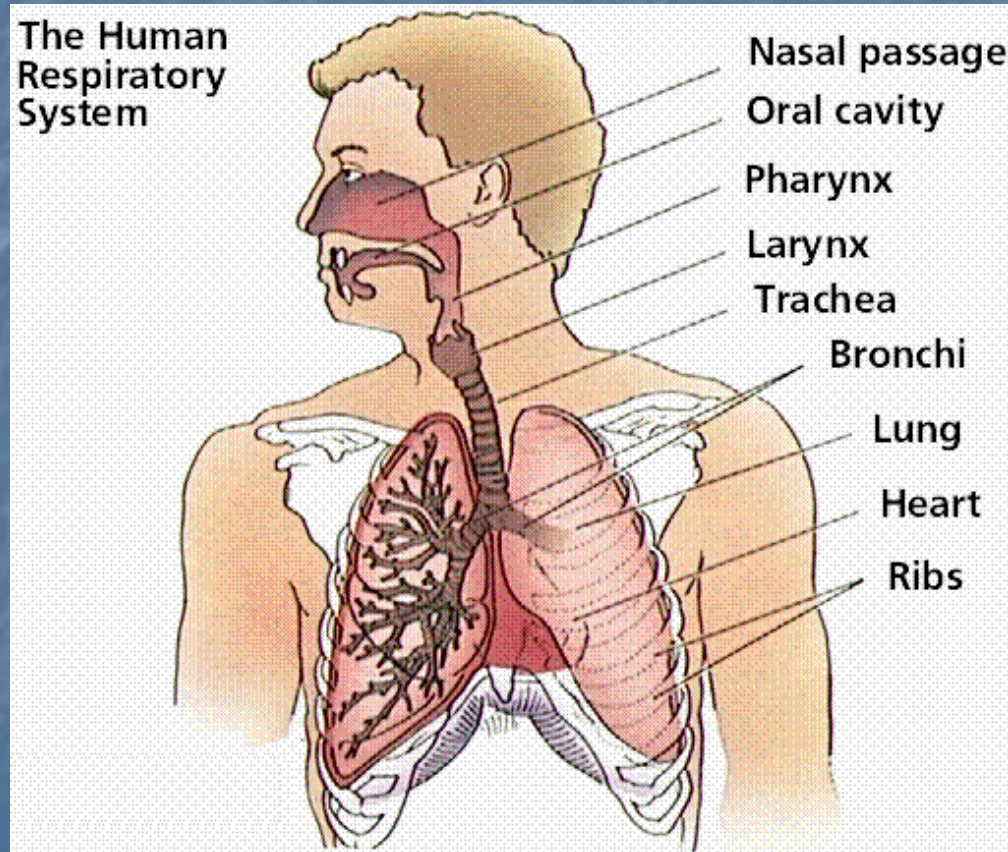


Lung parasitic infections; Pneumocystosis

Jarmila Kliescikova, MD

Respiratory system



Examination of the thorax

- Inspection (globally, locally)
- Percussion
- Auscultation

Laboratory examination

- Sputum
 - Induced sputum
 - BAL
-
- Pulmonary function examination
 - Imaging studies

Respiratory system

Affection by parasites:

- Initial port of entry
- As a site of definitive multiplication and affection of host
- As a transitory site of development within host (not the port of entry)

Site of terminal multiplication
(port of entry)

Pneumocystis jiroveci

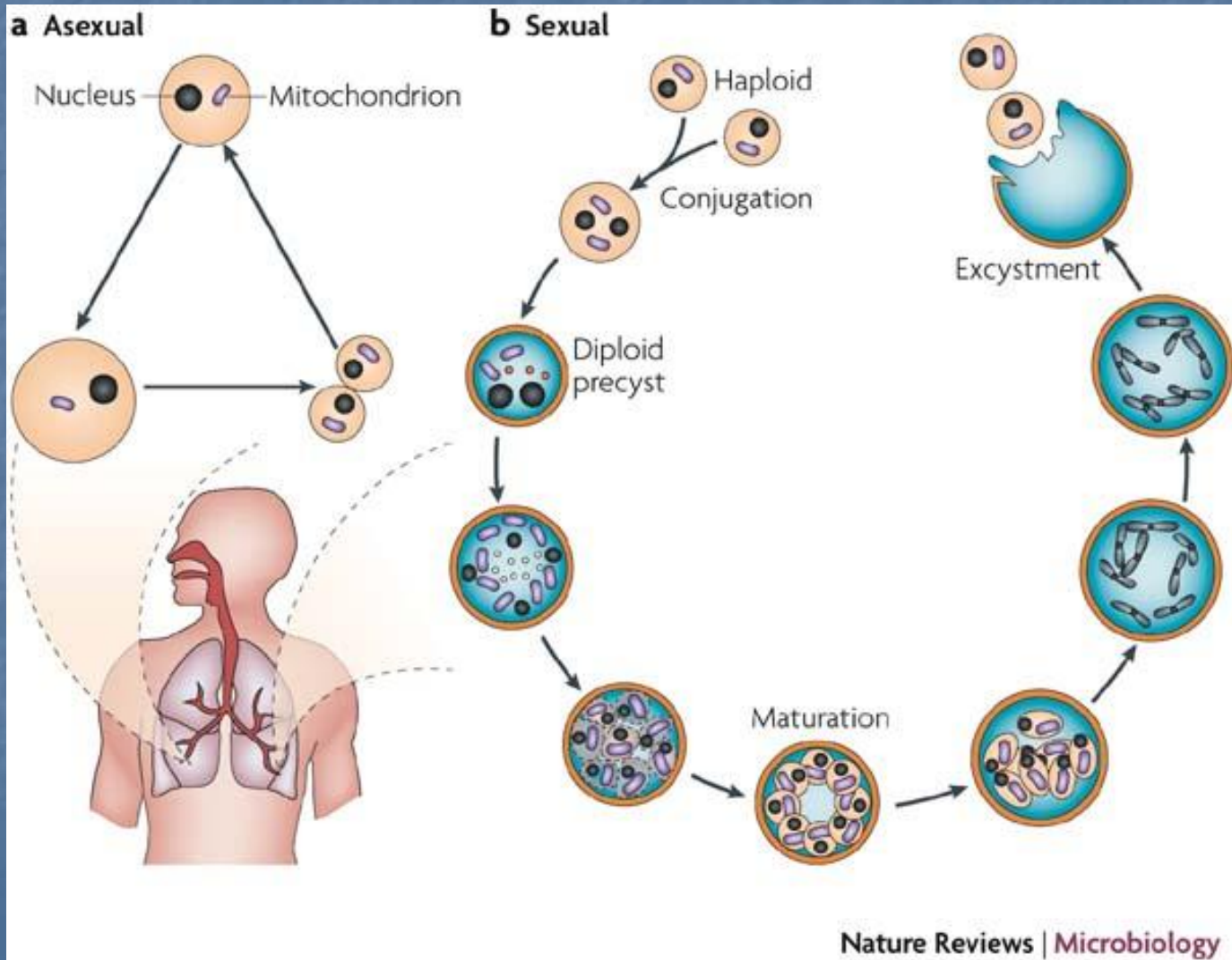
Pneumocystis jiroveci

- (*Pneumocystis carinii*)
- Causative agent of **pneumocystic pneumonia** called in honor to czech parasitologist Otta Jírovec
- Fungi like microorganism belonging to the group of yeasts (***Sacharomyces cerevisae***)
- Distribution: cosmopolite
- Associated with **immunodeficiency**
- *Pneumocystis* isolated from dogs, monkeys, rats, mices, cats, sheeps...

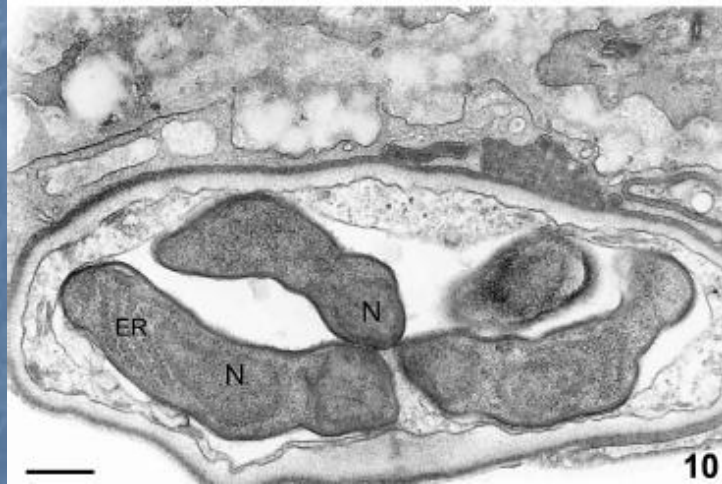
Epidemiology

- $\frac{3}{4}$ of population - antibodies against *P. jiroveci*
- Nutrition status of the population
- Immunocompromised patients:
 - in the past 80%
 - at present: 10-20%
- Mortality: HIV – 10-20%
- Mortality increased in patients without therapy to 75-100%

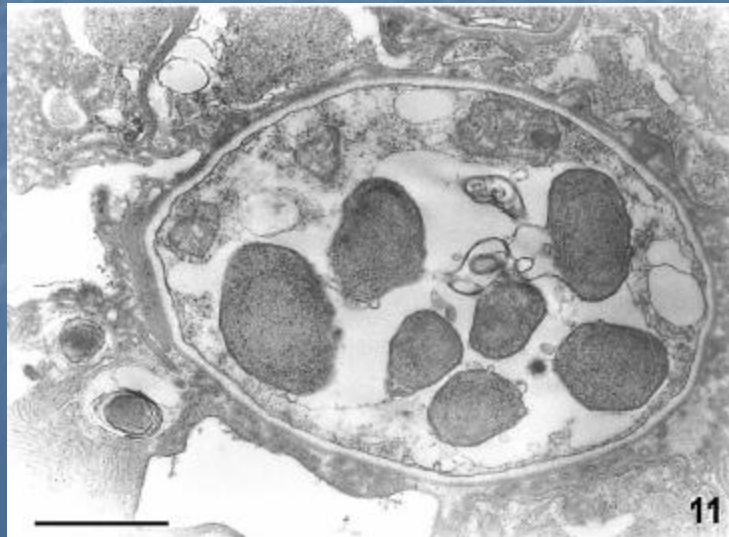
Life cycle



Forms of organism



- **Trophozoite** (haploid) in vivo creating clusters
- **Praecyst**
- **Cyst** (8 spherical intracystic bodies, give rise to 8 trophozoites)
- Main form responsible for infection still not known



Immunocompetent host

- Exposition mostly at the age 3-4 years
- Transmission: **inhalation of infectious particles** (most probably cysts)
- Localisation in lungs: tight contact with type I. pneumocytes secured by presence of fibronectine
- Macrophages in lungs destroy majority of pneumocysts

Pathophysiology

- Destruction of basal membrane leads to changes in permeability of alveoli/capillaries
- Changes in rate ventilation/perfusion
- Situation similar to ARDS

Forms of infection

- Immunocompetent individuals:
asymptomatic seroconversion
- Immunocompromised population:
interstitial pneumonia (if CD4 decreased below 200/uI): proliferation of organism with low or no inflammatory response

Clinics

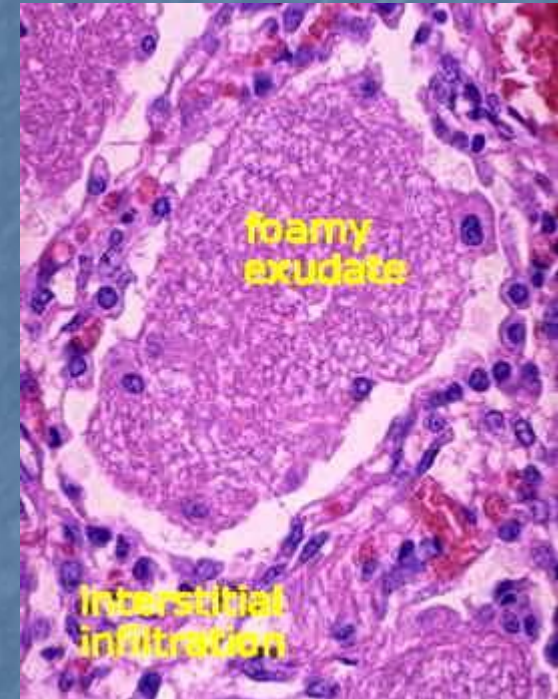
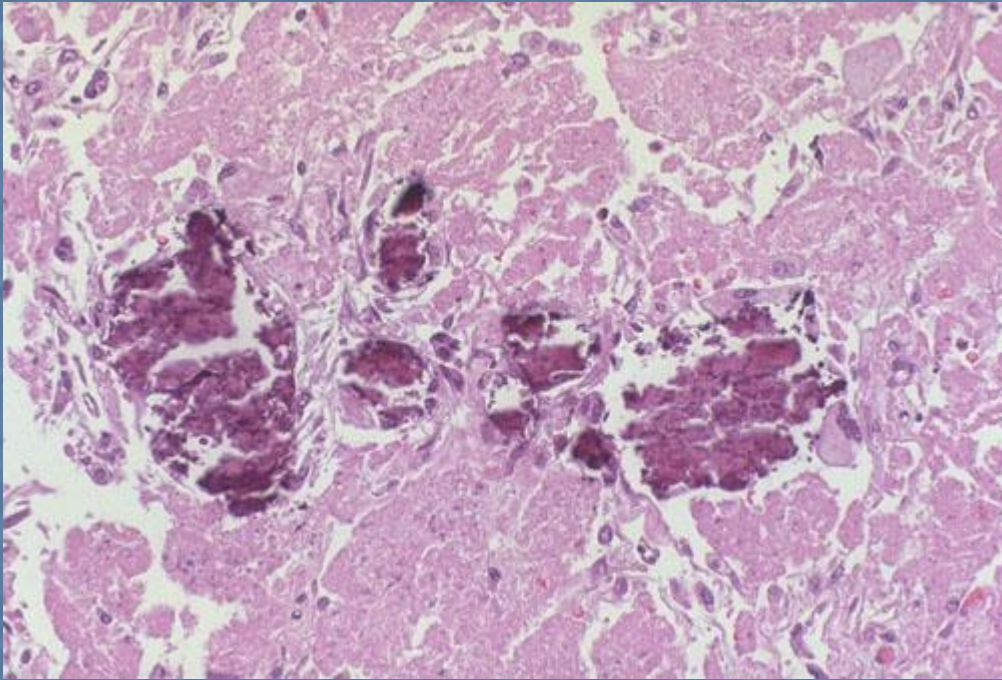
- Fever
- Non-productive mild cough
- Dyspnoea; chest pain
- Tachypnoea

Patients with prophylaxis: symptoms milder
BUT increased risk of dissemination;
increased risk of pneumothorax

Clinics II

- Auscultation: crackles; often normal finding
- Extrapulmonary (about 1% of cases):
 - Lymphadenopathy
 - Hepatosplenomegaly
 - Chorioid leasions

Pneumocystis pneumonia



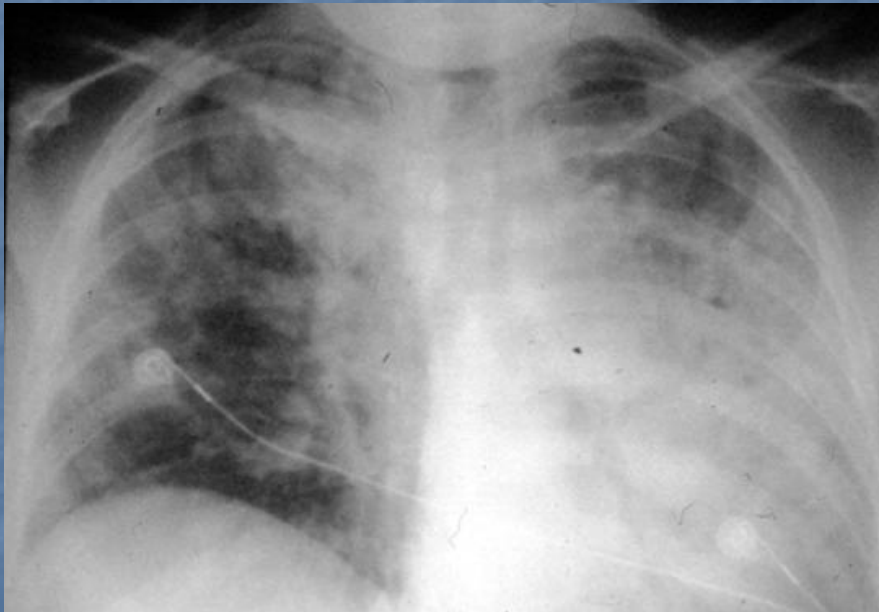
Foamy exsudate in the lungs affected by *P. carinii*; calcifications

Diagnostics

- Increased LDH: over 220 (non-specific)
- Puls oxymetry: desaturation
- Blood gases: hypoxemia, decreased CO_2
- RTG: interstitial pneumonia
- High resolution CT
- Bronchoscopy (associated with BAL)

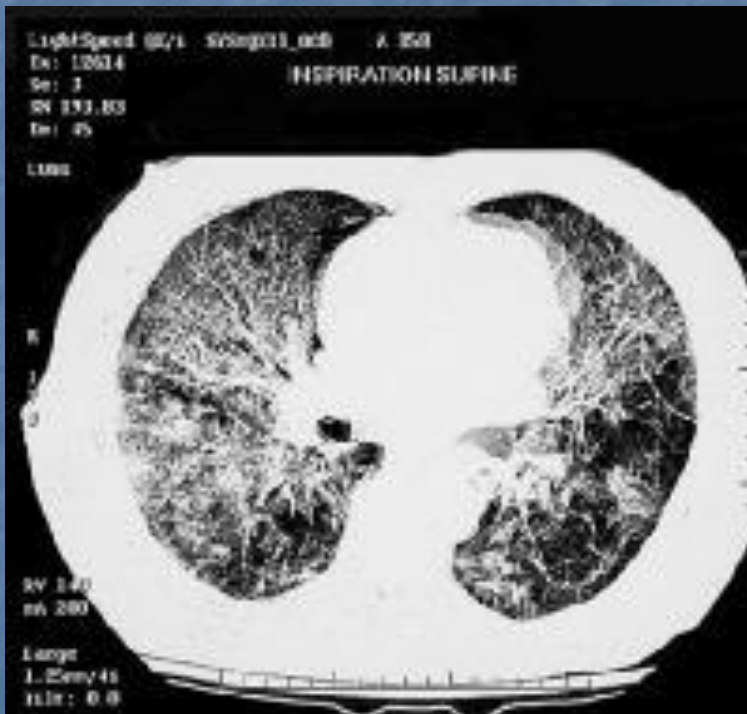
Imaging studies

RTG



Imaging studies II

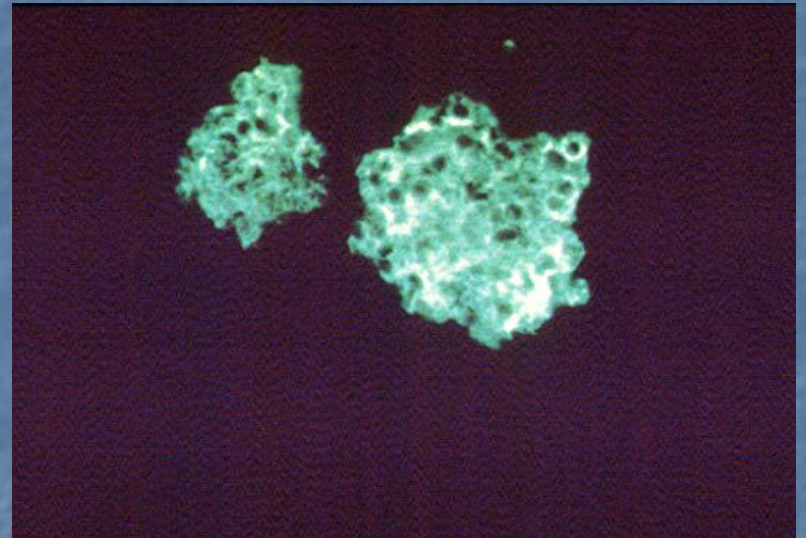
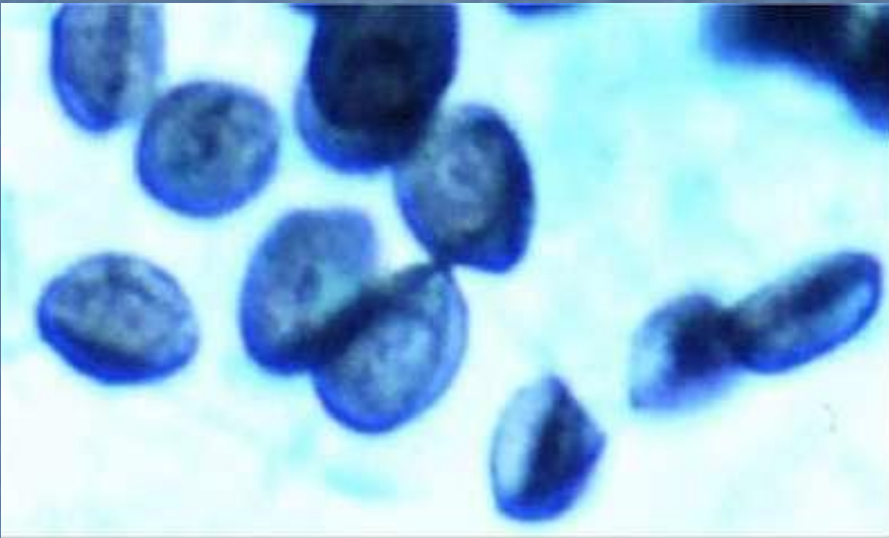
CT



Diagnostics II

- Direct detection of *Pneumocystis*:
parasitological examination:
 - Sputum: 30%
 - Induced sputum: 60%
 - Bronchoalveolar lavage: 90%
- Microscopy vs PCR

Pneumocystis jiroveci



Therapy

- Trimetoprim/sulfamethoxazole

Trimetoprim 15-20 mg/kg/day

Sulfamethoxazole 100 mg/kg/day in 6 doses

- Pentamidine

4 mg/kg/day iv

- Dapsone

100 mg/day po + trimetoprim 5 mg/kg/day

21 days

Site of terminal multiplication
(not port of entry)

Paragonimus spp.



Paragonimus spp.

- **Fluke**; parasite of carnivores
- Distribution: tropical and subtropical regions (Asia, Africa, and Latin America)
- Prevalence of infection in endemic areas: 0.1-23.75%
- 8 species causing significant disease in human; most important

P. westermani



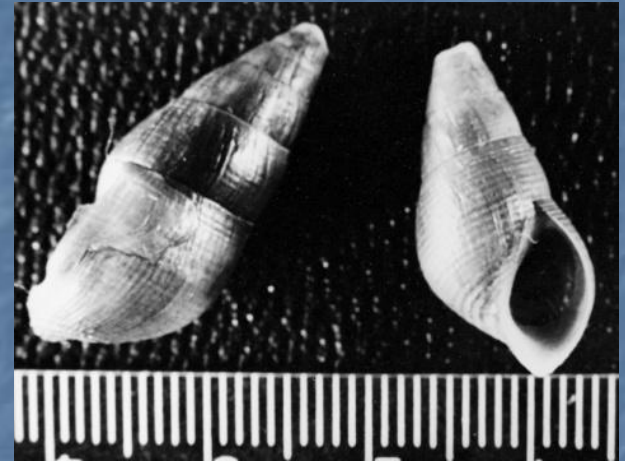
Epidemiology



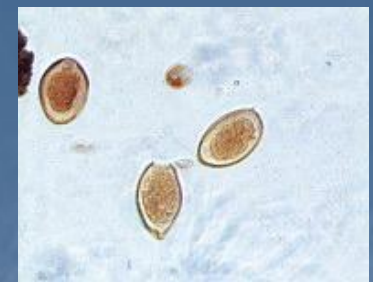
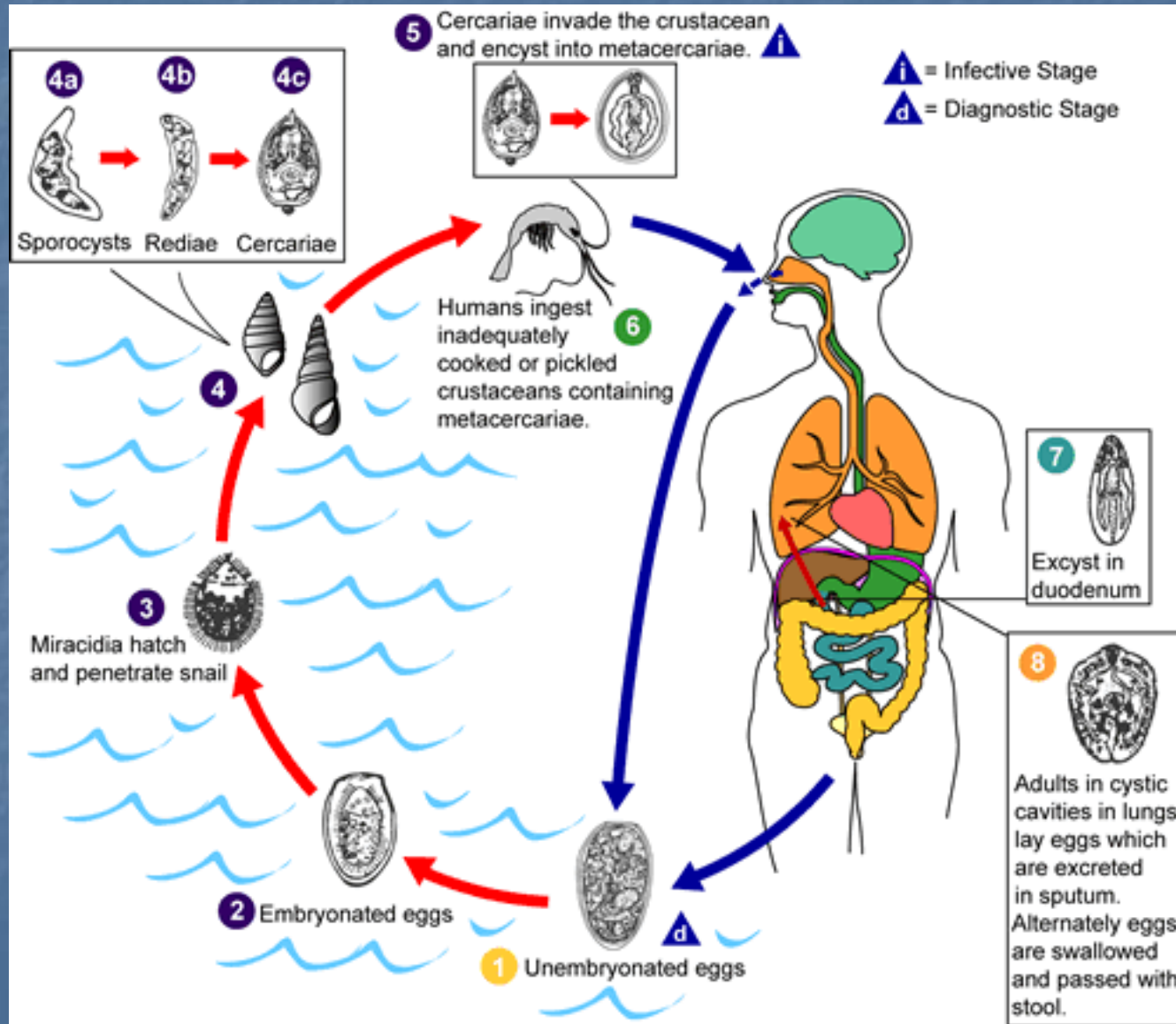
Life cycle

2 intermediate hosts

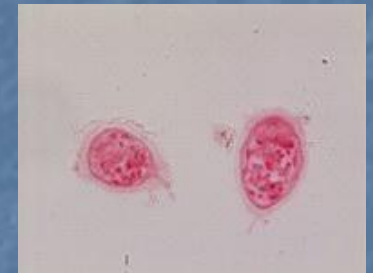
- specific fresh water **snail**
(*Pleuroceridae*, *Thiaridae*,
Hydrobiidae, *Semisulcospira*
libertina)
 - crustacean: **crabs or crayfish**
(*Geothelphusa*, *Sinopotamon*,
Parathelphusa, *Cambaroides*,
Procambarus...)
- + human



Life cycle



Egg



Miracidium



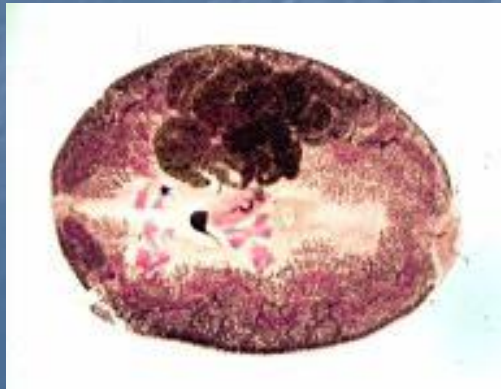
Redia



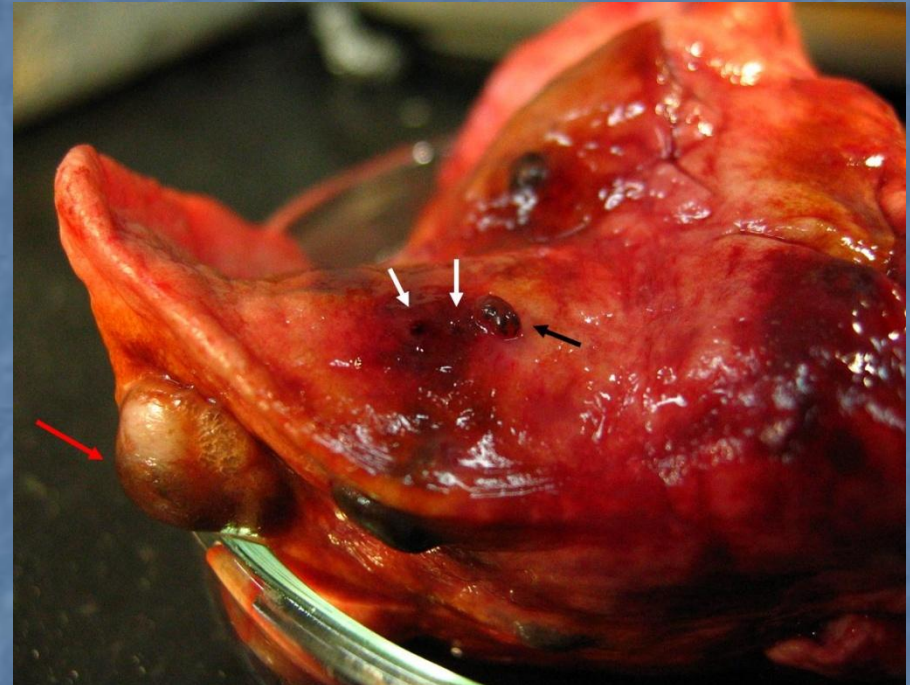
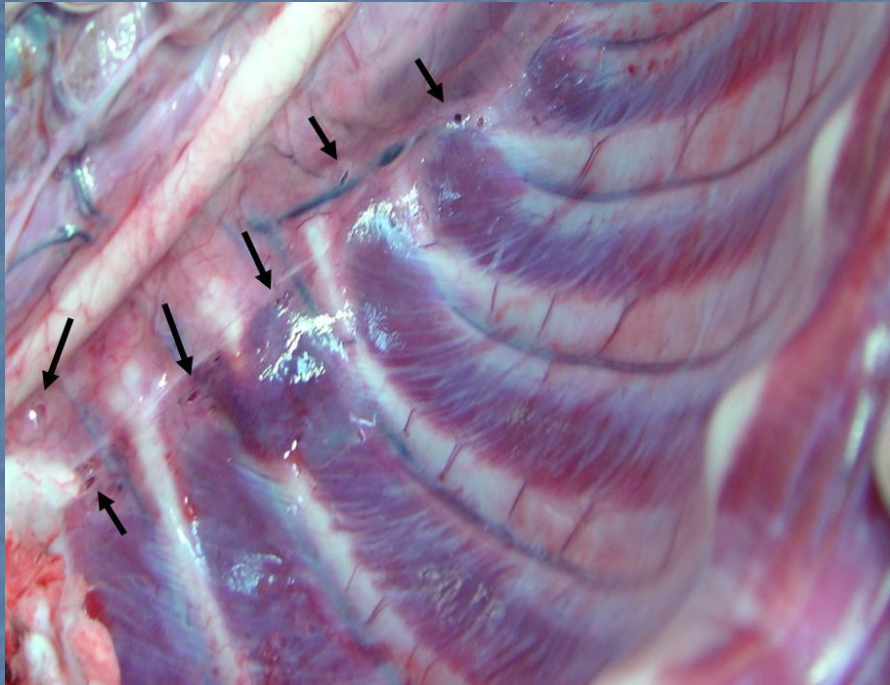
Metacerkaria

Development in human host

- Intestine → abdominal wall/liver (1 week) → diaphragm → lungs
- **Patent period: 5-6 weeks pi** (eggs found in sputum or in the stool)
- Life expectancy of fluke: 20 years



Experimental infection: migration into pleural cavity



Clinics

- Incubation period: 2-20 days
- 20% of patients are **asymptomatic**
- **Acute phase**: intestinal phase
respiratory phase
- **Chronic phase**: pulmonary vs
extrapulmonary symptoms

Acute disease

- **Intestinal phase:** abdominal pain, diarrhea and urticaria
- **Lung phase:** fever, cough, dyspnea, chest pain, malaise, and sweats

Chronic disease: pulmonary

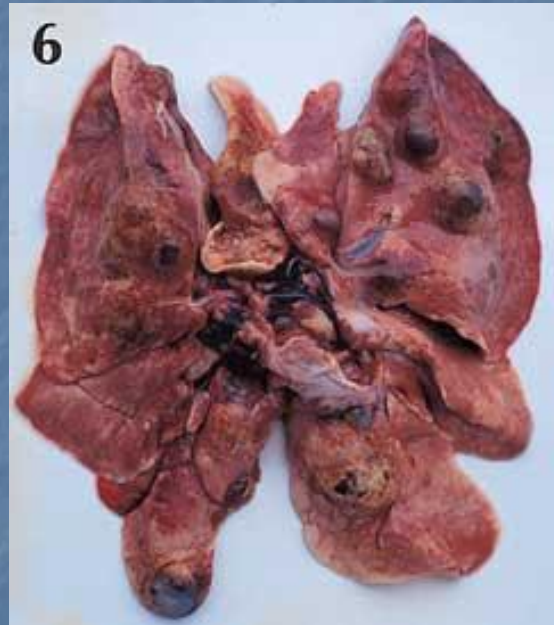
- 6 months after infection
- Often mistaken for tuberculosis
- Dry cough followed by a **cough productive** of tenacious and rusty or **golden sputum**
- Peripheral eosinophilia, increased temperature (no fever)
- **Hemoptysis**
- Vague chest discomfort, dyspnea on exertion, or wheezing
- Without treatment: fibrosis of lungs, cor pulmonale

Pathology

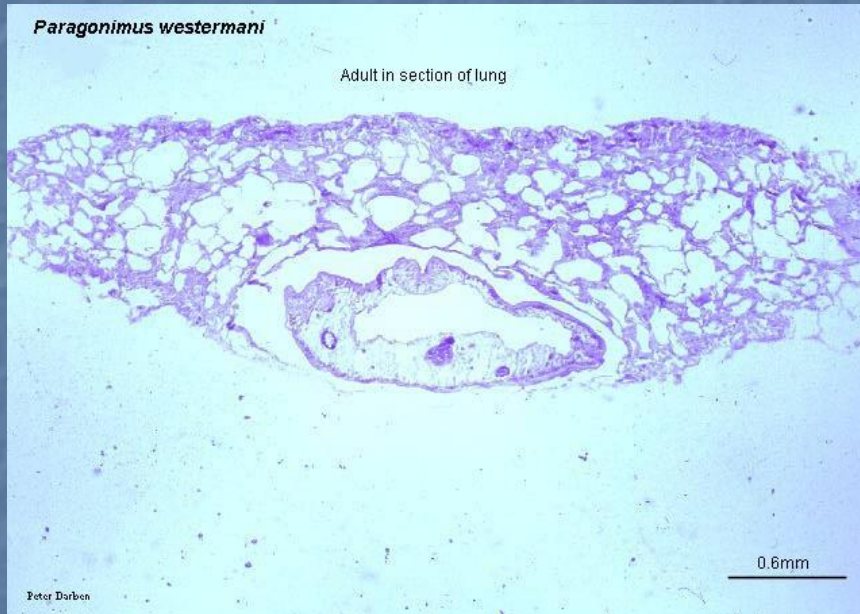
Cyst of fluke in trachea



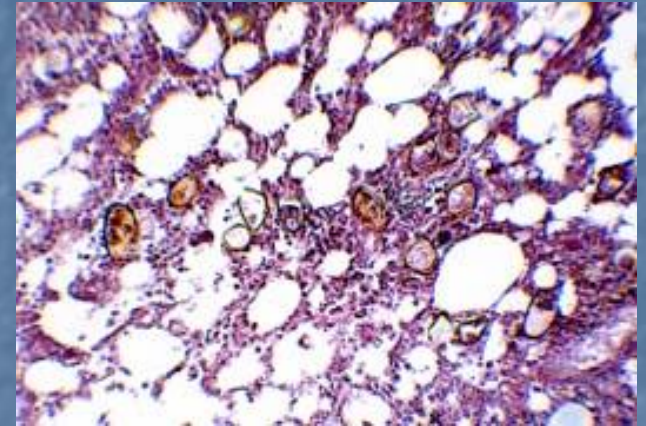
Flukes in lungs (exp. inf. dog)



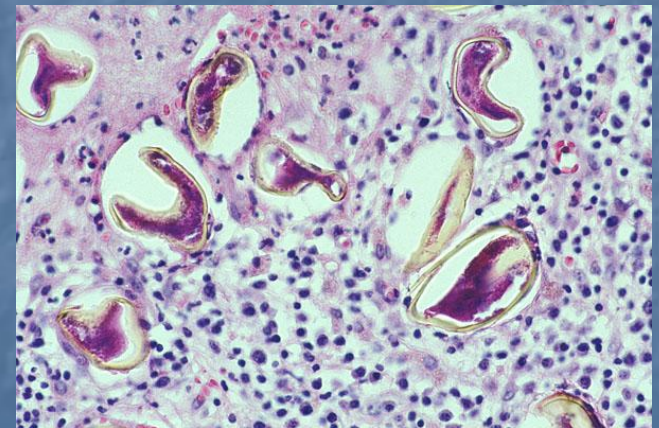
Histopathology



Adult fluke in lung section



Eggs in lung section



Eggs within bronchi

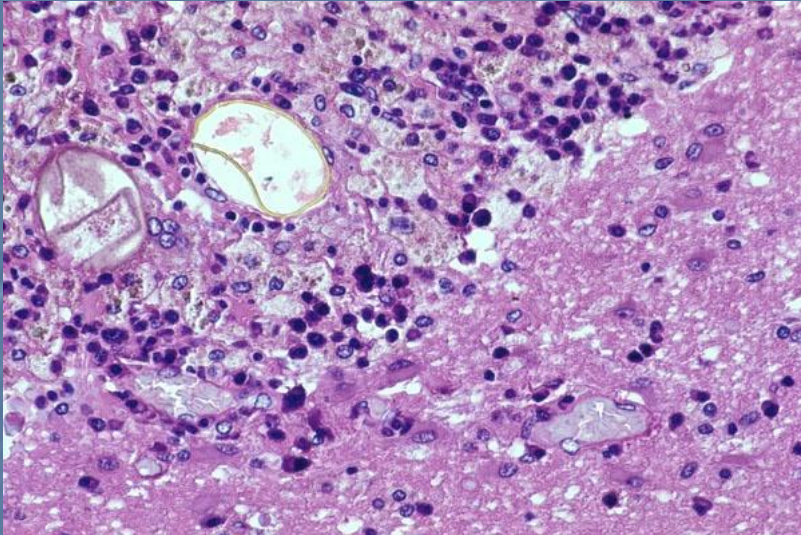
Chronic disease: extrapulmonary

- Cerebral, abdominal, subcutaneous, and miscellaneous
- Either **migration of adult fluke** or **eggs** entering the circulation being carried to different organs

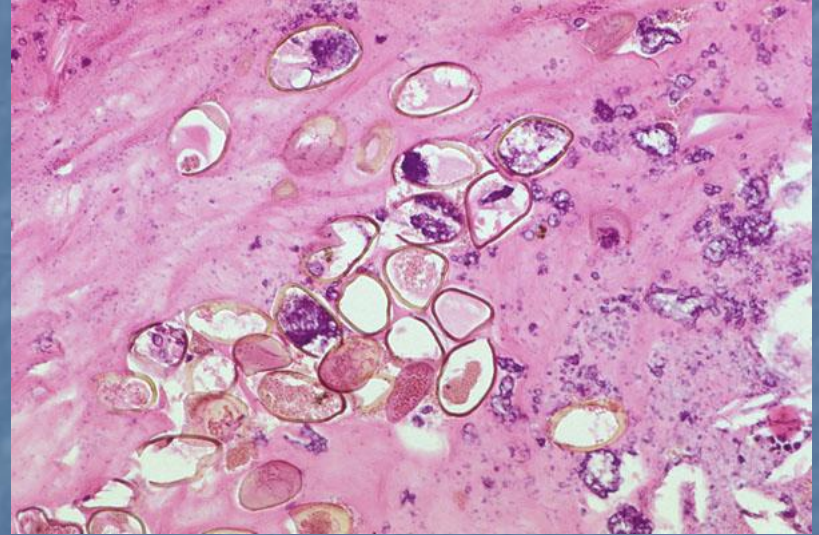
Extrapulmonary disease

- **Cysts** in the intestinal wall, liver, spleen, abdominal wall, peritoneal cavity, or mesenteric lymph nodes: bloody diarrhea or abdominal pain.
- Cerebral form: mainly in children (up to 1%): **meningoencephalitis** (headache, vomiting, seizures, or weakness, Jackson's epilepsy)

Histopathology



Eggs of fluke, brain



Calcified ova, brain

Physical examination: acute pulmonary disease

- Clubbing of fingers (hypoxemia)
- Auscultation: signs of pneumonia (crackles, dullness to percussion)



Physical examination: chronic pulmonary disease

- Similar to chronic bronchitis or bronchiectasis
- Profuse expectoration, pleuritic chest pain, dyspnea, cough, occasional hemoptysis

Physical examination: extrapulmonary disease

- **Cerebral**: palsy, hemiplegia, seizures, and paraplegia
- **Ocular**: impaired visual acuity: optic atrophy, papilledema, and hemianopsia
- **Spinal**: monoplegia, paraplegia, lower extremity paresthesias, or sensory loss
- **Abdominal**: palpable masses
- **Kidneys**: hematuria
- **Subcutaneous**: migratory swelling or subcutaneous nodules containing immature flukes (often in lower abdominal and inguinal region)

Laboratory studies

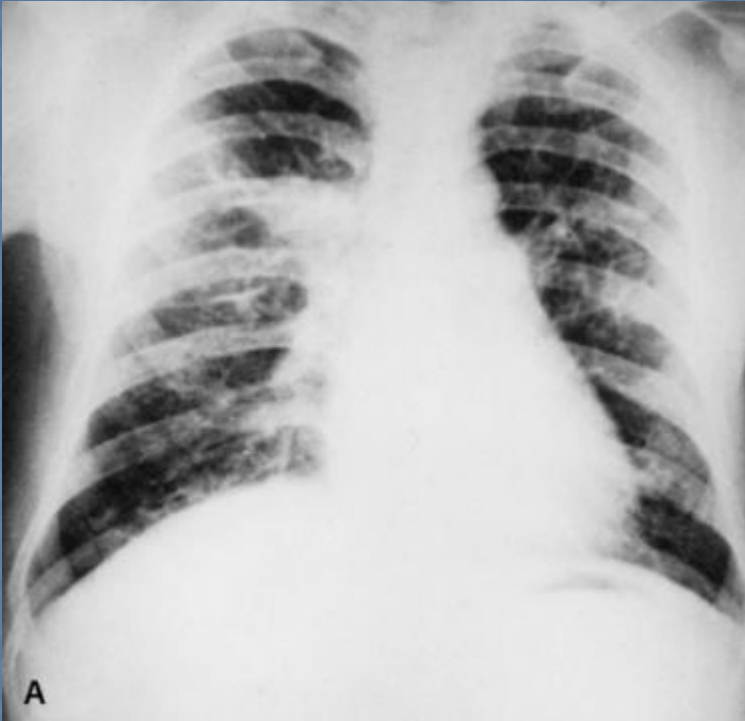
- Eosinophilia (10-30%)
- Total WBC: normal
- **Ova detected**: in sputum, feaces, pleural fluid, cerebrospinal fluid (CSF), or pus
- **Worms or eggs**: biopsy of involved organ
- Sputum detection: 50% (recommended multiple examinations)



Imaging studies

- **RTG**: ring shadows, representing cavitating lesions, fibrosis, nodules or linear infiltrates with calcified foci, loculated pleural effusions, and pleural thickening
soap bubble sign of frontal lobes
- **CT/NMR**: cerebral calcification, cystic lesions, or hydrocephalus

RTG

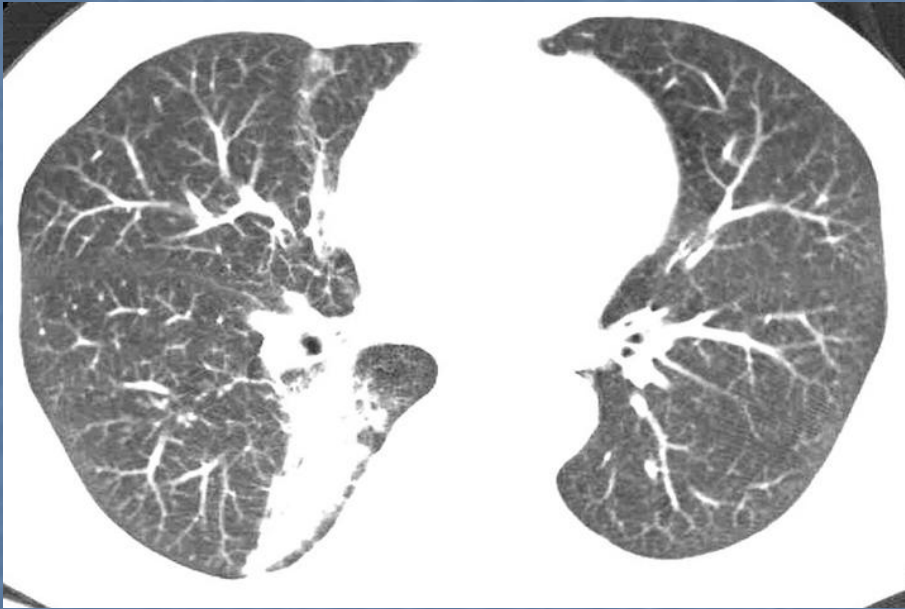


Patchy infiltrate; cystic cavities

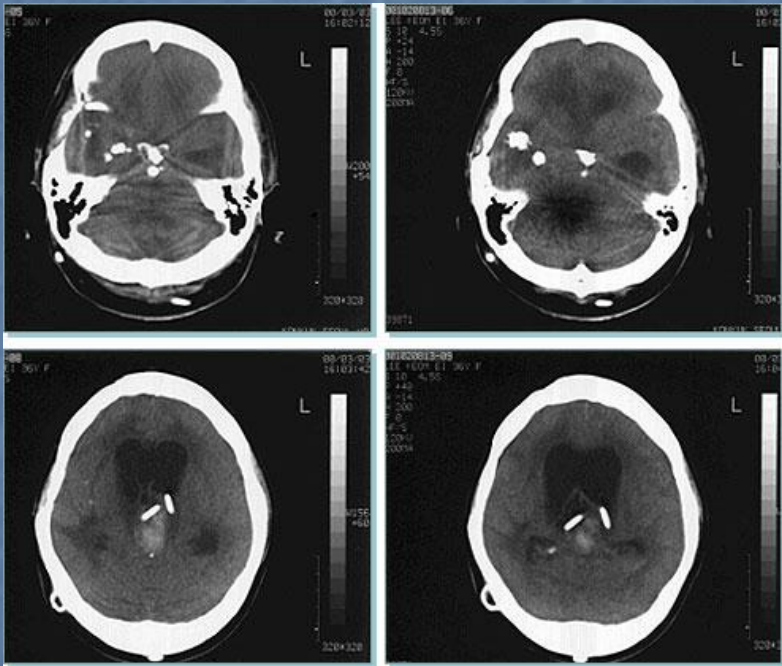


Small pneumothorax due to migration of flukes into the lungs

CT; PET



Involvement of the brain



Lesions within brain; hydrocephalus



Soap bubble sign, RTG

Diagnostics

- **Serology**: complement fixation test, ELISA, Immunoblot
- Skin test: false positive results may occur, epidemiological studies more than diagnostics



Diagnostics

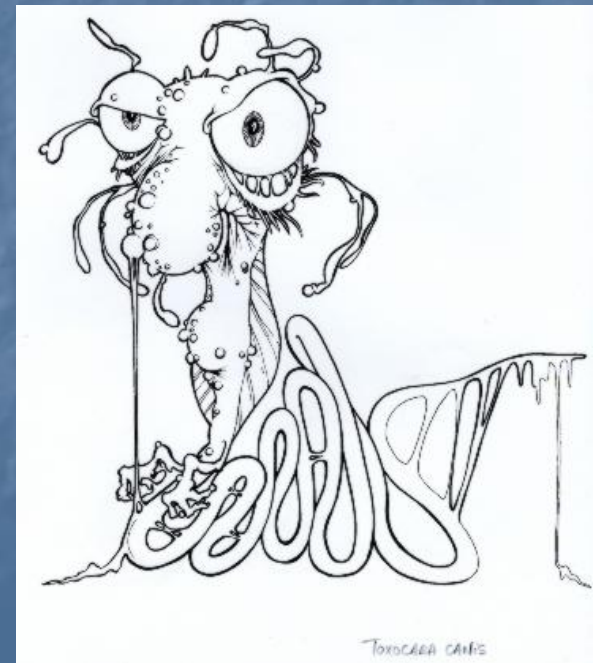
- **CSF**: numerous eosinophils
- **Thoracentesis**: serosanguineous, has more than 1000 red cells with accompanying eosinophilia; low glucose
- **Lung biopsy**: multiple worms or eggs
- Adults found in cysts (mostly right lung): granulation tissue with fibroblasts, mononuclear cells, plasma cells, lymphoid cells, and eosinophils; Charcot-Leyden crystals

Therapy

- Praziquantel: 25 mg/kg PO tid for 2 d
- Extrapulmonary lesions should be surgically excised.
- An intraventricular shunt may be needed to manage hydrocephalus
- Persistent seizures in cerebral involvement
- Prognosis: good, with therapeutic cure rates between 90 and 100%

Site of possible terminal
multiplication (not port of entry)

Toxocara canis/cati



Toxocara canis/cati

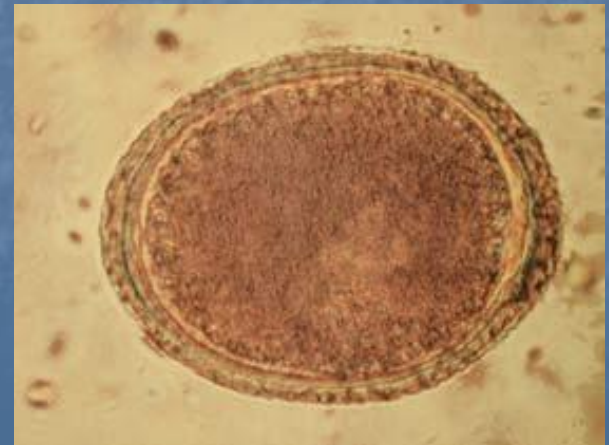
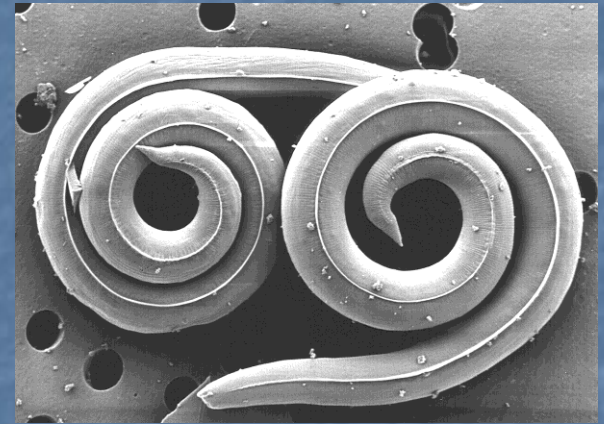
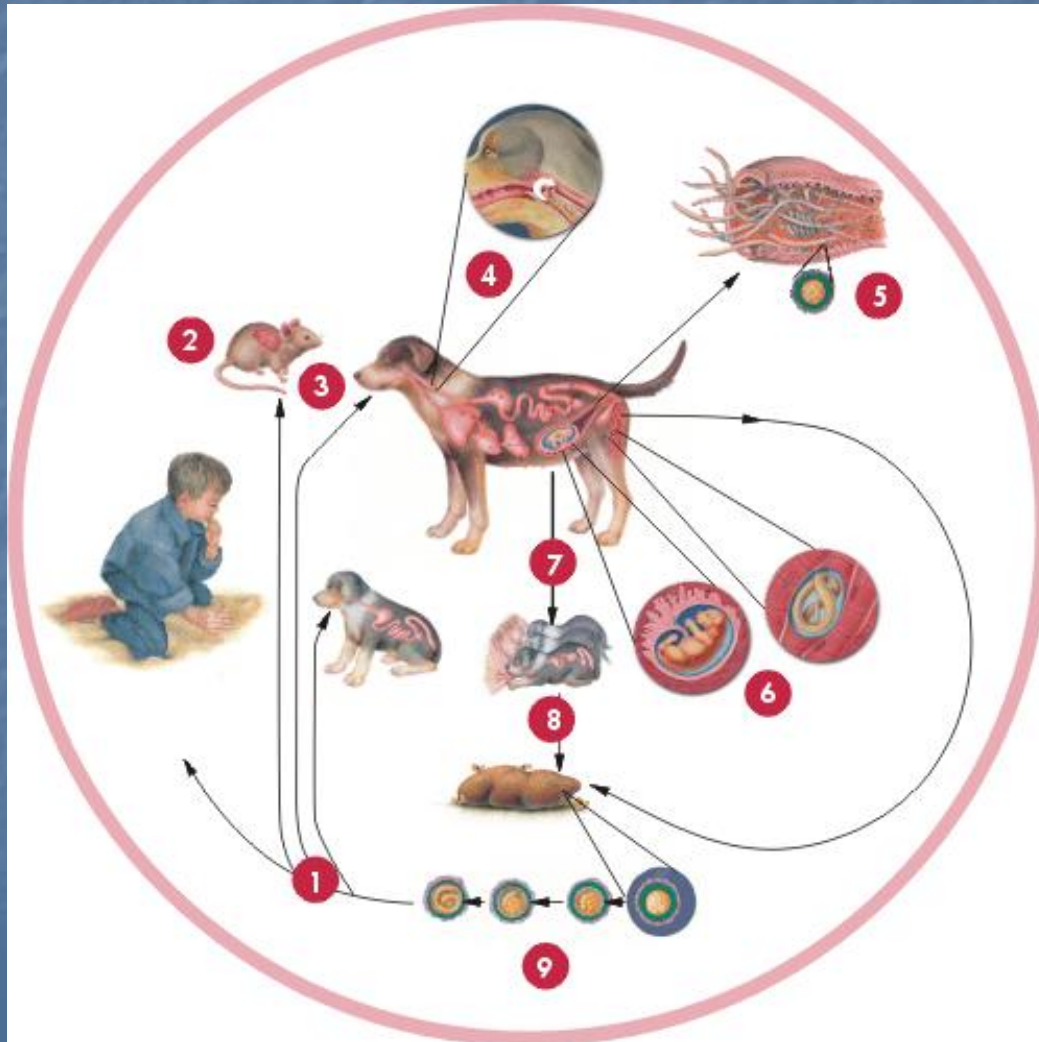
- Roundworm
- Distribution: worldwide
- Eggs – the soil of parks and playgrounds
- Transmission: per os



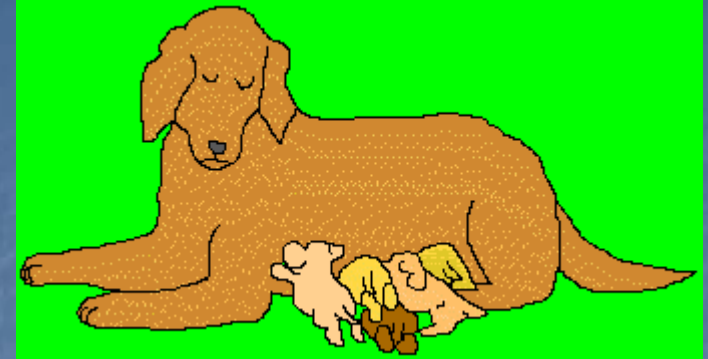
Epidemiology

- Epidemiology: 2-5% positive rate in urban Western countries
- 14.2-37% in rural areas of Western countries
- Tropical countries:
 - 63.2% in Bali,
 - 86% in Saint Lucia (West Indies), and
 - 92.8% in La Reunion (French Overseas Territories, Indian Ocean)

Life cycle

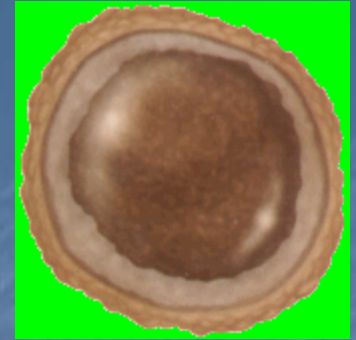


Disease in dog



- 5-51% positive dogs in Europe
- Adult: 10 cm long
- Similar to *Ascaris* infection in human
- Ability to form „sleeping larvae“ – transplacental/transmammary transmission
- Prepatent period: 56 days
- Eggs shed to the environment are immature

Maturation of eggs



- Temperature + humidity

28-30°C – 15 days

Below 10°C – no maturation



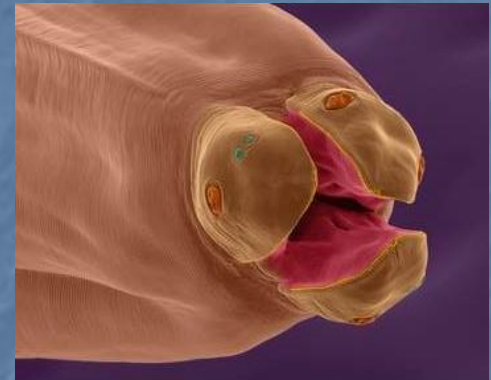
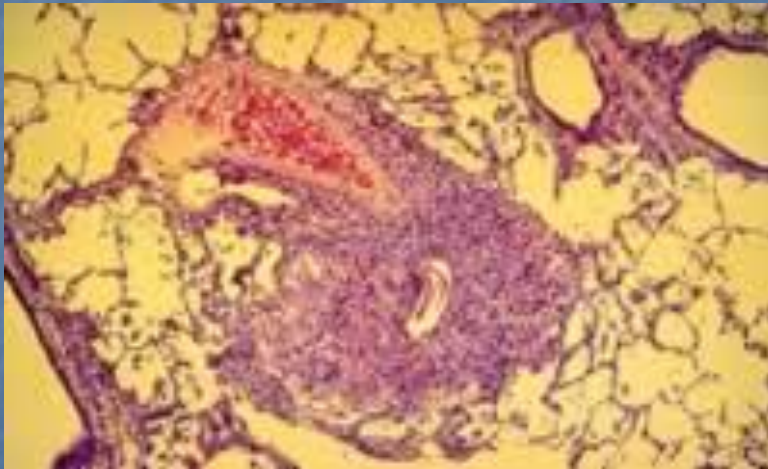
- Viability of the eggs in the outer environment:
5 years
- If is the outer environment anaerobic – viability
6-8 months

Human

- **Infectious agent:** mature eggs; sleeping larvae in the paratenic hosts
- Accidental host; **Paratenic host**
- **Larvae:** 0.02mm x 0.5mm
- Zoonosis
- Disease usually asymptomatic/mild

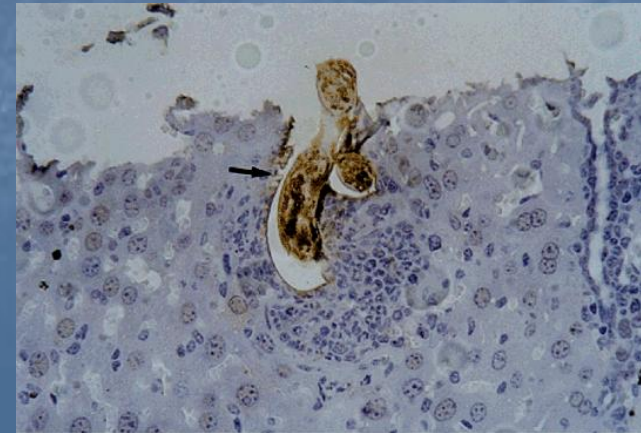
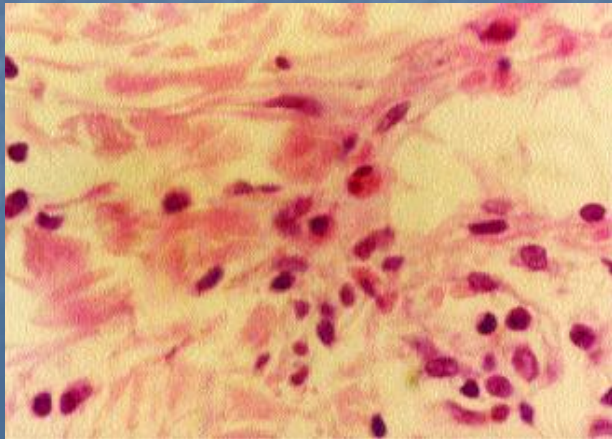
Symptomatic disease

- Number of the larvae in the host
- Allergic reaction



Pathophysiology

- **Migration** of the larvae in the host:
 - Allergic reaction (eosinophilic)
 - **Mechanic** destruction of the tissue
 - Proteolytic **enzymes** production by larvae



Human

- Larva migrans visceralis (liver, lung, muscle and brain)
- Larva migrans ocularis (eye)

Anamnesis

- Living with or raising **dogs and cats**
- Eating without **hand washing**
- Infection from contact with **soil** from a yard, sandbox, park, or playground

Larva migrans visceralis

- Diarrhoea, abdominal pain, anorexia, nausea, fatigue
- Pruritus, rash
- Liver
- Lungs: Cough, temperature (38°C), bronchospasm, wheezing
- Brain: Difficulty sleeping, abdominal pain, headaches, and behavioral problems, seizures, temperature

Examination

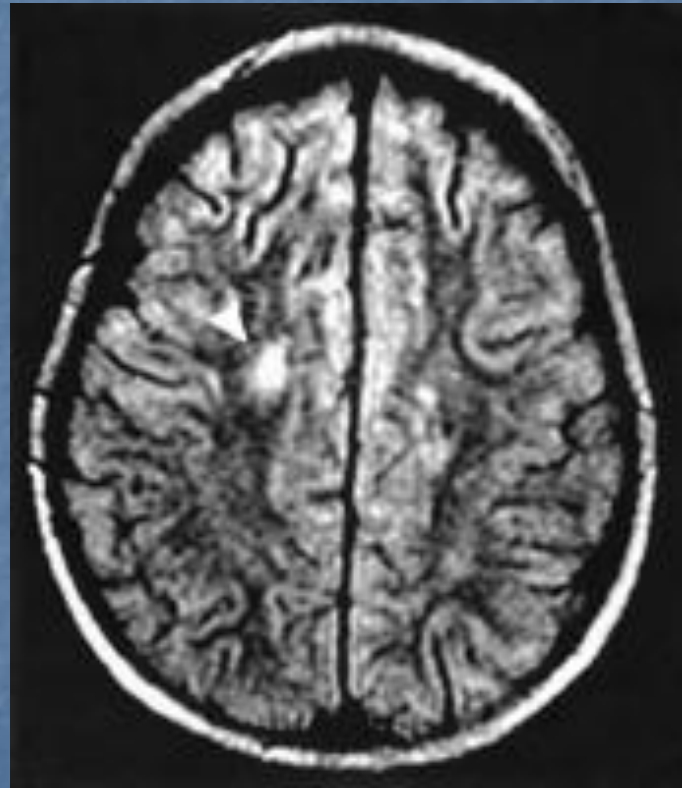
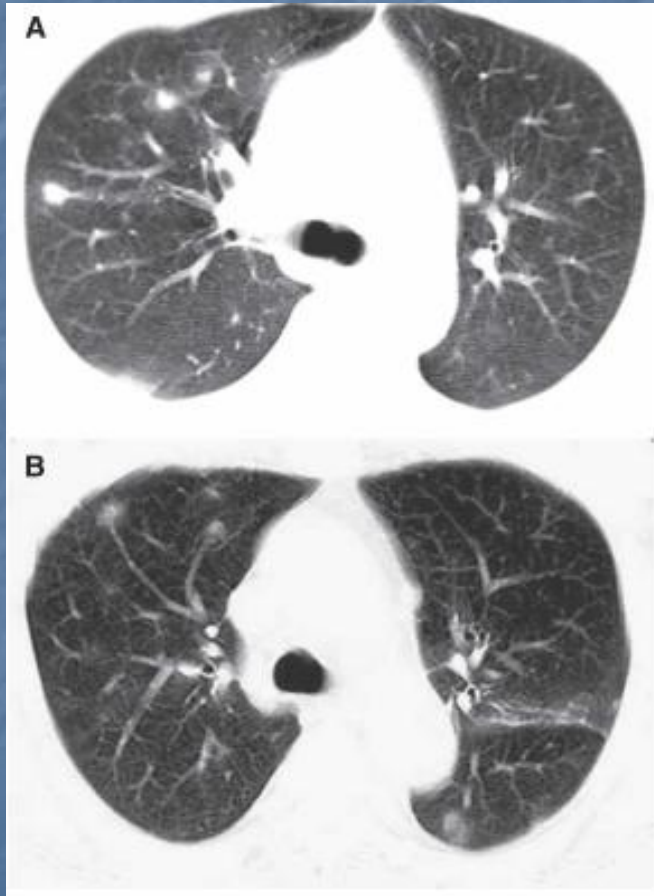
- Hepatomegaly, splenomegaly, lymphadenitis, and wheezing



Larva migrans visceralis: laboratory

- Elevation of the leukocytes
- Eosinophilia (20-90%)
- Diagnostics: Serology (ELISA)
Biopsy

Imaging studies



Therapy

- Dont treat positive titres if person asymptomatic!!!!
- **Mebendazole** (Vermox) - 25 mg/kg/d PO single dose for 4 wk
- **Albendazole** (Albenza) - 10 mg/kg/d PO single dose for 4 wk

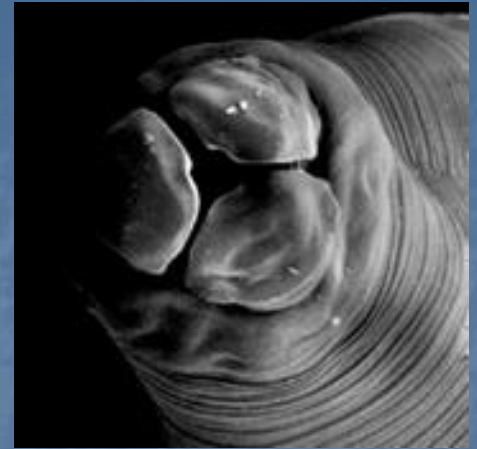
Site of possible terminal
multiplication (not port of entry)

Echinococcus
granulosus/multilocularis

Transitory site of development

Ascaris lumbricoides, *Strongyloides stercoralis*,
Ancylostoma duodenale, *Necator americanus*,
Toxocara canis/cati, Schistosomiasis,
Echinococcosis

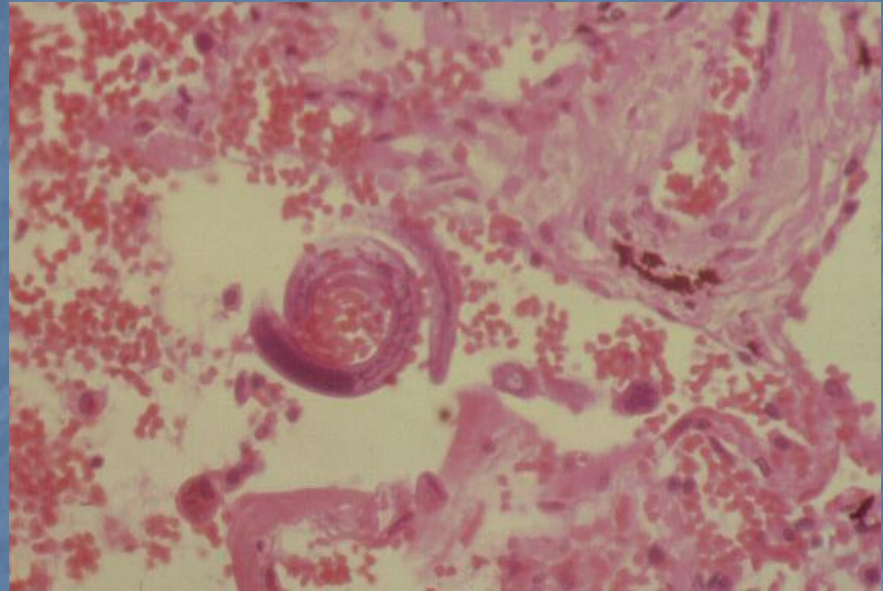
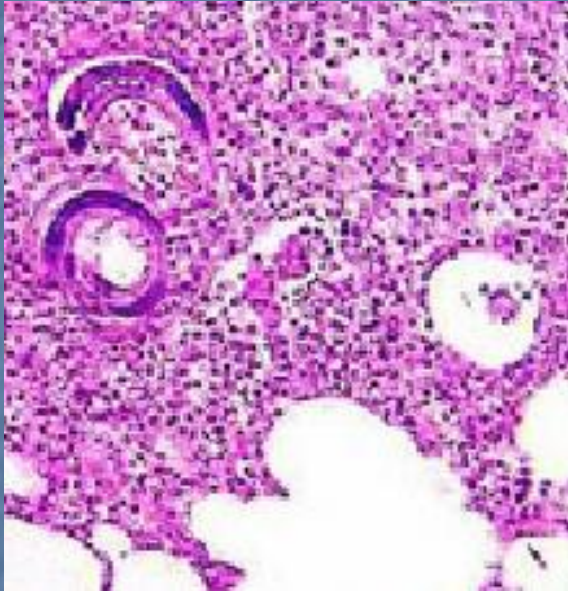
- Life cycle of many parasites involves specific developmental changes taking place within lungs
- Patient usually **asymptomatic** (not in severe infection)
- Affection of lung is transitory, histopathological changes are transitory



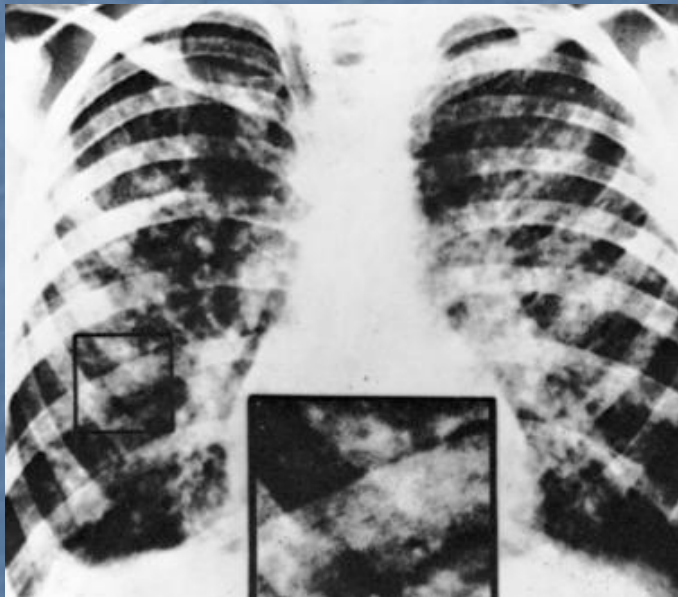
- Migration of parasites: **eosinophilia**
- Lung phase: (**pneumonia**): damage of capillaries and alveoli -
cough, chest pain, subfebrilia
blood in the sputum

Sputum positive for detection of larvae of the parasites (if examined)

Histopathology



Imaging studies



- Symptoms lasting for particular time
- After finish of development parasite migrates to definitive pathological site (intestine, portal venous system, ...)
- Therapy: specific (low detection); corticosteroids