Lung parasitic infections; Pneumocystosis

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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 Jírovéč
- 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

- ¾ 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/ul): proliferation of organism with low or no inflammatory response
Clinics

- Fever
- Non-productive mild cough
- Dyspnoe; chest pain
- Tachypnoe

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 exudate 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/sulfametoxazol**
  - Trimetoprim 15-20 mg/kg/day
  - Sulfametoxazol 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

Geographic distribution of Paragonimiasis
Life cycle

2 intermediate hosts
- specific fresh water snail *(Pleuroceridae, Thiaridae, Hydrobiidae, Semisulcospira libertina)*
- crustacean: crabs or crayfish *(Geothelphusa, Sinopotamon, Parathelhusa, Cambaroides, Procambarus…)*

+ human
Life cycle

1. Unembryonated eggs
2. Embryonated eggs
3. Miracidia hatch and penetrate snail
4a. Sporocysts
4b. Rediae
4c. Cercariae
5. Cercariae invade the crustacean and encyst into metacercariae.
6. Humans ingest inadequately cooked or pickled crustaceans containing metacercariae.
7. Excyst in duodenum
8. Adults in cystic cavities in lungs lay eggs which are excreted in sputum. Alternatively, eggs are swallowed and passed with stool.
Development in human host

- Intestine \(\rightarrow\) abdominal wall/liver (1 week) \(\rightarrow\) diaphragm \(\rightarrow\) 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, Jacksons 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 pneumotorax due to migration of flukes into the lungs
CT; PET
Involvement of the brain

Leasions 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/catii*
**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**: Coughed, 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

- Don't 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 - cought, 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