



Full Length Research Article

NAEGLERIA FOWLERI

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INTRODUCTION

Naegleria fowleri, ("brain-eating amoeba"), it is a free-living, bacteria-feeding amoeba which can cause a brain infection called *naegleriasis*, also known as primary amoebic meningoencephalitis (PAM). This *microorganism* is typically found in bodies of warm freshwater, such as ponds, lakes, rivers, and *hot springs*. It is also found in the soil near warm-water discharges of *industrial plants*, and in *unchlorinated or minimally-chlorinated swimming pools*. It can be seen in either an *amoeboid* or temporary *flagellate* stage.

Naegleria fowleri infects people when water containing the amoeba enters the body through the nose. While swimming or diving in warm freshwater places, like lakes and rivers. *Naegleria* infections may also occur when people submerge their heads or cleanse their noses during religious practices, and when people irrigate their sinuses (nose) using contaminated tap water. The amoeba then travels up the nose to the brain where it destroys the brain.

Naegleria fowleri has not been shown to spread via water vapor or aerosol droplets (such as shower mist or vapor from a humidifier).

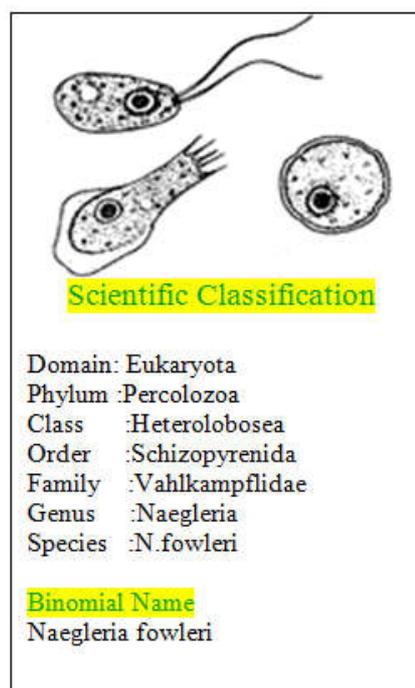
Conditions favourable for *N.fowleri* amoeba

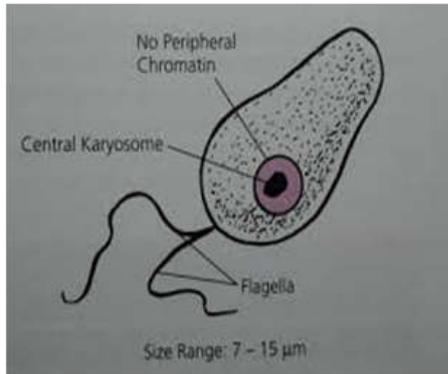
- Bodies of warm freshwater, such as lakes and rivers
- They are able to grow best at moderately elevated temperatures making summer month
- Geothermal (naturally hot) water, such as hot springs
- Warm water discharge from industrial plants

- Geothermal (naturally hot) drinking water sources
- Swimming pools that are poorly maintained, minimally-chlorinated, and/or un-chlorinated
- Water heaters. *Naegleria fowleri* grows best at higher temperatures up to 115°F (46°C) and can survive for short periods at higher temperatures.
- Soil

(*Naegleria fowleri* is not found in salt water, so they are not in sea)

Life cycle of *N. fowleri* has three stage:- trophozoite, flagellate, and cyst.





Life Cycle

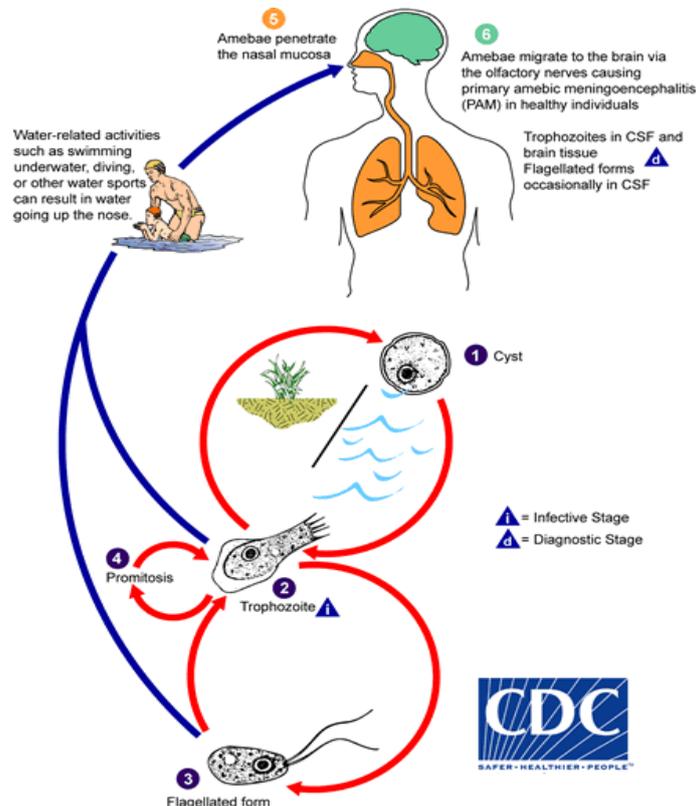
The trophozoite is the infective stage of the amoeba (10-20mm long, a nucleus with a large karyosome surrounded by a halo) that reproduce by binary fission and are motile due to round processes filled with granular cytoplasm called lobopodia. When a change in pH or ion concentration of the amoeba's environment occur. It enter into flagellate stage where trophozoites differentiate into bi-flagellated cells. This change can be induced by placement of trophozoites from culture into distilled water. Additionally, in unfavorable conditions ie: low nutrient, crowding, cold temperatures and desiccation, *N. fowleri* can form cysts. when introduced to the favorable environment of the human nasal passages can revert to the trophozoite stage and become infective. The first PAM infections were reported in 1965 in Australia. The amoeba identified caused a fatal infection in 1961 and turned out to be a new species that has since been named *Naegleria fowleri*.



Trophozoite

2) Cysts

3) Flagellate

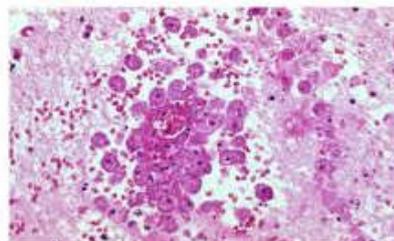


History

The infection was reported in 1962 in Florida. Subsequent investigations in Virginia using archived autopsy tissue samples identified PAM infections that had occurred in Virginia as early as 1937. According to the Centers for Disease Control and Prevention (CDC), victims die from the amoeba after about 5 days. Since 1962, there have been 128 cases of *Naegleria fowleri* [infection] and only one survivor, Back in 1978, a patient survived after being treated with antibiotics. About 133 cases are reported all over the world between 1992 to 2014 and about 10 cases are reported in india. Recently a simiar was reported in alappuzha, kerala a 16 year boy who died due to PAM infection. 97 percent of the victims are killed by this disease within days of attack. After entering the nose, the amoeba travels into the brain along the olfactory nerve and through membranes to enter the brain. Once the amoeba enter brain, it cause primary amoebic meningoencephalitis (meaning inflammation of the brain and the lining around the brain) sometimes abbreviated as PAM. A person infected with *Naegleria fowleri* will usually develops stage 1 symptoms within two to seven days of exposure

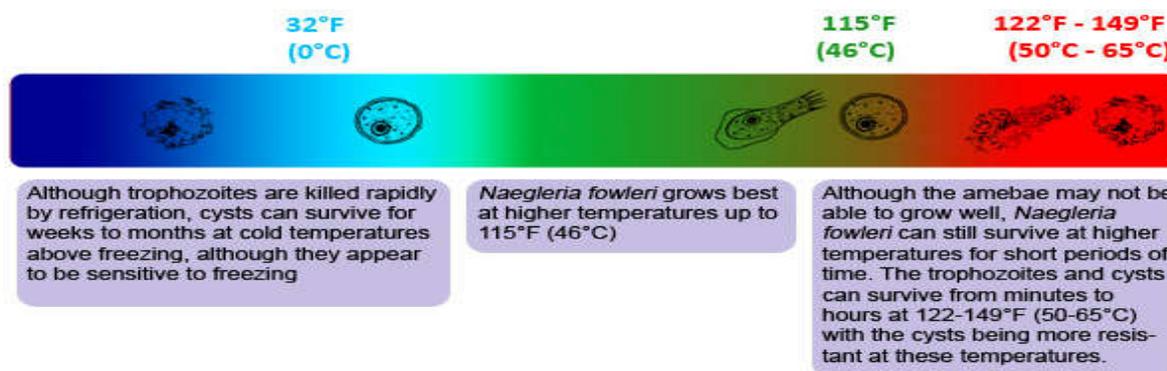
- Hallucinations
- Coma.

NAEGLERIA FOWLERI



Computerized tomography (CT) or magnetic resonance imaging (MRI) can reveal swelling and bleeding within the brain.

- CT scan. This procedure combines X-ray views taken from many different directions into detailed cross-sectional images.



Diagnosis

Treatment Main drugs

Recommended Drugs for Primary Amebic Meningoencephalitis Caused by <i>Naegleria fowleri</i>					
Drug	Dose	Route	Maximum Dose	Duration	Comments
Amphotericin B	1.5 mg/kg/day in 2 divided doses	IV	1.5 mg/kg/day	3 days	14-day course
	1 mg/kg/day once daily	IV		11 days	
Amphotericin B	1.5 mg once daily	Intrathecal	1.5 mg/day	2 days	10-day course
	1 mg/day every other day	Intrathecal		8 days	
Azithromycin	10 mg/kg/day once daily	IV/PO	500 mg/day	28 days	
Fluconazole	10 mg/kg/day once daily	IV/PO	600 mg/day	28 days	
Rifampin	10 mg/kg/day once daily	IV/PO	600 mg/day	28 days	
Miltefosine	Weight < 45 kg 50 mg BID	PO	2.5 mg/kg/day	28 days	50 mg tablets
	Weight > 45 kg 50 mg TID				
Dexamethasone	0.6 mg/kg/day in 4 divided doses	IV	0.6 mg/kg/day	4 days	

Signs and symptoms of the infection include

- Stage 1
 - Severe frontal headache
 - Changes in smell and taste
 - Fever
 - Nausea
 - Vomiting
- Stage 2
 - Stiff neck
 - Seizures
 - Altered mental status
- MRI. An MRI machine uses radio waves and a strong magnetic field to produce extremely detailed images of soft tissues, such as the brain.
- *Naegleria fowleri* organisms in cerebrospinal fluid (CSF), biopsy, or tissue specimens, or
- *Naegleria fowleri* nucleic acid in CSF, biopsy, or tissue specimens,
- *Naegleria fowleri* antigen in CSF, biopsy, or tissue specimens.
- Spinal tap (lumbar puncture): *Naegleria* amoeba can be seen under a microscope in the fluid that surrounds your brain and spinal cord. The spinal fluid is obtained by

inserting a needle between two vertebrae in your lower back. This test also can measure the cerebral spinal fluid pressure and look for inflammatory cells.

The primary treatment for naegleria infection is an antifungal drug, amphotericin B — usually injected into a vein (intravenously) or into the space around your spinal cord to kill the amoebas. An investigational drug called miltefosine (Impavido) is now available for emergency treatment of naegleria infection through the Centers for Disease Control and Prevention (CDC).

Prevention

Naegleria fowleri is found in many freshwater lakes and rivers, The only sure way to prevent PAM is to avoid participation in freshwater-related activities.

- Don't swim in or jump into warm freshwater lakes and rivers.
- Hold your nose shut or use nose clips when jumping or diving into warm bodies of fresh water.
- Avoid disturbing the sediment while swimming in shallow, warm fresh waters.
- Don't survive in chlorinated water and highly boiled water.
- The highest incidence of this disease occurs in the hot summer months in children and young adults, with males having the highest incidence of disease. Be careful out there.
- Filter water using a filter designed to remove water-loving germs. The absolute pore size should be 1 micron or smaller.
- Buy and use only water that is labeled as distilled or sterile.
- Disinfect any devices after use with water that has been boiled, filtered, distilled, or sterilized and let the device air dry entirely.
- Avoid putting your head under the water,
- . Avoid warm freshwater when the water temperature is high and the water level is low.
- Avoid digging or stirring up the sediment in shallow, warm freshwater areas.

Conclusion

It is a brain eating amoeba which can cause a brain infection known as primary amoebic meningoencephalitis (PAM). The amoeba grows best at high temperature. It enters the body through the nose, while swimming or diving in warm fresh water and victims die from the amoeba after 5 days. They are not found in salt water. *N. fowleri* has three distinct morphological stages:-

Trophozoite, Flagellate, and cyst. Major symptoms include severe frontal head ach, changes in smell and taste, fever, nausea etc. It is diagnosed by CT or MRI as they can reveal swelling and bleeding in brain. The primary treatment for naegleria infection is an antifungal drug, Amphotericin B. Other drugs are Azithromycin, Fluconazole, Rifampin etc. Main prevention are hold your nose shut or use nose clips when jumping, avoid disturbing the sediment while swimming in shallow etc.

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