Parasitic Infections in Central Nervous System

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Malaria

- **Aetiology:**
  - *P. falciparum*
  - *P. vivax*
  - *P. malariae*
  - *P. ovale*

- **Trias:** fever, anemia and splenomegaly
Plasmodium falciparum

Its specific behaviour: sequestration (mengasingkan diri) in deep capillary for schizogony and gametogony process

Sequestration in brain, lung, heart, liver, kidney, etc → Sequestration forms sludge and inhibits micro-circulation → temporary organ dysfunction/failure.

If patients are cured in this stage, no sequel is observed
Parasite` sequestration
Parasite sequestration
Pathogenesis of Cerebral Malaria

- Capillary obstruction mechanism:
  - Rosetting (erythrocyte segregation)
  - Cytoadherence (erythrocyte adherence to endothel)
- Impaired delivery substrate: hypoglycaemia, hypoxia, anemia
- Endotoxin mechanism: NO, cytokines, etc
- Clotting
  → coma, seizures, hyperpyrexia
Malaria diagnosis

• To find parasite or parasite product in blood circulation:
  Plasmodium *spp* live in erythrocyte, by making thick and thin blood smear, morphologically plasmodium could be differentiated according to the species (Giemsa, QBC)
• *P. falciparum* Antigen Detection
• Detection DNA or RNA parasite
Neurosistiserkosis
Important species in Indonesia

- *Taenia saginata*; intermediate host: cow
- *Taenia solium*; intermediate host: pig, dog
Life Cycle

Undercooked meat + cysticercus

cysticercus evaginated in human small intestinal

cysticercus

scolex + neck

Immature proglotid

mature proglotid

Gravid proglotid

Eggs in faeces

Intermediate host

Expelled

Taeniasis
Distribusi Taeniasis/Sistiserkosis di Indonesia
Cysticercosis

- aetiology: cysticercus cellulosae (larvae of the tapeworm *T. solium*)
- Larvae are acquired by ingestion of *T. solium* ova

Microscopically cannot be differentiated between *T. saginata* and *T. solium*
Cysticercus:
a white opalescent vesicle, ovoid to round, measuring 8-15 mm x 5-8 mm containing only one protoscolex
May infect many organs (subcutaneous tissue, brain, eye, muscles).
Cysticercosis:

- the onchospheres migrate to the tissues and develop to cysticerci
- the cysticercus dies and becomes calcified

→ depend on location of the larvae:
- subcutaneous
- eye
- muscle
- cerebral tumor
Pathogenesis of Neurocysticercosis

• mechanical compression & damage of tissue e.g. granuloma
• immunopathological eg cellular infiltration
• late secondary sequelae of cysticercosis e.g. fibrotic scar
Clinical Manifestations

- epilepsy
- cerebellar ataxia
- sensory defect
- acute onset of focal seizures
- less common: hemiparesis, visual changes and sensory disturbances
- no fever
Risk Factors

- Immigrant from endemic area
- Poor sanitation, use of sewage for fertilizer and lack of controlled pens for pigs
- Contact with other household member who often travel to endemic area (carrier)
Pig, intermediate host of *T. solium*
Playing at dirty places
Diagnosis

- Microscopic: to find *Taenia* egg → examine stools for ova & parasites (3 consecutive days)
- Serology: antibody detection by enzyme-linked immunotransfer blot (EITB) and ELISA
- Radiology:
  1. CT scan shows the cyst (solitary or multiple and usually 5-20 mm in diameter) and granuloma stages of neurocysticercosis. Most often in the cortex / gray-white junction.
  2. Magnetic resonance imaging
Toxoplasmosis

- Mode of infection:
  - ingestion of cyst in raw meats
  - ingestion of oocyst (in cat faeces)
  - transplacental
  - transfusion
  - organ transplantation
  - laboratory accident

Toxoplasma gondii
Organ damage

- depends on host age, virulence and organ infected (CNS and eye: more severe)
- CNS:
  - meningoencephalitis
  - brain abscess (multiple)
  - aquaductus sylvii congestion → hydrocephalus
  - intracranial calcification
  - mental and motoric retardation
Acquired Toxoplasmosis

- Rarely detected (asymptomatic)
- Lymphadenopathy (self limiting)
- Fever, headache, myalgia, sore throat, hepatosplenomegaly
- Retinochoroiditis
- Myocarditis
- Encephalitis
Congenital Toxoplasmosis Disease in Infants

- Normal at birth
- Hepatosplenomegaly
- Icterus
- Lymphadenopathy
- Erythroblastosis
- Hydrops foetalis
- Death: 5% - 15%
- Classic triad
Classic triad

1. Hydrocephalus
2. Intracranial calcification
3. Retinochoroiditis: atrophy of retina & choroid pigmentation
4. + Psychomotoric retardation → Tetrade Sabin
Fig. 5.—Cerebral calcification in a 10-year-old boy presenting microcephaly, healed chorioretinitis in the macular region of both eyes (very poor vision), mental retardation, and a history of recurrent "attacks" (since 2½ years of age) characterized by "seeing spots before his eyes," followed by dizziness of vision, headache, nausea, drowsiness and recovery without loss of consciousness or convulsions after vomiting. Toxoplasma neutralization tests positive on patient and his mother. (Fig. of calcification retouched.) (Reproduced by courtesy of Dr. Bronson Crothers and with the permission of the publishers.)
Toxoplasmosis Serology

Acute toxoplasmosis:
• Serial blood exam: IgG increase significantly after 3 weeks or more (4 fold)
• Conversion: negative to positive
• IgG and IgM in neonatal blood
• Polymerase chain reaction
Amebic Brain Abscess

- **Aetiology:** *Entamoeba histolytica*
- usually occurs in the framework of systemic amebiasis
- fewer than 10% of patients with a hepatic amebic abscess have cerebral amebiasis
- the cerebral abscesses are usually multiple with accompanying cerebral edema.
- abscesses are most commonly located in the cerebral hemisphere, although a cerebellar location is not infrequent
chronic amoebiasis colitis
↓
portal vein
↓
amebic lever abscess
↓
 hematogenous spread
↓
pulmonary amoebiasis abscess
↓
brain abscess
Clinical manifestations

• usually preceded by gastrointestinal or hepatic or respiratory symptoms.
• an abrupt onset of mental status change and/or focal neurologic deficits, headache, nausea, vomiting, delirium, coma, sensorial alteration
• meningitis can occur
• cranial nerve involvement is frequent
• death occurs over 12-72 hours without adequate therapy
Diagnosis

• Serologic tests, such as IFA, ELISA, for specific antibodies to *E. histolytica* are very helpful in diagnosis of invasive amebiasis

• Computed tomograph (CT) and nuclear magnetic resonance (NMR) for the brain abscess
Free living amoeba
Naegleria fowleri

- Infect immunocompetent host
- Infective stage: the trophozoites
- Mode of infection:
  1. through the olfactory neuroepithelium
  2. nasal passages when water is forced into the nose via diving or jumping or submerged underwater
- Trophozoites are found in cerebrospinal fluid and tissue
Primary Amebic Meningoencephalitis (PAM)

- an acute, a deadly disease of the brain characterized by necrotizing and haemorrhagic meningoencephalitis
- symptoms usually occurs 3-7 days after infection
- aetiology: *Naegleria fowleri*
- epidemiology: individuals with warm water related activities, diving in the river, summer time
Clinical features

- Fever
- Sore throat
- Swelling in nose
- Severe headache
- Stiff neck and back
- Nausea, vomiting
- Confusion, seizures
Diagnosis

- Microscopic examination
- Culture
- Immunofluorescent antibody
- Polymerase chain reaction
**Granulomatous Amebic Encephalitis**

- **Aetiology:** Acanthamoeba sp (A. *castellani*, A. *polyphaga*, A. *culbertsoni*) → free living amoeba capable of causing subacute or chronic in individuals with immunocompetent and compromised and also in animals

- The trophozoites and cysts are the infective forms → entry into the body through the lower respiratory tract, ulcerated or broken skin and invade the central nervous system by hematogenous dissemination
Clinical features

- Subfebris
- Headache
- Altered mental status
- Stiff neck
- Nausea and vomit
- Focal neurologic deficit which progresses over several weeks to death
Trypanosomiasis

1. *T. rhodesiense*  
   → Vektor: *Glossina morsitans*

2. *T. gambiense*  
   → Vektor: *Glossina palpalis*
African trypanosomiasis

- Chancre trypanosoma on port d’entrée
- Fever
- Hepatosplenomegaly
- Lymphadenopathy (winter bottom sign)
- Meningoencephalitis: apathy, lethargy, coma and death (*T. rhodesiense* more virulent)
Infected tsetse fly ingests blood, injects parasites

Primary chancre develops at bite wound, in lymph

Trypomastigotes invade bloodstream

Tsetse fly bites, acquires infection

PATHOLOGY

Metacyclic trypanosome

Perivascular cuffing (late onset)

CNS

Winterbottom's sign (early onset)
Sleeping sickness
American trypanosomiasis/Chagas disease

- caused by *T. cruzi*
- amastigot forms in macrophages on port d’entrée
- granuloma formation
- unilateral orbital edema and conjunctivitis (romana sign)
American trypanosomiasis/ Chagas disease

- Hepatosplenomegaly, generalized lymphadenopathy
- Myocarditis
- Meningoencephalitis, ganglion cell disruption and autonomic function loss resulting in megaesophagus and megacolon
Diagnosis

1. Finding the parasite (biopsy, blood examination, etc)
2. Culture
3. Inoculation / xenodiagnosis
4. Immunological reactions
5. PCR
Wassalamualaikum

Terima Kasih