Systematic Approach To Fat Containing Lesions Of The Thorax

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Disclosure statement

We have no actual or potential conflicts of interest in relation to this electronic exhibit.
Goals

1. To become familiar with a variety of fat containing intra-thoracic lesions.

2. Learn to easily narrow the differential diagnosis based on the imaging characteristics and location within specific compartments of the thorax.
Objectives

1. To identify fat containing lesions and their imaging characteristics.

2. To review intrathoracic examples of such lesions.
Target Audience

This electronic presentation is geared towards Radiology residents.
## Imaging of fat and patterns of distribution

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<th>Macroscopic fat on CT</th>
<th>Patterns of fat distribution</th>
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<td>-10 to -100 Hounsfield units.</td>
<td>Homogenous</td>
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<td><strong>Fat on MRI</strong></td>
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<td>Hyperintense on T1 weighted images and intermediate to hyperintense on T2 weighted images.</td>
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<td>Echogenic</td>
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Endobronchial Lesions

- Bronchogenic adenocarcinoma
- Squamous cell carcinoma
- Small cell carcinoma
- Bronchial carcinoid
- Endobronchial metastasis
- Leiomyoma
- Squamous cell papilloma
- Pleomorphic adenoma
- Granular cell tumor
- Amyloidoma
- Fibroepithelial polyp

FAT?

- NO
- YES

- Hamartoma
- Lipoma

Hamartoma

**Symptoms:** Obstructive in nature, including chronic cough, hemoptysis and fever.
**Contents:** Cartilage, fat, fibrous and epithelial tissue.
**CT findings:** Postobstructive changes. Smooth bordered endobronchial lesion with alternating foci of fat and calcification.

Lipoma

Benign. Predilection for mainstem bronchi.
**Symptoms:** Post obstructive symptoms. Chest pain, dyspnea, fevers, pneumonia.
**CT findings:** Postobstructive changes. Pedunculated homogenous lesion with fat attenuation (approximately -100 HU)

*Figure 1: Endobronchial hamartoma:* Heterogenous endobronchial lesion with areas of fat attenuation in the right middle lobe bronchus. Post obstructive atelectasis is noted in the right middle lobe. Case courtesy of H. Page McAdams, MD, Duke University Medical Center, Durham, NC.
Intraparenchymal Lesions

Broad differential including malignant, benign, infectious, vascular and inflammatory etiologies.

- Hamartoma
- Lipoma
- Lipoid Pneumonia

INTRAPARENCHYMAL FAT CONTAINING LESIONS

Hamartoma


Location: Most common in the hilar region.

CT findings:
- Soft tissue mass or nodule
- Popcorn calcification (5-50%)
- Focal or generalized fat (50%)

Lipoma

Origin: Adipose tissue.

Asymptomatic, rare and benign.

CT findings:
- Well circumscribed lesion.
- Homogenous fat attenuation.

Figures 2 a,b,c,d: Intraparenchymal Hamartoma. Right hilar mass with punctate focus of calcification and focal areas of fat.
INTRAPARENCHYMAL FAT CONTAINING LESIONS

Lipoid Pneumonia

Etiology:
- Exogenous: Acute or chronic aspirations of oils.
- Endogenous: Secondary to a central obstructive lesion.

Pathophysiology:
- Macrophage phagocytosis within alveoli and eventual transport to interlobular septa.
- Local edema and inflammation which may progress to fibrosis.

CT findings:
- Predominantly involve middle and lower lobes.
- Mass like ground glass or consolidative opacities with areas of fat attenuation.
- Crazy paving pattern may be seen.
- Fibrotic changes such as traction bronchiectasis.

Figure 3 a,b: Lipoid Pneumonia. Mass like consolidation in the left lower lobe with focal area of fat.
Mediastinal Lesions

**Anterior Mediastinum**
- Thymic Masses
- Germ Cell Tumors
- Thyroid Masses
- Lymph Node Masses
- Vascular
- Parathyroid Masses

**Middle Mediastinum**
- Lymph Node Masses
- Duplication Cyst
- Vascular

**Posterior Mediastinum**
- Neurogenic Masses
- Vascular
- Duplication Cyst
- Neurenteric cyst
- Lymph node masses

- Thymolipoma
- Teratoma and Teratocarcinoma
- Mesenchymal lesions such as lipomatosis and lipoma.
- Extramedullary Hematopoiesis
- Esophageal lipoma
- Lipoblastoma
- Liposarcoma

MEDIASTINAL FAT CONTAINING LESIONS

Lipoma

Origin: Mesenchymal tumor originating from adipose tissue.
Symptoms: Secondary to mass effect.
Location: Most common in anterior mediastinum
CT findings:
- Well circumscribed mass
- Homogenous fat attenuation

Lipomatosi

Seen in exogenous steroid use and obesity.
CT Findings:
- Unencapsulated
- Infiltrating fat

Figure 4a: Mediastinal Lipomatosi. Figure 4b: Mediastinal Lipoma.
MEDIASTINAL FAT CONTAINING LESIONS

**Thymolipoma**

Rare and benign anterior mediastinal lesion

**Symptoms:** Mass effect. Typically asymptomatic.

**CT findings:**
- Well delineated mass
- Fat attenuation mixed with normal thymic tissue
- Connection to thymus or superior mediastinum can often be demonstrated.

*Figures 5a, 5b: Thymolipoma:* Well circumscribed mass in the anterior mediastinum, anterior to the aortic arch which demonstrates mixed fat and soft tissue density.
**MEDIASTINAL FAT CONTAINING LESIONS**

### Teratoma

**Origin:** Germ Cell  
**Mediastinal Location:** Typically Anterior.  
**Histology:** Mature (Benign) Immature (Malignant)  
**CT Findings:**
- Heterogeneous cystic lesion  
- Smooth Contoured, encapsulated, multicystic  
- Calcification.  
- Soft tissue component.  
- Fat component (76% of cases)  
- Fat fluid level.

### Teratocarcinoma

**Male Predilection**  
**CT Findings:** Above findings with following differences
- Poorly defined, irregular and nodular margins.  
- Thick enhancing capsule with contrast admin.

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**Figure 6a:** Teratoma: Anterior mediastinal cystic mass with soft tissue, fluid, fat and calcium components.

**Figure 6b:** Teratocarcinoma: Anterior mediastinal mass with soft tissue and fat component. Nodular and irregular margin.
Lipoblastoma

**Origin:** Mesenchymal  
**Age:** Early childhood  
**Location:** Typically in the extremities (70%). Can also be seen in the mediastinum as well as other locations.

**Symptoms:** Secondary to mass effect.

**CT Findings:**
- Mostly fatty mass  
- Well defined margins  
- Can have septa and nodularity  
- Intratumoral stranding  
- Cystic changes can be seen.

**MRI Findings:**
- Intratumoral streaks and whorls

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Figure 7a: Lipoblastoma.  
7 year old patient. CT shows a heterogenous fatty lesion. Thoracic inlet is a characteristic location for lipoblastoma. Case courtesy of Mark J. Kransdorf, MD, Mayo Clinic, Jacksonville, Fla.

Figure 7b: Lipoblastoma.  
Coronal T1 weighted image. Heterogeneous fatty lesion at the right thoracic inlet. Internal streaks and whorls are demonstrated which are representative of its characteristic fibrovascular network. Case courtesy of Mark J. Kransdorf, MD, Mayo Clinic, Jacksonville, Fla.
Cardiac Lesions

- Myxoma
- Papillary fibroelastoma
- Rhabdomyoma
- Fibroma
- Hemangioma
- Paraganglioma
- Sarcomas
- Primary cardiac lymphoma
- Pericardial Mesothelioma

FAT?

NO

- Lipoma
- Liposarcoma
- Lipomatous Hypertrophy of the interatrial septum
- Arrhythmogenic right ventricular dysplasia

YES
CARDIAC FAT CONTAINING LESIONS

Lipoma

Location: Typically Extra Myocardial. Can be either subendocardial or subepicardial.
Symptoms: Secondary to mass effect. Include: anginal pain, arrhythmia, sudden death and CHF.
CT findings:
- Encapsulated oval fat attenuation mass.

Figure 8: Cardiac Lipoma: Well marginated fat attenuation lesion along the right atrial wall.
Liposarcoma

Malignant

**Location:** Typically right side of heart.

**Behavior:** Local invasion or metastasis.

**Histology:** Well differentiated, myxoid, round cell, pleomorphic.

**Symptoms:** Chest pain, dyspnea, arrhythmia, symptoms of CHF.

**Imaging findings:**
- Mass with varying fat content ranging from homogeneously fatty to nearly complete soft tissue attenuation.
- Signs of invasion or infiltration.
- Calcification.
- Adjacent mediastinal structure may have poorly defined margins.

Figure 9a, 9b: Well differentiated liposarcoma: Axial T2 and coronal T1 weighted MR images demonstrate a lobular hyperintense mass along the right heart border. Case courtesy of Mark J. Kransdorf, MD, Mayo Clinic, Jacksonville, Fla.
Lipomatous Hypertrophy of the Interatrial Septum

Benign
Unencapsulated fat containing lesion in the interatrial septum.
No extracardiac or intracavitary component.

Symptoms: Asymptomatic. Maybe associated with arrhythmias or sudden cardiac death.

Imaging findings:
- Fat containing lesion in the interatrial septum.
- Characteristic dumbbell shape.
- Nonenhancing.
- Well marginated, non encapsulated.
- Relative sparing of oval fossa.
- Moderate FDG uptake on PET/CT
CARDIAC FAT CONTAINING LESIONS

Arrhythmogenic Right Ventricular Dysplasia (ARVD)

Fatty or fibrofatty replacement of the right ventricular myocardial tissue.

Location: Right ventricular apex is the most commonly affected.

Symptoms: Ventricular arrhythmias or sudden cardiac death.

Imaging findings:
- Fatty or fibrofatty replacement of the right ventricular myocardium.
- Diffuse or focal right ventricular dilatation.
- Right ventricular wall thinning.
- MR cine imaging can show wall motion abnormalities and lack of normal systolic thickening.

Figure 11a ARVD: Axial Fast Spin echo T2 weighted MR image demonstrates fatty replacement of the myocardium in the right ventricular apex. (Black Arrows) Case courtesy of David A. Lynch, MD, University of Colorado Health Sciences Center, Denver.

Figure 11b, c ARVD: Cine MR images at end systole (b) and end diastole (C) demonstrate lack of normal systolic wall thickening and akinesia of the right ventricular wall. Case courtesy of David A. Lynch, MD, University of Colorado Health Sciences Center, Denver.
Solid Pleural and Extrapleural Lesions

- Pleural Thickening
- Localized fibrous tumor of the pleura
- Pleural Metastasis
- Lymphoma
- Lung Cancer with chest wall invasion
- Splenosis
- Mesothelioma
- Askin tumor

FAT?

- Lipoma
- Hiatal Hernia
- Bochdalek Hernia
- Morgagni Hernia
- Juxtacaval Fat


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PLEURAL FAT CONTAINING LESIONS

Lipoma

Benign encapsulated fatty tumor
Origin: submesothelial layer of the parietal pleura.  
Symptoms: Typically asymptomatic. Can be associated with cough, back pain, exertional dyspnea.
CT findings:
  - Well circumscribed.
  - Homogenous fat attenuation.

Figure 12 Pleural Lipoma
EXTRAPLEURAL FAT CONTAINING LESIONS

Morgagni Hernia

Herniation of abdominal contents through a diaphragmatic defect termed foramen of Morgagni. Location: Anterior and retrosternal. Right sided (90% of the cases)

Hernia contents: omentum > colon > stomach > liver > small intestine.

CT findings:
- Sagittal or coronal images can assist in demonstrating the diaphragmatic defect.

Figure 13 a, b: Morgagni Hernia. Axial and sagittal images demonstrate right sided, anterior and retrosternal herniation of bowel and omental fat. Sagittal image demonstrates diaphragmatic defect.
EXTRAPLEURAL FAT CONTAINING LESIONS

**Bochdalek Hernia**

Developmental defect in posterior portion of the diaphragm results in herniation of abdominal contents.

**Presentation:** Infancy

**Laterality:** Left sided (70-90% of cases)

**Contents:** Typically fat and omental tissue. Retroperitoneal and intraperitoneal contents may also herniate.

**CT findings:**
- Sagittal or coronal images can assist in demonstrating the diaphragmatic defect.

*Figure 14 a,b: Bochdalek Hernia. Axial and coronal images demonstrate right sided paraspinal lesion with fat attenuation. Coronal image demonstrates the diaphragmatic defect.*
EXTRAPLEURAL FAT CONTAINING LESIONS

Juxtacaval Fat

Focal fat collection medial to and adjacent to the lumen of the IVC near the hepatic venous junction.

CT appearance:
- Focal lesion with fat density adjacent to and medial to IVC
- Can appear to be intracaval. Attributed to subdiaphragmatic narrowing of the IVC.

Figure 15: Juxtacaval Fat. Homogeneous lesion with fat attenuation, appears to be within the lumen of the IVC at the level of the hepatic venous junction.
Conclusion

Identifying fat containing intra-thoracic lesions and their anatomic location within the thorax can assist the radiologist in narrowing the differential so that a more accurate radiologic diagnosis can be made thus facilitating the implementation of prompt and appropriate patient management.


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