Parasitic Infections Affecting CNS and Special senses

Dr Ayat Abdelaziz

Case Scenario

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?

Q: Which parasite or parasites may have caused this condition?

a. Neurocysticercosis

b. African trypanosomiasis

c. Trichomoniasis

d. Secondary amoebic abscess

e. Naegleriasis

➢Parasitic Infections Affecting CNS :

Free living amoeba:	• Primary Amoebic Meningoencephalitis • Granulomatous Amoebic Meningoencephalitis
***Trypanosoma bruci* :**	• Sleeping Sickness
Entamoebae histolytica	• Secondary Amoebic Cerebral Abscess
Taenia solium:	• NeuroCysticercosis

➢ Parasitic Infections Affecting special sense :

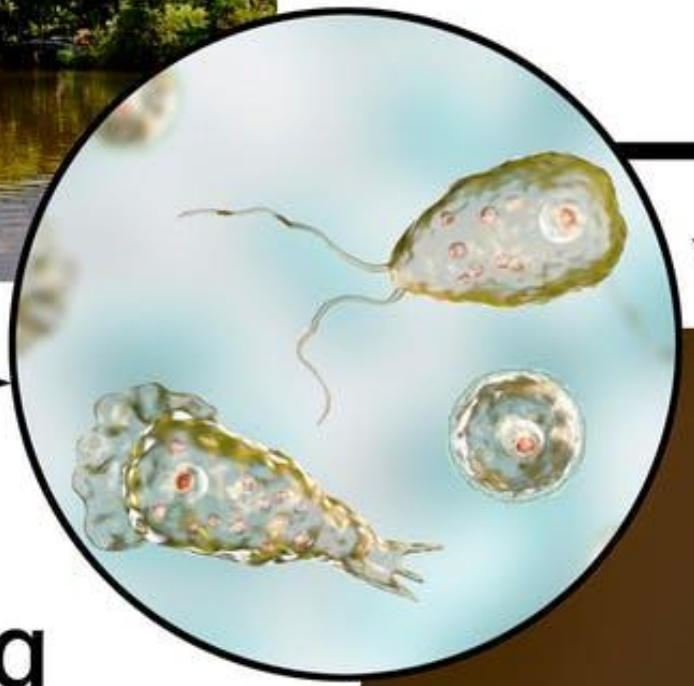
***Acanthamoeba castellani*:**	• Keratitis & corneal ulcers
Taenia solium:	• NeuroCysticercosis
Onchocerca volvulus	• Onchocerciasis

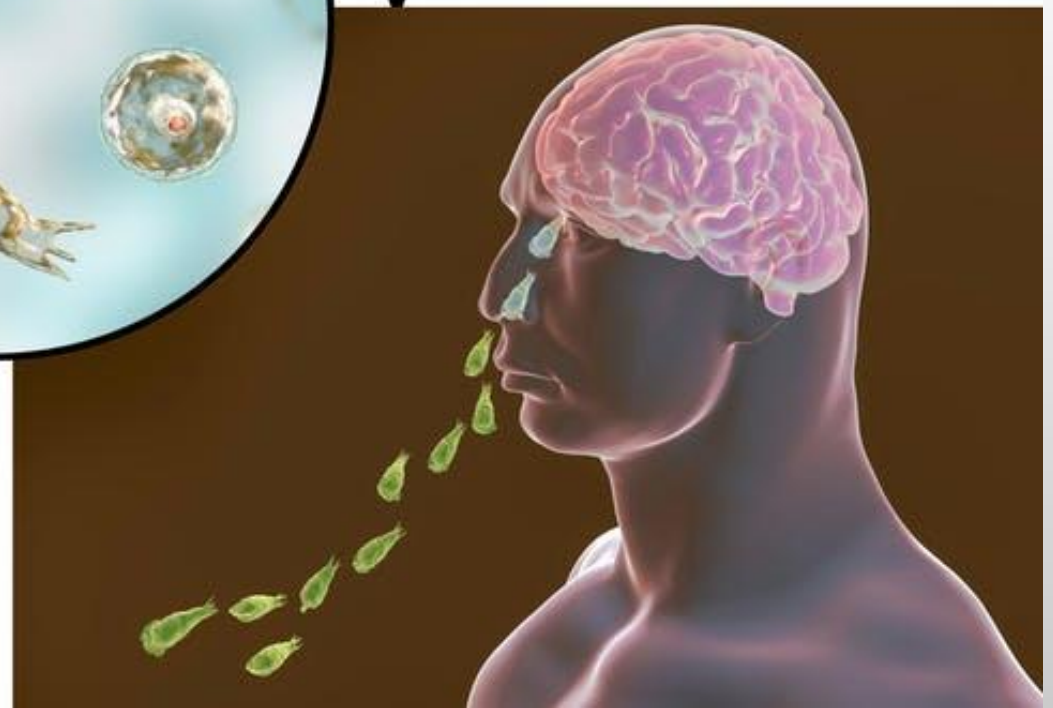
1) Pathogenic Free-Living Amoebae

1) *Naegleria fowleri*

2) *Acanthamoeba castellani*

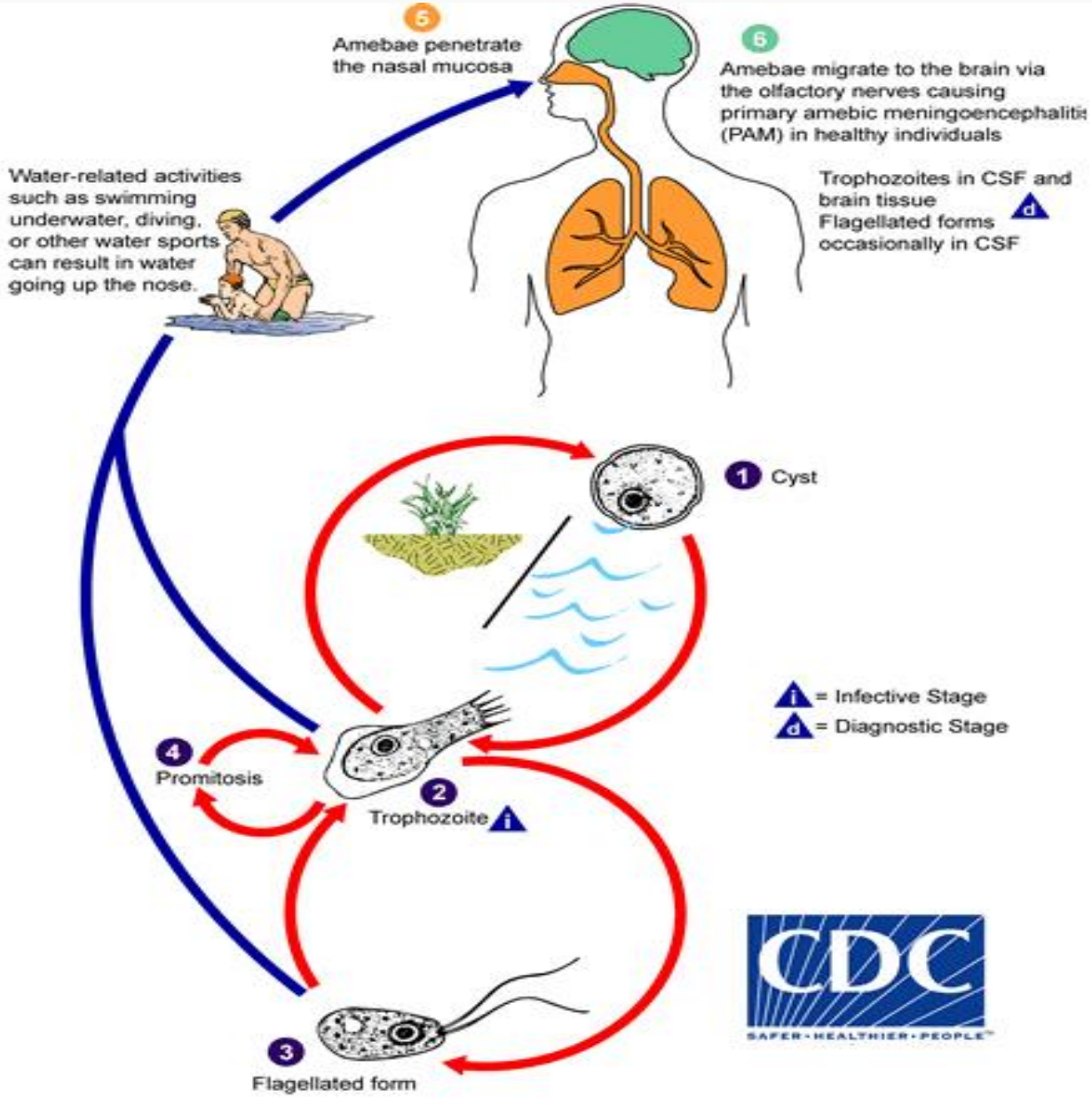
Naegleriasis

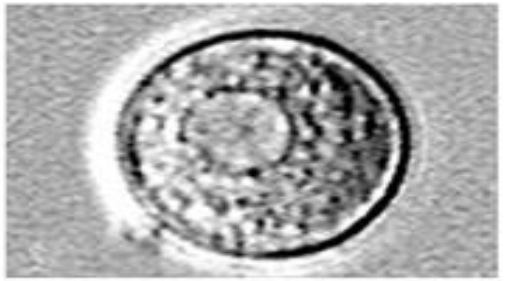




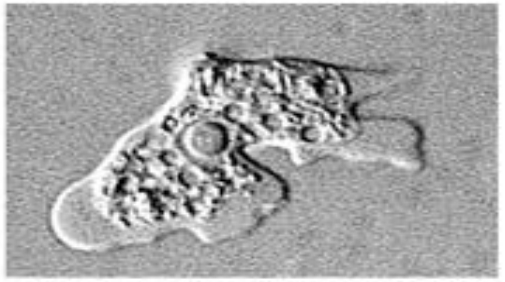
Brain-Eating Amoeba Infection

Naegleria fowleri Life cycle:

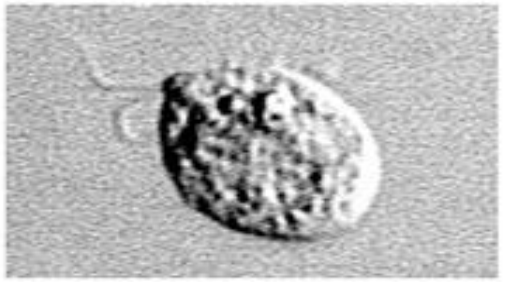




Cyst stage



Trophozoite stage



Flagellated stage

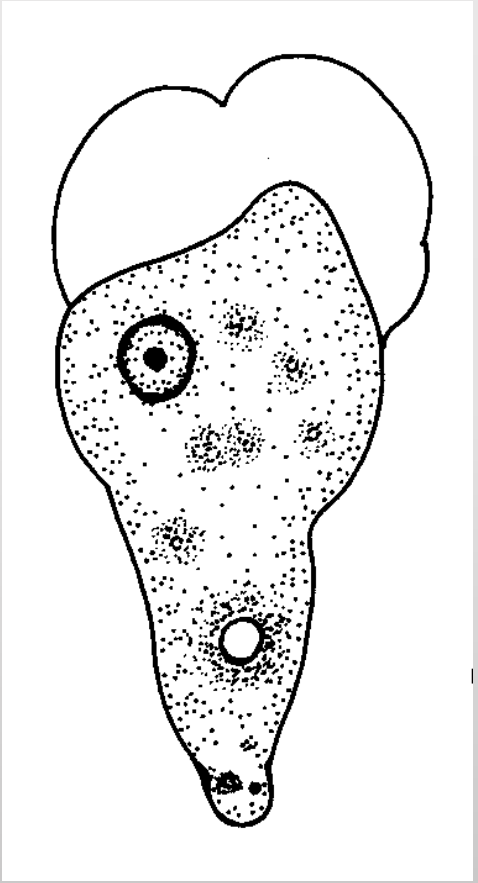
Naegleria fowleri Life cycle:

- Habitat:
- Free living in soil and fresh- stagnant water
- In man it attack CNS
- Infective stage: Amoeboid trophozoite
- Mode of infection: through Nasal route.

1- Swimming in /or sniffing contaminated water.

2- Inhalation of contaminated air.

➢*Naegleria fowleri* morphological stage:



Amoeboid Trophozoite:

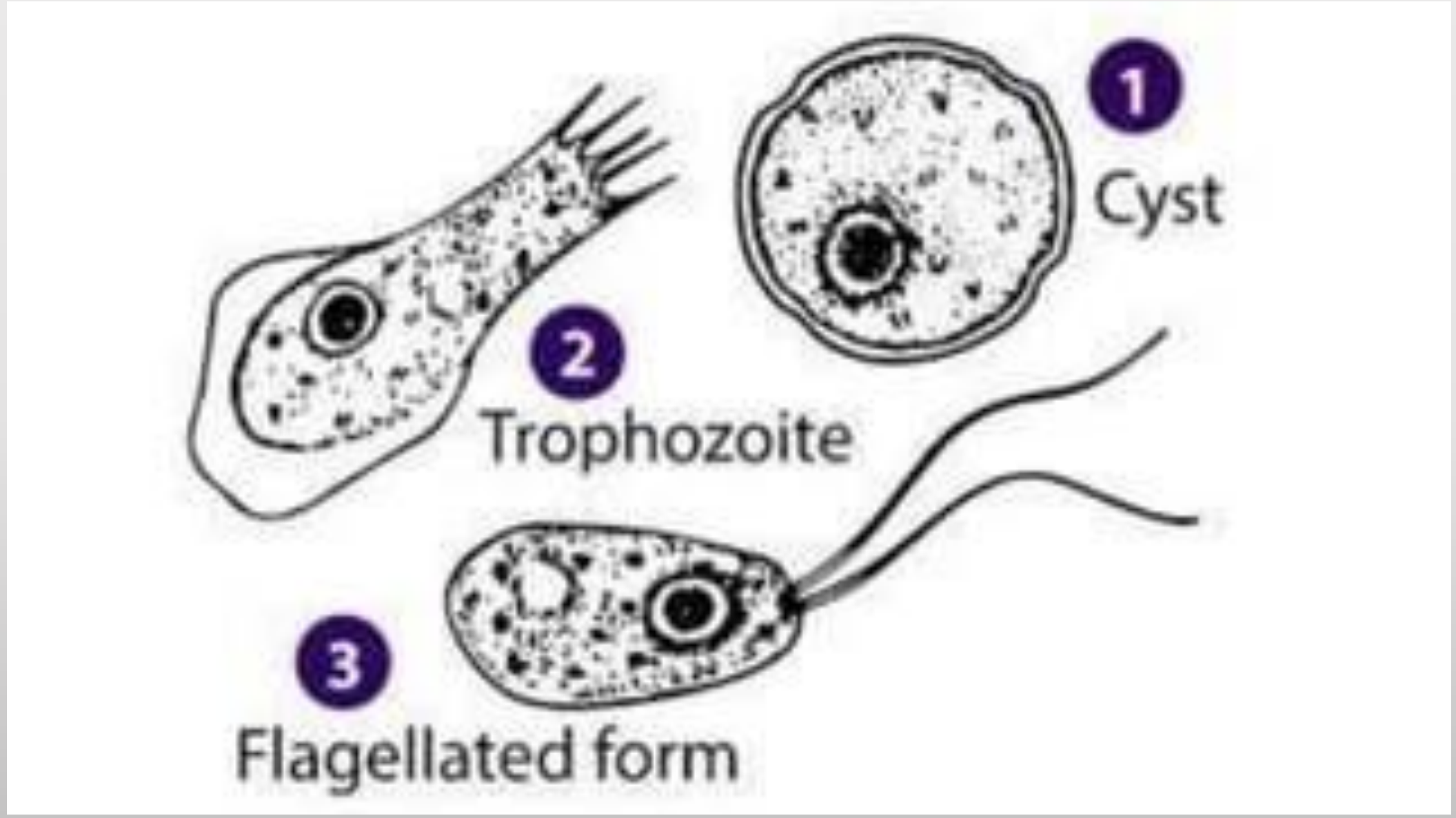
- (in tissues and CSF)
- Elongate with broad anterior end, tapering posterior end.
- with single pseudopodium.
- 15µ

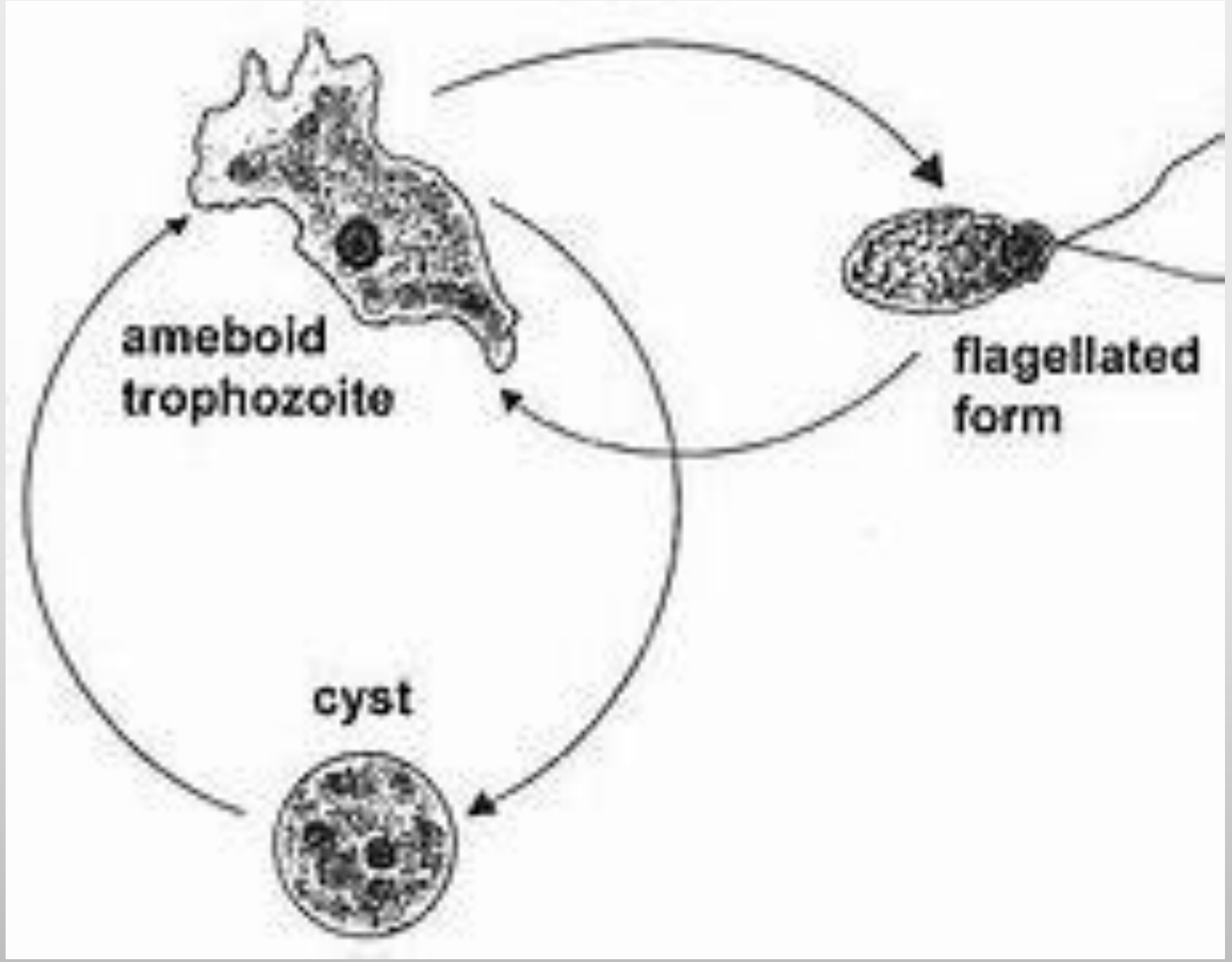
Flagellate Trophozoite

- (when contact with water)
- Pear shaped
- two long equal flagellae

Cyst:

- Occurs in soil (never in tissues):
- Rounded
- 10 µm.


1
Cyst
2
Trophozoite
3
Flagellated form


amebold
trophozoite
flagellated
form
cyst

Pathogenesis of *Naegleria fowleri*

➢ Primary Amoebic Meningoencephalitis

- Amoeboid trophozoite is **neurotropic**, where it feeds on nerve tissue, by means of an **amoebostome**, resulting in significant necrosis and bleeding; causing **acute meningoencephalitis**.
- In the subarachnoid space, an inflammatory exudate of neutrophils and monocytes is seen.

Pathogenesis of *Naegleria fowleri*

➢ Primary Amoebic Meningoencephalitis

- In **the grey matter**, there is haemorrhage and extension of the inflammatory exudates, rounded amoebae and necrosis of the tissues are also seen.
- In **the white matter** of the brain and spinal cord, there is **demyelination** due to the production of **phospholytic enzyme** or enzyme-like substance by the growing amoebae

Clinical picture of *Naegleria fowleri*

➢ Acute meningoencephalitis:

- 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.

2- **Rapidly developing Signs of meningeal irritation (Stage II)**

- as stiffness of neck (Kering's sign).
- Fever, photophobia, seizures, altered mental status.

3- The patient become **irritable then lapse in coma** before dying.

Diagnosis of *Naegleria fowleri*

1-Clinical diagnosis: **History of swimming in lakes, few days before the disease.**

2- Laboratory diagnosis:

a- C.S.F. examination by lumbar puncture →

-- Amoeba (trophozoite) forms

-- CSF pressure is raised – Purulent. CSF protein is above 1gm/L.

-- marked raised cell count, mainly polymorph-nuclear cells

b- Culture of C.S.F. on non nutrient agar (with E. coli)

c- Intracerebral inoculation of mice

d- Molecular diagnosis

Treatment of *Naegleria fowleri*:

❑**Treatment:**

1- Hospitalization

2- I.V. Amphotericin-B, Fluconazole and Rifampicin.

❑**Prevention and control:**

-Public education.

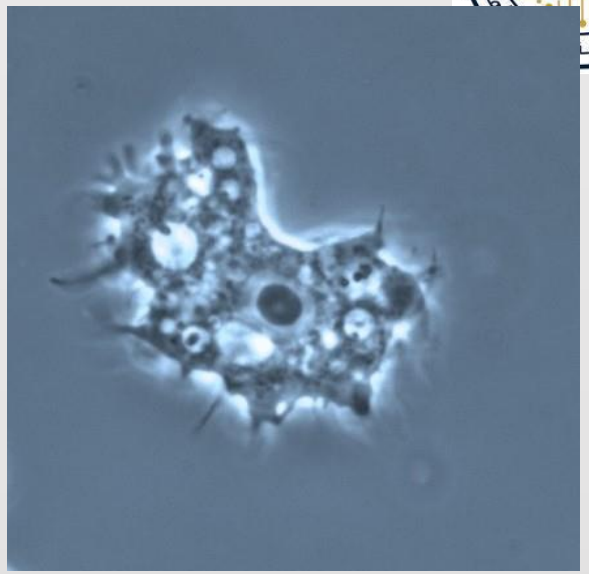
-Adequate chlorination of swimming pools and water supplies.

Pathogenic Free Living Amoebae

1) *Naegleria fowleri*

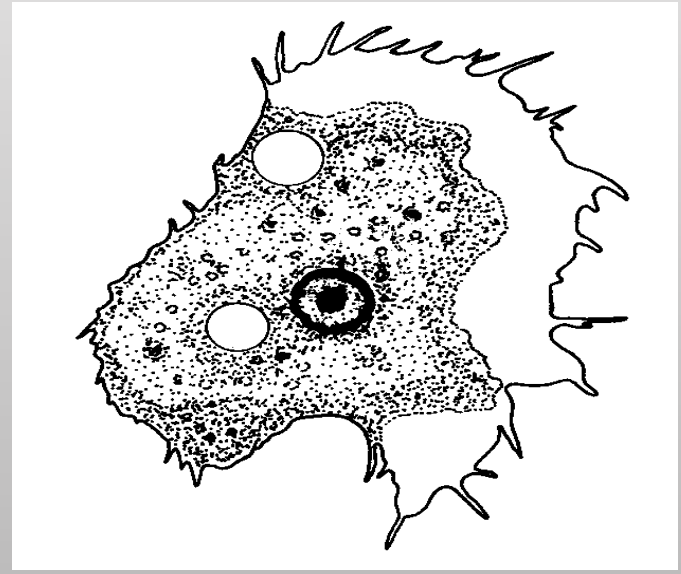
2) *Acanthamoeba castellani*

Acanthamoeba castellani



<u>Free-living trophozoite and cyst stages may exist in environment and in tissues</u>

- **Present in soil, dust, stagnant water and contact lens fluid.**
- **<u>in man it affect CNS, eye, skin and lungs.</u>**



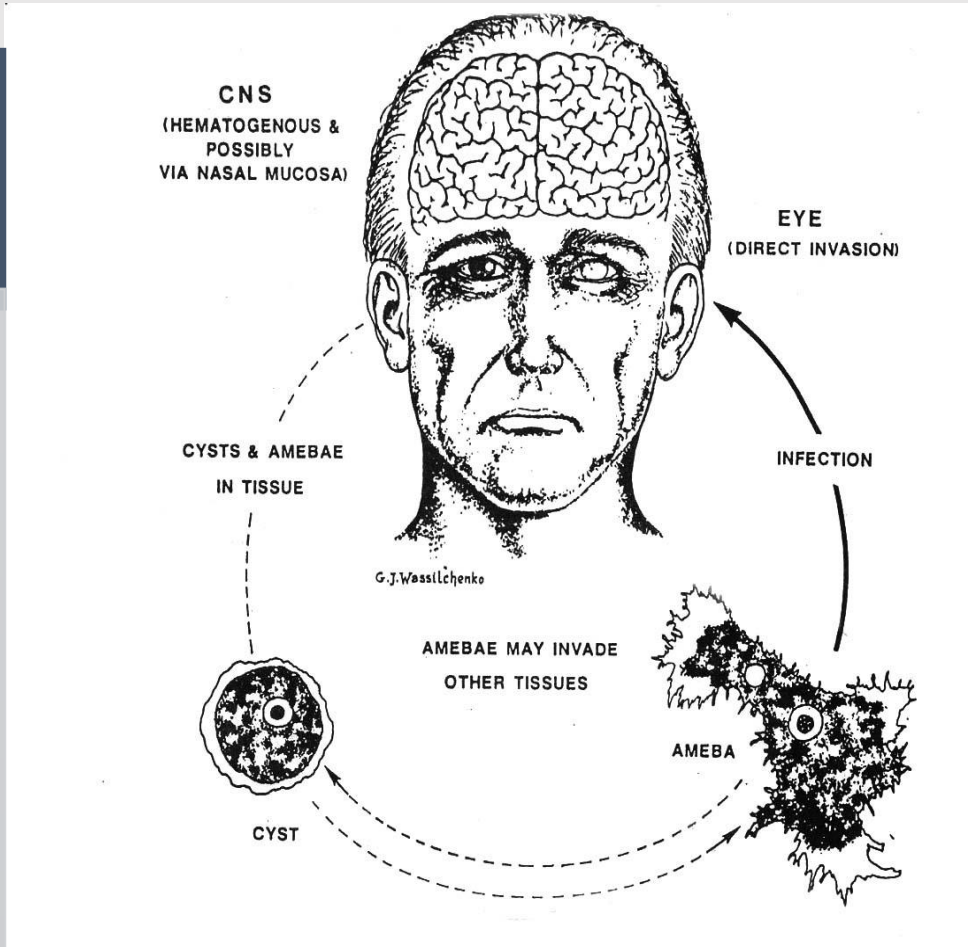
Acanthamoeba castellani Morphology

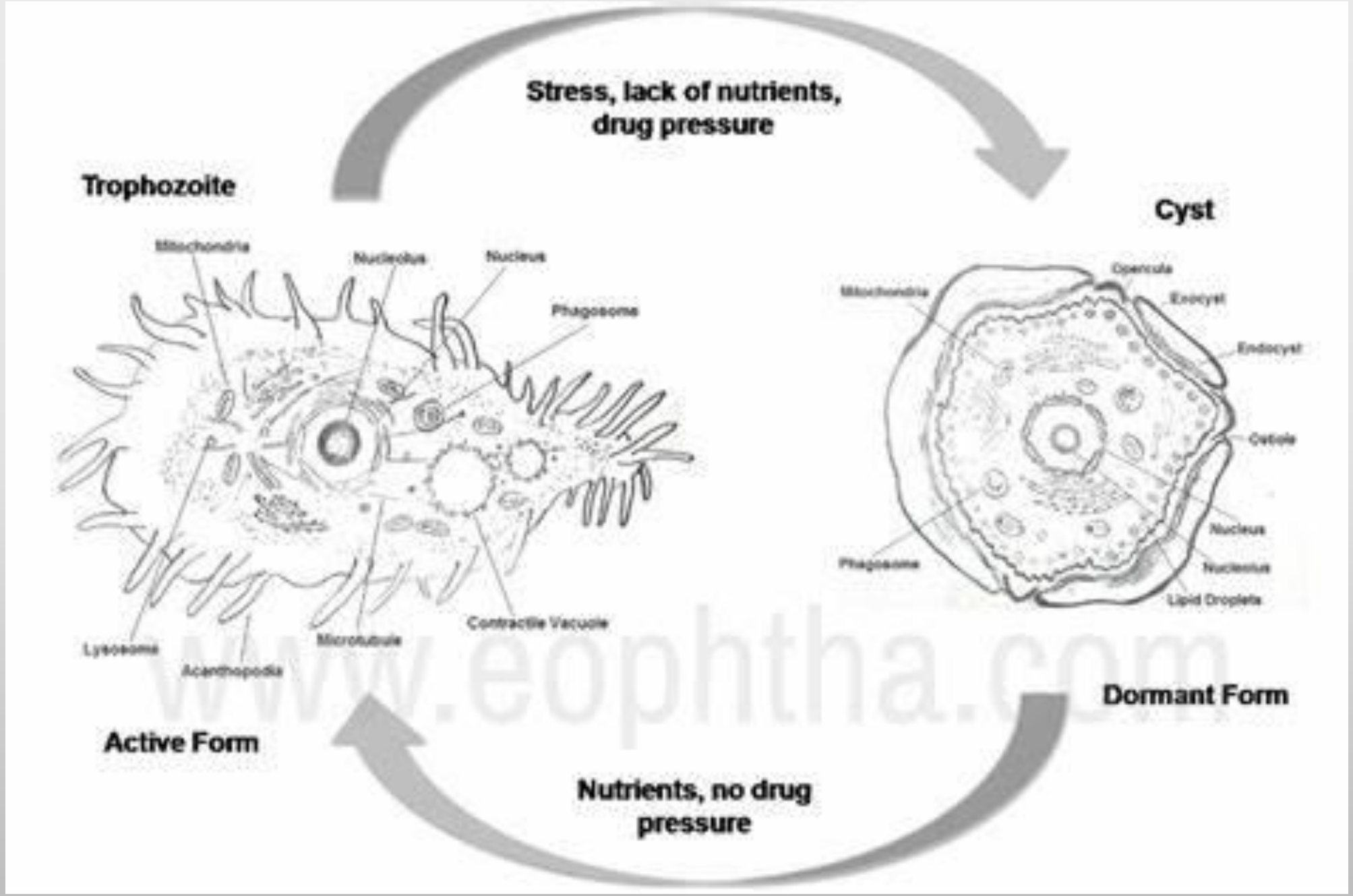
Trophozoite:

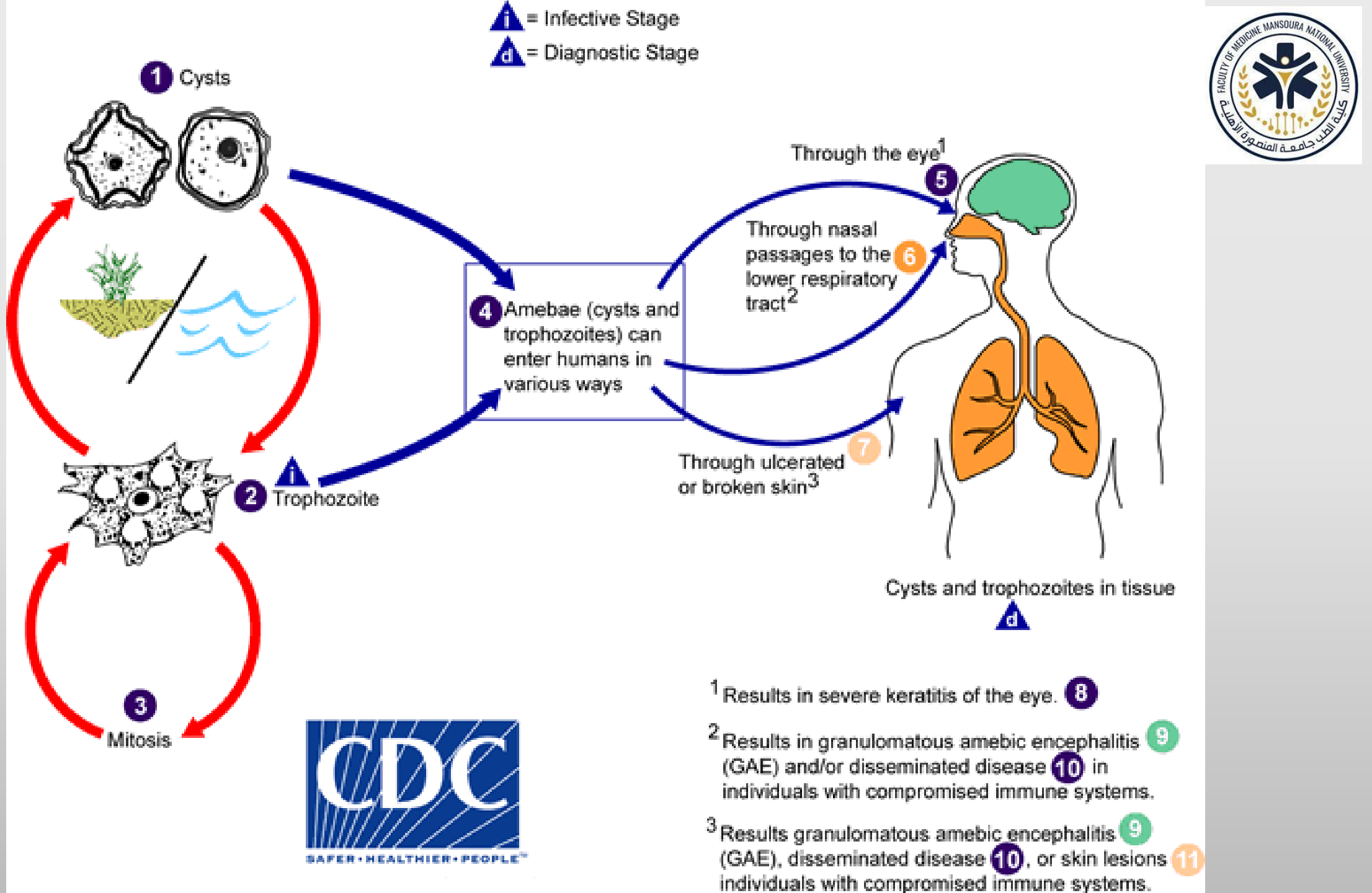
- Amoeboid
- Cytoplasm is well differentiated
- Pseudopodia are multiple and spiky (Acanthopodia).
- 20-40 µm in size

Cyst:

- Double wall
- Rounded
- 20 µm.






i = Infective Stage
d = Diagnostic Stage
1 Cysts
2 Trophozoite
3 Mitosis
4 Amebae (cysts and trophozoites) can enter humans in various ways
Through the eye[1]
5
Through nasal passages to the lower respiratory tract[2]
6
Through ulcerated or broken skin[3]
7
Cysts and trophozoites in tissue
d
CDC
SAFER • HEALTHIER • PEOPLE™
[1] Results in severe keratitis of the eye. 8
[2] Results in granulomatous amebic encephalitis (GAE) and/or disseminated disease 10 in individuals with compromised immune systems. 9
[3] Results granulomatous amebic encephalitis (GAE), disseminated disease 10, or skin lesions 11 individuals with compromised immune systems. 9

Life Cycle of *Acanthamoeba castellani*

- **Habitat: free living in soil, stagnant water and dust.**

Or infect Human host (Brain, eye, skin)

- **Infective stage: Trophozoite & Cyst**
- **Source of infection: dust, stagnant water and contact lens fluid.**
- **Portal of entry (Mode of infection):**

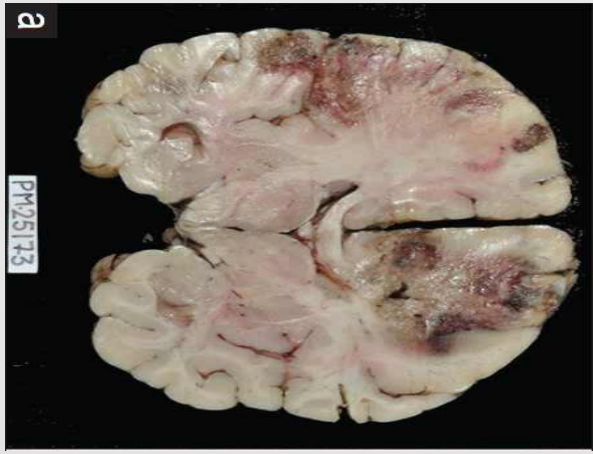
  -Through skin and mucosal ulcers,

  -Inhalation into the lungs,

  -Through cornea (contaminated contact lenses)

Pathology & Clinical picture of *Acanthamoeba castellani*

(1)CNS: Granulomatous amoebic meningoencephalitis



- Haematogenous spread from the lungs or skin abrasions → focal granulomas as tumours (**space occupying lesions**).

- Infected tissues contain trophozoites, cysts and multinucleated giant cells.

- **The patient complains of headache, seizers, stiff neck, nausea and vomiting.**

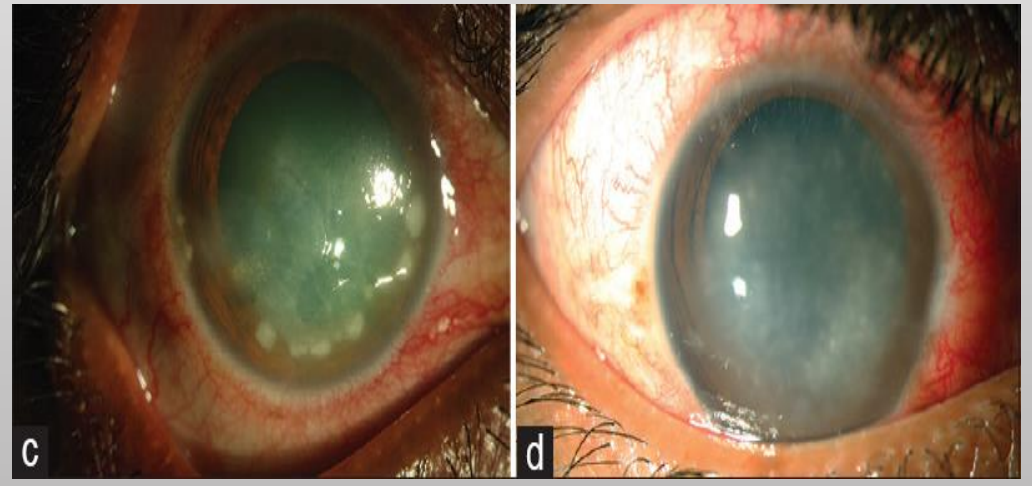
- Chronic course. Usually immunocompromised patient (opportunistic).

Clinical picture of Primary Amoebic Meningoencephalitis:

2) 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.

3) Chronic granulomatous skin lesions.



Diagnosis of *Acanthamoeba castellani*

a-CSF examination: Identification of trophozoites and cysts in brain tissues or CSF.

b- ***Culture of CSF*** on non-nutrient agar seeded with Escherichia coli.

c. ***CT scan*** of brain.

2. Amoebic keratitis: Corneal scrapings or histologic sections for detection of the organism by direct microscopy or after staining and culture

Treatment of *Acanthamoeba castellani:*

➢ **Treatment:**

CNS: Sulfamethoxazole/Trimethoprim+ Fluconazole and Rifampin.

➢ **Prevention and control:**

1) Health education.

2) Avoid swimming in stagnant water.

3) The use of proper contact lens solution.

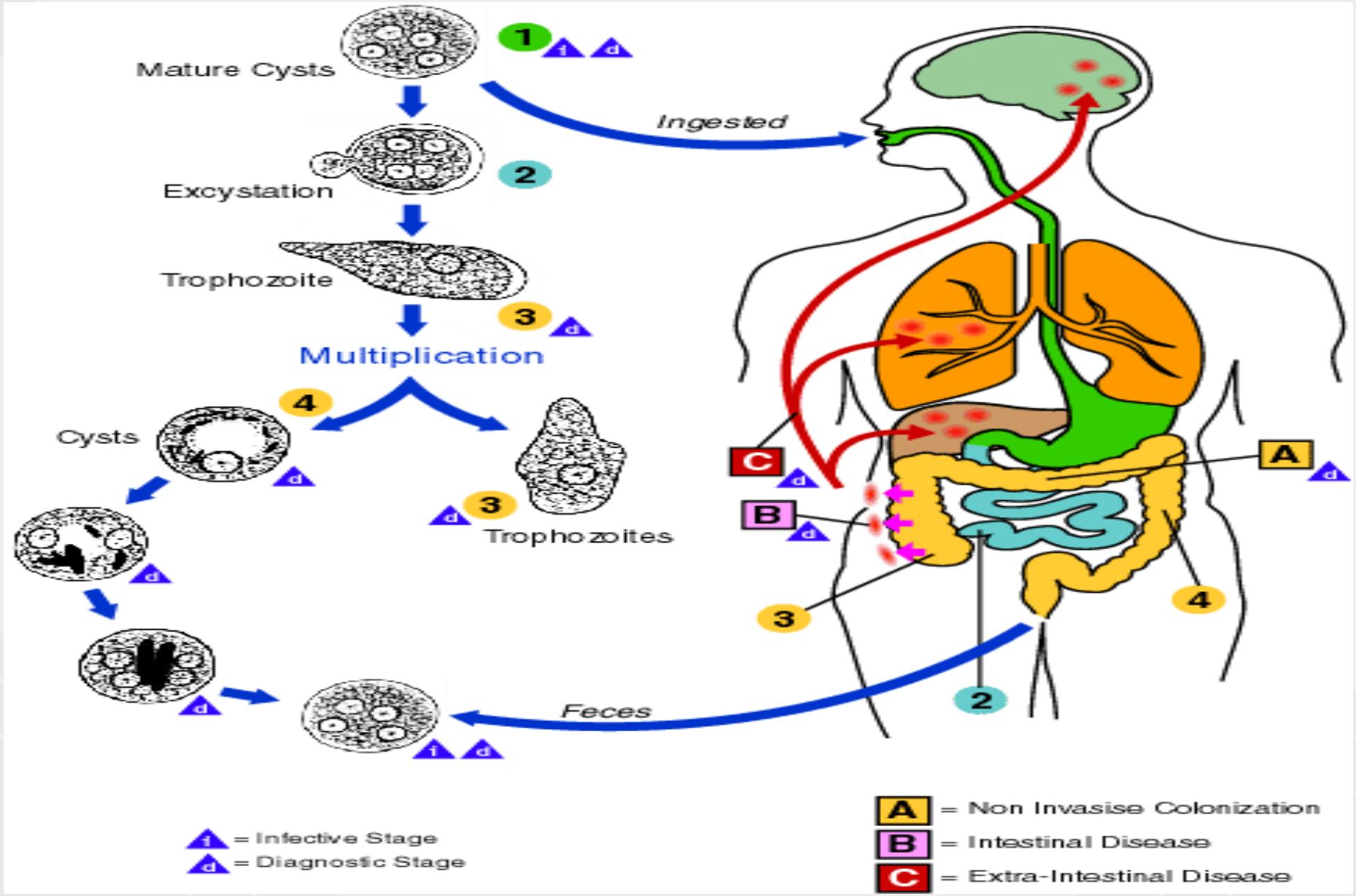
4) Secondary Amoebic Cerebral Abscess

- Invasion of brain tissue by *Entamoeba 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 of mature quadrinucleated *E. histolytica* cysts (**infective stage**), in contaminated food or drink. Mechanical transmission by flies and cockroaches. Autoinfection: feco-oral route (hand to mouth contact)

Entamoeba histolytica Life cycle:

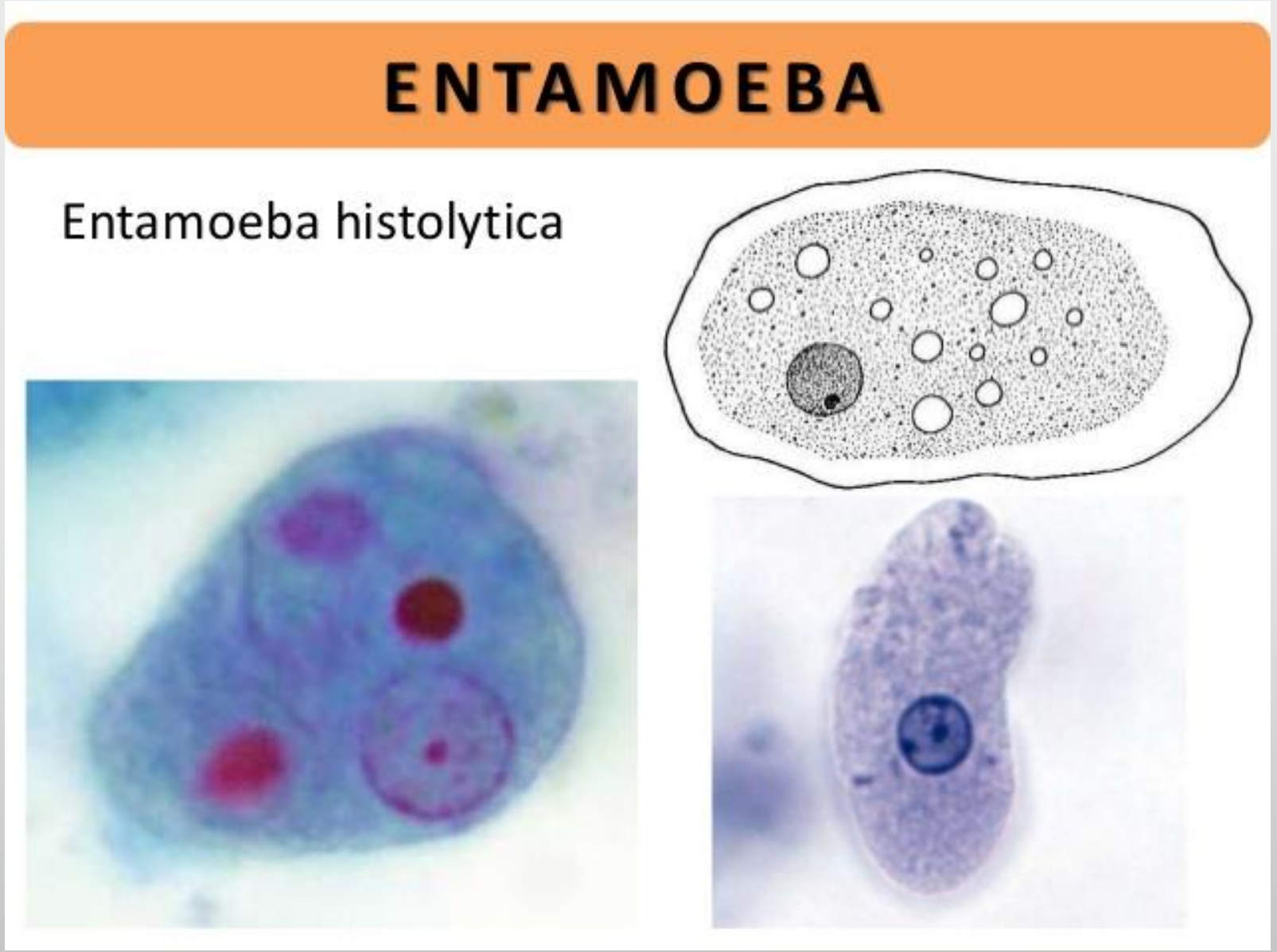


Trophozoite:

-Size: 10-60 µ (average 20 µ).

- Shape: Irregular outline with pseudopodia

- Nucleus: It has centrally located fine karyosome and peripheral chromatin dots



***Entamoeba* trophozoite**

Clinical picture and Diagnosis:

Haematogenous 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:

1. Microscopic examination For detection of trophozoites in CSF samples.

2. Serodiagnosis: circulating amoebic antigens or antibodies can detected by ELISA.

3. Radiological examination: by ultra-sonography (US), computed axial tomography (CT) or magnetic resonance imaging (MRI)

Treatment:

➢Tissue amoebicides: They act against the tissue invasive form (trophozoite).

- Metronidazole.

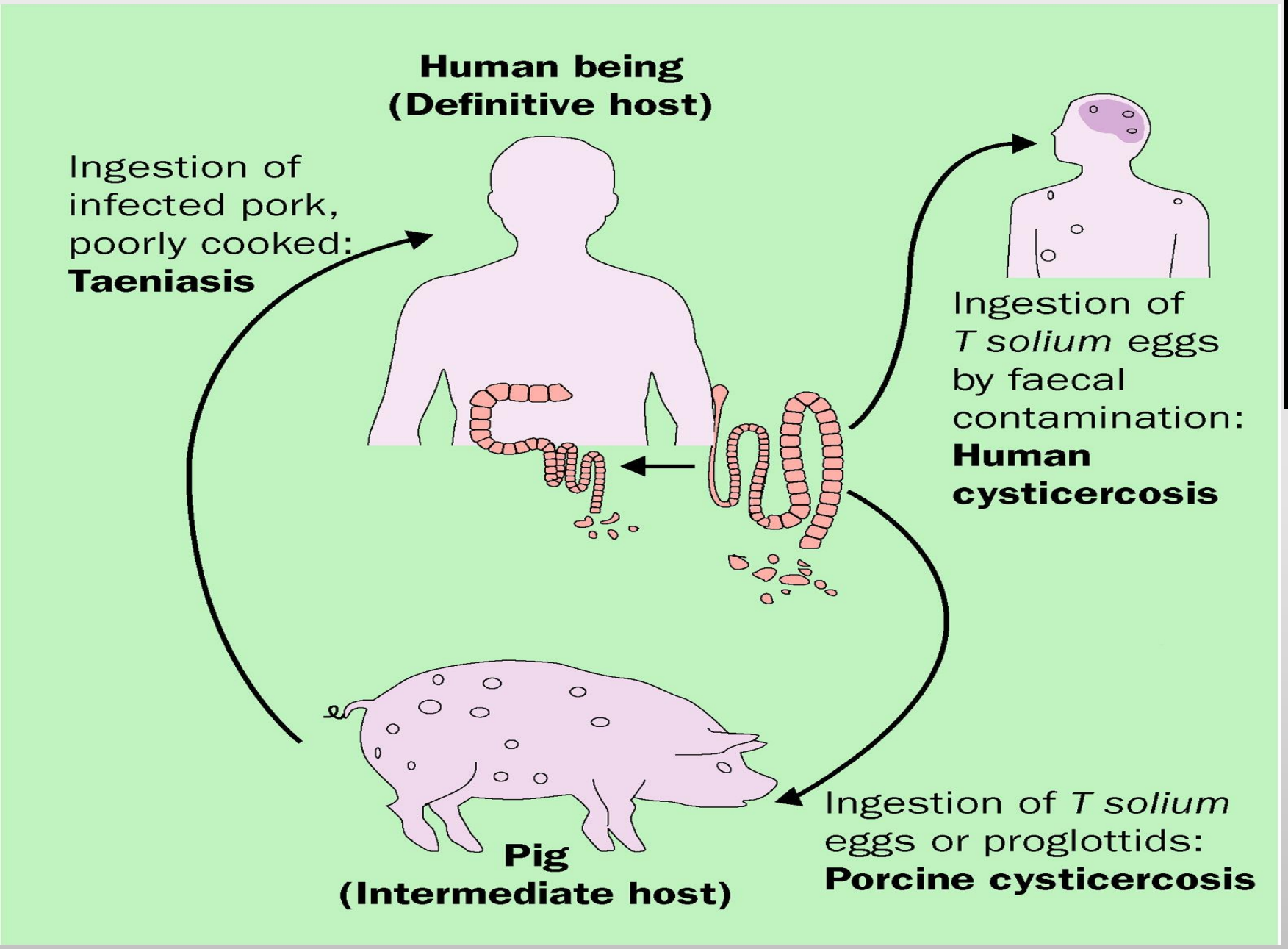
-Tinidazole.

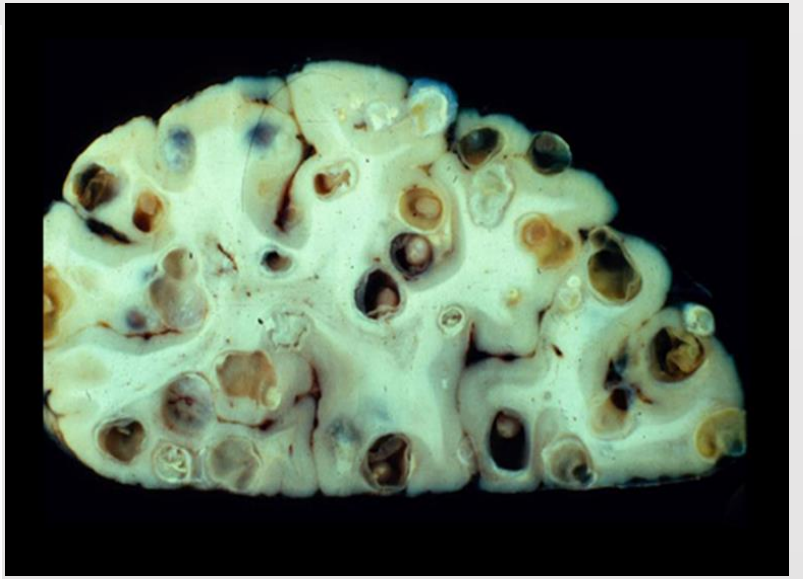
Prevention and control:

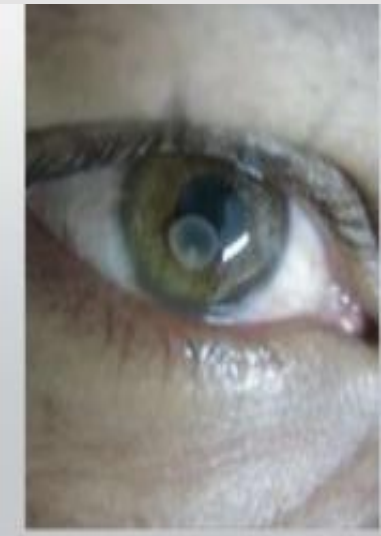
- Health education.
- Safe water supply.
- Proper sewage disposal.
- Treatment of cases.
- Repeated examinations of food handlers.
- Insect control.

4) Neurocysticercosis

- Invasion of CNS by the larval stage of *Taenia solium* (Cysticercus cellulosa).
- In this case man acts as an intermediate host.
- Mode of infection:
- Ingestion of food or water contaminated by the **eggs (Infective stage) of *Taenia solium***.
- Autoinfection either:
- a- External autoinfection: Feco-oral.
- b- Internal autoinfection: antiperistaltic movements of intestine leads to regurgitation of the gravid segments from small intestine to the stomach.


Human being
(Definitive host)
Ingestion of infected pork, poorly cooked:
Taeniasis
Ingestion of *T solium* eggs by faecal contamination:
Human cysticercosis
Ingestion of *T solium* eggs or proglottids:
Porcine cysticercosis
Pig
(Intermediate host)





Neurocysticercosis
Pathogenicity & 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

- 1- Serological tests may be helpful in diagnosis as I.H.A.T and ELISA.
- 2- Imaging: Ultrasound, C.T. and MRI.
- 3- X-ray for calcified cyst.
- 4- Biopsy for histopathological examination.

➢ Neurocysticercosis Treatment:

- Surgical removal when possible.
- Praziquantel combined with corticosteroids.
- Albendazole is also effective.

Prevention and control:

- 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.

Case Scenario

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?

Q: Which parasite or parasites may have caused this condition?

a. Neurocysticercosis

b. African trypanosomiasis

c. primary amoebic meningioencephalitis

d. Granulomatous amoebic meningio-encephalitis

e. Secondary amoebic abscess

Answer: d. Granulomatous amoebic meningio-encephalitis

MCQ1: Which infection can be transmitted via swimming in contaminated pool?

a) primary amoebic meningioencephalitis

b) Granulomatous amoebic meningio-encephalitis

c) Onchocerciasis

a) Secondary amoebic meningioencephalitis

d) Neurocysticercosis

Answer: a) primary amoebic meningio-encephalitis

MCQ 2: Patient developed cerebral space occupying lesion symptoms after ingesting nauseating drug, his stool examination showed Taenia egg.

What is the suspected cerebral lesion?

a. Sleeping sickness

b. Primary amoebic meningio-encephalitis

c. Neurocysticercosis

d. Onchocerciasis

e. Granulomatous amoebic meningio-encephalitis

Answer: c. Neurocysticercosis

Discussion & Feedback

10 minutes