often requires that more than one exposure be obtained in hilar and mediastinal tomography. We have found that the use of a compensating filter makes it possible for a single tomography to [demonstrate a feature of clinical importance in both lateral and medial aspects of the hilus and medias-

A B C

Fig. 6 The schematic presentation of mediastinal structures as demonstrated by tomography using a compensating filter following pneumomediastinography. Cross-hatching corresponds to band-like translucency.
A, Anterior mediastinum B, Middle mediastinum C, Lateral view

tinum. The filter is made of on Aluminum device which compensates for the considerable difference in tissue density among the lung parenchyma, hilus and mediastinal tissue[6-10].

Therefore, by using a compensating filter, the wall and lumen of the tracheobronchial tree, and vascular shadow in mediastinal and hilar region were visualized clearly and serially as shown in Fig. 2, 3. Consequently, the obstruction, stenosis and invasion of tracheobronchial wall and lumen were detected by these tomography relatively easily as shown in Fig. 4, 5 and the correlation between tracheobronchial and vascular shadow was demonstrated more clearly. The filtered tomography used is convenient, not expensive, and requires a small exposure dosage. Small exposure doses were as following. Surface dosage was reduced to 46% in mediastinum, lung field to 12% compared with conventional tomography[6]. On the information of tomography using a compensating filter, this technique was extremely useful for evaluating the hilus and mediastinal abnormality in the initial step of routine work. Computed tomography is a valid diagnostic method to assess the mediastinum-related lesions as described before.

However, we often find some difficulty in identifying small lesion of thymus tissue, minimum lymph node swelling, the extent of mediastinal lesions and/or the presence and expansion of adhesion and cancerous invasion. Pneumomediastinography has been considered useful on the evaluation of mediastinal lesions since before the use of tomography. Fig. 6 shows the evaluation of mediastinal structures as demonstrated by tomography using a compensating filter following pneumomediastinography with a scheme. Sone et al[11] described and illustrated on the potential distensible spaces of mediastinum and the anatomic pathways

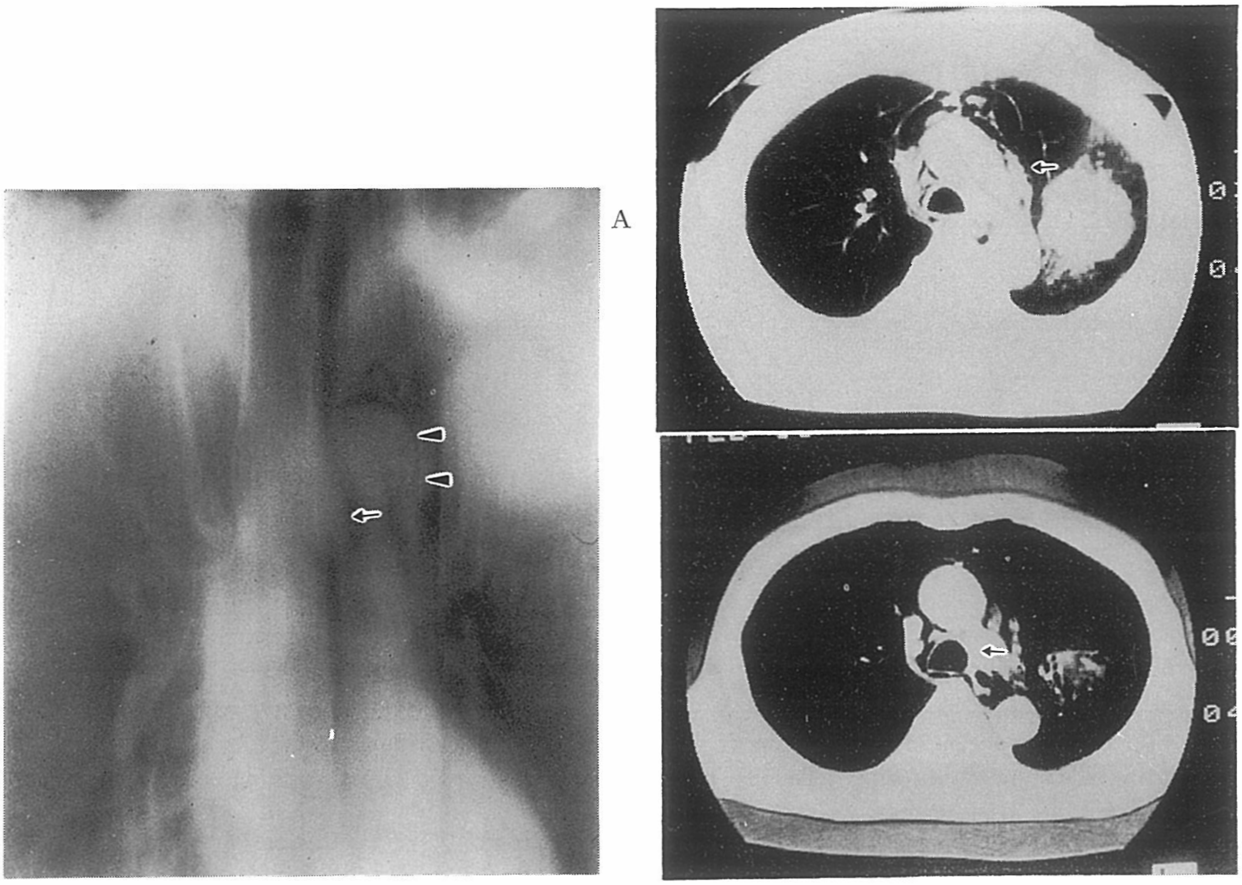


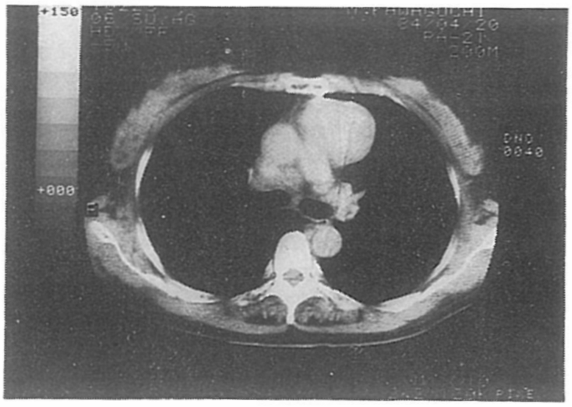
Fig. 7 Filtered tomogram and computed tomogram following pneumomediastinography. A 73-year-old man with mediastinal lymph node metastasis from renal cell carcinoma.

A, Filtered tomogram shows the thickening of lower portion of left side of tracheal wall, and the visualization of paraaortic lymph node swelling surrounded by band-like translucency (arrow head) because of the left tracheobronchial and paraaortic lymph node involvement.

B, Computed tomography following pneumomediastinography shows the enlarged tracheobronchial lymph node swelling (arrow) confirmed by operation. Namely, band-like translucency between left side of tracheal wall and pulmonary artery is not visualized because of the enlarged tracheobronchial lymph node.

C, Computed tomography following pneumomediastinography shows the enlarged paraaortic lymph node swelling (arrow).

between the mediastinal structures by using CT following pneumomediastinography. Namely, in interpreting radiographs of a mediastinal space occupying lesion, an accurate knowledge of the potential space for its expansion and the anatomic route for its extension to the neighboring area helps in understanding and predicting the site of the origin and extent of the lesion in relation to the surrounding structures. We agreed with their point of view and confirmed that the combinated tomography using a compensating filter and/or CT following pneumomediastinography should be provide much information on the mediastinal and hilar abnormality[6-10),12)].



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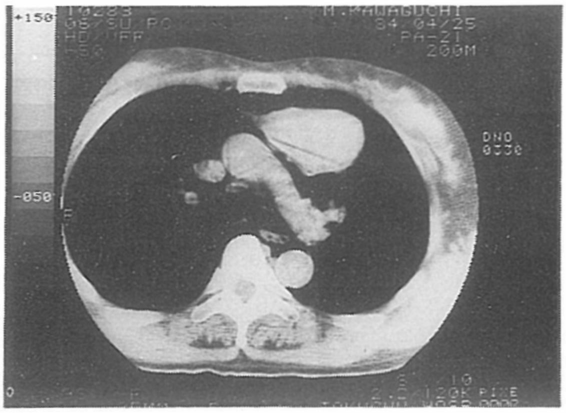

B

Fig. 8 Computed tomography following pneumomediastinography. A 48-year-old woman with benign thymoma

A, Computed tomography without pneumomediastinography

B, Computed tomography following pneumomediastinography shows the shape of the hypertrophic thymus without adhesion (band-like translucency is visible clearly)

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