BioMedical Parasitology

Protozoology

Amoebae

Prof Peter O'Donoghue

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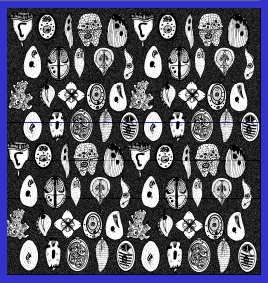
PROTOZOA
defining characteristics

- eukaryotes
- unicellular
- motile



proto-zoa = first animals

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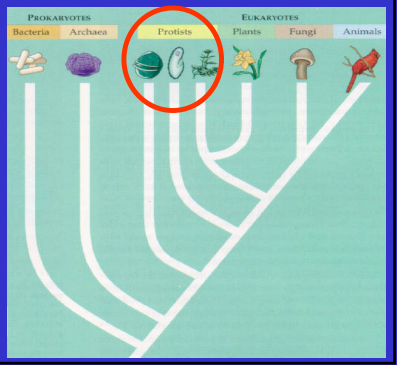
PROTOZOA

- eukaryotes
- protista
- unicellular
- motile
- free-living or symbiotic (mutualist, commensal, parasite)



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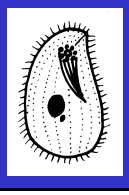
Essential life activities

- ingestion (holozoic, holophytic, saprozoic)
- digestion (food vacuoles, storage granules)
- excretion (fluids, solids)
- respiration (aerobic, anaerobic, mixed)
- reproduction (asexual, sexual)
- motility (creepers, swimmers)



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PROTOZOA

65,000 species

(31,250 extant + 33,750 extinct)

flagellates	amoebae	sporozoa	ciliates
			
6,900 species	11,550 species	5,600 species	7,200 species
5,100 free-living 1,800 parasitic	11,300 free-living 250 parasitic	all parasitic	4,700 free-living 2,500 parasitic

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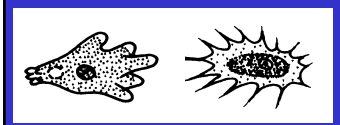
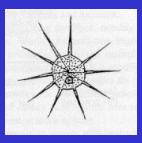
AMOEBAE

Rhizopods (lobopodia, filopodia)	Actinopods (axopodia)
	
free-living bactivores commensals/parasites	plankton

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Actinopods

Radiolaria (with mineral skeletons)

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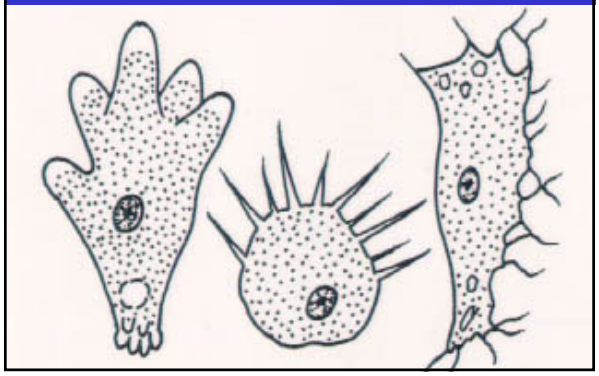
RHIZOPODS

lobopodia filopodia reticulopodia



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Testate amoebae

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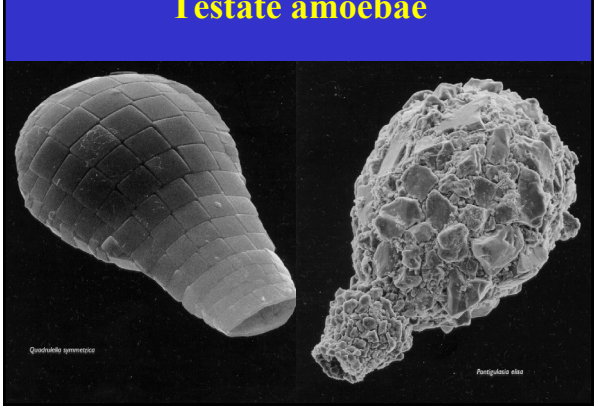
Testate amoebae



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Forams

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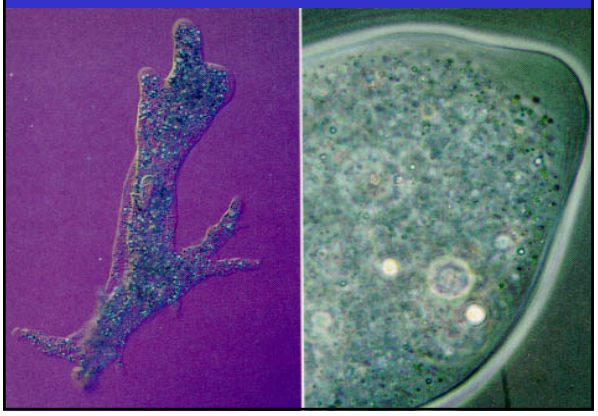
Naked amoebae



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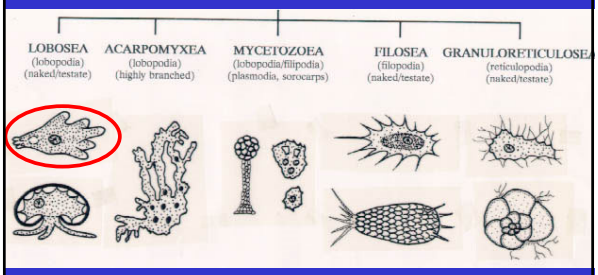
Parasite assemblage

RHIZOPODA



lobose amoeba f-l amoeba slime molds filose amoebae forams

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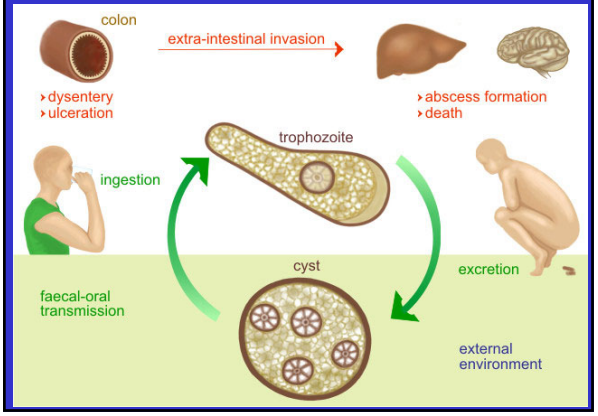
Parasite life-cycle

Entamoeba histolytica



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Parasite problem

Amoebic dysentery

- intestinal infection
- dysenteric disease, extra-intestinal complications
- environmental contamination, tropics

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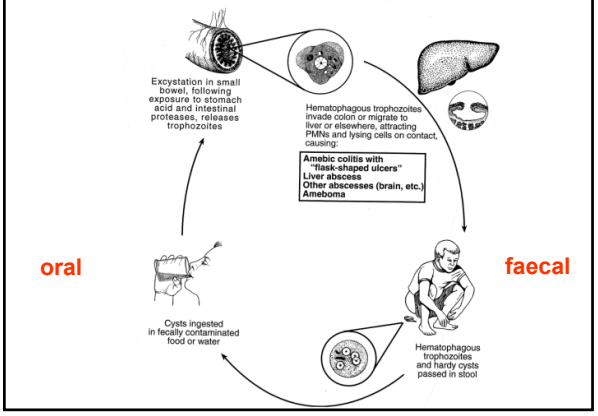
Parasite life-cycle

Entamoeba histolytica



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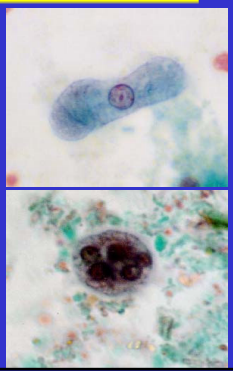
Parasite morphology

Entamoeba histolytica

- protistan parasite
- amoebae (naked)
- motile trophozoite
- faecal cyst
- invasive
- colon → soft tissues



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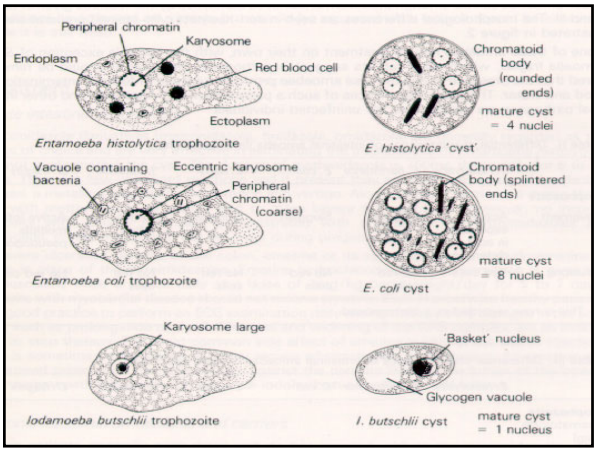

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Parasite pathogenesis

Amoebic dysentery

extremely variable presentation

- asymptomatic (vast majority)
- intestinal disease
- extra-intestinal disease

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Parasite pathogenesis

Amoebic dysentery

Complications
- trophozoites carried away from colon
- invade soft tissues, histolysis
- abscess formation

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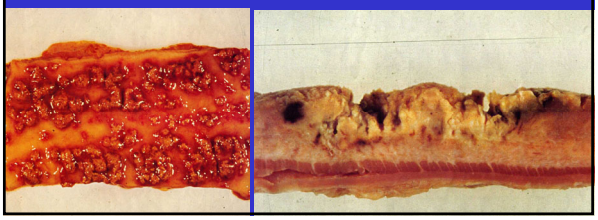
Parasite pathogenesis

Amoebic dysentery

- bloody diarrhoea
- mucosal penetration
- ulceration (caecum, appendix, ascending colon)
- colitis (colicky abdominal pain, tenesmus)



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Parasite pathogenesis

Amoebic liver abscess

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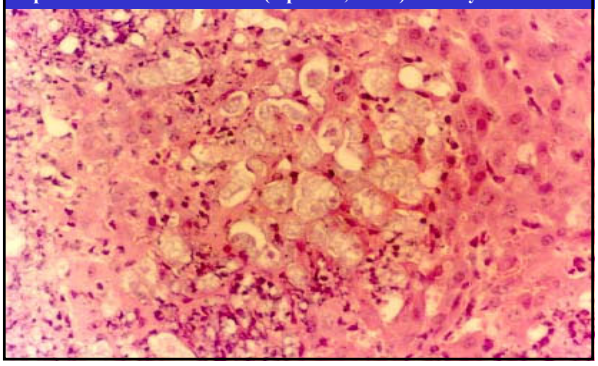
Complications - amoebic abscesses

predilection for soft tissues (esp. liver, brain) - histolysis



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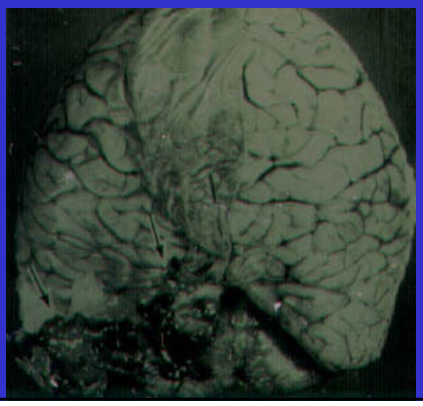
Amoebic brain abscess



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WHO top 10 parasites

	Disease	Infections/yr	Deaths/yr
1.	Ascariasis	900 million	20,000
2.	Hookworm disease	800 million	55,000
3.	Malaria	800 million	1,500,000
4.	Trichuriasis	500 million	-
5.	Amoebiasis	480 million	75,000
6.	Filariasis	280 million	-
7.	Schistosomiasis	200 million	750,000
8.	Giardiasis	200 million	-
9.	Trypanosomiasis	25 million	65,000
10.	Leishmaniasis	1 million	1,000

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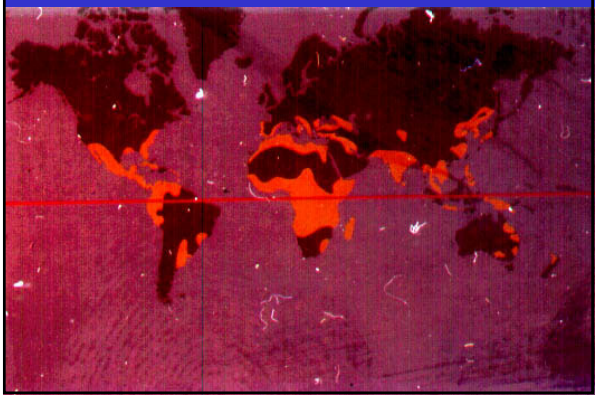
Distribution



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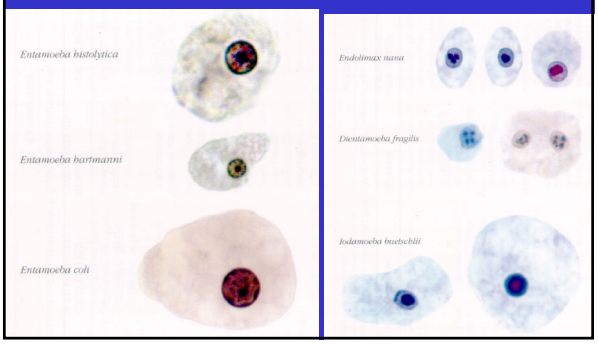
Trophozoites
characteristic nuclei



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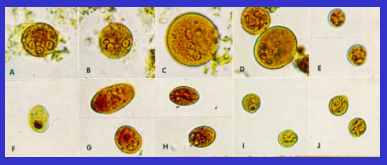
Parasite diagnosis

Diagnosis

- symptomatology (nonspecific bloody diarrhoea)
- parasite detection (confusion with cysts of other amoebae species) (cyst size, number nuclei, chromatin patterns, inclusions)



- indirect detection (antigen/antibody/DNA tests)

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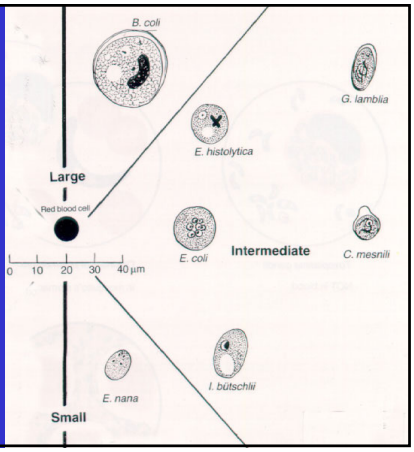
Cysts

- size
- no. nuclei
- chromatin



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Parasite biodiversity

Enteric amoebae

Entamoeba histolytica	enteropathogen (tropics, subtropics, travellers)
Entamoeba dispar	nonpathogenic '*histolytica*'?
Entamoeba polecki	sometimes pathogenic
Dientamoeba fragilis	sometimes pathogenic
Entamoeba coli	nonpathogenic
Entamoeba hartmanni	nonpathogenic
Endolimax nana	nonpathogenic
Iodamoeba butschlii	nonpathogenic

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Parasite management

TREATMENT OF ENTERIC AMOEBAE

Entamoeba

luminal amoebicides (treat asymptomatic patients)

iodoquinol	+
diloxanide furoate	+
paromomycin	+

tissue amoebocides (treat intestinal/extra-intestinal disease)

metronidazole	+++
chloroquine	+
dehydroemetine	+

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Parasite management

Control

- break faecal-oral transmission cycle
- good sanitation (effluent disposal)
- good hygiene (education – germ theory)
- identify patients, carriers and at-risk individuals
- diagnostic screening
- institute barriers for isolation
- disinfect
- food preparation
- water treatment

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OPPORTUNISTIC INFECTIONS

- free-living amoebae ubiquitous in soil and water
- all exhibit phagocytosis (bactivores)
- can become histophages (tissue-eaters)
- can feed and multiply in tissues when given opportunity

- must gain entry
- must become thermo-tolerant
- must avoid host immune responses

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Parasite problem

Infect CNS

CNS immunologically protected site full of soft tissues

Opportunistic infections cause meningoencephalitis (M)

- PAM primary amoebic M - *Naegleria*
- SAM secondary amoebic M - *Entamoeba*
- GAM granulomatous amoebic M - *Acanthamoeba* - *Balamuthia*

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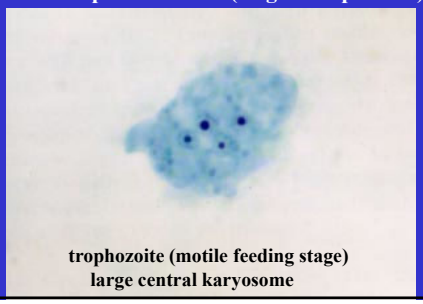
Parasite morphology

Naegleria fowleri

Cause of PAM (primary amoebic meningoencephalitis)

vahlkampfid amoebae (single lobopodium)



trophozoite (motile feeding stage)
large central karyosome

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Parasite problem

Naegleria

Common cosmopolitan species in water

Can develop thermotolerance
- shallow stagnant pools
- geothermal springs
- heated pools (esp. for toddlers)
- heated spas

Infections acquired by intranasal inoculation
Cause primary amoebic meningoencephalitis

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Naegleria

trophozoites (elongate) | cysts (round)

not formed in tissues

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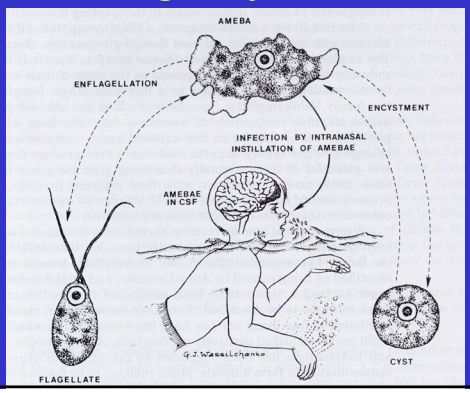
Parasite life-cycle

Naegleria fowleri



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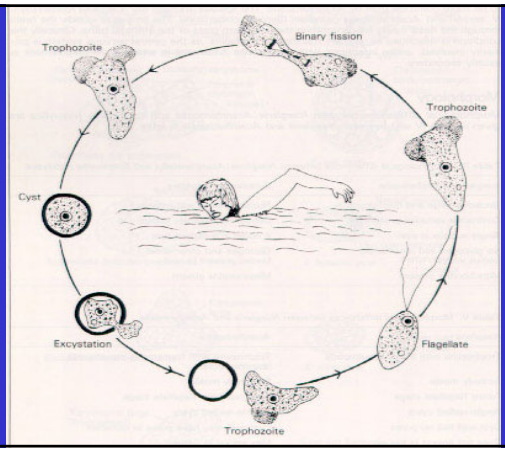

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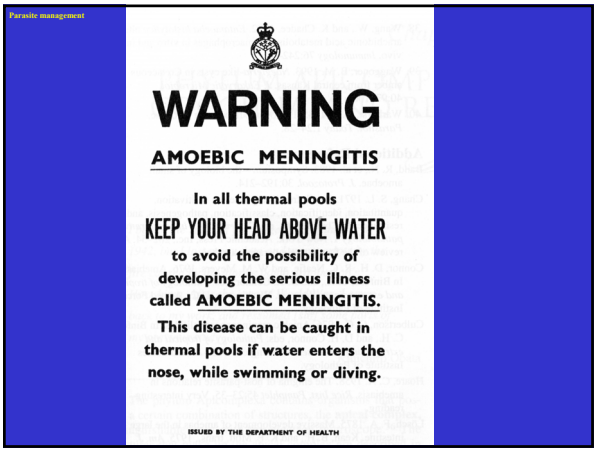
Parasite management



WARNING

AMOEBIC MENINGITIS

In all thermal pools

KEEP YOUR HEAD ABOVE WATER

to avoid the possibility of developing the serious illness called **AMOEBIC MENINGITIS.**

This disease can be caught in thermal pools if water enters the nose, while swimming or diving.

ISSUED BY THE DEPARTMENT OF HEALTH

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Naegleria fowleri

PAM = primary amoebic meningoencephalitis

- **fulminant and rapidly fatal disease particularly in children and young adults**

Opportunistic pathogen

- **entry to brain via nasal mucosa and olfactory nerves**
- **suppurative infection of brain and meninges**
- **headache, vomiting, pyrexia, stiff neck, vomiting, mental confusion, coma, death**
- **5-20 days course**

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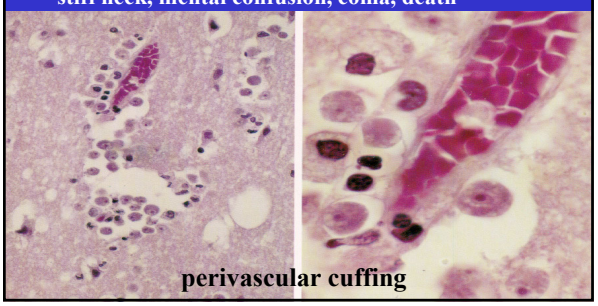
Parasite pathogenesis

Naegleria lesions

- **suppurative infection of brain and meninges**
- **headache, vomiting, pyrexia**
- **stiff neck, mental confusion, coma, death**



perivascular cuffing

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Naegleria fowleri

No effective treatment (amphotericin B?)
Common cosmopolitan species in water
Can develop thermotolerance
- shallow stagnant pools
- geothermal springs
- heated pools (esp. for toddlers)
- heated spas

Can become resistant to water disinfection
- chlorination

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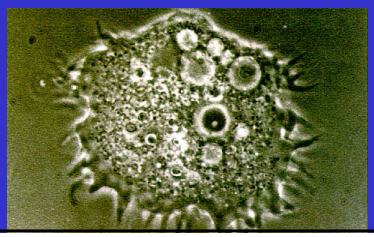
Parasite morphology

Acanthamoeba

Cause of granulomatous ameobic meningoencephalitis (GAM) and corneal keratitis (thickening of cornea)

amoebae with numerous spiny acanthopodia



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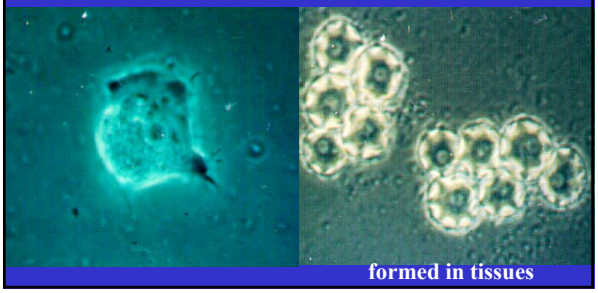
Acanthamoeba

trophozoites (spiky)

cysts (stellate)



formed in tissues

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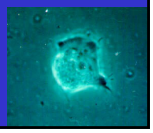
Parasite problem

Acanthamoeba

Common cosmopolitan species in water

Opportunistic pathogen
- haematogenous spread from skin or lung
- associated with trauma or underlying disease (predisposing factors include immunodeficiencies, ulcers, injury, chemotherapy, infections (TB))
- cause granulomatous meningoencephalitis
- may also cause corneal keratitis (esp. in those wearing contact lenses)



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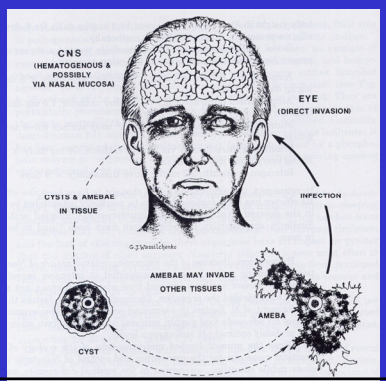
Parasite life-cycle

Acanthamoeba



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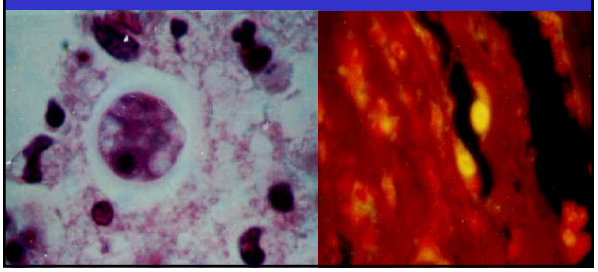
Parasite pathogenesis

GAM disease

- subacute/chronic onset, fever, headache, stiff neck
- granulomatous inflammation necrosis, thrombosed vessels
- corneal keratitis, ulceration, uveitis, blindness



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Disease

GAE subacute/chronic onset

- fever, headache, stiff neck
- granulomatous inflammation necrosis
- thrombosed vessels
- keratitis, uveitis, corneal ulceration, blindness
- hard and soft contact lens wearers

- variable responses to chemotherapy (pentamidine, clotrimazole, polymixin B, paromomycon, miconazole, acriflavine)
- surgical intervention (corneal transplants)

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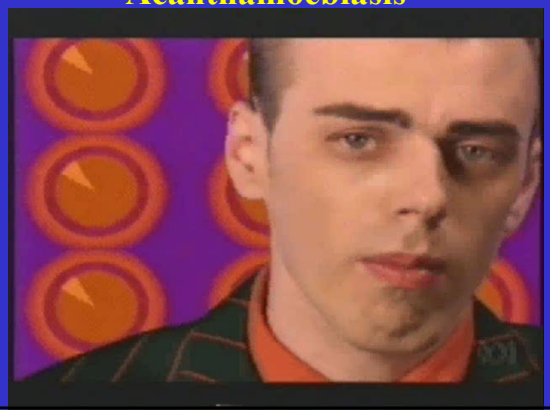
Parasite problem

Acanthamoebiasis



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Balamuthia mandrillaris

another cause of GAM

(granulomatous amoebic meningoencephalitis)

leptomyxid soil amoeba with multi-lobed pseudopodia

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Balamuthia

- causes meningoencephalitis in humans (esp. children and immunocompromised), mandrills, gorillas, orang utans, sheep, horses
- trophozoites prominent in malacic lesions in the brain
- depression, lethargy, head pain, ataxia, disorientation
- acute onset meningoencephalitis
- often fatal
- brain lesions are more necrotic than granulomatous
- opportunistic via nasal mucosa and cribiform plate

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Review

- most amoebae free-living
  - (good guys because eat bacteria and algae, help clean water, turnover soil nutrients)
- several facultative parasites/commensals of intestinal tract (differential diagnosis difficult)
- one species (*Entamoeba histolytica*) causes:
  - intestinal disease (dysentery)
  - extra-intestinal disease (abscesses)
- few amoebae opportunistic pathogens of CNS
  - *Naegleria* causes PAM (primary..)
  - *Acanthamoeba* causes GAM (granulomatous..)
  - *Balamuthia* causes NAM (necrotic..)

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