Diseases of the Respiratory System

Tumours of the Lung

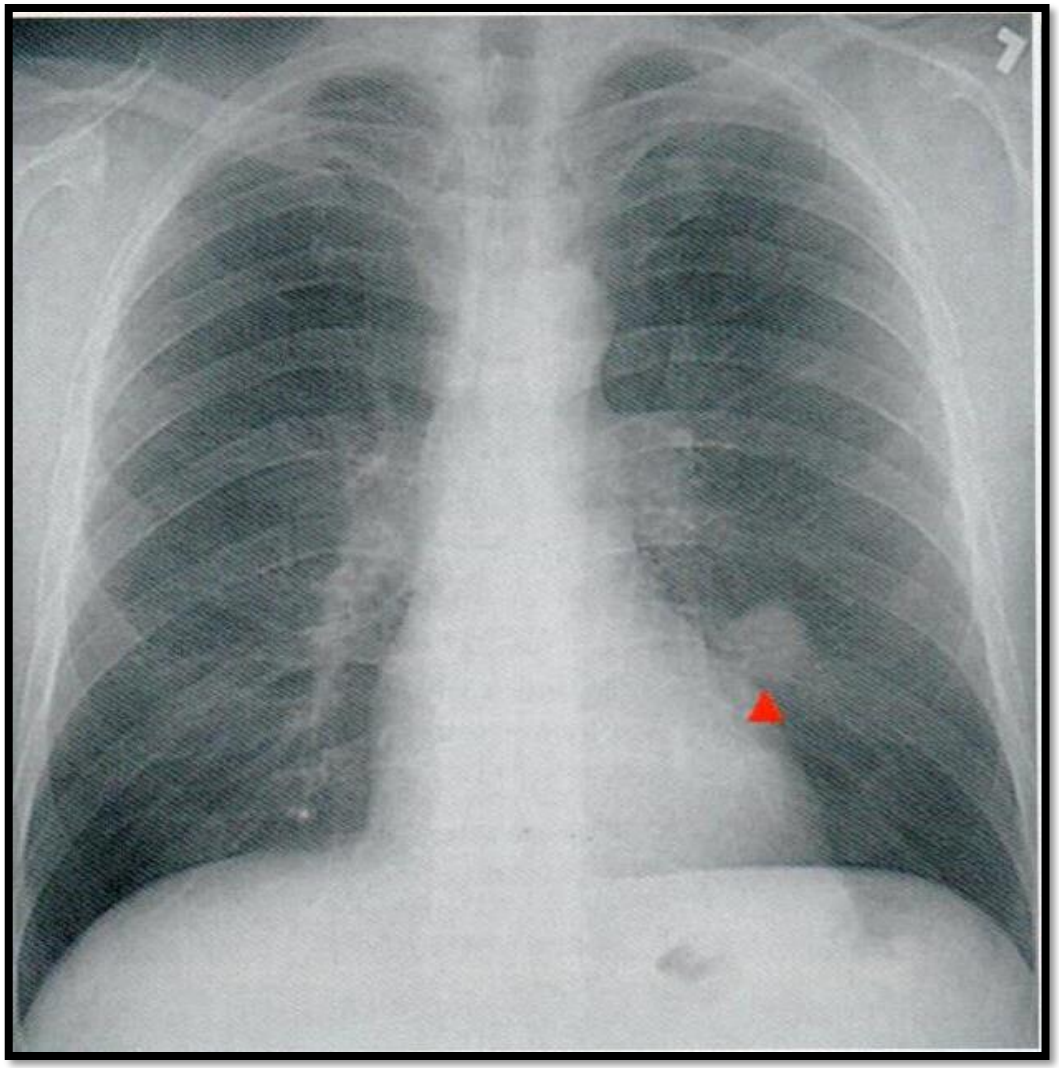
Objectives

- Know the **epidemiology of lung cancer**
- Is aware of classification of bronchogenic carcinoma which include: squamous carcinoma, adenocarcinoma, small cell and large cell (anaplastic) carcinomas.
- Understand the predisposing factors of bronchogenic carcinoma.
- Understands the clinical features and gross pathology of bronchogenic carcinoma. Know the precursors of squamous carcinoma (squamous dysplasia) and adenocarcinoma (adenocarcinoma in situ and atypical adenomatous hyperplasia).
- Have a basic knowledge about neuroendocrine tumours with special emphasis on small cell carcinoma and bronchial carcinoid.
- Is aware that the lung is a frequent site for metastatic neoplasms.

Lung Tumors

- Most lung tumors are malignant.
- Primary lung cancer is a common disease BUT metastatic tumors are the most common lung carcinoma seen in clinical practice.
- 95% of primary lung tumors are carcinomas
- 5% carcinoids, mesenchymal malignancies (fibrosarcomas, leiomyomas) and lymphomas

- The most common benign lesions are hamartoma



Hamartoma, radiograph

Hamartoma, gross

Hamartoma, microscopic

Primary lung cancer
Epidemiology

1. Primary lung cancer is the most common fatal cancer in both men and women worldwide.

a. Accounts for >30% of cancer deaths in men

b. Accounts for >25% of cancer deaths in women

2. Incidence of lung cancer is declining in men but increasing in women.

3. Peak incidence is at 55 to 65 years of age.

Classification of Malignant epithelial tumors of lung:
(Bronchogenic carcinoma)

I. Non-Small Cell Lung Carcinoma (NSCC) (70%-75%)

1. Squamous cell carcinoma (25%-35%)
2. Adenocarcinoma, including bronchioloalveolar carcinoma (30%-35%).
3. Large cell carcinoma (10%-15%).

II. Small cell lung carcinoma (SCC) (20%-25%).

III. Combine patterns (5%-10%).

- Most frequent patterns:
  - Mixed squamous cell ca and adenocarcinoma.
  - Mixed squamous cell ca and SCLC.

IV. Carcinoid tumors

V. Others

Both small cell carcinoma and carcinoids are neuroendocrine tumors as both arise from the neurendocrine cells normally present in the lung

Bronchogenic carcinoma

- is a common cause of cancer death in both men and women.
- For therapeutic purposes, bronchogenic carcinoma are classified into:

1. **Non- Small cell lung carcinoma (NSCC)** which includes squamous cell, adenocarcinomas, and large-cell carcinomas.
2. **Small cell lung carcinoma (SCC)**

Bronchogenic carcinoma

It is important to differentiated NSCC from SCC because treatment are different.

NSCC therapy

- Surgical:- offers the best chance for curing.
- Radiation:- controls local disease. Radiation therapy is most commonly used to palliate symptoms.
- Chemotherapy:- not effective.

SCC therapy

- Chemotherapy is very effective because small cell carcinomas are highly responsive to chemotherapy

Predisposing factors of bronchogenic carcinoma

1. Tobacco smoking:

- Some 85% of lung cancers occur in cigarette smokers. Most types are linked to cigarette smoking, but the strongest association is with squamous cell carcinoma and small cell carcinoma
- The nonsmoker who develops cancer of the lung usually has an adenocarcinoma.
- is directly proportional to the number of cigarettes smoked daily and the number of years of smoking.
- Cessation of cigarette smoking for at least 15 years brings the risk down.
- Passive smoking increases the risk to approximately twice than non-smokers.
- Cigarette smokers show various histologic changes, including squamous metaplasia of the respiratory epithelium which may progress to dysplasia, carcinoma in situ and ultimately invasive carcinoma

Predisposing factors of bronchogenic carcinoma: Other causes

2. **Radiation**: All types of radiation may be carcinogenic and increase the risk of developing lung cancer. Tradium and uranium workers are at risk
3. **Asbestos:** increased incidence of cancer with asbestos exposure, especially in combination with cigarette smoking.
4. **Industrial exposure** to **nickel and chromates, coal, mustard gas, arsenic, iron** etc.
5. **Air pollution:** May play some role in increased incidence. Indoor air pollution especially by radon.
6. **Scarring:** sometimes old infarcts, wounds, scar, granulomatous infections are associated with adenocarcinoma.

Bronchogenic carcinoma

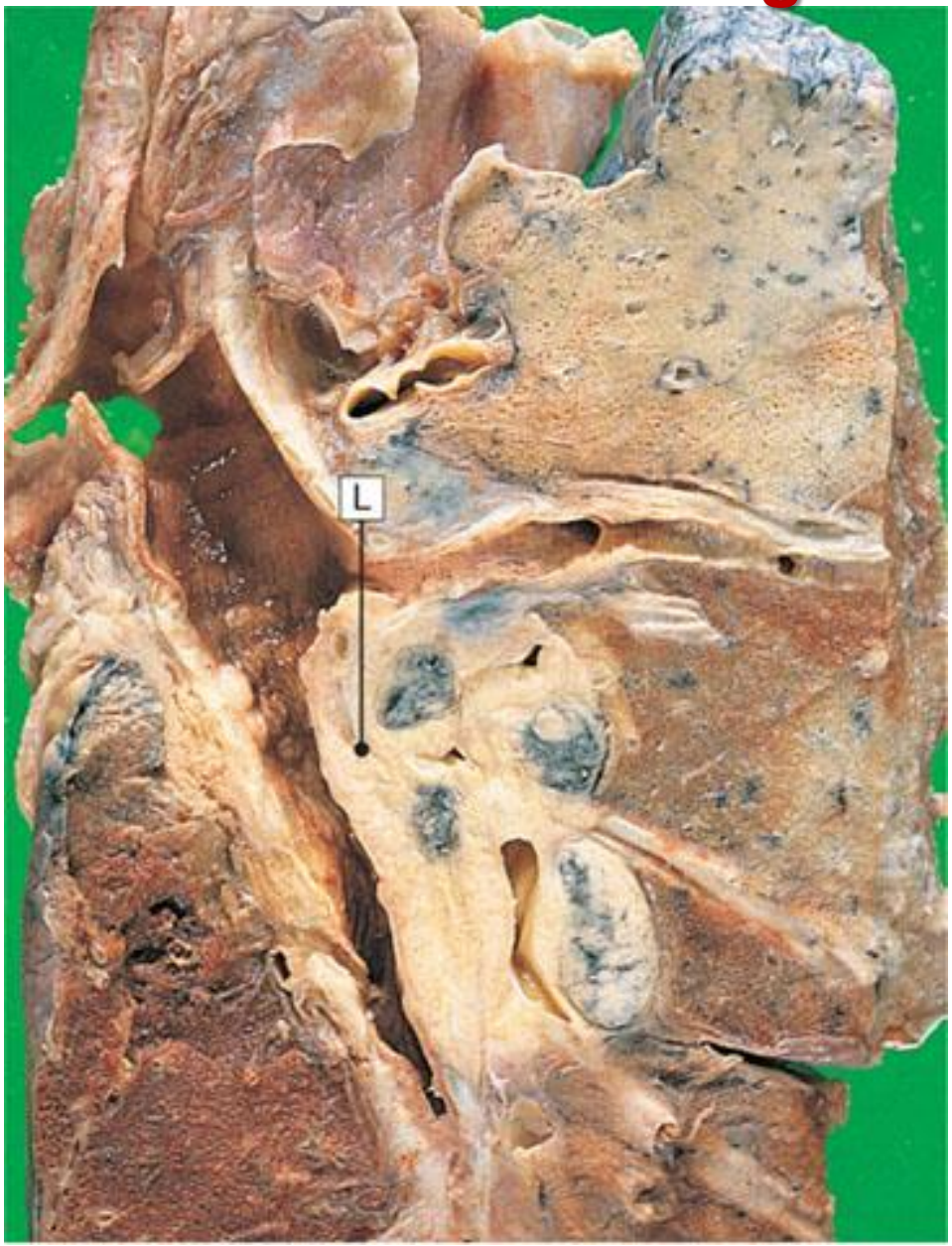
Central tumors

- Squamous cell CA
- Small cell CA

Peripheral tumors

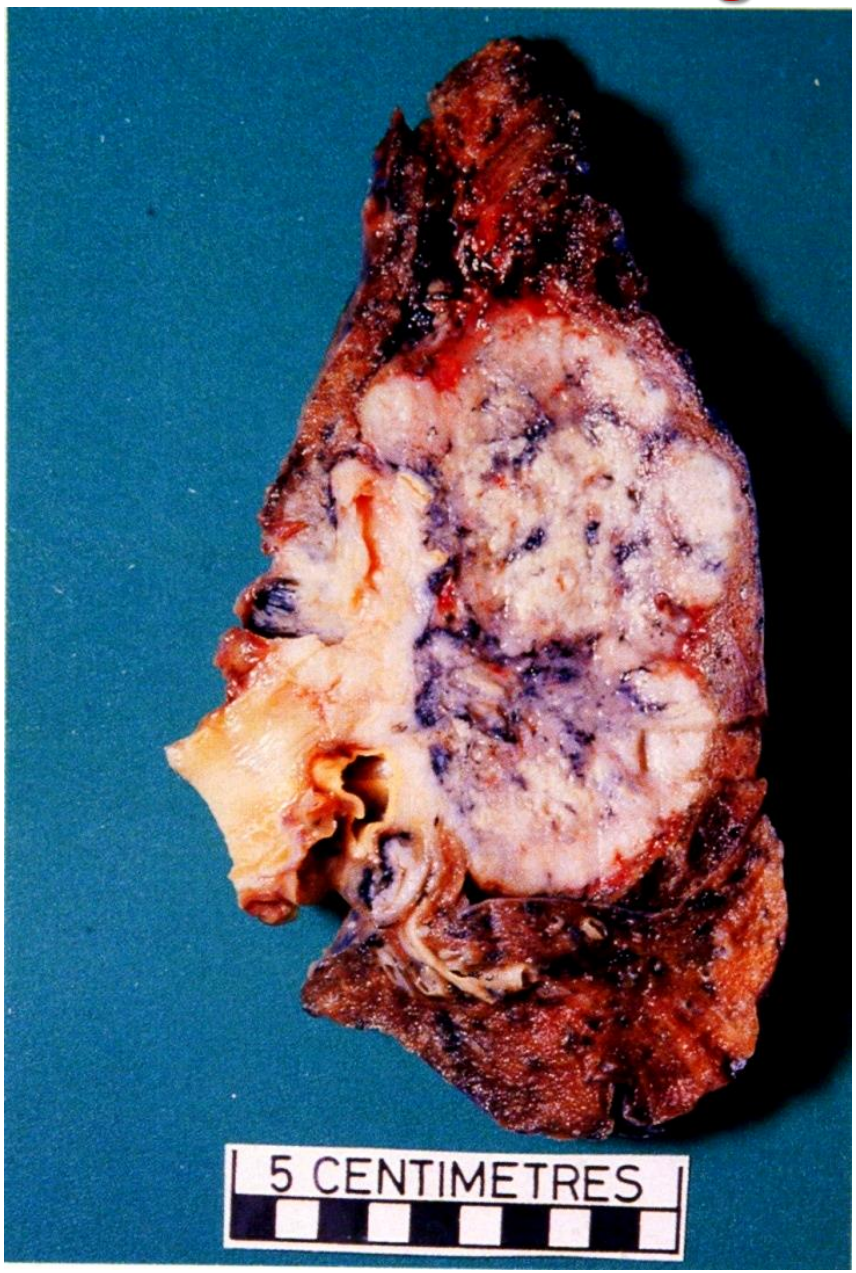
- Adenocarcinoma
  - bronchial derived
  - bronchioloalveolar ca
- Large cell carcinoma

Diseases of Lung



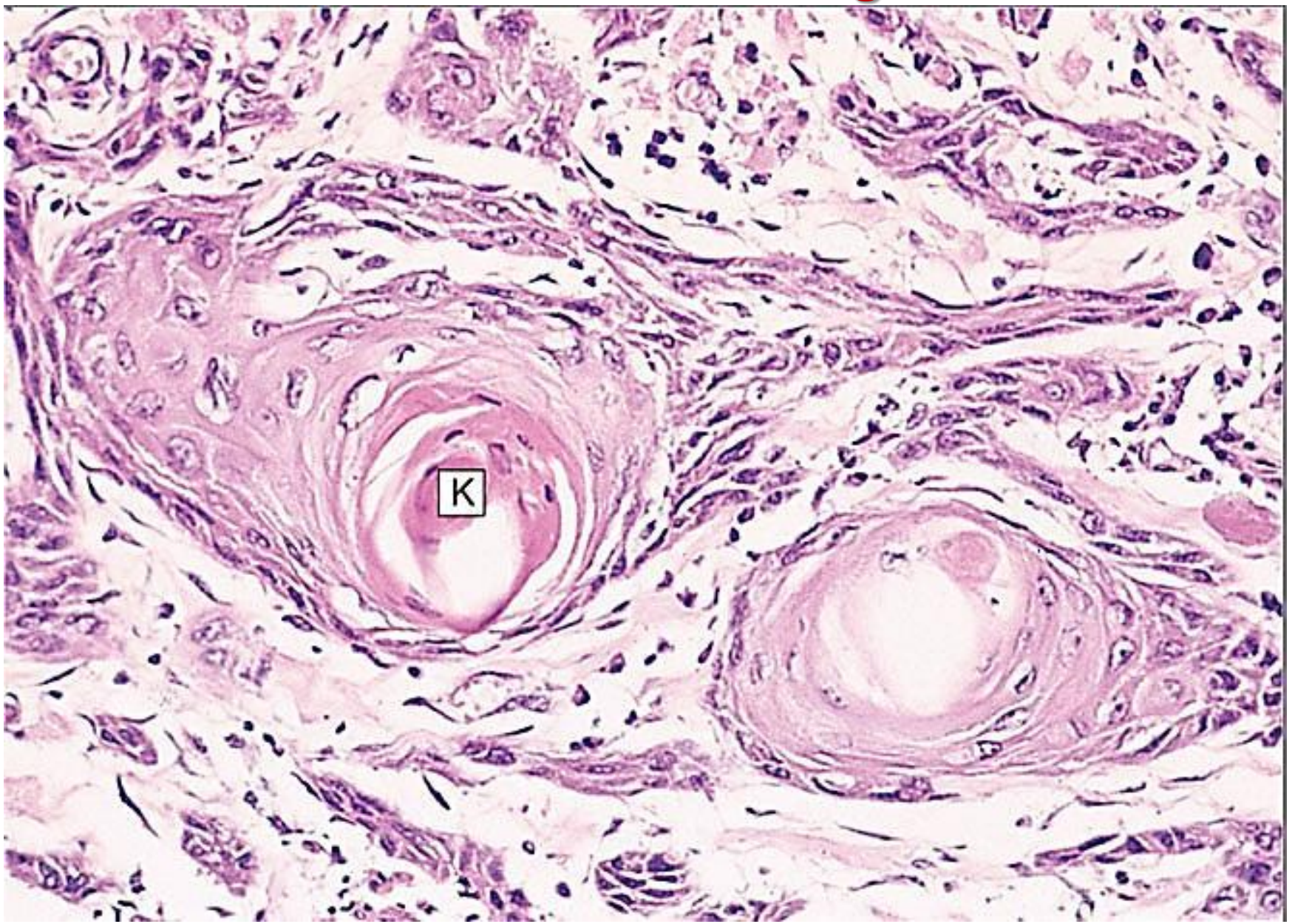
Central carcinoma of the bronchus. Central carcinomas of the lung (L) appear as friable white masses of tissue that extend into the lumen of bronchi and invade into the adjacent lung.

Diseases of Lung



Carcinoma of the lung

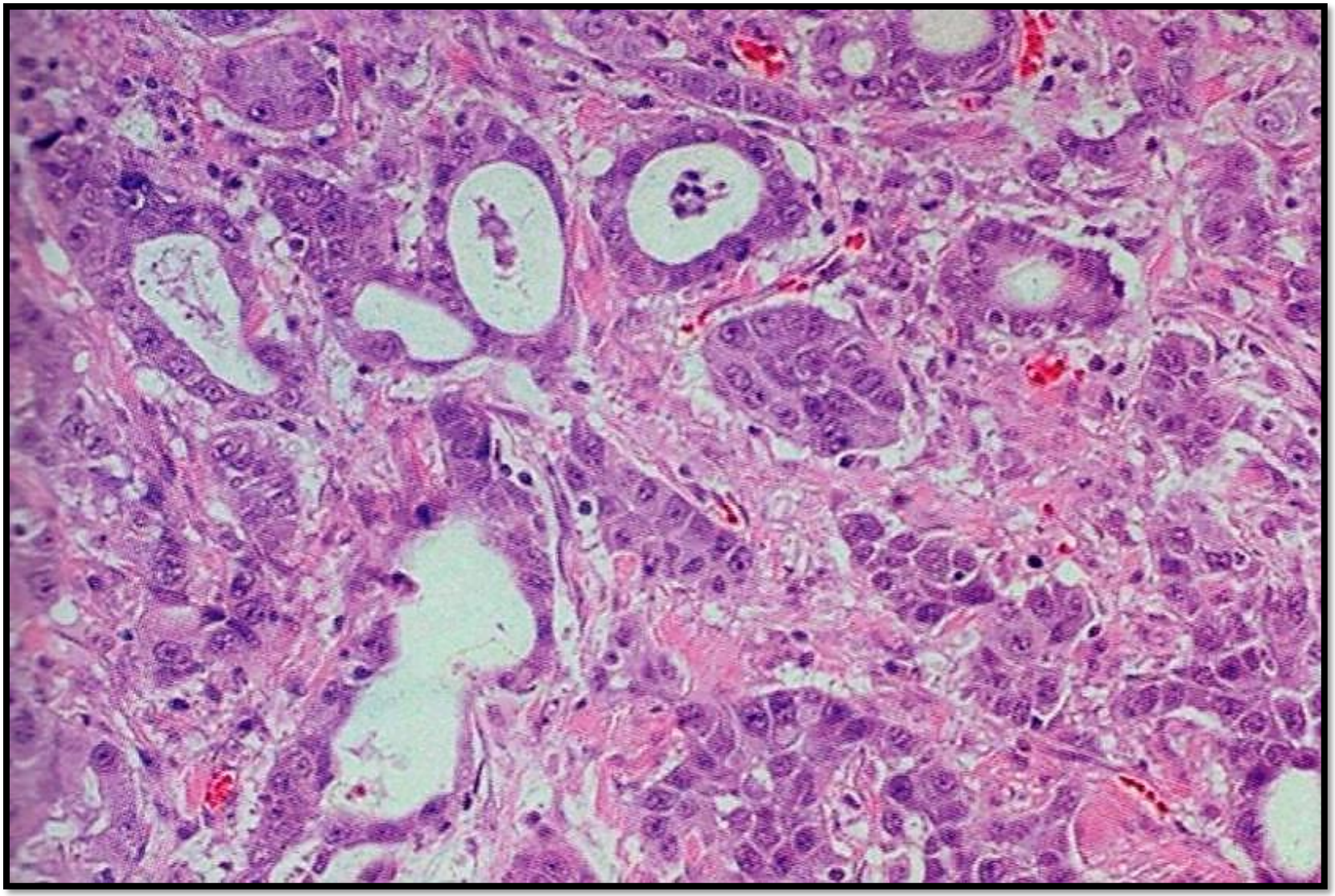
Diseases of Lung



Squamous cell carcinoma of the lung

Diseases of Lung

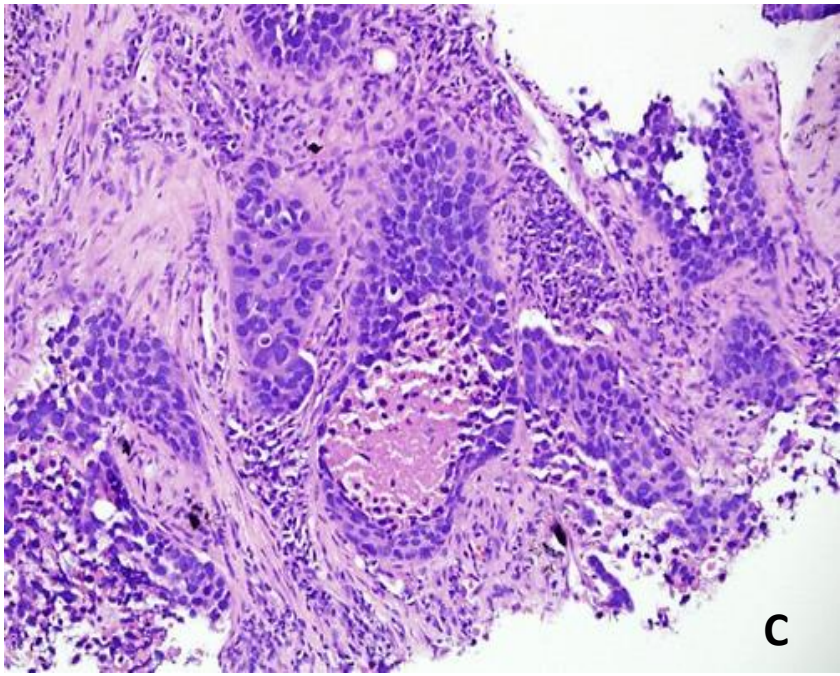
Peripheral carcinoma of the lung. Peripheral carcinomas of the lung (C) appear as ill-defined masses, often occurring in relation to scars, and frequently extend to the pleural surface.

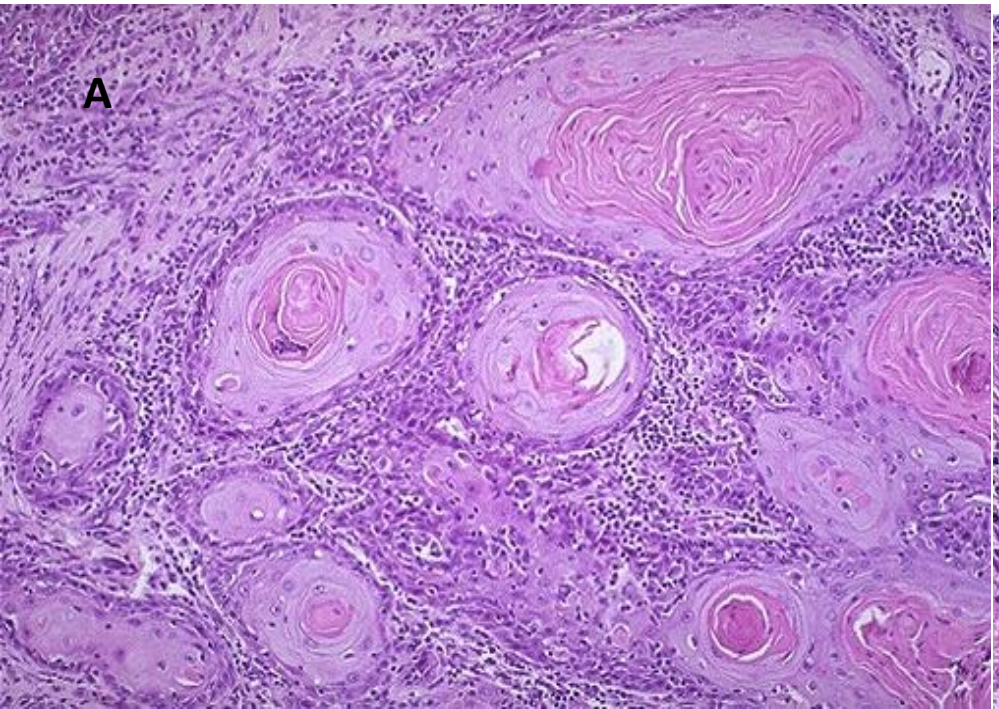


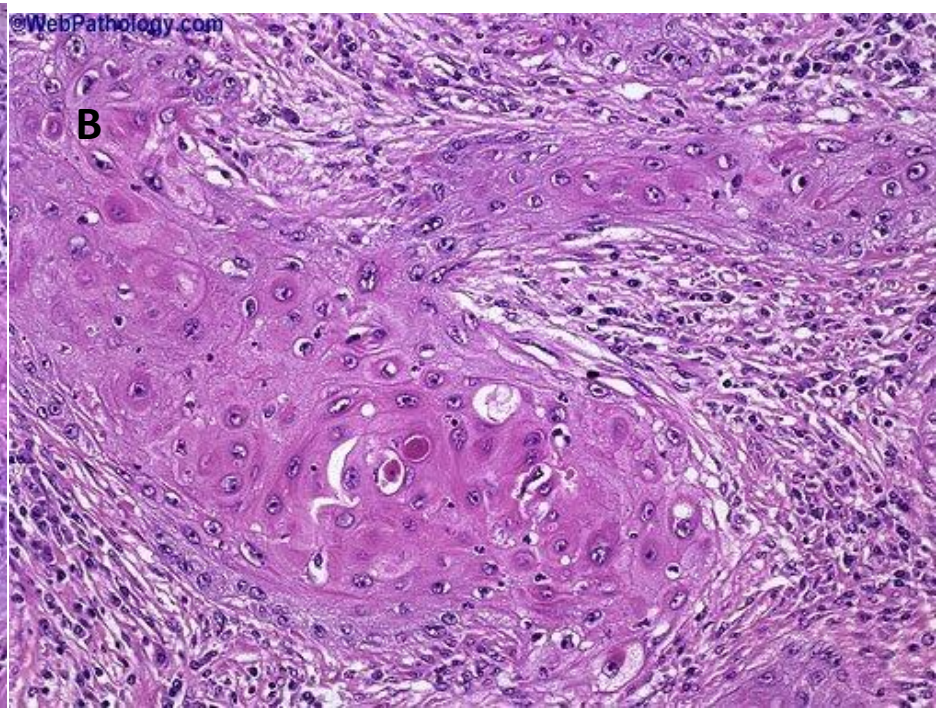
Adenocarcinoma, microscopic

Squamous cell carcinoma (SqCC)

- Histologically, these tumors are graded according to degree of squamous differentiation and tumors ranges from:
  - well-differentiated squamous cell carcinoma (A),
  - moderately differentiated SqCC (B) to
  - poorly differentiated SqCC (C).
- Tumor cells produces a parathyroid hormone related peptide



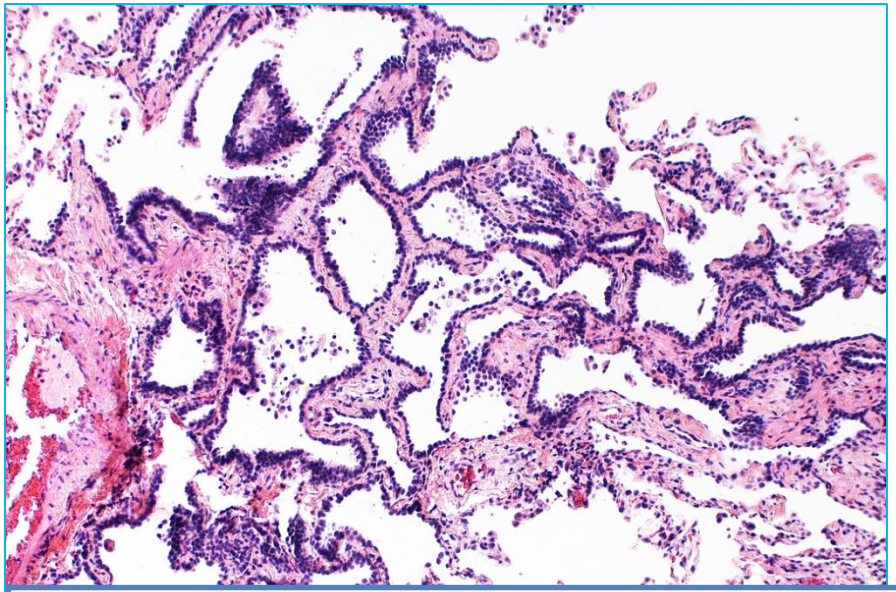




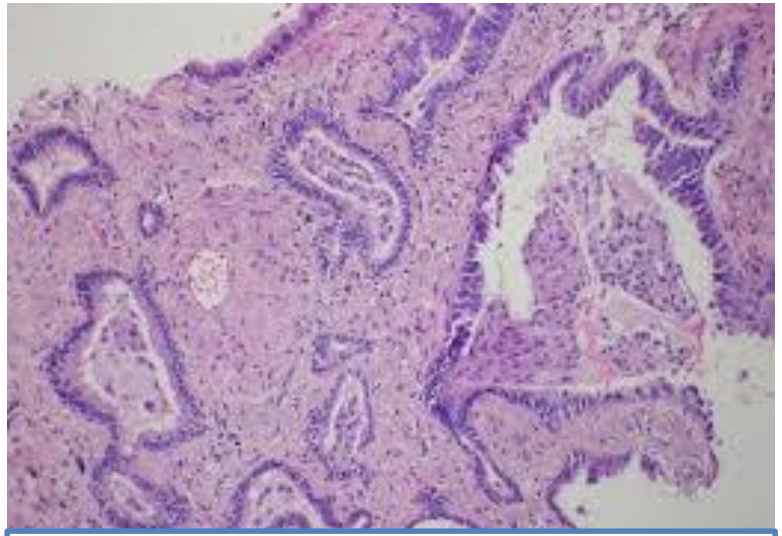
Adenocarcinomas

- Adenocarcinomas is now the most frequent histologic subtype of bronchogenic carcinoma; more common in women.
- They do not have a clear link to smoking history
- They are classically peripheral tumors arising from the peripheral airways and alveoli.

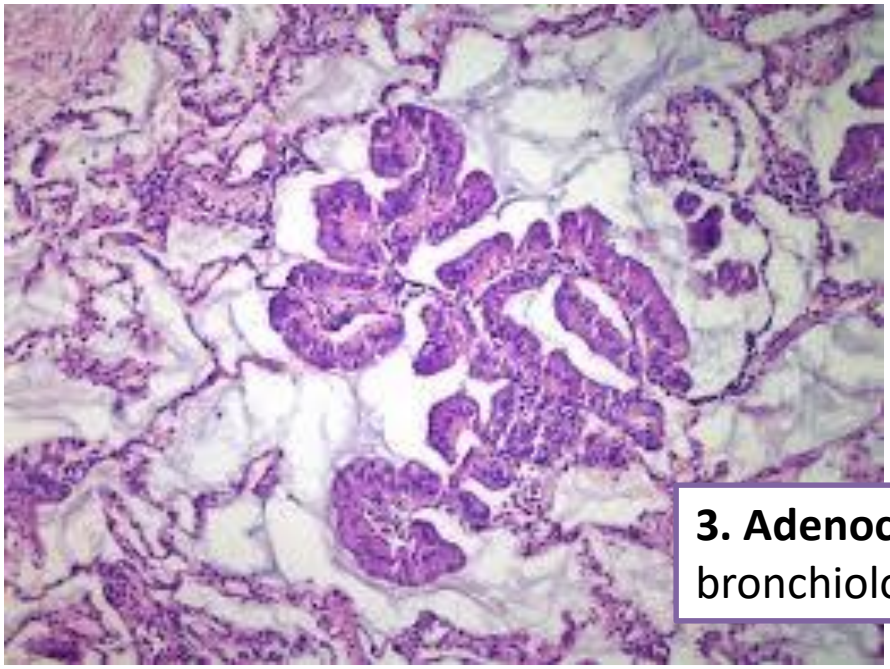
Precursors of lung adenocarcinoma



1. Atypical adenomatous hyperplasia



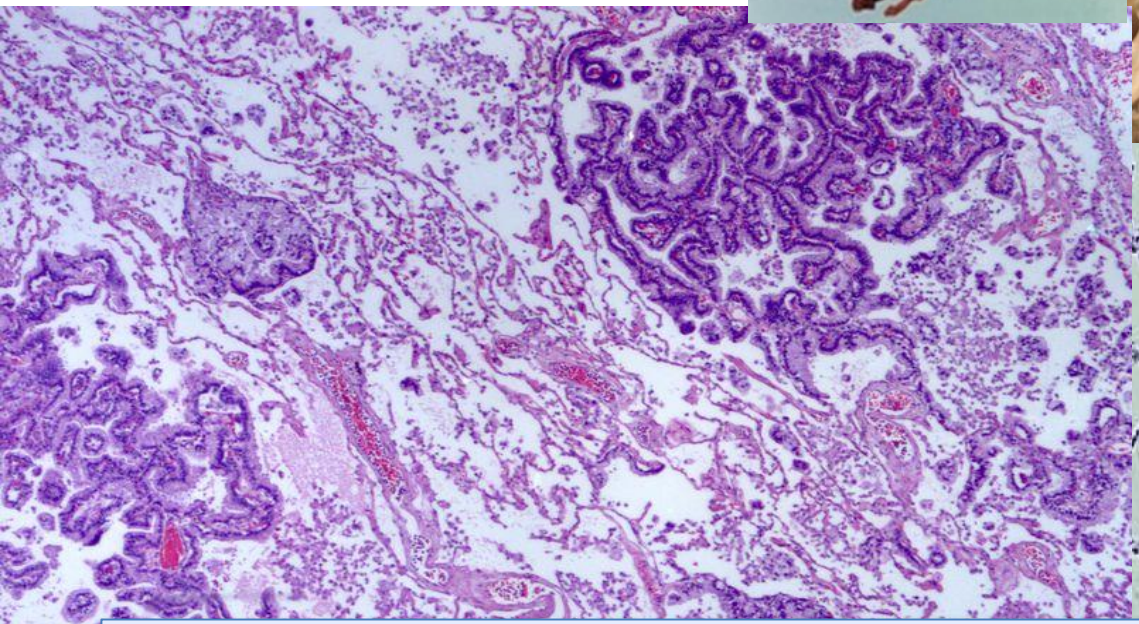
2. Minimally invasive adenocarcinoma of lung

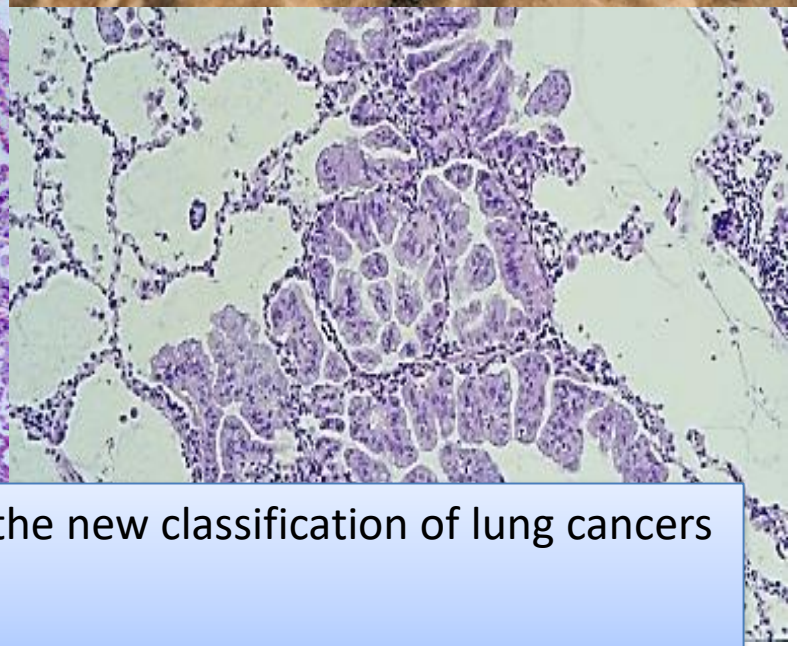


3. Adenocarcinoma in situ (formerly called bronchioloalveolar carcinoma)

Adenocarcinoma in situ (formerly called bronchioloalveolar carcinoma

Malignant cells grow along alveolar septae



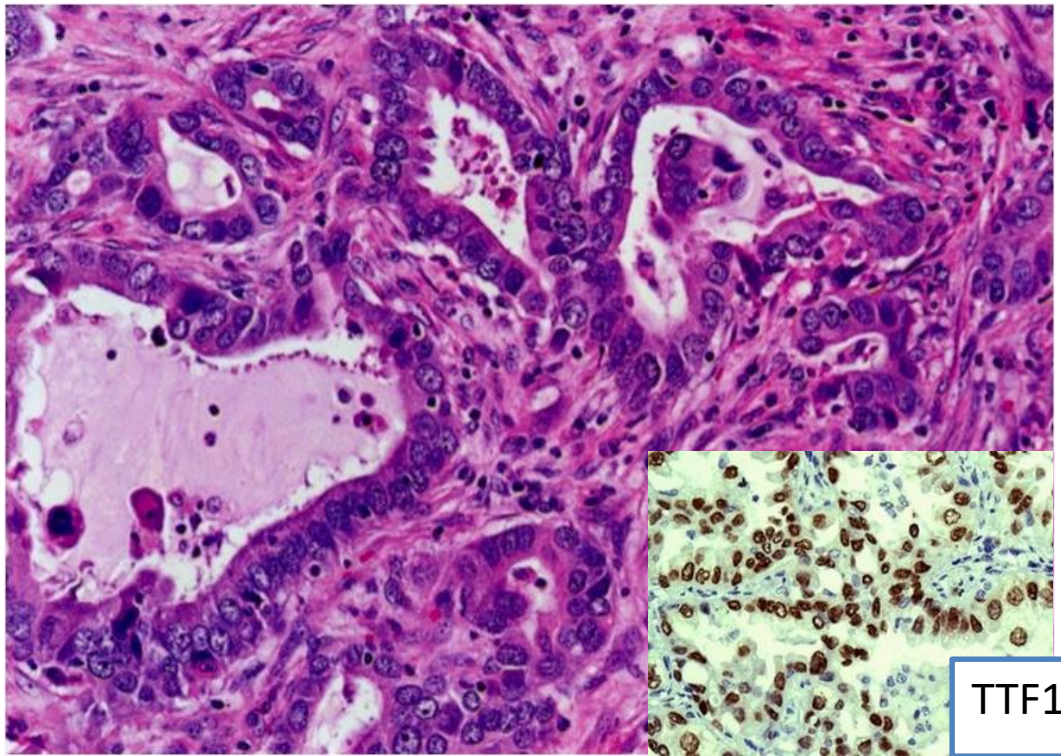


referred to as adenocarcinoma in situ according to the new classification of lung cancers

Adenocarcinomas

More common in patients under the age of 40, women and non-smokers.
Tend to metastasize widely at early stage

- The hallmark of adenocarcinomas is the tendency to form glands that may or may not produce mucin.
- Peripheral adenocarcinomas are sometimes associated with pulmonary scars (from a previous pulmonary inflammation/infection) and therefore is also referred to as scar carcinoma.
- Rarely cavitate



TTF1

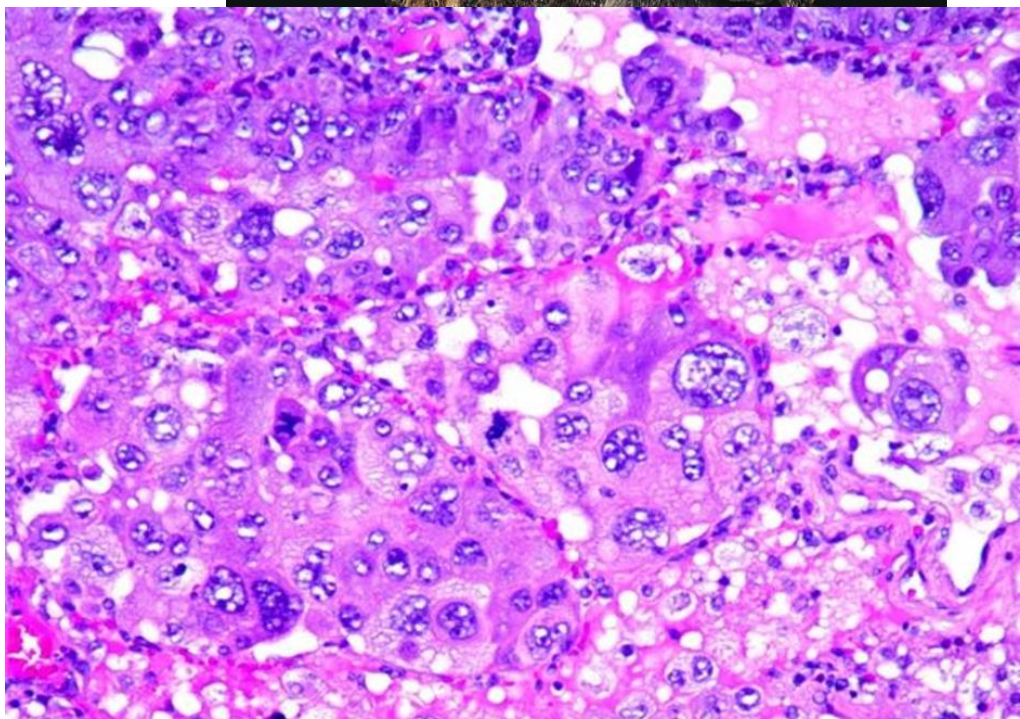
Adenocarcinoma

- Associated with hypertrophic pulmonary osteoarthropathy "Clubbing of the fingers"

- 20% of adenocarcinoma of the lung are associted with mutation of epidermal growth factor receptor (EGFR) and respond to its anti therapy

Large Cell Carcinoma

- **Frequency: 10 %**
- strongly associated with smoking
- Large-cell carcinoma are usually located peripherally. These group of carcinomas are undifferentiated. They made up of large and anaplastic cells. They may exhibit neuroendocrine or glandular differentiation markers when studied by immunohistochemistry or electron microscopy**.**
- Poor prognosis.

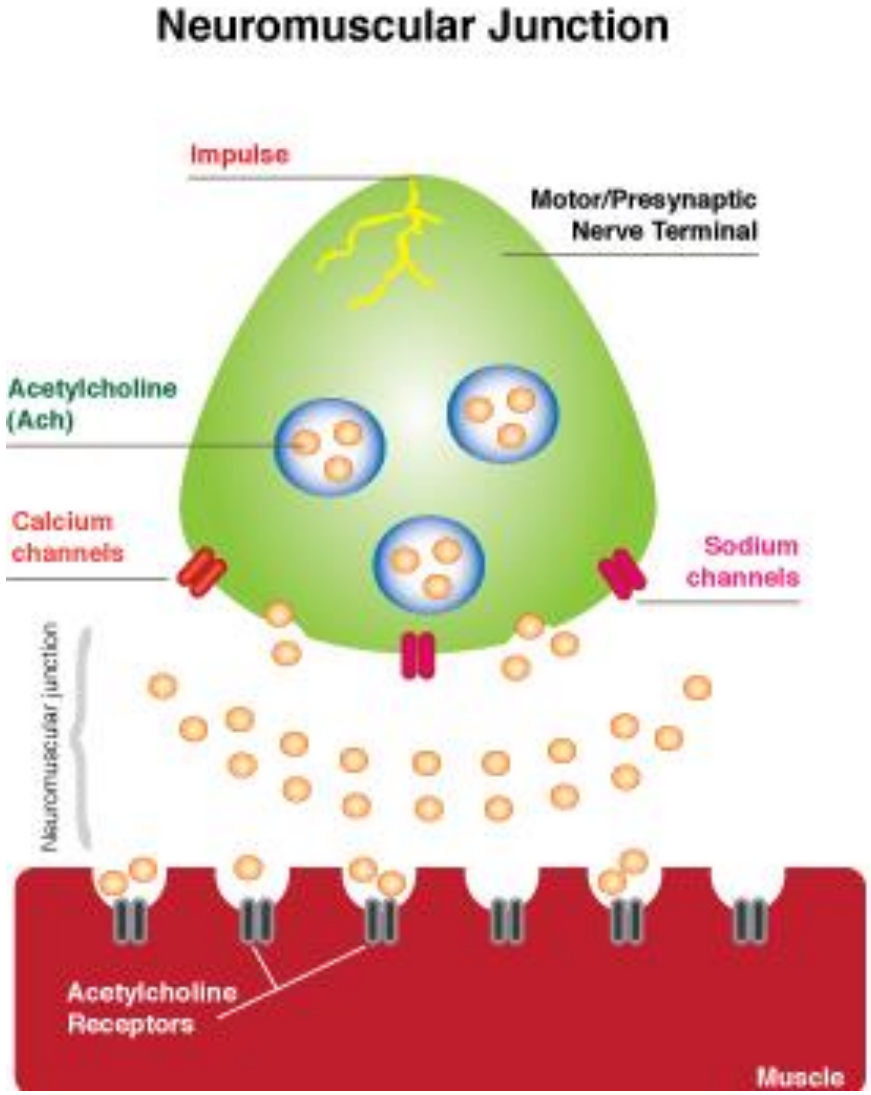


Small cell carcinomas

- SCLC are a type neuroendocrine tumors arising from neuroendocrine cells. More common in men.
- Highly malignant and aggressive tumor, poor prognosis, rarely resectable.
- Strongly associated with cigarette smoking. 95% of patients are smokers
- Centrally located perihilar mass with early metastases (Early involvement of the hilar and mediastinal nodes)
- Chemotherapy responsive
- least likely form to be cured by surgery; usually already metastatic at diagnosis
- Ability to secrete a host of polypeptide hormones like ACTH, antidiuretic hormone (ADH), calcitonin, gastrin-releasing peptide and chromogranin.
- It may be associated with paraneoplastic syndrome, Cushing's, and Eaton-Lambert syndrome

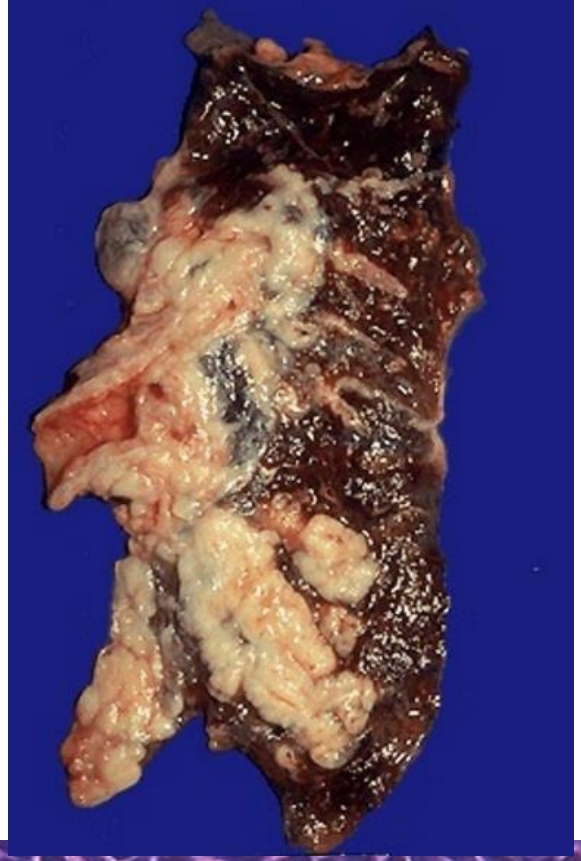
Eaton-Lambert syndrome

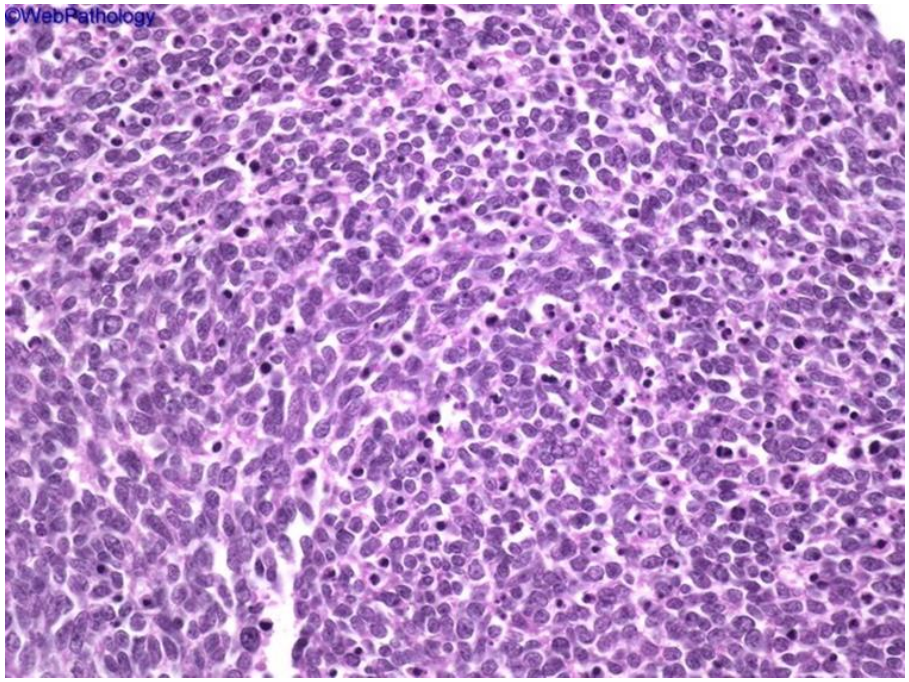
- is an autoimmune disease
- The immune system attacks the connection between nerve and muscle (the neuromuscular junction) and interferes with the ability of nerve cells to send signals to muscle cells lead to muscle weakness

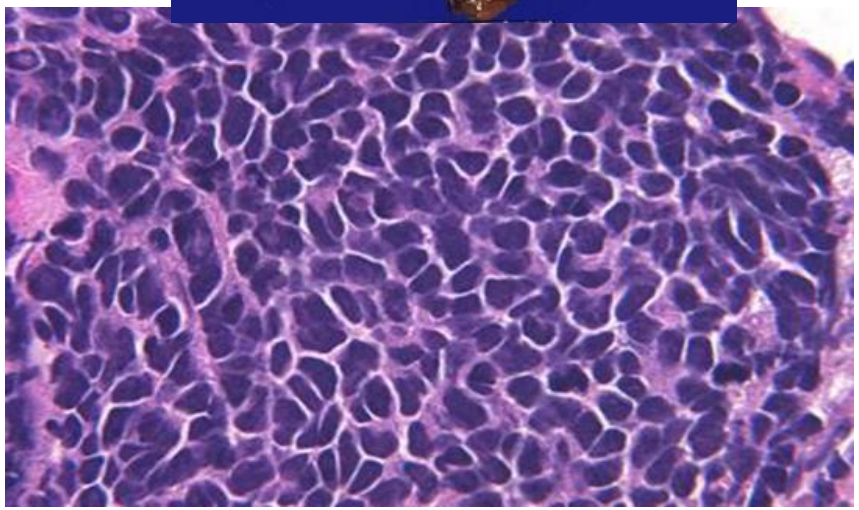


Small cell carcinomas

- Microscopically composed of small, dark, round to oval, lymphocyte-like cells with little cytoplasm.
- Electron microscopy: dense-core neurosecretory granules.







Clinical features of bronchogenic carcinoma

- Can be silent or insidious lesions
- Cough
- Most common symptom (75% of cases)
- Weight loss (40% of cases)
- Chest pain (30% of cases)
- Hemoptysis (25%–30% of cases)
- Dyspnea
- Hoarseness, chest pain, pericardial or pleural effusion.
- Symptoms due to invasion and metastatic spread.

Clinical features: may also be manifest by the following

a) **Superior vena cava syndrome:** invasion leads to obstruction of venous drainage which leads to dilation of veins in the upper part of the chest and neck resulting in swelling and cyanosis of the face, neck, and arms

b) **Pancoast tumor (superior sulcus tumor):** Apical neoplasms may invade the brachial sympathetic plexus to cause severe pain, numbness and weakness in the distribution of the ulnar nerve.

c) Pancoast tumor is often accompanied by destruction of the first and second ribs and thoracic vertebrae. It often coexists with **Horner syndrome**

d) **Horner syndrome:** invasion of the cervical thoracic sympathetic nerves and it leads to ipsilateral enophthalmos, miosis (small pupil), ptosis (dropping eyelid), and facial anhidrosis.

e) The combination of these clinical findings is known as **Pancoast syndrome.**

Complications of bronchogenic carcinoma

- Bronchiectasis
- Obstructive pneumonia
- Pleural effusion, bloody
- **Hoarseness from recurrent laryngeal nerve paralysis**
- **Paraneoplastic syndrome**

Paraneoplastic syndrome

- are extrapulmonary, remote effects of the tumor
- 3% to 10% of lung cancers develop paraneoplastic syndromes

Squamous cell carcinomas may secrete parathyroid hormone-like peptide lead to hypercalcemia

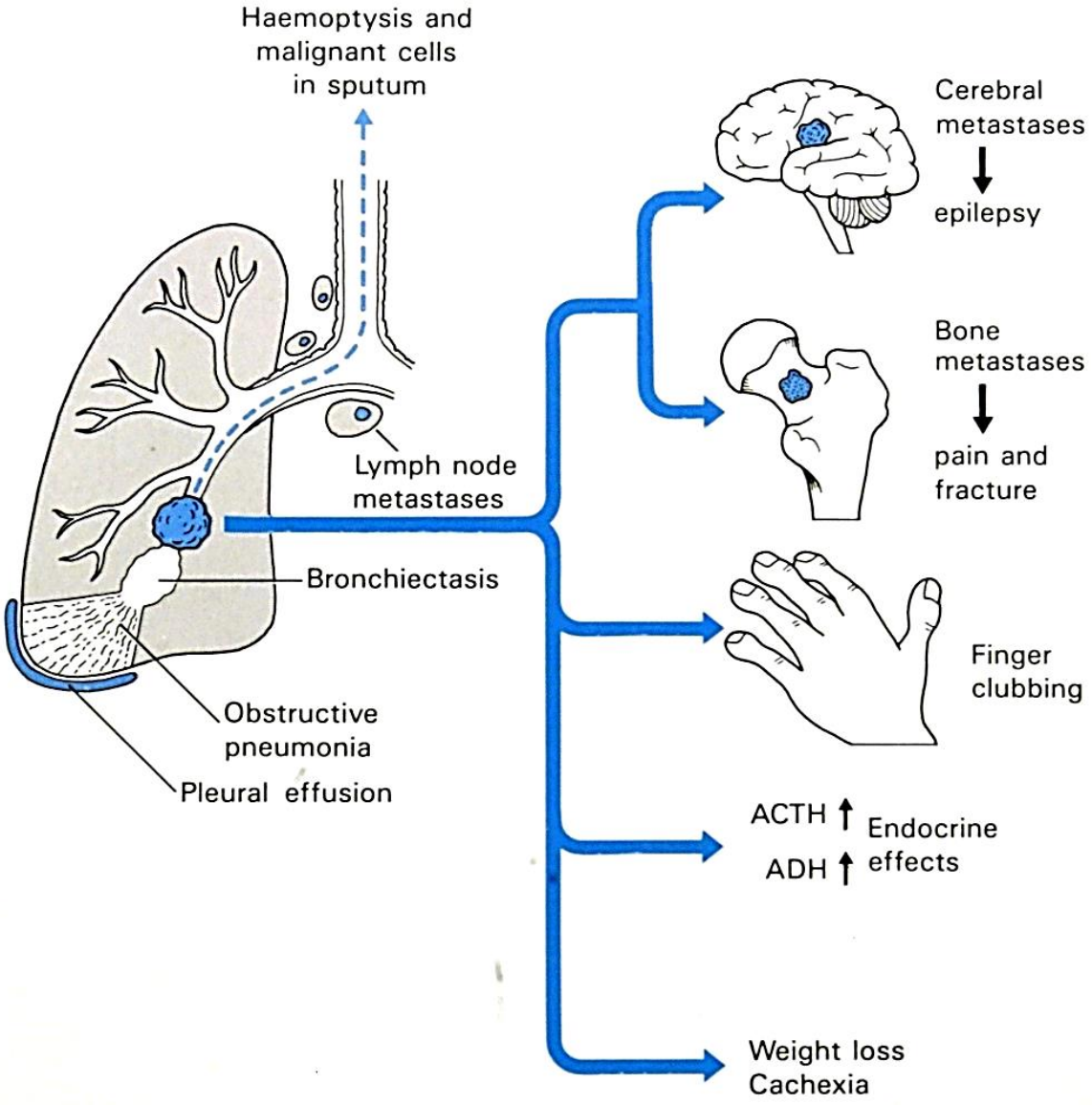
Adenocarcinomas can lead to hematologic manifestations and Digital clubbing due to reactive periosteal changes

Small cell carcinomas

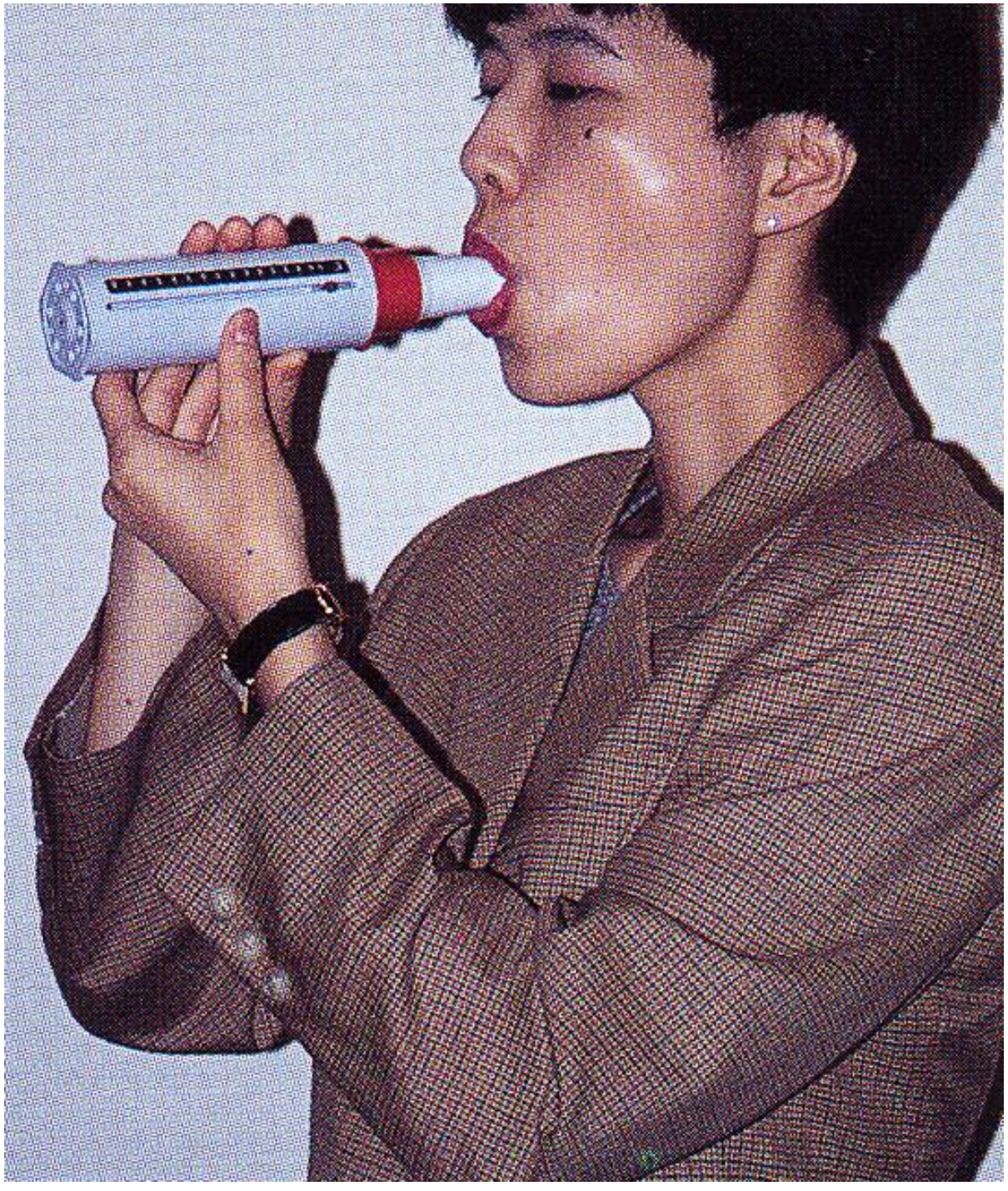
ACTH (leading to Cushing's syndrome)

ADH (water retention and hyponatremia)

Diseases of Lung



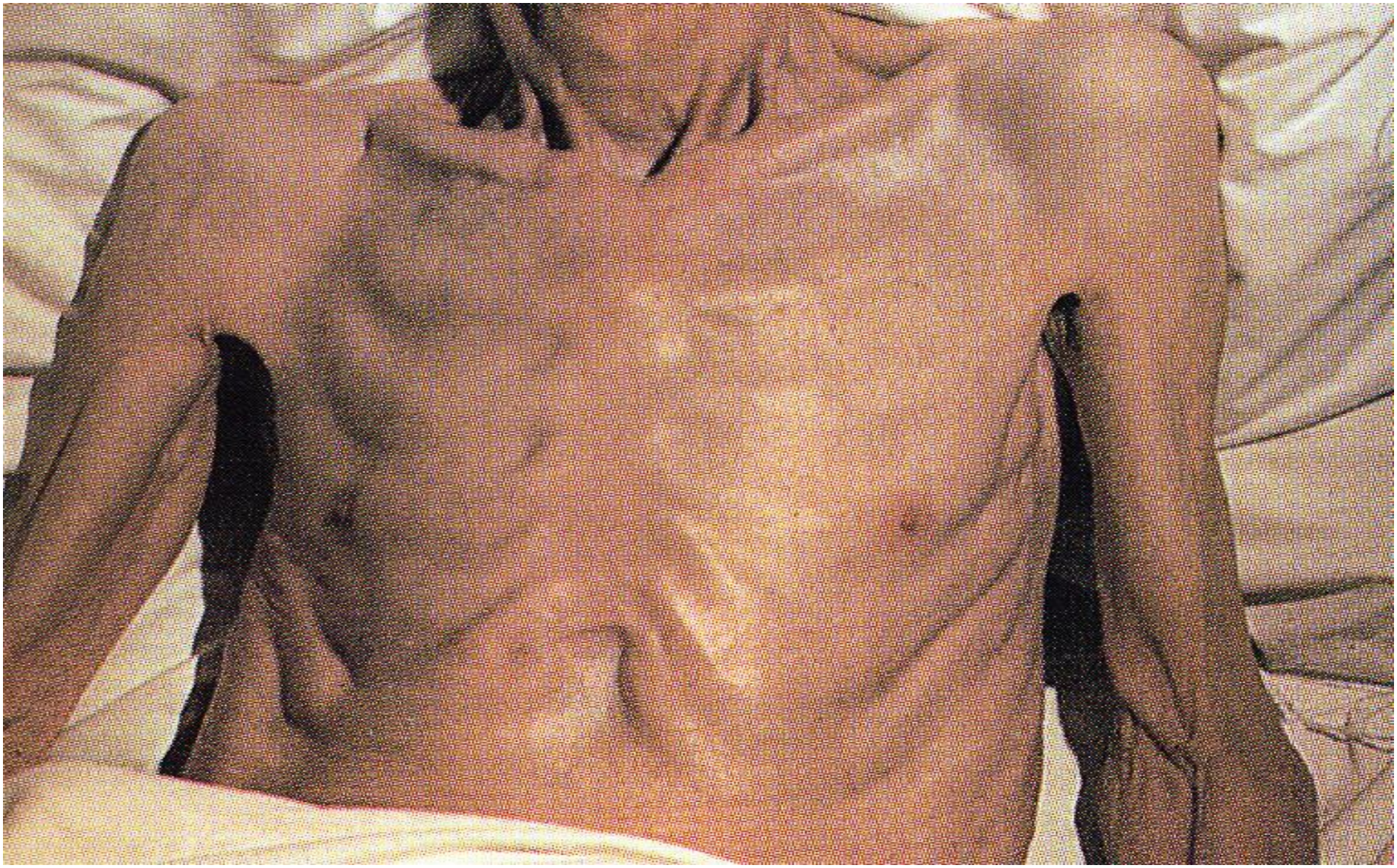
Clinical features and complication of bronchogenic carcinoma



This patient has smoking-induced chronic obstructive airway disease.

Horner’s syndrome resulting from a right Pancoast tumour. The patient had a right ptosis and a constricted right pupil, caused by tumour infiltration of the inferior cervical sympathetic ganglia.

Tar-stained fingers. This patient smoked 40 cigarettes a day, but staining is more dependent on the action of smoking cigarettes right to the stub than on the total number smoked. This patient also has acute, recent onset clubbing (note the reddening and swelling of the nailfolds). He had bronchial carcinoma.



Cachexia may occur in a number of severe disorders, including chronic lung diseases such as pulmonary fibrosis, tuberculosis and emphysema, malignant disease, including bronchial carcinoma.

Cushing’s syndrome resulting from ectopic adrenocoticotrophin hormone (ACTH) secretion by a small-cell bronchial carcinoma. The facial appearance is similar to that of Cushing’s disease of other causes, but the disease often runs a very rapid course.

Spread of bronchogenic carcinoma

1. Lymphatic spread.
   * successive chains of nodes (scalene nodes).
   * involvement of the supraclavicular node (Virchow's node).
2. Extend into the pericardial or pleural spaces. Infiltrate the superior vena cava.
3. A tumor may extend directly into the esophagus, producing obstruction, sometimes complicated by a fistula.
4. Phrenic nerve invasion usually causes diaphragmatic paralysis
5. May invade the brachial or cervical sympathetic plexus (Horner's Syndrome).
6. Distant metastasis to liver (30-50%), adrenals (>50%), brain (20%) and bone (20%).

Prognosis:

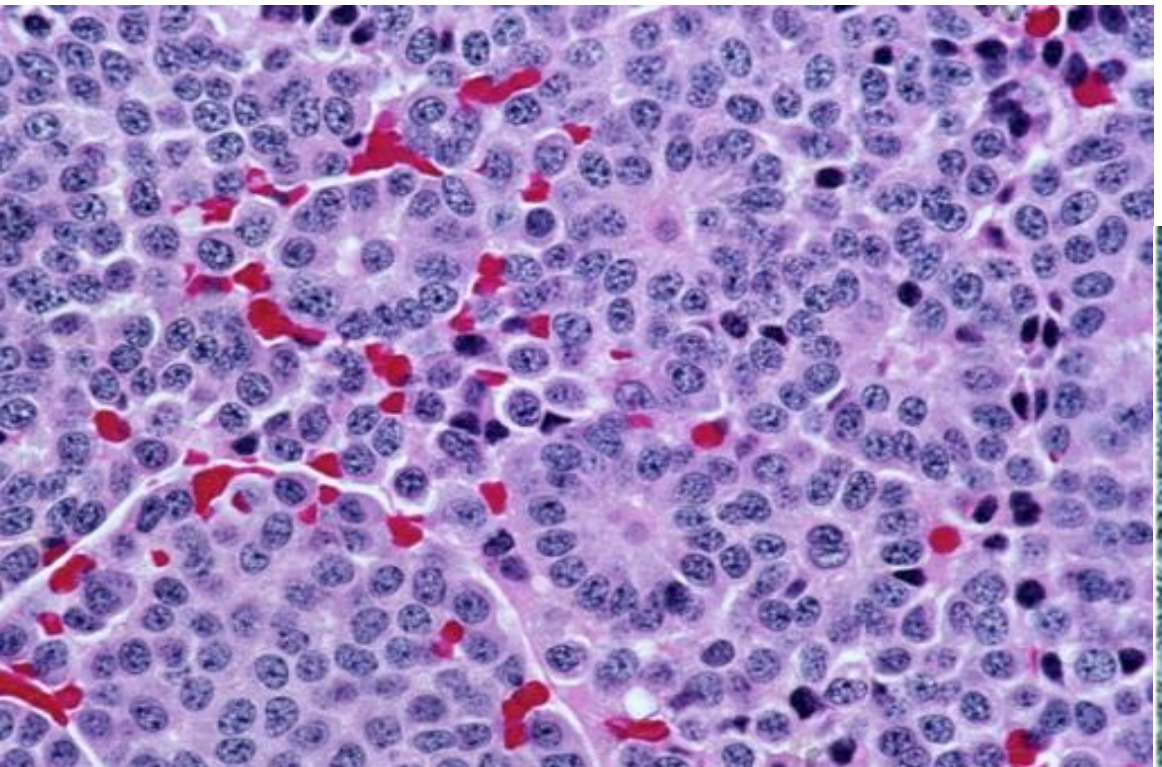
- Histological types and the stage of lung cancer determine the outcome
- Survival is better for early stage disease, except for small cell carcinoma (very early metastases)
- Non–small cell cancers fare better than small cell carcinoma
- Overall combined 5-year survival rate is ~15%

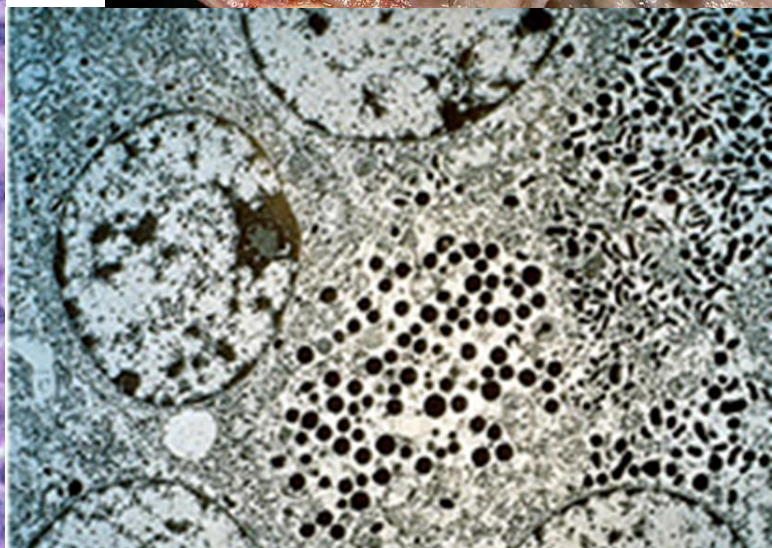
Carcinoid tumor

- Carcinoid tumors of the lung are neuroendocrine neoplasms
- These neoplasms account for 2% of all primary lung cancers,
- It shows no sex predilection, and are not related to cigarette smoking or other environmental factor.
- Usually seen in adults
- Can be central or peripheral in location.
  - **Tumor cells** produce serotonin and bradykinin leading to carcinoid syndrome
- Can occur in patients with Multiple Endocrine Neoplasia (MEN-I)
- Low grade malignancy, Often resectable and curable.
- Spreads by direct extension into adjacent tissue

Morphology of typical carcinoid tumors

- Composed of uniform small cells with “salt and pepper” like nuclear chromatin and absent mitoses.
- Electron microscopy: dense-core neurosecretory granules





Mesothelioma

- Malignant tumor of mesothelial cells lining the pleura
- Highly malignant neoplasm
- Most patients (70%) have a history of exposure to asbestos
- Smoking is not related to mesothelioma
- The age of patients with mesothelioma is 60 years.
- Pleural mesotheliomas tend to spread locally within

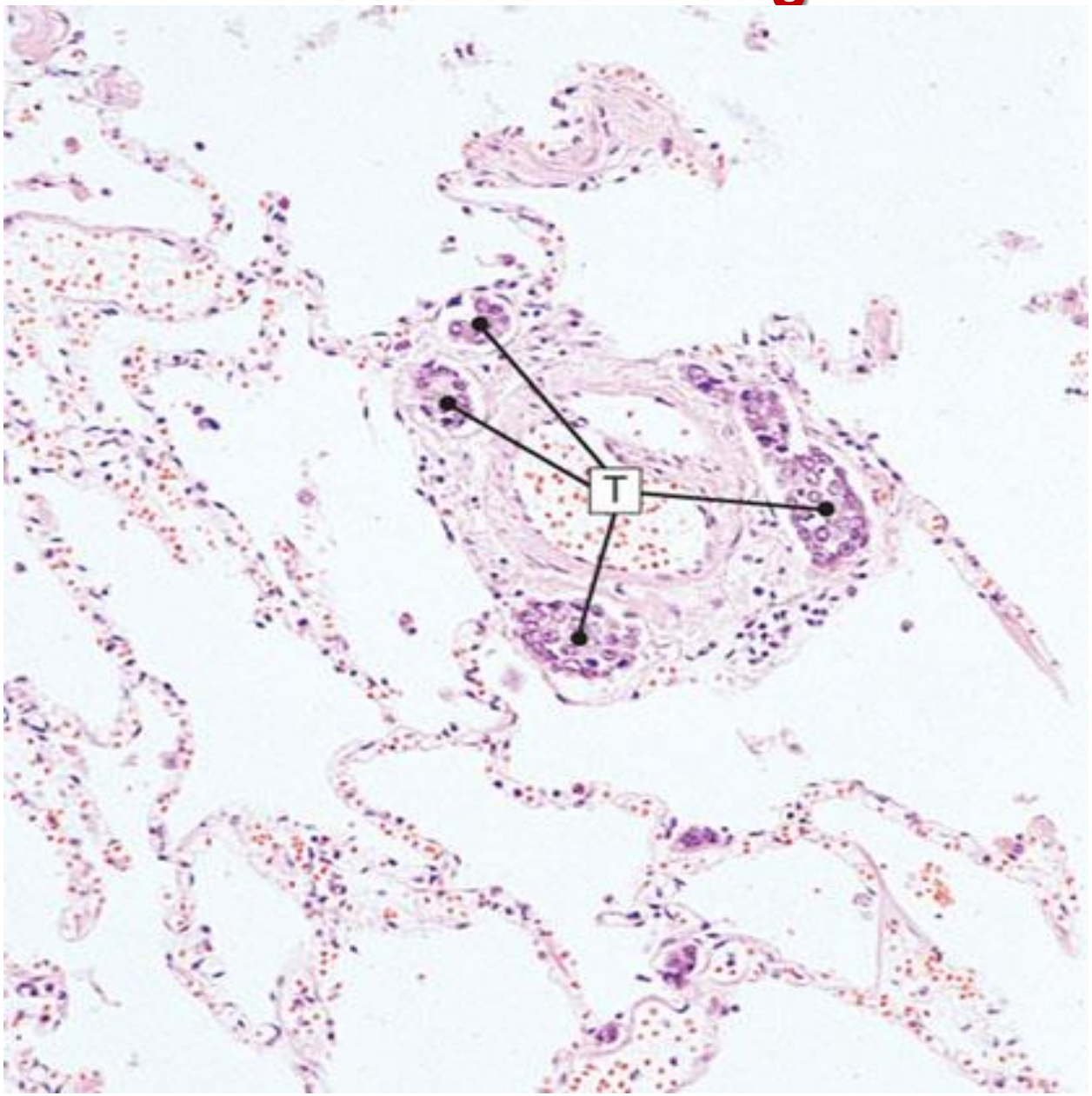
the chest cavity, invading and compressing major structures.

- Metastases can occur to the lung parenchyma and mediastinal lymph nodes, liver, bones, peritoneum etc.
- Treatment is largely ineffective and prognosis is poor
- few patients survive longer than 18 months after diagnosis

Carcinoma metastatic to the lung

- Pulmonary metastases are more common than Primary Lung Tumors
- Metastatic tumors in the lung are typically multiple and circumscribed. When large nodules are seen in the lungs radiologically, they are called cannon ball metastases
- The common primary sites are the breast, stomach, pancreas, kidney and colon.

Diseases of Lung



Lymphangitis carcinomatosa

Diseases of Lung

Type of effusion	Pathogenesis	Causes
Transudate Less than 30 g protein/L	Increased hydrostatic pressure	Cardiac failure
	Decreased oncotic pressure	Vena caval obstruction Hypoalbuminemia
Exudate More than 30 g protein/L	Infections	Bacterial, including TB Other organisms
	Neoplasm	Metastatic carcinoma Primary carcinoma of lung Mesothelioma of pleura
	Pulmonary infarction	Thromboembolic disease
	Autoimmune disease	Rheumatoid disease Systemic lupus erythematosus
	Abdominal disease	Pancreatitis Subphrenic abscess

Pleural effusion.

Diseases of Lung

Key Facts Lung cancer

. Caused by inhaled environmental agents, particularly smoking and radon.

. Peak incidence 40-70 years, most common form of cancer.

. Four main types: squamous cell, small-cell anaplastic, adenocarcinoma and large-cell anaplastic.

. Bronchoalveolar carcinoma is a special form of adenocarcinoma with a better prognosis than other types.

. Clinical division is into small-cell and non-small cell types (all others).

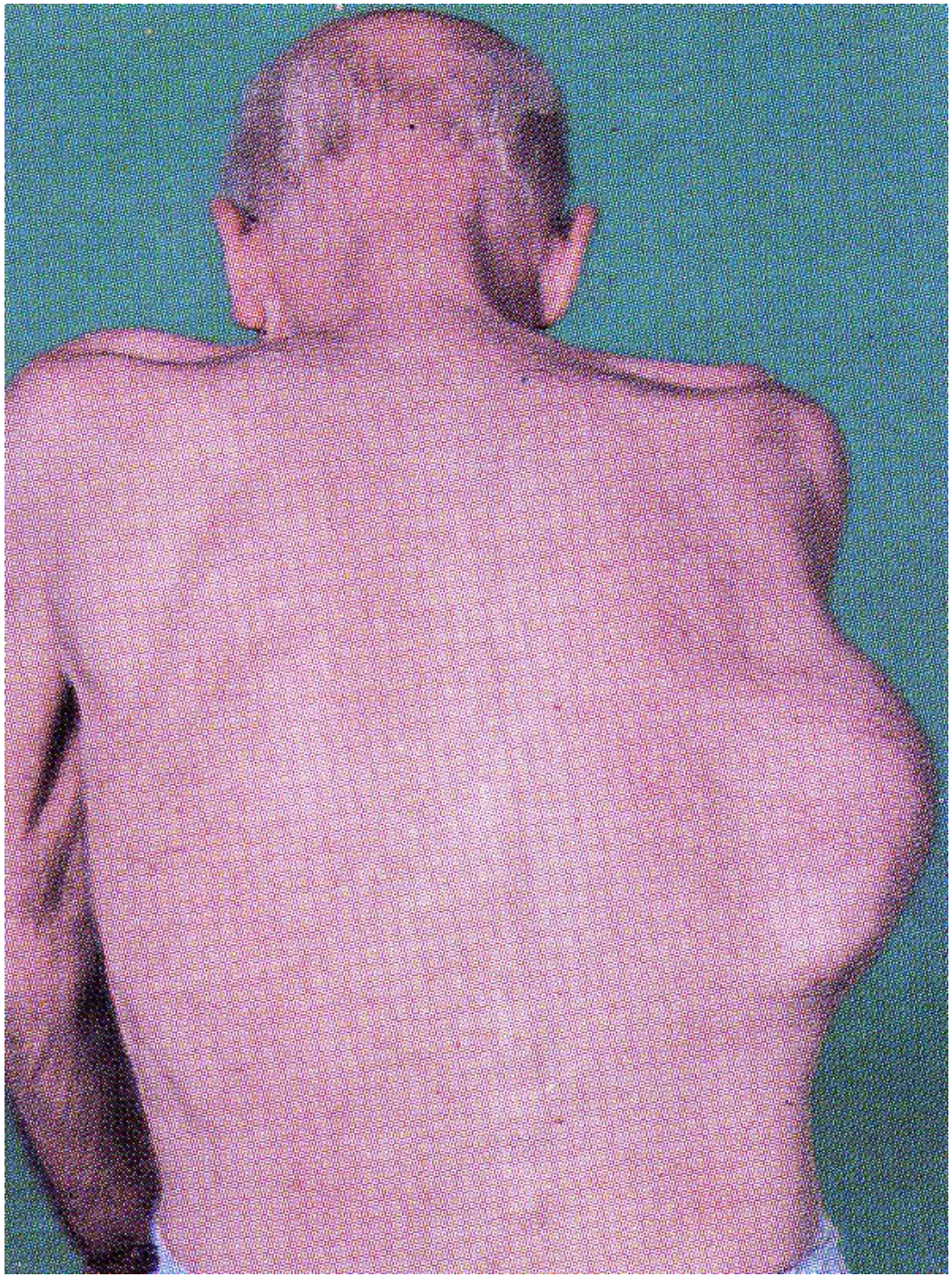
. Tumors may be central (all types) or peripheral (mainly adenocarcinomas).

. Small-cell carcinoma is neuroendocrine, highly malignant, and may be associated with ectopic endocrine syndromes.

. TNM staging used for NSCLC.

. Simple staging used for SCLC-Limited and Extensive.

. Overall survival 5-30% at 5 years, highly dependent on type and stage of disease.



Mesothelioma. This patient presented with an asbestos link pleural plaque.

Diseases of Lung

Malignant mesothelioma. Mesothelioma is seen as a thick sheet of white tumor that encases the whole of the lung.