Imaging findings of diseases of the middle mediastinum

Poster No.: C-0029
Congress: ECR 2016
Type: Educational Exhibit
Authors: Y. Ozawa, M. Hara, Y. Ishihara, H. Maki, Y. Shibamoto; Nagoya/JP
Keywords: Mediastinum, Lung, Thorax, CT, CT-Quantitative, MR, Surgery, Computer Applications-Detection, diagnosis, Decision analysis, Education and training, Kv imaging, Neoplasia
DOI: 10.1594/ecr2016/C-0029

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

1) To review the mediastinal compartment classification
2) To describe the differential diagnosis of middle mediastinal lesions
3) To review the imaging findings of diseases of the middle mediastinum

Background

Diseases of the middle mediastinum are relatively rare, but could show some characteristic imaging findings. The purpose of this article was to summarize the image findings of diseases of the middle mediastinum.

Findings and procedure details

1. Mediastinal compartment classification

1) Felson’s compartments on lateral chest X ray (Fig. 1 on page 12)

- This classification is based on the lateral chest X ray [1].
- Anterior, middle, posterior mediastinal compartments are included in this classification.
- The borderline between anterior and middle mediastinum is the line anterior to the trachea in the upper chest and posterior to the heart in the lower chest. The border between middle and posterior mediastinum is the line of 1 cm back from the anterior edge of the vertebral bodies.
- This classification is simple, and interobserver agreement is good, and useful for differentiation of the mediastinal lesions.

2) Mediastinal compartment classification of transverse images according to the JART (Japanese Associations for Research on the Thymus) general rules for study of mediastinal tumors (Fig. 2 on page 12)

This classification is divided into 4 compartments by computed tomography (CT), as below [2].
1. superior portion of mediastinum
2. anterior mediastinum (prevascular zone)
3. middle mediastinum (peri-tracheoesophageal zone)
4. posterior mediastinum (paravertebral zone)

- Superior portion of mediastinum is defined as the space between the superior border of the mediastinum and a horizontal plane at the intersection of the caudate margin of the brachiocephalic vein with the trachea.
- Posterior lateral boundary of superior mediastinum and posterior mediastinum is a vertical line against the posterior rim of the chest wall at the lateral rim of the thoracic vertebral transverse process.
- The anterior border of the posterior mediastinum is vertical line connecting a point on each thoracic vertebral body at 1 cm behind its anterior margin: middle-posterior boundary line (M-PBL).

3) Mediastinal compartments defined by ITMIG (International Thymic Malignancy Interest Group) (Fig. 3 on page 13)

This classification is divided into 3 compartments by CT, as below [3].

1. prevascular compartment (anterior mediastinum)
2. visceral compartment (middle mediastinum)
3. paravertebral compartment (posterior mediastinum)

- This definition has modified the mediastinal compartment classification defined by JART.
- The main differences between the classification of JART and that of ITMIG are
  - ITMIG compartments do not have superior portion of mediastinum.
  - ITMIG compartments include the heart and great vessels in the middle compartment.

2. Diseases of the middle mediastinum

Neurogenic tumors (NTs)
• NTs are derived from tissue of neural crest (cells of the peripheral, autonomic, and paraganglionic nervous systems), and more than 90% of NTs are benign [4-6].
• NTs are the most common posterior mediastinal tumors (95% of mediastinal NTs)[4], however sometimes develop in the middle mediastinum.
• Schwannomas, that arise from the vagus nerves in the middle mediastinum is extremely rare [7], accounting for 2% of all intrathoracic schwannomas. The locations of main nerves in the mediastinum are shown in Fig. 4 on page 14 [8].

< Imaging findings of schwannomas > (Fig. 5 on page 15, Fig. 6 on page 16)

CT [4-6]
  • Well defined round or oval mass
  • Cystic degeneration
  • Calcification; punctate, mottled, curvilinear seen along the tumor wall.
  • Homogeneity of contrast enhancement (CE) depends on the degree of cellularity. (loose cellularity with diffuse edematous change could cause low CE.)
  • Heterogenous area correspond to cystic, hemorrhagic change or hypocellularity.

MRI [5, 6]
  • T1WI: low signal intensity (SI)
  • T2WI: heterogenous high SI
  • CE: unenhancing cystic necrotic areas are clearly visualized.
  • The relationship between pathological components and signal intensity, degree of enhancement.

The Antoni A (hypercellular component): relatively low signal intensity on T2WI, and strong contrast enhancement.

The Antoni B (hypocellular component): high signal intensity on T2WI, and gradual weak contrast enhancement.

• MRI clearly depicts the tumor margin, especially when the tumors grow through the intervertebral foramina.
FDG-PET [9]

- SUV\textsubscript{max} 1.9-7.2 (mean 4.6)
- Schwannomas tend to have a high FDG uptake.
- The degree of cellularity could result in wide variation in SUVs; mean SUV\textsubscript{max} and \textit{av} of the hypocellular tumors was significantly lower than those of the hypercellular tumors (p=0.01).

**Bronchogenic cyst (BC)**

- Mediastinal cysts comprise 12 to 20% of all mediastinal masses. The most common mediastinal cysts are foregut cysts; BCs and enterogenous cysts [4].
- BCs develop during embryologic development as an anomalous budding of the tracheobronchial tree.
- BCs are lined with pseudostratified, columnar respiratory epithelium, also contain bronchial glands and cartilage [4,10].
- The most common site BCs occur is near the tracheal carina of the middle mediastinum or posterior mediastinum, though they could occur in any part of the mediastinum and, less common, in the lung, pleura, diaphragm [10].

< Imaging findings of bronchogenic cyst > ( Fig. 7 on page 17 , Fig. 8 on page 18 )

**CT [4,10,11]**

- Solitary, well defined round or oval mass.
- The attenuation of BC depends on its component, and varies from water to soft tissue attenuation. (high protein level of calcium oxalate in BC result in high attenuated BC.) Contrast enhancement is not seen.
- The wall of BC is thin and imperceptible.
- Calcification sometimes occurs in the wall or cyst contents.
- Air-fluid level in BC is uncommon, may occur by secondary infection or communication with the adjacent tracheobronchial tree.

**MRI [10,11]**

- T1WI: variable SI, depend on contents of BC (protein, hemorrhage, mucoid material).
- T2WI: high SI
- Fluid-fluid level may be seen.
Esophageal cysts (EC) [10]

- Adjacent to / within the esophageal wall.
- Hemorrhage or rupture may occur, because of ectopic gastric or pancreatic mucosa.
- CT, MRI findings of ECs are similar to those of BC, however EC’s wall tends to be thicker.

**Enlarged medastinal lymph nodes**

- Metastasis to Lymph node
- Malignant lymphoma
- Sarcoidosis
- Castleman’s disease
- Tuberculosis
- Histoplasmosis
- Lymphadenopathy caused by other pneumonia
- Pneumoconiosis

**Castleman’s disease (CD)**

- A rare benign lymphoproliferative hyperplasia of lymph nodes
- 2 histological subtypes [12-15]
  - hyaline vascular type (HV) 90% of CD
  - plasma cell type (PC) 10%
    - Distribution
  - HV: unicentric (localized) CD
  - PC: unicentric or multicentric CD
    - 70% of CD occur in thorax, 10-15% in the neck, and 10-15% in the abdomen [15,16].
    - The majority of multicentric CD is associated with HIV, HHV-8 infection [13].

< Imaging findings of Castleman's disease > (Fig. 9 on page 19)

**CT [13,15,16]**

- Well circumscribed, soft tissue mass
- 10% of CD have calcification; punctate, discrete, coarse, peripheral, arborizing.
• Intense enhancement, especially in HV type.

MRI [13-16]

• T1WI: intermediate to slightly high SI
• T2WI: slightly high SI
• Flow voids in the mass, reflecting vascularity
• Central linear hypointense septate maybe seen.

FDG-PET [17]

• Max SUV: 3-5
• It has been reported that PET examination was useful for detecting the CD foci, especially in multicentric type.

- CD of the chest -

Unicentric (localized) CD

• Solitary rounded mediastinal or hilar mass (LN involvement)
• Well circumscribed, sometimes shows calcification
• Avid contrast enhancement, especially in HV type. PC typically demonstrates less avid enhancement.

Multicentric CD

• Multiple lymphadenopathy of mediastinum and hilum. Abdominal, pelvic, cervical lymphadenopathy are also seen.
• Pulmonary involvement also occurs; centrilobular nodular opacities, septal thickening, ground glass opacities, air-space consolidation.
• Multicentric CD is associated with the development of lymphoma, Kaposi sarcoma.

Malignant lymphoma (ML)

• Malignant lymphomas are mainly divided to Hodgkin disease and non Hodgkin disease.

< Imaging findings of malignant lymphoma > ( Fig. 10 on page 20 )

Pattern of lymph node involvement
1) Hodgkin disease [18]

most frequently involves the anterior mediastinal and paratracheal LNs, followed by subcarinal, peridiaphragmatic, preiesophageal and internal mammary nodes, in the thorax. Isolated hilar lymphadenopathy is rare.

2) Non-Hodgkin lymphoma [18]

also most frequently involves the anterior mediasinal and paratracheal LNs. Subcarinal, hilar, posterior mediastinal, and pericardial nodes are other common sites.

- Mediastinal lymph node disease is frequently seen compared with hilar involvement. Hilar lymph node disease is usually asymmetric, and accompanied by mediastinal lesions [19].

- Lymph node calcification is rare before therapy [18, 20].

- Incidence: 0.84% (8 /956 lymphomas) of cases

- Calcification of lymphoma occurred more often in the mediastinum.

- Only in patients with the aggressive type of disease.

- Lymphoma may show irregular or eggshell calcification on CT after treatment [18].
- Associated pleural effusion could be seen.

Lymph node metastasis [19, 21]

- Other than lung cancer, breast cancer, melanoma, head & neck, gastrointestinal cancer, genitourinary cancer are malignancies that could metastasise to intrathoracic lymph nodes.
- Pattern of lymphadenopathy is usually asymmetric.

Sarcoidosis

- Sarcoidosis is a systemic granulomatous disorder of unknown cause, that is characterized by noncaseous epithelioid cell granulomas.
- Typically affects adults less than 40 years old
• 50% of cases: asymptomatic, the other cases: nonspecific symptoms; fatigue, weight loss, cough, dyspnea.
• Sarcoidosis is the direct cause of death in 5%.

(About 80% of case die from cardiac involvement in Japan, while most cases die from pulmonary complications (extensive lung fibrosis) in United States.)

• Clinical course
- 2/3 of cases remain stable or recede within a decade after diagnosis.
- 20% of cases develop chronic condition, leading to pulmonary fibrosis.
- Recurrence after a remission lasting 1 year or more is uncommon, however recurrence may occur in any organ and age.

< Imaging findings of sarcoidosis > ( Fig. 11 on page 21 , Fig. 12 on page 22 )

• Involvement of the lung and the mediastinal, hilar lymph nodes is most common; 90% of patients [19, 22, 23].
• Mediastinal and hilar lymph nodes (typical)
  - Well defined, bilateral symmetric hilar and right paratracheal lymphadenopathy is the most common type.
  - Mediastinal lymphadenopathy w/o hilar involvement is rare, is seen in older patients more frequently.
• Mediastinal and hilar lymph nodes (atypical)
  - Lymphadenopathy may be occasionally asymmetric or seen in unusual locations (paravertebral, internal mammary, retrocrural LNs)[23].
DDx: lymphoma, tuberculosis
  - Lymph nodes of sarcoidosis may be calcified, and this finding
suggests chronic condition[19, 22, 23].

- Calcification occurs in 3% of cases after 5 years, in 20% after 10 years [23].

- The shape of calcification; amorphous, punctate, popcorn-like, eggshell-like.

  - Lung [22, 23]

Lesions along the lymphatic vessels are characteristics.

- Multiple perivascular small nodules

- Irregular thickening of bronchovascular bundles, interlobular septa, subpleura

- Upper, middle lung distribution is predominant

- Fibrosis, like traction bronchiectasis, honeycombing emphysema, bullae, architectural distortion, could be seen at end stage sarcoidosis

**Silicosis**

- Caused from the inhalation of crystalline silicon dioxide, or silica.

- Major cause of occupational lung disease in exposed workers.

- The latent period is 10 to 30 years, however, could be months after heavy exposure to the silica dust.

- Occupations commonly associated with silicosis are as follows;

  - Mining
  - Quarrying
  - Drilling
  - Foundry working
  - Ceramics manufacturing
- Sandblasting

< Imaging findings of silicosis > (Fig. 13 on page 23)

- Mediastinum [24]
  - Hilar and mediastinal lymphadenopathy with calcification (diffuse or peripheral; egg-shell), as a result of reach of silica containing macrophages to the lymph nodes.

- Lung - Simple silicosis [24]
  - Multiple small nodules (2-5mm, up to 10mm)
  - Upper and posterior lung zones predominant
  - Centrilobular distribution predominant
  - Pseudoplaques (coalescence of subpleural silicotic nodules)

- Lung - Complicated silicosis (PMF) [24]
  - Confluence of silicotic nodules into larger symmetric opacities, more than 1 cm in diameter
  - Those opacities have irregular margins, are uncommonly calcified.
  - Occur in the apical and posterior segments of the upper lobes, most commonly.
  - Fibrosis and volume loss progress over time.
  - Large opacities migrate toward the hilum.
  - Large opacities could have central necrosis, cavitation because of ischemia, tuberculosis.
  - Paracicatricial emphysema
  - Pulmonary tuberculosis occur in up to 25 % of cases with silicosis.
Images for this section:

**Fig. 1:** Fig.1 Felson's compartments on lateral chest X ray

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 2: Mediastinal compartment classification of transverse images according to the JART (Japanese Associations for Research on the Thymus) general rules for study of mediastinal tumors

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 3: Fig.3 Mediastinal compartments defined by ITMIG (International Thymic Malignancy Interest Group)

© radiology, nagoya city university hospital - Nagoya/JP
**Fig. 4:** The locations of main nerves in the mediastinum

© radiology, nagoya city university hospital - Nagoya/JP
**Fig. 5:** Fig. 5 Schwannoma derived from the vagus nerve. CECT shows well defined, round mass with homogenous enhancement, adjacent to the trachea (arrow).

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 6: Fig. 6 Schwannoma in the middle mediastinum. CECT shows well defined oval mass (arrow). The mass appears to have enhanced rim (open arrow), otherwise unenhanced component, that reflects cystic degeneration. B, C) The mass has intermediate signal intensity (SI) on T1WI, high SI with several septa in it on T2WI. D) CE T1WI shows cystic mass with enhancement of the rim and septa (arrow head).

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 7: Bronchogenic cyst. A) NECT shows well defined, oval mass of increased attenuation in the middle mediastinum (arrow). Small peripheral calcification is also seen (arrow head). B) CECT demonstrates this mass is unenhanced one.

© radiology, nagoya city university hospital - Nagoya/JP
**Fig. 8:** Bronchogenic cyst. A) T1WI shows a cyst with slightly high signal intensity in the middle mediastinum (arrow). B) T2WI shows high signal intensity cyst.

© radiology, nagoya city university hospital - Nagoya/JP
**Fig. 9:** Fig.9 CD (HV type) in the middle mediastinum. A) CT demonstrates a soft tissue mass with central coarse calcifications. B) Contrast enhanced CT shows intensely enhancing mass. C) Central coarse calcification are also seen. D-F) The mass is slightly higher SI compared with muscle on T1WI, and slightly high SI on T2WI. Contrast enhanced T1WI shows strong enhancement. Central linear low SI on T1, T2WI and unenhanced part is also seen (open arrow), which is thought to fibrosis.

© radiology, nagoya city university hospital - Nagoya/JP
**Fig. 10:** Fig.10 Malignant lymphoma. A, B) CECT shows large, homogenous mass in the middle mediastinum. Anterior mediastinal lymphadenopathy and right pleural effusion are also seen.

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 11: Fig.11 Sarcoidosis. A, B) Mediastinal and bilateral hilar lymphadenopathy is seen on NECT(arrow).

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 12: Fig.12 Sarcoidosis. A, B) NECT demonstrates multiple, calcifying hilar and mediastinal lymphadenopathy, which mimics pneumoconiosis.

© radiology, nagoya city university hospital - Nagoya/JP
Fig. 13: Fig. 13 Pneumoconiosis. A, B) NECT shows multiple lymph nodes enlargement with calcification (arrow). C) CT shows mass with coarse calcification, called as pulmonary massive fibrosis (PMF) in the upper lobe (arrowhead).

© radiology, nagoya city university hospital - Nagoya/JP
Conclusion

Diseases of the middle mediastinum were shown to have some characteristic findings. This information could be useful for their diagnosis and management.

Personal information

References


