Naegleria fowleri

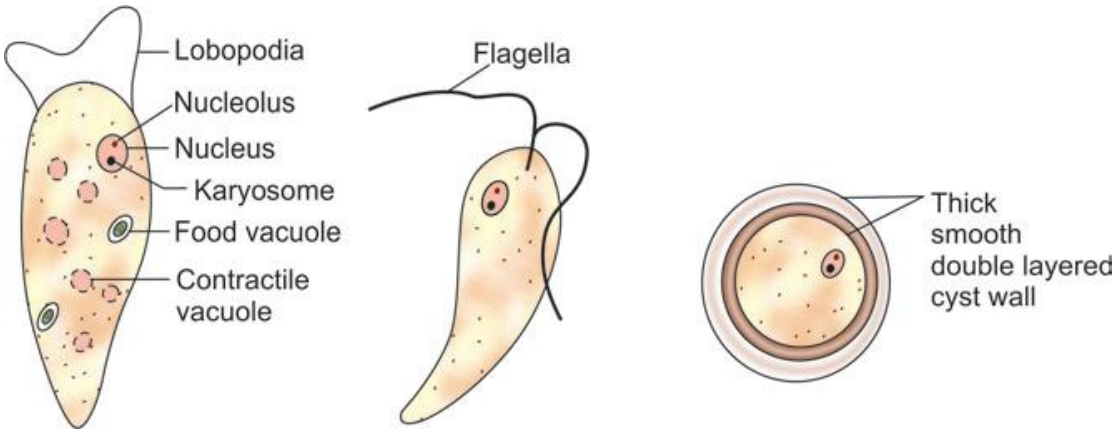
1 *Naegleria* is a free living amoeba, typically found in warm fresh water, such as ponds, lakes, rivers and hot springs. It is also found in soil.

2 Only one species, *N. fowleri*, is known to cause infection, although two other species, *N. australiensis* and *N. italica*, can cause infection in mice

3 *N. fowleri* (also known as "the brain eating amoeba") is first described by physicians M. Fowler in Australia in 1965.

Morphology

Naegleria fowleri exists in nature as cyst and trophozoite forms (Fig. 3.15).



Figs 3.15 A to C: *Naegleria fowleri* trophozoite stage (schematic diagram) (A) amoeboid form; (B) flagellated form; (C) cyst stag

1 Trophozoite Stage

The trophozoites occur in two forms, amoeboid and flagellated form. Both measure 8–15 µm.

- **Amoeboid form:** It is the only recognizable form in humans. It possesses lobate pseudopodia (called as **lobopodia**). Cytoplasm is granular with food vacuoles; nucleus shows central karyosome and

no peripheral chromatin. It is the only replicating form and it divides by binary fission (Fig. 3.15 A)

- **Flagellated form:** When the amoeboid forms are exposed to a change in ionic concentration such as placement in distilled water at 27–37°C, they transform to pear shaped flagellated form that possess two flagella at the broader end. This change occurs very quickly within a few hours.

2 Cyst Stage

Cysts measure 7–15 μm in size and is surrouuded by a thick, smooth double wall. Nucleus is identical to that found in the trophozoite. Cysts are not found in tissue (humans) but can be grown in culture. (Fig. 3.15 C).

Life Cycle and Pathogenicity

- **Infective form:** Amoeboid form is the invasive form
- **Mode of transmission:** Man acquires infection by nasal contamination during swimming in fresh hot water bodies like ponds, river, swimming pools or lakes.

- **CNS invasion:** The amoeboid form invades the nasal mucosa, cribriform plate and travels along the olfactory nerve to reach brain. The penetration initially results in significant necrosis and hemorrhages in the nasal mucosa and olfactory bulbs

- The two main mechanisms of pathogenesis are:

1. Direct ingestion of the brain tissue by producing food cups or **amoebostome** into which the cytopathic enzymes are liberated
2. Contact dependent cytolysis mediated by hemolytic proteins, cytolysins and phospholipase enzymes

- Only amoeboid trophozoites are found in cerebrospinal fluid (CSF) and in brain tissue; but not other forms.

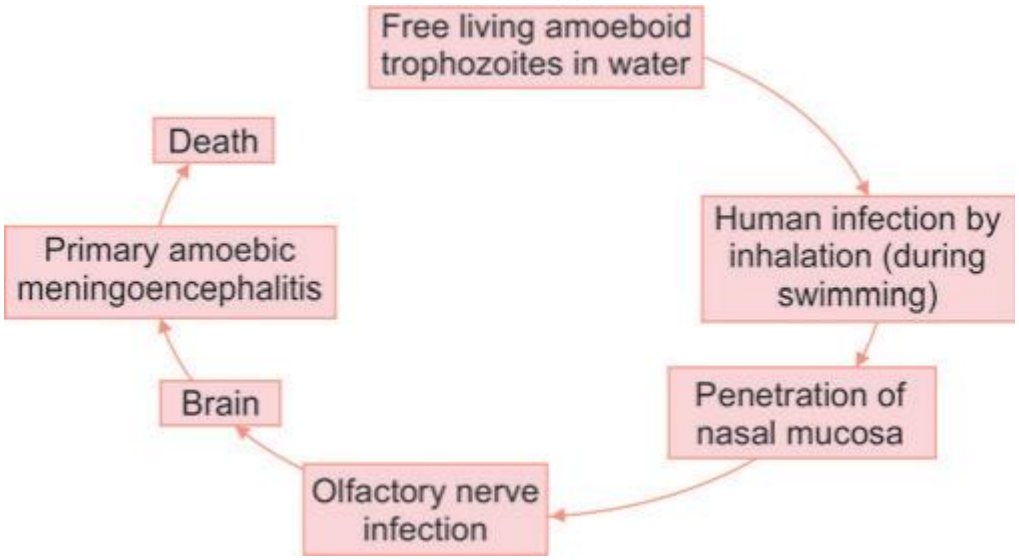


Fig. 3.16: Life cycle of *Naegleria fowleri*

Clinical Features (Primary amoebic meningoencephalitis)

- **initial symptoms include changes** : in the taste and smell (due to olfactory nerve involvement) followed by headache, anorexia, nausea, vomiting, high fever, and signs of meningeal involvement like stiff neck

- **Secondary symptoms** include : confusion, lack of attention, ataxia, and seizures

- The mortality rate is nearly 98%. Death occurs within 7–14 days after exposure.

Treatments:

- Amphotericin B has describe anti *Naegleria* effect.
- Other drugs like rifampicin, azithromycin and antifungals like miconazole and voriconazole are also found to be effective.

Acanthamoeba

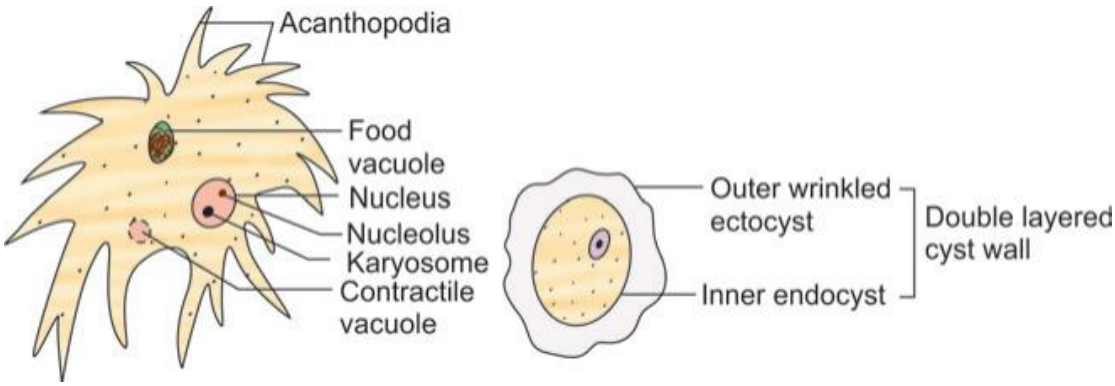
- *Acanthamoeba* species is ubiquitous and present worldwide. They have been isolated from soil, fresh and salt waters

- Griffin and Sawyer proposed the name in 1975. It is so named because of the spine like pseudopodia present in trophozoite (called as acanthopodia).

- More than 24 species have been identified.
- It principally affects CNS and eye.
- ***Reservoir for bacteria:*** Approximately 20–24% of clinical and environmental isolates of *Acanthamoeba* harbor bacterial pathogens such as *Legionella* species *Mycobacterium avium* and *Listeria,* and may serve as a potential reservoir and act as **Trojan horse** of the microbial world.

- **morphology**

Acanthamoeba species exists in nature as cyst and trophozoite forms. There is no flagellated form. (Fig. 3.18 A and B).



Figs 3.18 A and B: *Acanthamoeba* species (A) amoeboid form; (B) cyst

Trophozoite

- It is larger than *Naegleria* measuring 15–25 µm size
- It bears spine or thorn like pseudopodia **(acanthopodia)**
- **Nucleus:** Single with central karyosome and no peripheral chromatin.

Cyst

It is double walled (outer wrinkled ectocyst and inner endocyst).

Life Cycle

Mode of transmission:

- Man acquires infection by inhalational route by aerosol contaminated with cyst or trophozoite.
- or by direct spread through broken skin or infected eye
- From lungs, trophozoites reach CNS by hematogenous route

Pathogenesis:

- It causes **GAE (granulomatous amoebic encephalitis)** in immunocompromised patients like HIV positive patients and keratitis in healthy individuals.
- **GAE** is characterized by:

1 **Insidious onset:** Incubation period varies from several weeks to months

2 **Chronic course:** Lasts for months to years

In **HIV patients**, it produces: Nasal ulcers , Cutaneous ulcers and abscess, Musculoskeletal abscesses.

Symptoms:

Confusion, dizziness, nausea, headache, stiff neck

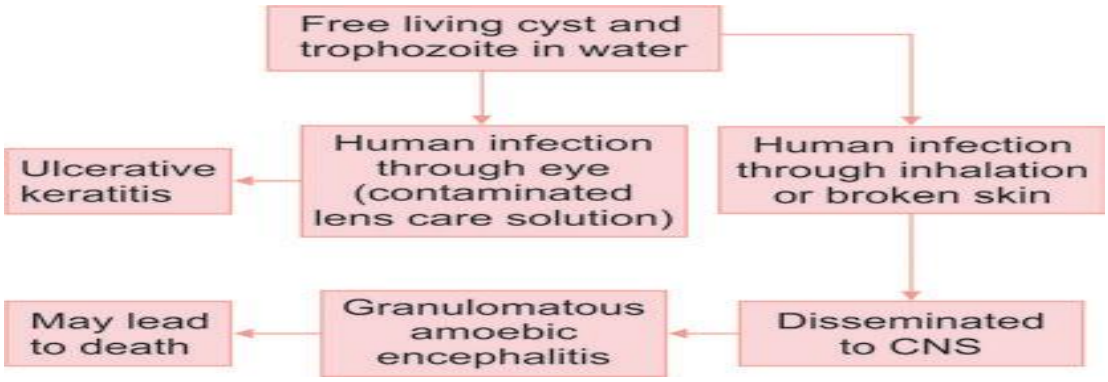


Fig. 3.19: Life cycle of *Acanthamoeba* species