Parasitic Infections Affecting CNS and Special senses

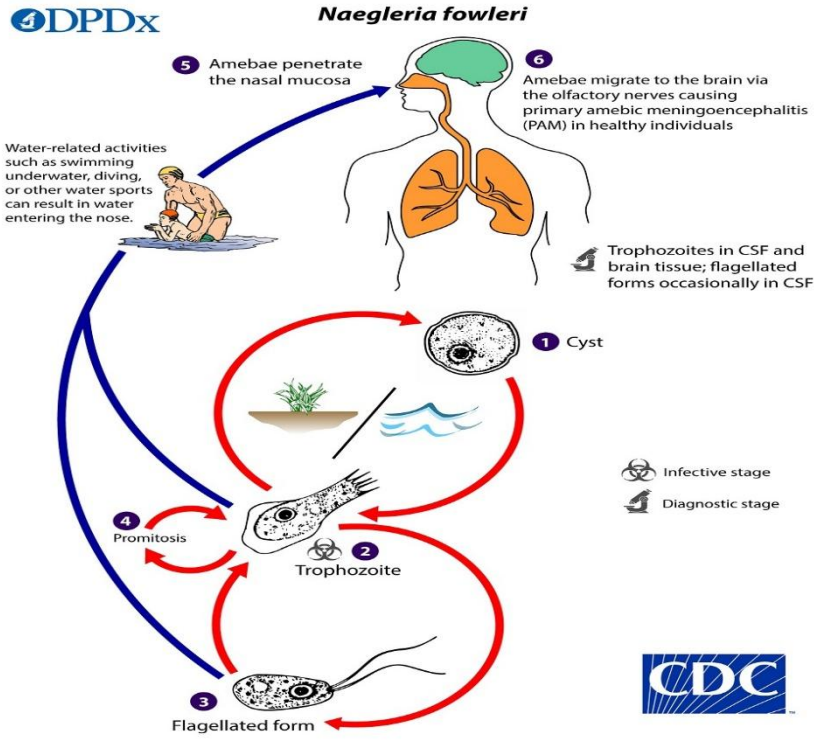
CNS	Free living amoeba	- Primary Amoebic Meningoencephalitis - Granulomatous Amoebic Meningoencephalitis
CNS	Trypanosoma brucei	Sleeping Sickness
CNS	Entamoebae histolytica	Secondary Amoebic Cerebral Abscess
CNS	Taenia solium	Neurocysticercosis
Senses	Acanthamoeba castellani	Keratitis & corneal ulcers
Senses	Taenia solium	Neurocysticercosis
Senses	Onchocerca volvulus	Onchocerciasis

1) Pathogenic Free-Living Amoebae

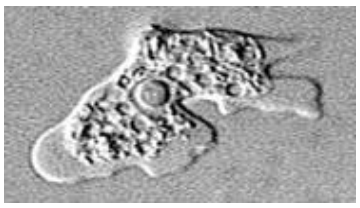
a) Naegleria fowleri

- Life-cycle:

Habitat	- Free living in **soil** and fresh-stagnant water - In man, it attacks CNS
Infective stage	Amoeboid trophozoite
Mode of infection	Through **nasal route**: - Swimming in /or sniffing contaminated water. - Inhalation of contaminated air.

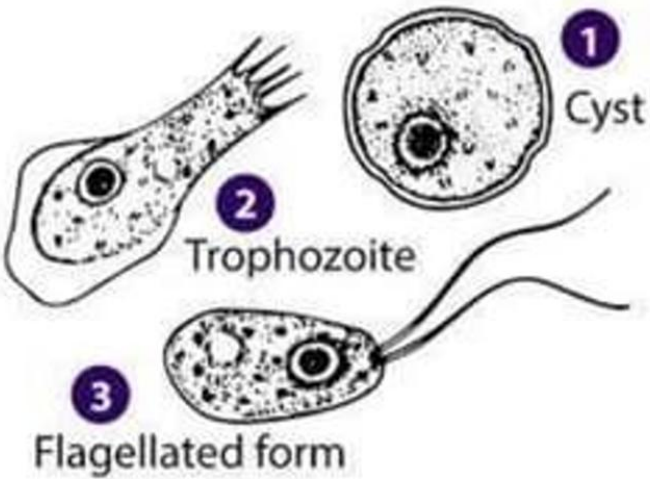


- *Morphological stages:*

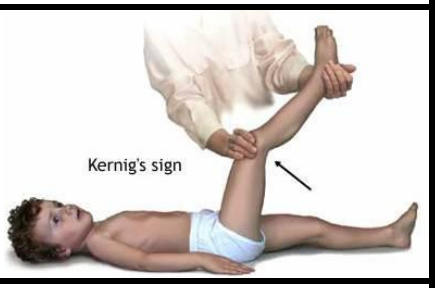
Amoeboid Trophozoite	*- In tissues and CSF.* *- Elongate with **broad anterior end**, **tapering posterior end**.* *- Single **pseudopodium**.* *- 15 µm.* 
Flagellate Trophozoite	*- When contact with water.* *- Pear shaped.* *- Two long equal flagellae.* 
Cyst	*- Occurs in soil (never in tissues).* *- Rounded.* *- 10 µm.* 

- *Pathogenesis (Primary Amoebic Meningoencephalitis [PAM]):*
  - *Amoeboid trophozoite is neurotropic, where it feeds on nerve tissue, by means of an amoebostome, resulting in significant necrosis and bleeding; causing acute meningoencephalitis.*

Subarachnoid space	*Inflammatory exudate of neutrophils and monocytes is seen.*
Grey matter	*- **Hemorrhage** and **extension** of the inflammatory exudates.* *- Rounded **amoebae** and **necrosis** of the tissues are also seen.*
White matter	*Demyelination due to the production of **phospholytic enzyme** or enzyme-like substance by the growing amoebae*



- **Clinical picture:**
  - *The course of PAM is dramatic and death usually occur after **3-6 days**.*

Prodromal symptoms (Stage I)	*- Severe **frontal headache**, fever, blocked nose.* *- Then **nausea** and vomiting.*
Rapidly developing Signs of meningeal irritation (Stage II)	*- Stiffness of neck (**Kering's sign**).* *- Fever, photophobia, seizures, altered mental status.* 
Last stage	*The patient becomes **irritable** then lapse in **coma** before **dying**.*

- **Diagnosis:**

Clinical	*History of swimming in lakes, few days before the disease.*	
Laboratory	*CSF examination*	*- Amoeba (trophozoite) forms* *- CSF pressure is raised – Purulent* *- CSF protein is above 1gm/L* *- Raised cell count, mainly PMNCs* 
	Culture of C.S.F. on non-nutrient agar (with E. coli)	
	Intracerebral inoculation of mice	
	Molecular diagnosis	

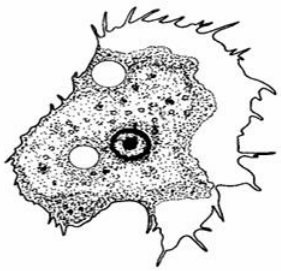
- **TTT & Prevention:**

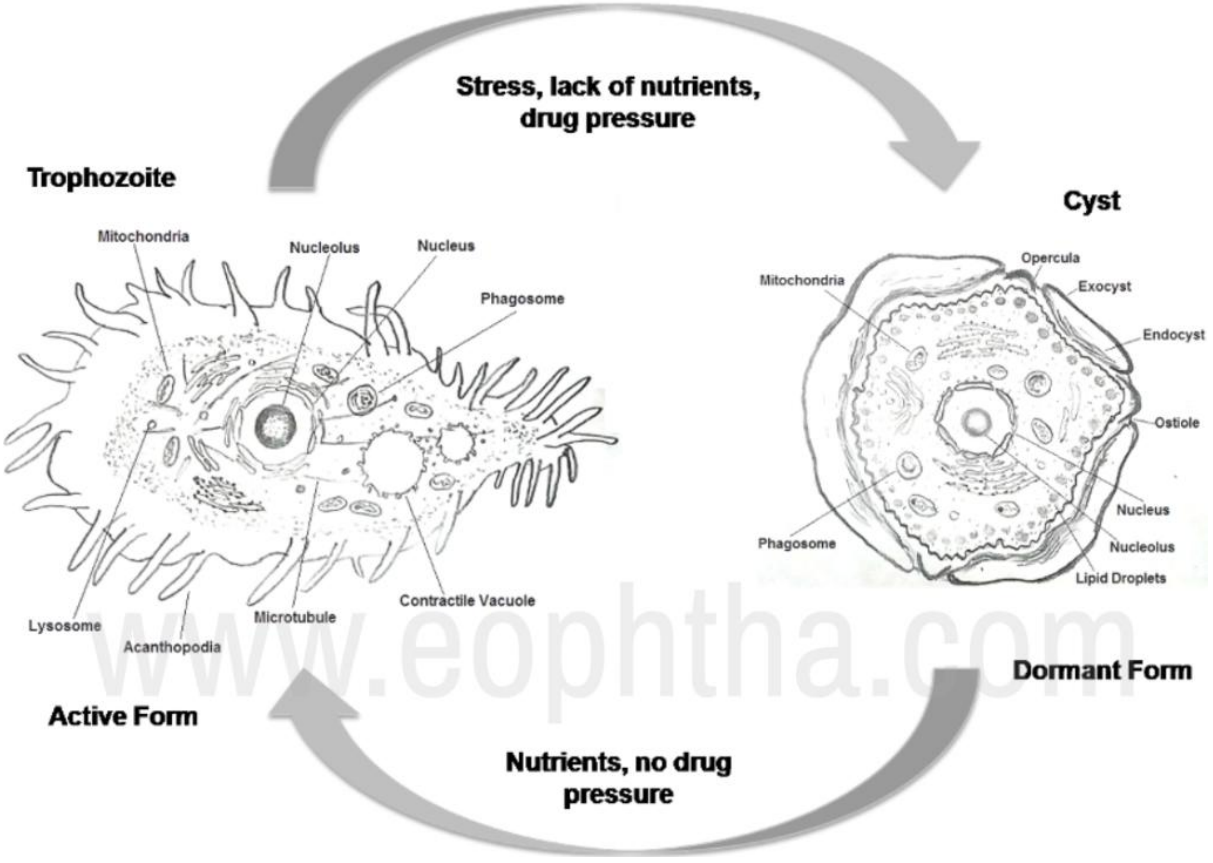
TTT	*- Hospitalization - I.V. Amphotericin-B, Fluconazole and Rifampicin.*
Prevention	*- Public education.* *- Adequate **chlorination** of swimming pools and water supplies*

b) Acanthamoeba castellani

- *Free-living trophozoite and cyst stages may exist in environment and in tissues.*
- *Present in soil, dust, stagnant water and contact lens fluid.*
- *In man, it affects CNS, eye, skin and lungs.*

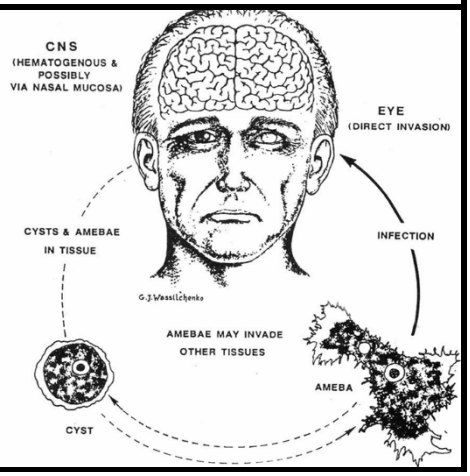
- *Morphological stages:*

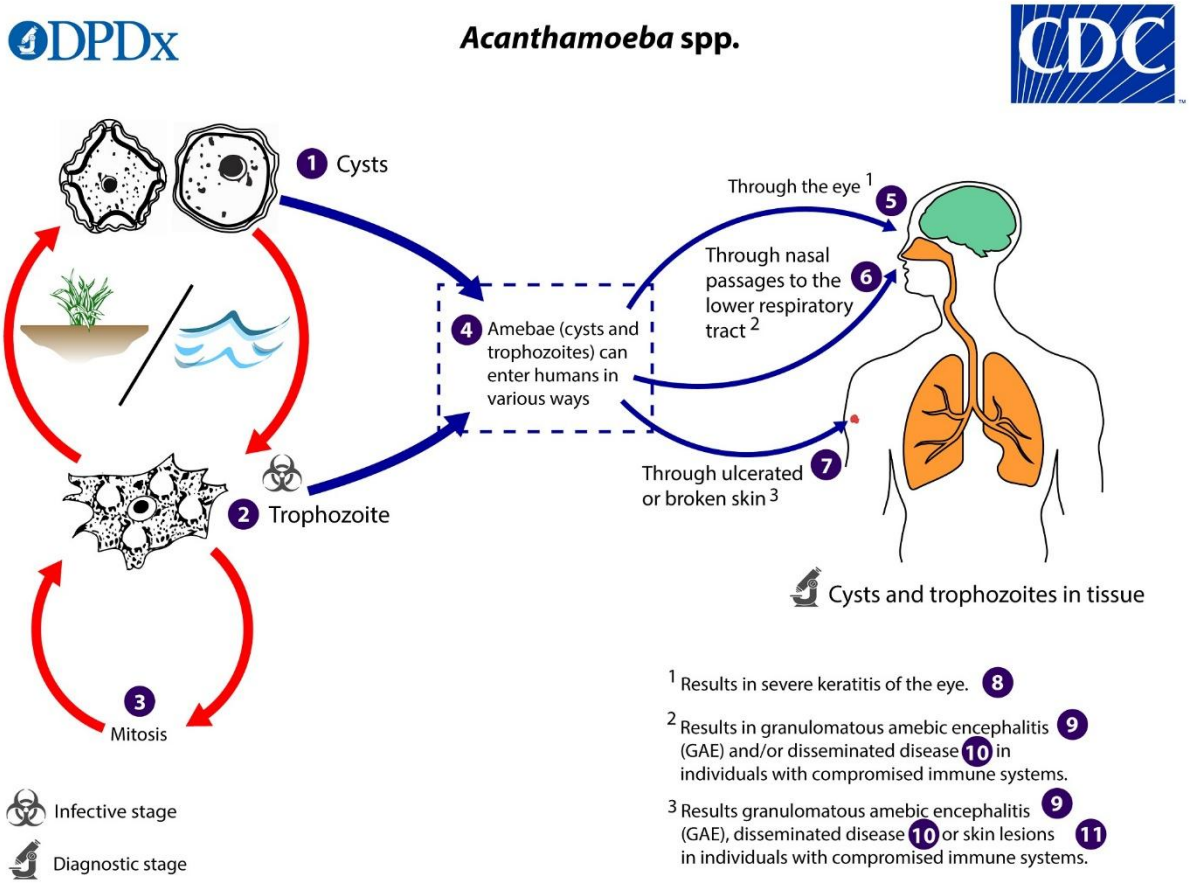
Trophozoite	*- Amoeboid* *- Cytoplasm is well differentiated* *- Pseudopodia are multiple and spiky (Acanthopodia).* *- 20-40 µm.* 
Cyst	*- Double wall* *- Rounded* *- 20 µm.*



- *Life-cycle:*

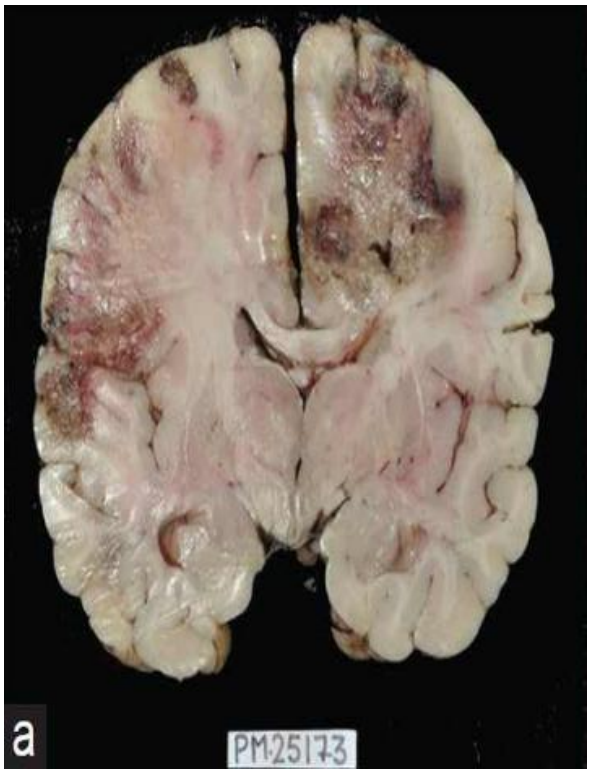
Habitat	*- Free living in soil, stagnant water and dust.* *- Infect Human host (Brain, eye, skin).*
Infective stage	*Trophozoite & Cyst*
Source of infection	*Dust, stagnant water and contact lens fluid*
Mode of infection	*- Through skin and mucosal* ***ulcers****.* *- **Inhalation** into the lungs.* *- Through cornea (contaminated contact lenses).*

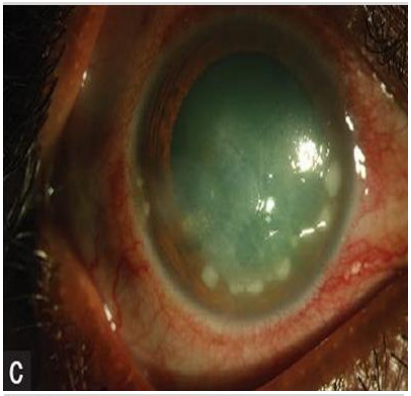




- **Pathology & Clinical picture:**

Granulomatous amoebic meningoencephalitis	- **Hematogenous** spread from the lungs or skin abrasions → focal granulomas as tumors (**space occupying lesions**). - Infected tissues contain **trophozoites, cysts and multinucleated giant cells**. - The patient complains of headache, seizers, stiff neck, nausea and vomiting. - **Chronic course**, usually **immunocompromised patient** (opportunistic).
Eye (Amoebic keratitis)	- Infection occurs by **direct contact** of the cornea with contaminated water or contact lens. - The disease is a **chronic progressive ulcerative keratitis**, characterized by severe **unilateral ocular pain**, **photophobia**, **annular corneal infiltration**, **congested conjunctiva** and **loss of vision** or even eye perforation may occur.
Chronic granulomatous skin lesions	-





- *Diagnosis:*

CSF examination	*Identification of trophozoites and cysts in brain tissues or CSF*
Culture of CSF	*On non-nutrient agar seeded with Escherichia coli*
Amoebic keratitis	*Corneal scrapings or histologic sections for detection of the organism by direct microscopy or after staining and culture*
Brain CT scan	-

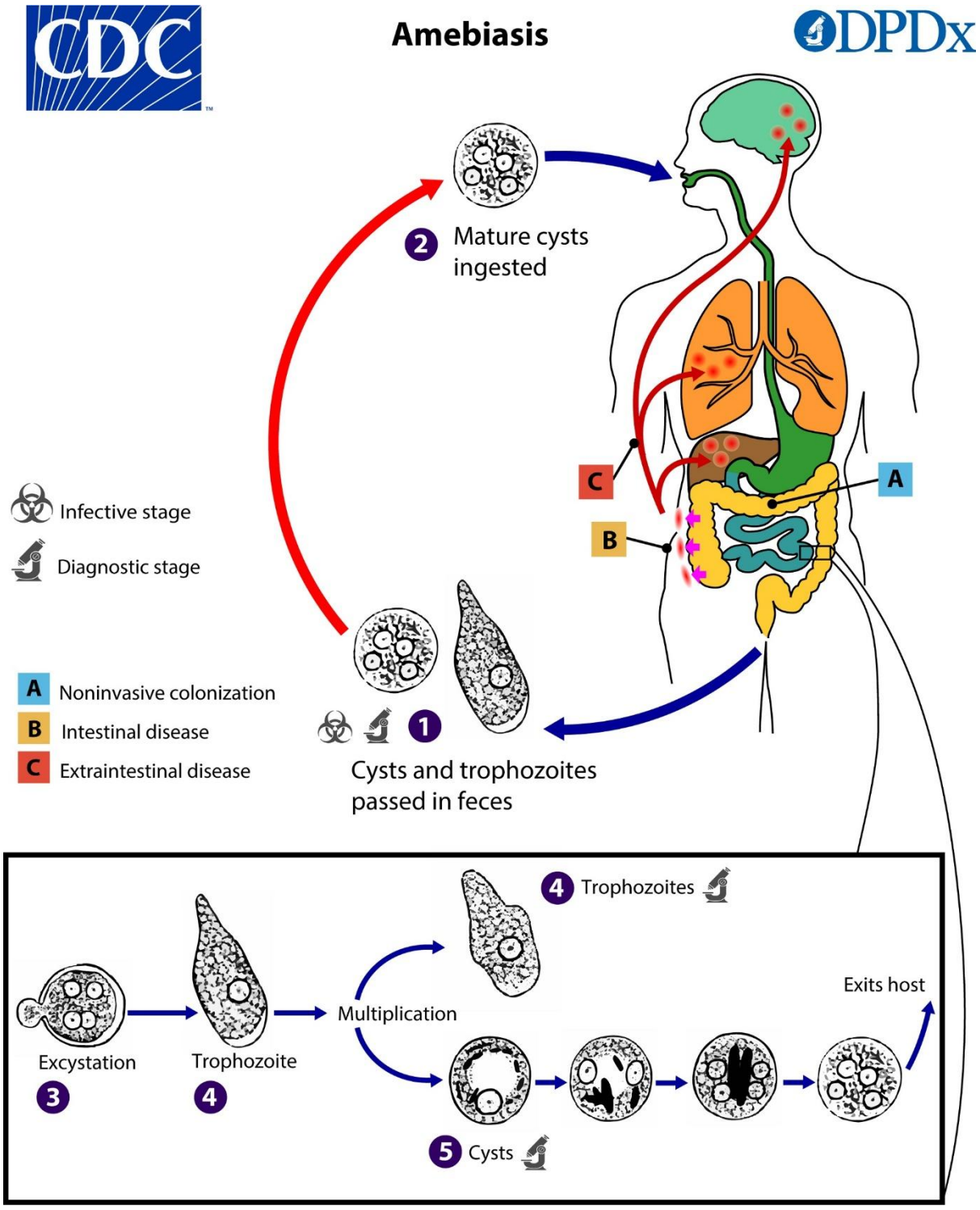
- *TTT & Prevention:*

TTT	*Sulfamethoxazole/Trimethoprim + Fluconazole and Rifampin.*
Prevention	*- Health education.* *- Avoid swimming in stagnant water.* *- The use of proper contact lens solution.*

c) Entamoeba Histolytica (Secondary Amoebic Cerebral Abscess)

- *Morphology:*

Trophozoite	*- 10-60 µm (average 20 µm).* *- **Irregular** outline with **pseudopodia*** *- It has centrally located fine **karyosome** and peripheral **chromatin dots***
Cyst	-



- **Pathogenesis:**
  - *Invasion of brain tissue by E. histolytica trophozoite (Never cyst detected in tissue).*
  - *E. histolytica trophozoite inhabit large intestine then invasion of submucosal blood vessels may lead to spread of amoebae causing extra intestinal amoebiasis e.g. liver, lung, brain.*

- **Mode of infection:**

Ingestion	Mature quadrinucleated E. histolytica cysts (infective stage) in contaminated food or drink.
Mechanical	By flies and cockroaches.
Auto-infection	fecal-oral route (hand-to-mouth contact).

- **Clinical Picture:**
  - *Hematogenous spread from amoebic liver abscess or pulmonary amoebiasis usually causes single brain abscess.*
  - *It results in secondary amoebic meningoencephalitis, with severe destruction of brain tissue.*
  - *It manifests as a brain tumor (Space-occupying lesion).*

- **Diagnosis:**

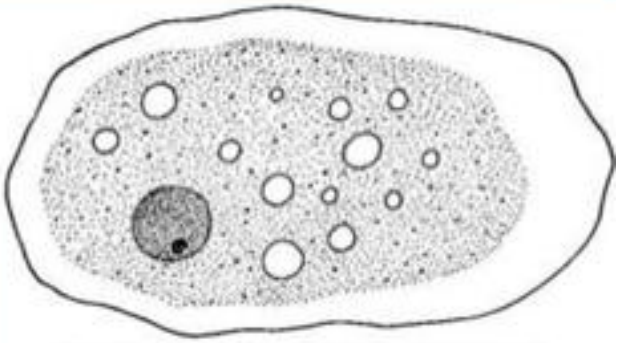
Microscopic examination	Detection of trophozoites in CSF samples.
Serodiagnosis	Circulating amoebic antigens or Abs detected by ELISA
Radiological	ultra-sonography (US), computed axial tomography (CT) or magnetic resonance imaging (MRI)

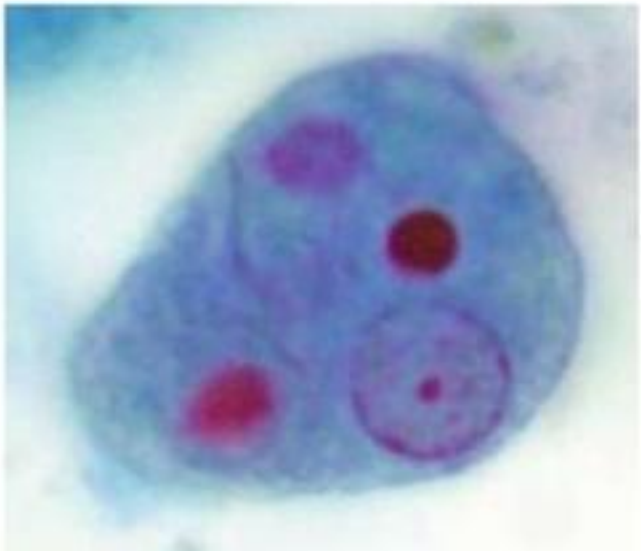
- *TTT & Prevention:*

TTT	*Tissue amebicides*	*They act against the tissue invasive form (trophozoite).* *- Metronidazole* *- Tinidazole*
Prevention	*- Health education.* *- Safe water supply.* *- Proper sewage disposal.* *- Treatment of cases.* *- Repeated examinations of food handlers.* *- Insect control*	

ENTAMOEBA

Entamoeba histolytica



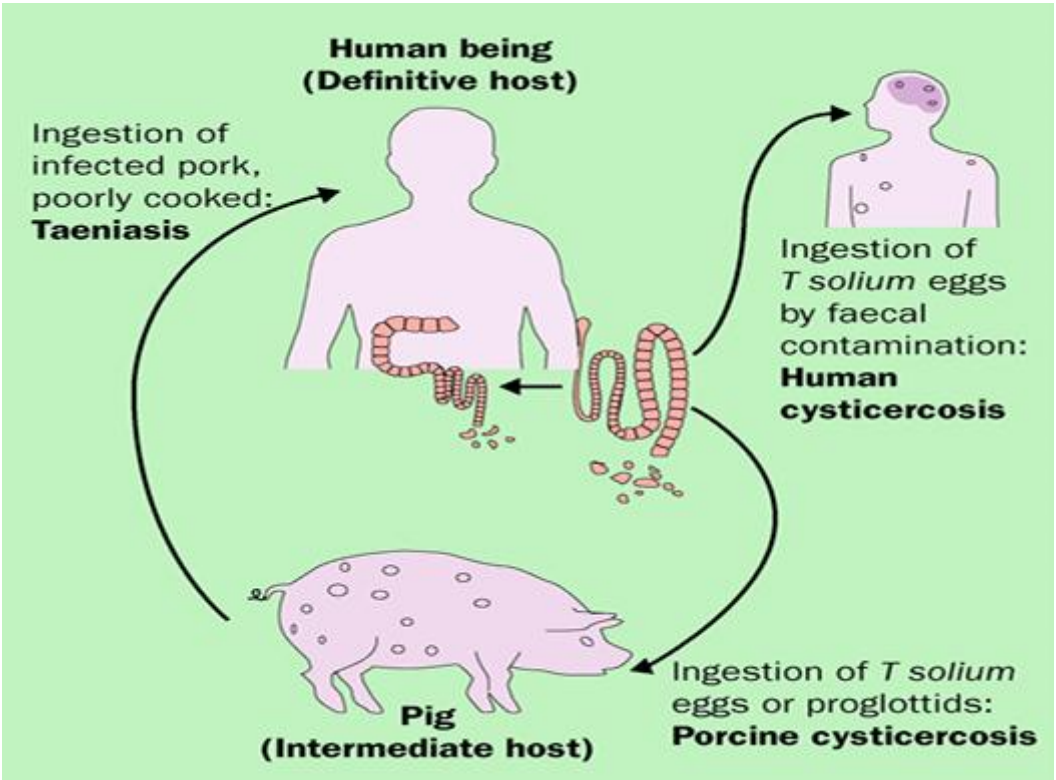


d) Taneia Solium (Neurocysticercosis)

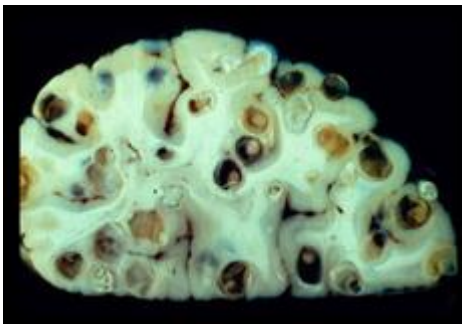
- **Pathogenesis:**
  - *Invasion of CNS by the larval stage of Taenia solium (Cysticercus cellulosae).*
  - *In this case, humans act as an intermediate host.*

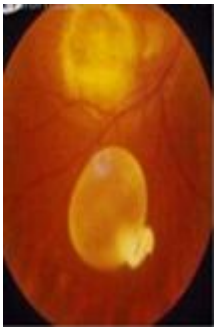
- **Mode of infection:**

Ingestion	*Food or water contaminated by the eggs (Infective stage) of Taenia solium.*	
Autoinfection	*External*	*Feco-oral route.*
	Internal	*Anti-peristaltic movements of intestine leads to regurgitation of the gravid segments from small intestine to the stomach*



- **Clinical Picture:**
  - The cyst produces local cellular reaction and infiltration with neutrophils, eosinophils and lymphocytes.
  - It acts as a brain tumor (Space-occupying lesion).
  - Cerebral cysticercosis results in severe **headache**, **convulsions** and **paralysis**.





- **Diagnosis:**

Serological tests	I.H.A.T and ELISA
Imaging	Ultrasound, C.T. and MRI.
X-ray	For **calcified cyst**.
Biopsy	Histopathological examination.

- **TTT & Prevention:**

TTT	Surgical removal when possible.
	Praziquantel combined with corticosteroids
	Albendazole is also effective.
Prevention	- Early treatment of persons harboring the adult worms to avoid autoinfection. - In infected patients no nauseating drugs should be given. - Avoid the use of human excreta as fertilizer. - Personal **cleanliness**, **fly control** and proper **washing** of raw vegetables.

- ***Quiz:***

A 63-year-old male with a history of kidney transplantation presented to the Emergency Department for altered mental status. Imaging of the head with CT showed an enhancing lesion suspicious for brain abscess. Biopsy of the lesion showed 20-40 µm amoeboid trophozoite with multiple spiky pseudopodia and 20 µm rounded cyst with double walls.

What is the most likely parasitic diagnosis?

1. Which parasite or parasites may have caused this condition?

a. Neurocysticercosis

b. African trypanosomiasis

c. primary amoebic meningoencephalitis

d. Granulomatous amoebic meningio-encephalitis

e. Secondary amoebic abscess

Answer: D

2. Which infection can be transmitted via swimming in contaminated pool?

a. primary amoebic meningoencephalitis

b. Granulomatous amoebic meningio-encephalitis

c. Onchocerciasis

d. Secondary amoebic meningoencephalitis

e. Neurocysticercosis

Answer: A

3. Patient developed cerebral space occupying lesion symptoms after ingesting nauseating drug, his stool examination showed Taenia egg. Suspected cerebral lesion is:

a. 2ry amoebic meningoencephalitis

b. Sleeping sickness

c. Neurocysticercosis

d. Onchocerciasis

Answer: C