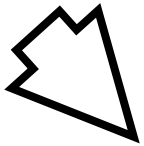
Pulmonary congestion

Congestion may be active or passive.

Active congestion: inflammation
Passive congestion: pulmonary vein pressure ↑ (caused by left sided heart failure or mitral stenosis)
→ pulmonary oedema
→haemosiderosis in chronic congestion

Brown induration (in case of mitral valve stenosis)

Pulmonary oedema



1. Haemodynamic oedema

2. Oedema caused by microvascular/alveolar epithelial injury

1. Hydrostatic and osmotic forces influences the movement of water through vessel wall.
2. Primary injury to the vascular endothelium or damage to alveolar epithelial cells → protein rich fluid (exsudate) leaks into interstitium and alveolar spaces (in extensive form ARDS develops)

Causes of pulmonary oedema

1. Haemodynamic

Pulmonary venous hypertension (Increased hydrostatic pressure)

left ventricular failure, mitral stenosis and pulmonary veno-occlusive disease, intravenous fluid overload.

Hypoproteinaemia (decreased oncotic pressure)

hypoalbuminemia, nephrotic syndrome, cirrrhosis, protein-losing enteropathies

2. Microvascular or Epithelial Injury

Acute pulmonary infection

Liquid aspiration: gastric contents

Radiation

Indirect injury: septicemia, shock, trauma, chemotherapeutic agents

High altitude: hypoxic vasoconstriction

Risk factors of pulmonary thromboembolism

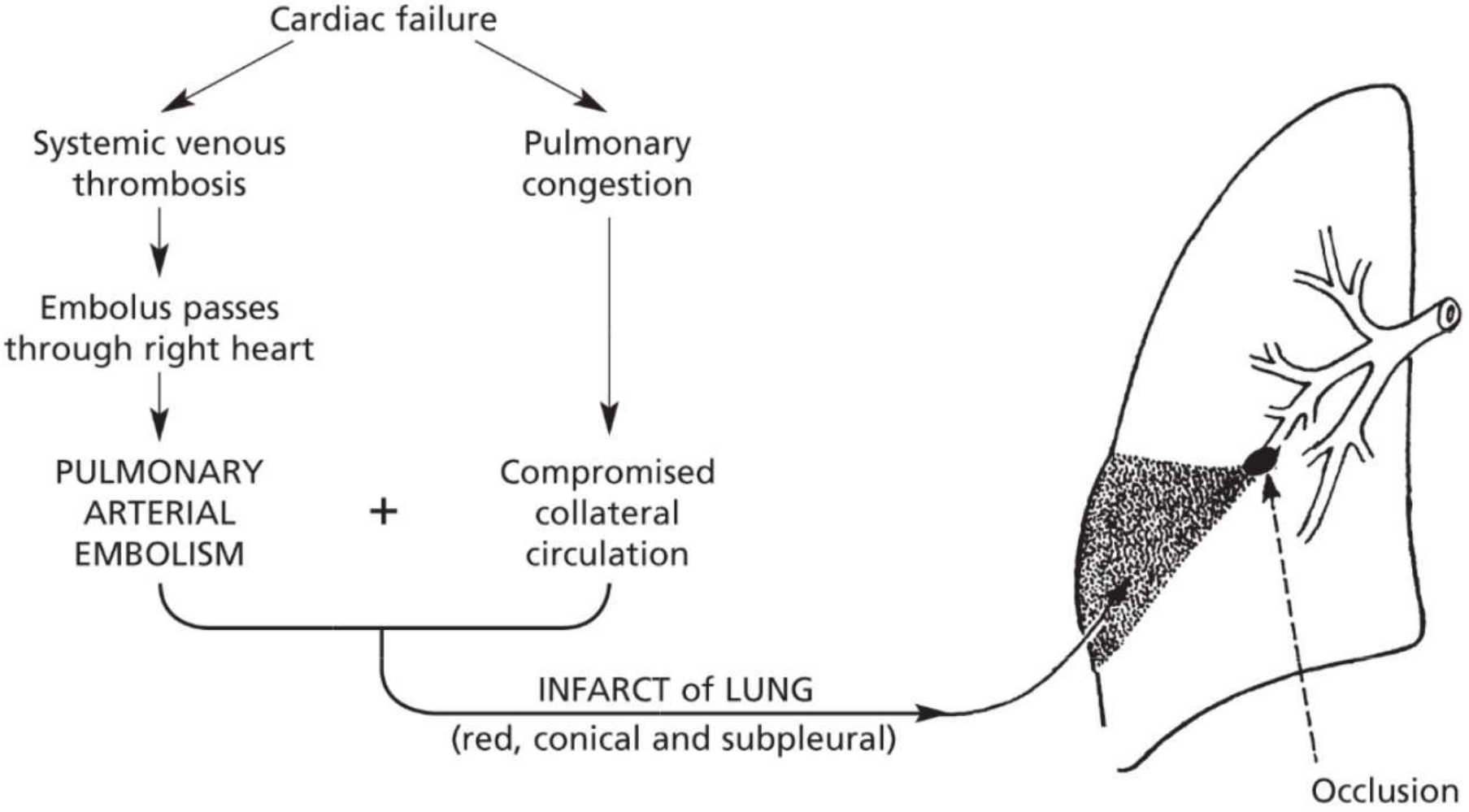
- **Major abdominal surgery**
- **Postoperative intensive care**
- Fracture of lower limbs
- **Varicose veins of lower limbs**
- **Advanced stage cancer**
- Hospitalisation – reduced mobility
- COPD
- Congestive heart failure
- Oral contraceptive
- Hormone replacement therapy
- Long-lasting sedentary travel
- Obesity

Total/massive embolisation: blocks main pulmonary artery trunk leading to sudden death

Subtotal embolisation: blocks right or left pulmonary artery

Partial embolisation: a segmental branch of pulm. artery is occluded (may manifest in infarct)

Microembolisation: embolus found in microvasculature



Non-thrombotic emboli

Fat embolism

Causes: bone fracture, soft-tissue trauma, liposuction

Amniotic fluid embolism

Embolism develops through small incomplete lower uterine tears.

Amniotic fluid containing debris of epidermal cells and meconium → DIC

Trophoblastic embolism

Associated to hydatidiform mole or choriocarcinoma

Tumour embolism

Only few tumour emboli survive as metastasis.

Tumour embolism can be massive resulting in right-sided heart failure

Bone marrow

Rib fractures caused by cardiac resuscitation. Sometimes bone fragments present related to fractures

Air Embolism: surgery using Trendelenburg position

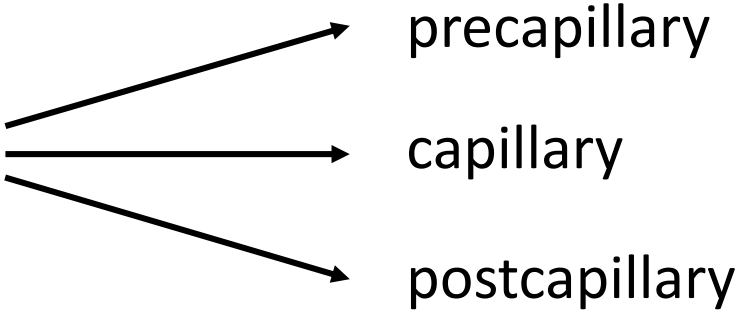
Foreign body embolism: injected, pulverized contents of tablets in drug addicts.

Pulmonary hypertension

Definition

Mean pulmonary artery pressure ≥ 25 mmHg at rest.

Causes may act on different levels



1. Precapillary: **primary pulmonary hypertension**, connective tissue disease, thrombembolism, appetite-suppressing drugs. Hypoxic origin: COPD, sleep apnoea syndrome, obesity
2. Capillary: pulmonary fibrosis
3. Postcapillary: left-sided heart disease, veno-occlusive disease (organized thrombi within pulmonary veins, chronic congestion)

Pulmonary hypertension

Primary („idiopathic”) pulmonary hypertension

- genetic background is present in 80% of the cases (e.g.: *BMPR2)*
- **dysfunction and proliferation of endothelial cells** and vascular smooth muscle cells.

Morphology

Tuft of capillary formation called **plexiform lesion**.

Medial hypertrophy → concentric **intimal fibrosis** → necrotising fibrinoid arteriopathy →dilatation lesions (e.g.: plexiform) →

→**pulmonary arterial atherosclerosis** → **cor pulmonale chronicum**

Plexifrom pulmonary hypertension can be the most advanced morphological manifestation in case of secondary pulmonary hypertension.
Plexiform lesions should be distinguished from recanalised thrombus.

Pulmonary hypertension

Examples for non „idiopathic" pulmonary hypertension

a) Chronic obstructive or interstitial lung diseases: increased resistance to blood flow

b) Congenital or acquired heart disease: elevated pulmonary venous pressure

c) Recurrent thromboemboli: reduced functional cross-sectional area of the pulmonary vasculature → increased pulmonary vascular resistance.

d) Autoimmune diseases (e.g.: systemic sclerosis) involvement of pulmonary vasculature and the interstitium → vascular resistance↑

e) Obstructive sleep apnea: obesity and hypoxemia → role of hypoxia induced vasoconstriction.

f) Vasculitis: endiotehlial damage

Pulmonary veno-occlusive disease

Definition

Intra- or extrapulmonary **veins are narrowed** or obliterated by fibrous thickening of the intima. This is **presumed to be postthrombotic** but thrombosis is seldom seen.

1, venous obliteration → venous hypertension → venous medial hypertrophy

2, marked pulmonary congestion, haemosiderosis

3, prolonged severe interstitial oedema → interstitial fibrosis

Etiology:

Idiopathic mainly

Probably chemotherapy, radiotherapy, bone marrow transplantation, renal transplantation, HIV infection, systemic sclerosis, sickle cell disease and the antiphospholipid syndrome causes a part cases

Diffuse Pulmonary Hemorrhage Syndromes

1. Goodpasture Syndrome:

- autoimmune disease: **circulating autoantibodies against collagen IV.** (basement membrane) lead to kidney and lung injury
- **type II hypersensitivity** reaction
- characterized by **necrotizing hemorrhagic interstitial pneumonitis (in 60-70% of cases)** and **rapidly progressive glomerulonephritis**

Gross morphology: heavy lungs with areas of red-brown consolidation.

Histology: alveoli are filled with hemosiderin-laden macrophages

- More frequent in young males (smokers).
- Clinical presentation: hemoptysis, uremia

2. Idiopathic Pulmonary Hemosiderosis

- anti-BM antibody cannot be detected
- intermittent, diffuse alveolar haemorrhage in children/young adults
- hemoptysis and anemia

Vasculitis

Polyangiitis with Granulomatosis - Wegener granulomatosis

T-cell–mediated hypersensitivity, PR3-ANCA antibodies

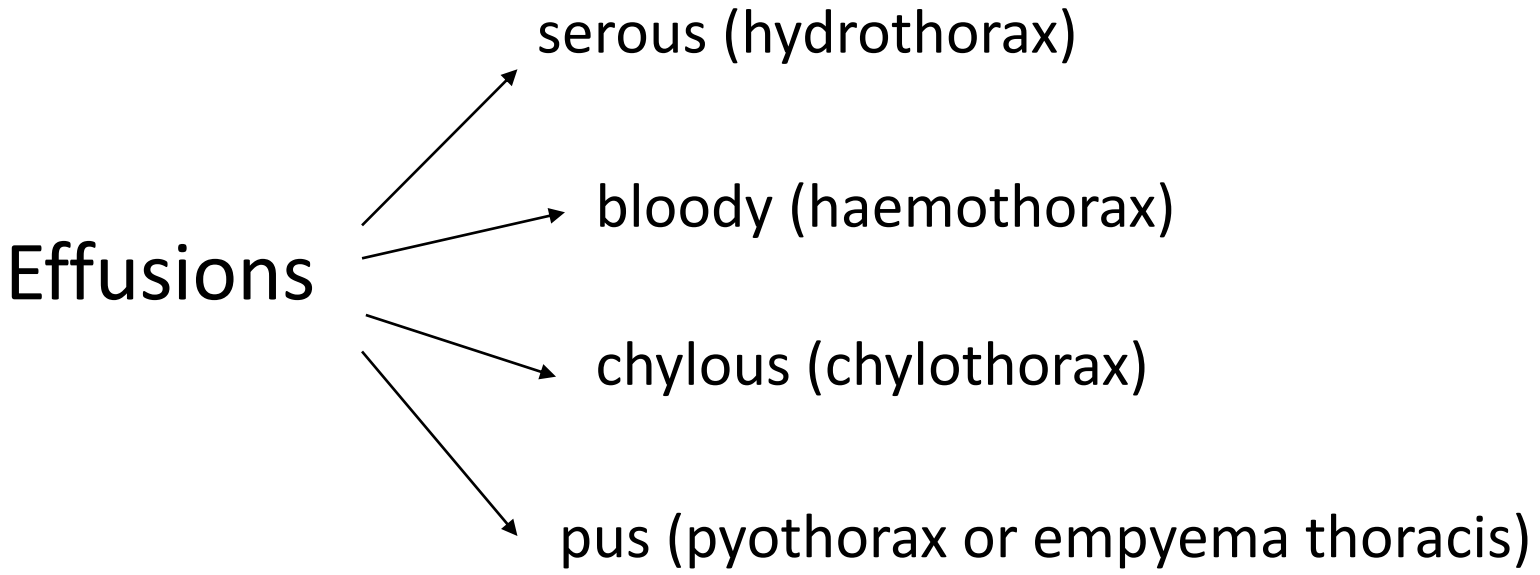
Components of Wegener's granulomatosis

a. **Necrotizing granulomatosis** of the upper and lower respiratory tracts
b. **Vasculitis**
c. **Glomerulonephritis**

Morphology:

- gross morphology: multiple irregular masses (haemorrhagic, necrotic, often cavitated centre)
- necrosis surrounded by granulation tissue and inflammation
- neutrophilic microabscesses
- vasculitis of medium-sized or small arteries or veins (inflammatory infiltrate in vessel wall, fibrinoid necrosis)
- IF microscopy frequently negative (pauci-immune) for Ig and complements

Pleural effusions



Serous effusion: less than 3 g protein/dl (cardiac failure, overhydration)
Haemothorax: trauma, spontaneous rupture of an aneurysm of the thoracic aorta
Chylothorax: obstruction or rupture of the thoracic duct (milky appears, triglycerides and chylomicrons ↑)
Empyema thoracis: collection of pus in the pleural space

Empyema thoracis (pyothorax)

- usually a **complication of pneumonia**
- May develop on the ground of **diabetes or alcoholism**
- Complication of necrotising pneumonia or **lung abscess**
- Causative agent: Streptococcus, Fusobacterium, Bacteroides, Escherichia coli, Pseudomonas aeruginosa

Cavitating rheumatoid nodule may result in bronchopleural fistula

Tuberculosis of the pleura

- Primery tbc reaches pleura on blood borne way.
- Typical tubercles can be seen histologically.
- Ultimately **caseation developes**, it may undergo calcification.
- Extensive thick rigid adhesions can be a end result.
- Postprimary tuberculosis erodes into the pleural sac.

Rheumatoid disease (RA)

Pleural effusion is the most common manifestation of rheumatoid disease in the chest

Bronchopleural fistula and pyopneumothorax may develop in relationship with cavitated rheumatoid nodule

The characteristic palisade of histiocytes forms a linear pattern over the surface of the pleura

Pneumothorax (PTX)

- **Air enters the pleural sac** through either the chest wall or the visceral pleura.
- Century ago artificial pneumothorax was a treatment of chronic respiratory tuberculosis (collapse and rest the lung)
- In some cases the tissues near the orifice act as a valve not allowing air to escape – this type is called **pressure or tension pneumothorax**
- **Causes: trauma, emphysema,** Marfan's syndrome, Ehlers–Danlos syndrome pleural endometriosis
- Therapy of repeated ptx: pleurodesis

Pleural plaques

- occupational or environmental origin of asbestos exposure
- It lasts 15-30 years to develop
- Harmless, no progression to lung cancer or mesothelioma

Asbestos-induced pleural fibrosis

- thin fibrous thickening of the visceral pleura is generally observable in asbestos workers
- bilateral or unilateral
- fibrous thickening of the visceral pleura may be thin without functional consequence
- Bulky fibrotic tissue compromises lung complience

Mesothelioma

Definition

- Mesothelioma is a **malignant disease of pleura**
- Benign neoplasm of mesothelial cells called adenomatoid tumour
- Rare case of well differentiated papillary mesothelioma exist
- Responsible for 1% of all cancer deaths in industrialized world

Aetiology

- **asbestos** and similar fibrous substances, but simian virus 40 (SV40) may also play a role
- inactivation of p53 and Rb tumour suppressor genes

Pathogenesis

- oxidative stress - **free radicals released by macrophages after ingestion of asbestos fibres**
- asbestos fibres damaging chromosomes during cell division
- Concentrated carcinogens on the surface of the fibres

Macroscopic appearance

- It develops first on the parietal pleura in nodular form
- Coalescence of nodules leads plaque formation
- Finally continuous sheet of tumour develops: **obliteration of the pleural space**
- Involvement of interlobar fissures

Mesothelioma

Microscopic appearance

- **1, epithelioid**
- **2, sarcomatoid (or fibrous)**
- **3, biphasic**

1, Epitheliod:

- Tubulopapillary pattern,
- Pure tubular,
- Pure papillary (psammoma bodies)

2, Sarcomatoid (fibrous) type of mesothelioma:

- spindle-shaped cells embedded into collagenous stroma
- desmoplastic variant: difficult to distinguish from scar tissue

Prognosis of mesothelioma

- widespread pleural involvement is common at the time of diagnosis
- extrapleural pneumonectomy is the only effective surgical solution
- invasion of the lung parenchyma in locally advanced disease
- poor prognosis (survival is less than 2 years)
- epitheliod mesothelioma spread to the regional lymph nodes
- sarcomatoid mesotheliomas metastasise to distant organ
- adverse prognostic factors: male sex, older age, advanced stage, weight loss, poor performance status

Solitary fibrous tumour

- visceral pleura involvement is more common
- often pedunculated (may be sessile on parietal pleura)
- benign tumour

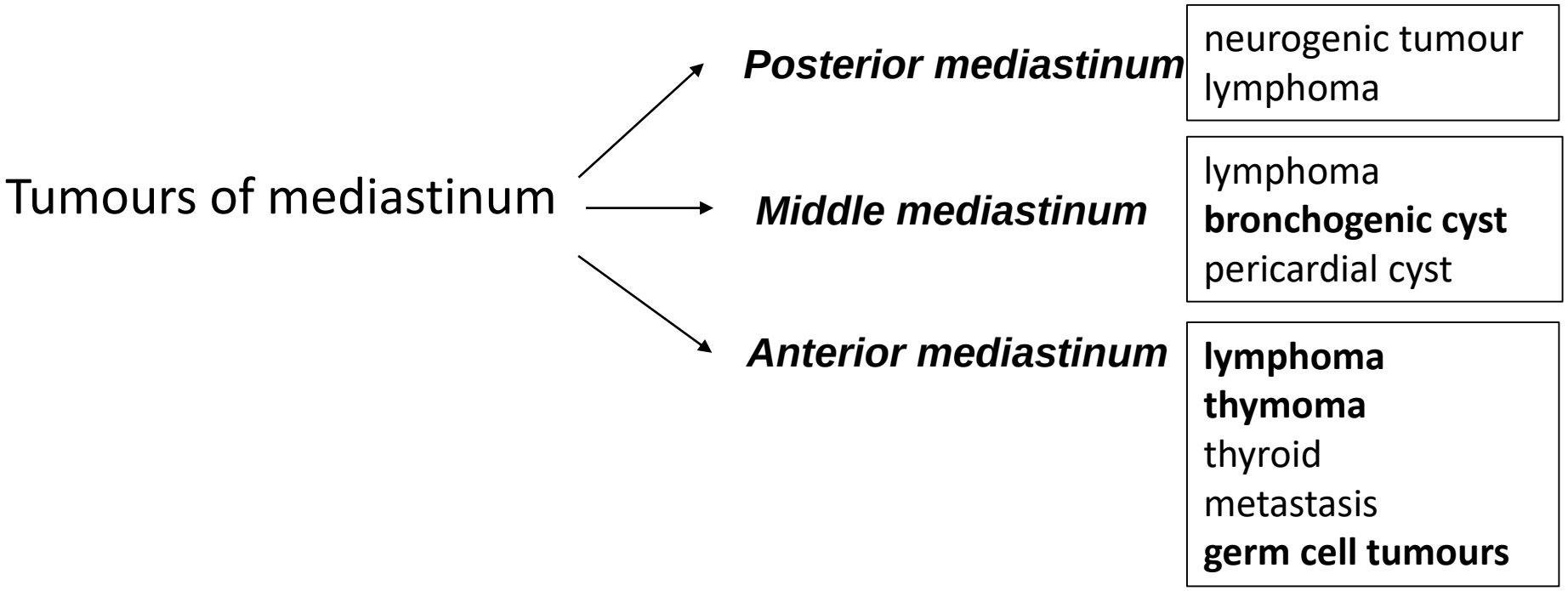
Mediastinitis

acute: retropharyngeal inflammation, traumatic esophageal perforation by invasive procedures, descending infection along prevertebral fascia

Main cause: thoracic surgery

sclerosing mediastinitis: irradiation, idiopathic, postinfectious (Histopl. Caps.)

chronic: granulomatous inflammation



Thymoma

thymic epithelial tumours

Benign: cytologically benign and noninvasive

Invasive: cytologically benign but invasive

Carcinoma: cytologically malignant, invasive and metastatic

mass lesion most frequently, localized to the **anterior superior mediastinum** (usually encapsulated lesion)

Paraneoplastic/autoimmune disorders: myasthenia gravis, Graves disease etc.

Gross: encapsulated, lobulated, firm, gray-white masses

Histology: Type A: spindle cell, Type B: polygonal cells, Type AB: mixed

Epithelial component: spindle-shaped medullary cells in type A and cortical cells with polygonal shape in type B

Nonneoplastic T-cell infiltrate is rich in B1, moderate B2, scarce in B3.

Prognosis: tumour free surgical margin toward retroperitoneum may be crucial for survival