Sporozoa

- The important Phylum of the Protozoa Kingdom, known as Apicomplexa, gathers several species of obligate intracellular protozoan **parasites** classified as Sporozoa or Sporozoans, because they form reproductive cells known as spores. Many sporozoans are parasitic and pathogenic species, such as *Plasmodium (P. falciparum, P. malariae, P. vivax), Toxoplasma gondii, Pneumocysts carinii, Coccidian, Babesia, Cryptosporidum (C. parvum, C. muris),* and *Gregarian*

- The Sporozoa reproduction cycle has both asexual and sexual phases. The asexual phase is termed **schizogony** (from the Greek, meaning generation through division), in which merozoites (daughter cells) are produced through multiple nuclear fissions. The sexual phase is known as **sporogony** (i.e., generation of spores) and is followed by gametogony or the production of sexually reproductive cells termed gamonts.

- Each pair of gamonts form a gamontocyst where the division of both gamonts, preceded by repeated nuclear divisions originates numerous gametes. Gametes fuse in pairs, forming zygotes that undergo meiosis (cell division), thus forming new sporozoites. When sporozoites invade new host cells, the life cycle starts again. This general description of Sporozoan life cycle has some variation among different species and groups.

- Sporozoans have no flagellated extensions for locomotion, with most species presenting only gliding motility, except for male gametes in the sexual phase, which have a flagellated stage of motility. Motile structures such as flagella or pseudopods are present only in certain gamete stages.
- All Sporozoa have a cellular structure known as apical complex, which gave origin to the name of the Phylum, i.e., Apicomplexa. The organelle is an adaptation that the apicomplexan applies in penetration of a host cell.

TOXOPLASMOSIS

Etiology

Toxoplasma gondii is the organism responsible for toxoplasmosis. *Toxoplasma gondii* is an intestinal coccidium that parasitizes members of the cat family as definitive hosts and has a wide range of intermediate hosts. Infection is common in many warm-blooded animals, including humans. In most cases infection is asymptomatic, but devastating disease can occur.

Toxoplasma gondii

Worldwide

.Zoonotic parasite; Toxoplasma is an **opportunistic** pathogen

.Infects animals, cattle, birds, rodents, pigs, and sheep

.and humans

.Causes the disease **Toxoplasmosis**

Toxoplasmosis is leading cause of abortion in pregnant women

.Intracellular parasite

Final host (Felidae family, cat)

Intermediate host (mammals)

Toxoplasmosis

.All parasite stages are infectious .1

Risking group: Pregnant women, meat handlers (food preparation) or anyone who eats the raw meat .2

Epidemiology

Toxoplasma has worldwide distribution and 20%-75% of the population is seropositive without any symptomatic episode. However, the infection poses a serious threat in immunosuppressed individuals and pregnant females

Morphology

1 -The intracellular parasites rapid replication form (tachyzoite) are 3x6 microns, 2-pear-shaped organisms that are enclosed in a parasite membrane to form a cyst slow replication form (bradyzoite) measuring 10-100 microns in size.

3- In cat feces (oocysts) are 10-13 microns in diameter. Each oocyst has two sporocyst each of them consiste four sporozoite.

Tachyzoite stage

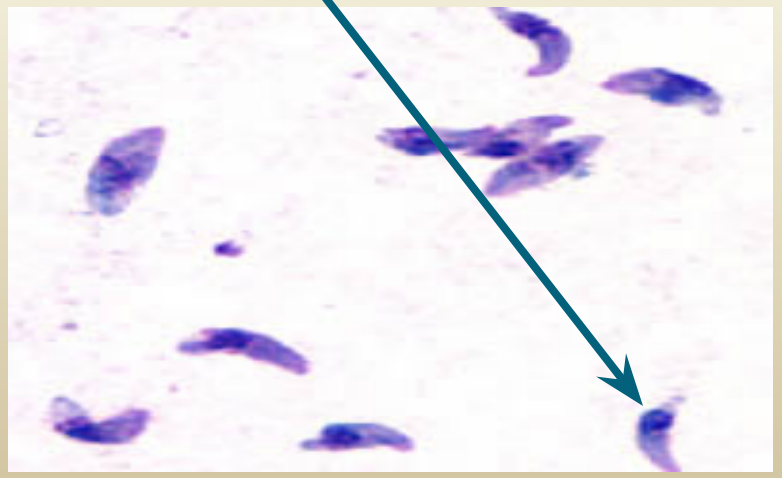
Rapidly growing stage observed in the early stage of infection.
.(Acute phase) habits in the body fluid

Crescent-shaped. One end is more pointed than the other subterminal placed
.nucleus

.Asexual form

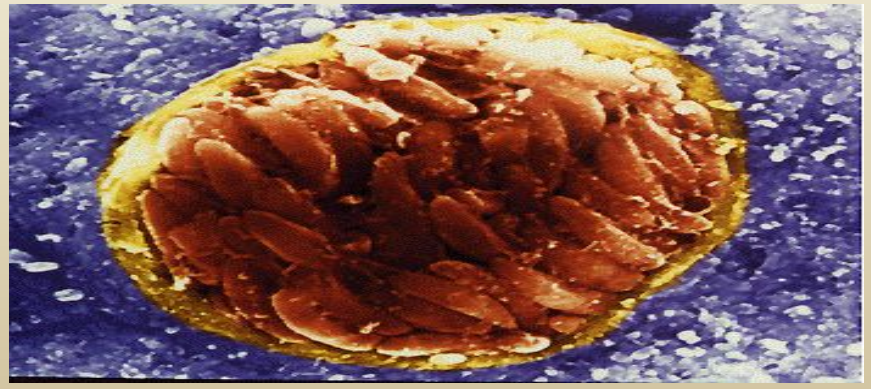
.Multiplies by endodyogeny

- It can infect phagocytic and non-phagocytic, cells.



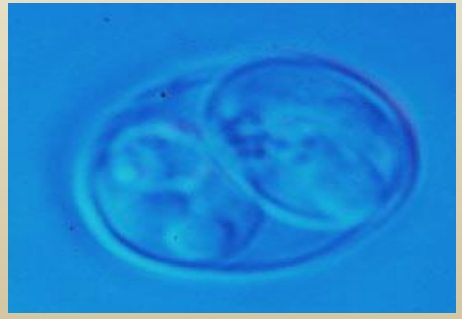
Bradyzoites

- .Are **slow-growing** stage inside the tissue cysts
- .Bradyzoites mark the **chronic** phase of infection
- Bradyzoites are **resistant** to **low pH** and **digestive enzymes** .during stomach passage
- Protective cyst wall is finally dissolved and bradyzoites infect .tissue and transform into tachyzoites
- Bradyzoites are released in the intestine and are highly .infective if ingested



Oocysts in the feces of cat

- Cat ingests tissue cysts containing bradyzoites.
- Gametocytes develop in the small intestine.
- Sexual cycle produces the oocyst which is excreted in the feces.
- Oocysts appear in the cat's feces 3-5 days after infection by cysts.
- Oocysts require oxygen and they sporulate in 1- 5 days.

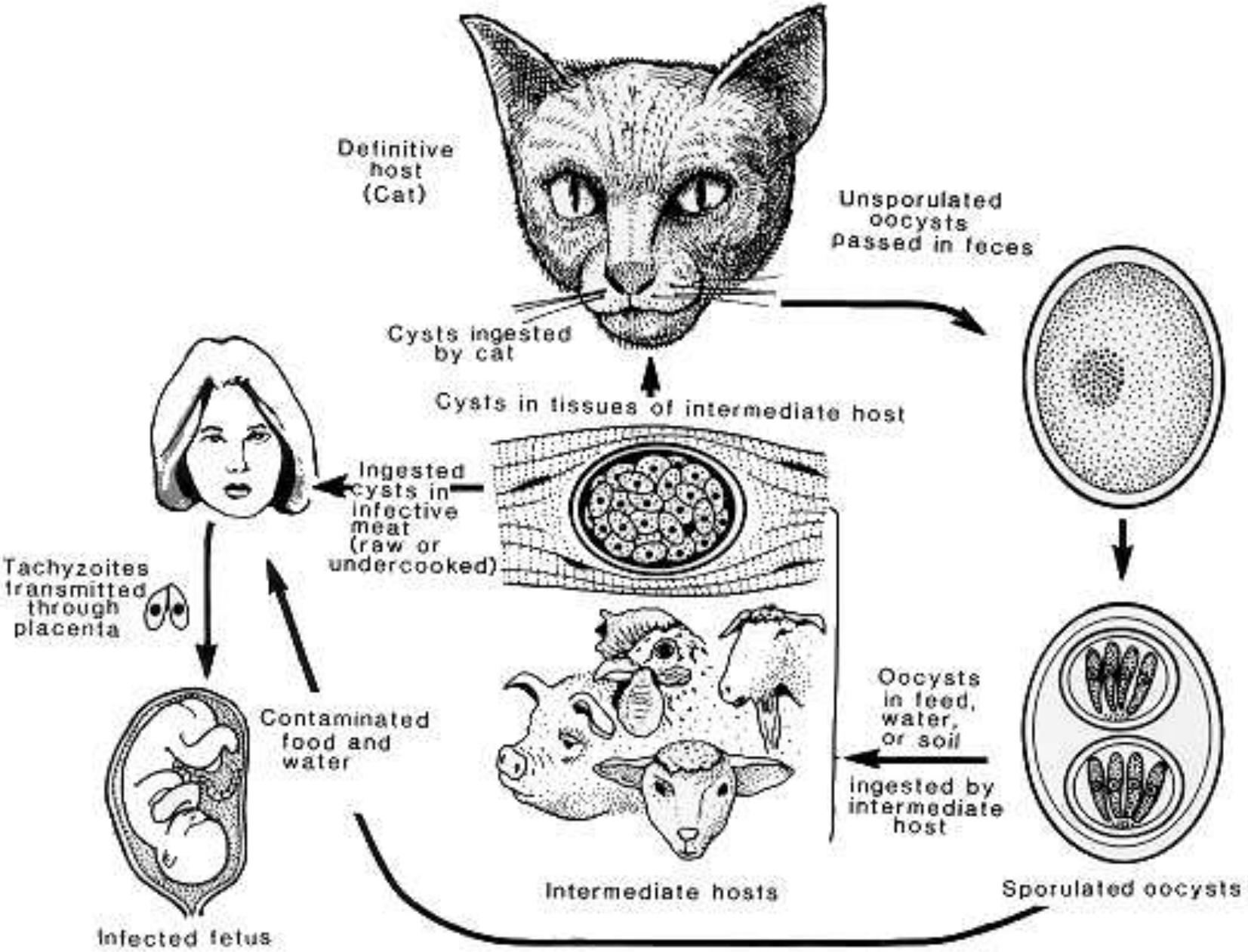


Cats (Mainly domestic and wild cats)

- Definitive (final) host: Domestic cats, who pick up the organism from eating infected rodents.

Humans (Mammals)

- Intermediate host..
- Asexual tissue cycle.
- Motile, disease producing phase = tachyzoites.
- Non-motile "slow" phase in tissue cyst = bradyzoites.

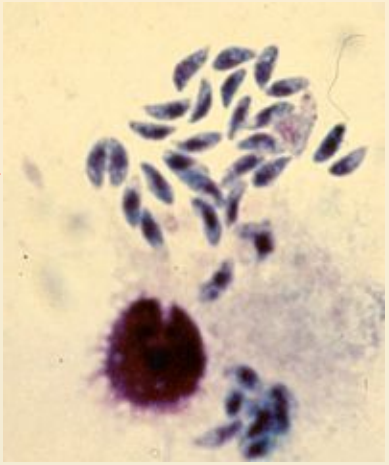

Definitive host (Cat)
Unsporulated oocysts passed in feces
Cysts ingested by cat
Cysts in tissues of intermediate host
Ingested cysts in infective meat (raw or undercooked)
Tachyzoites transmitted through placenta
Contaminated food and water
Oocysts in feed, water, or soil
Ingested by intermediate host
Infected fetus
Intermediate hosts
Sporulated oocysts

Toxoplasma gondii exists in three forms

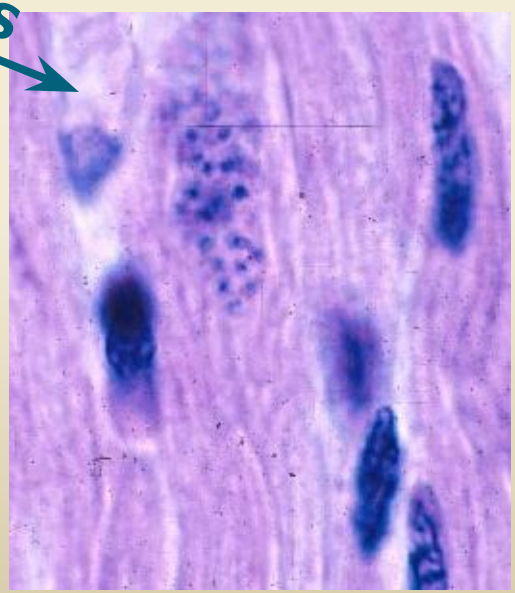
All parasite stages are infectious

TACHYZOITES .1
TISSUE CYSTS .2
BRADYZOIT .3
OOCYSTS .4

Tachyzoites

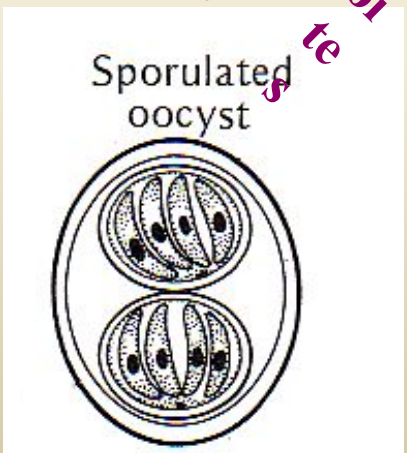


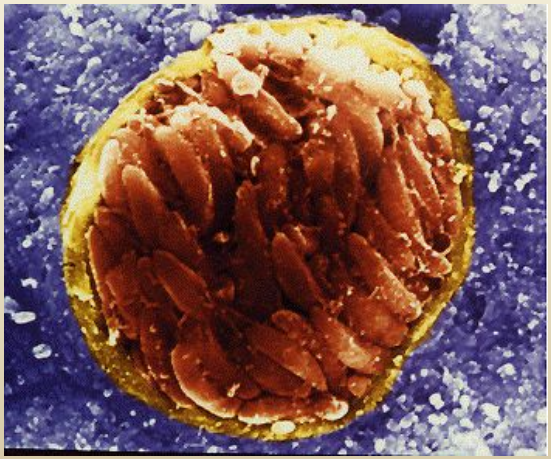
TISSUE CYSTS

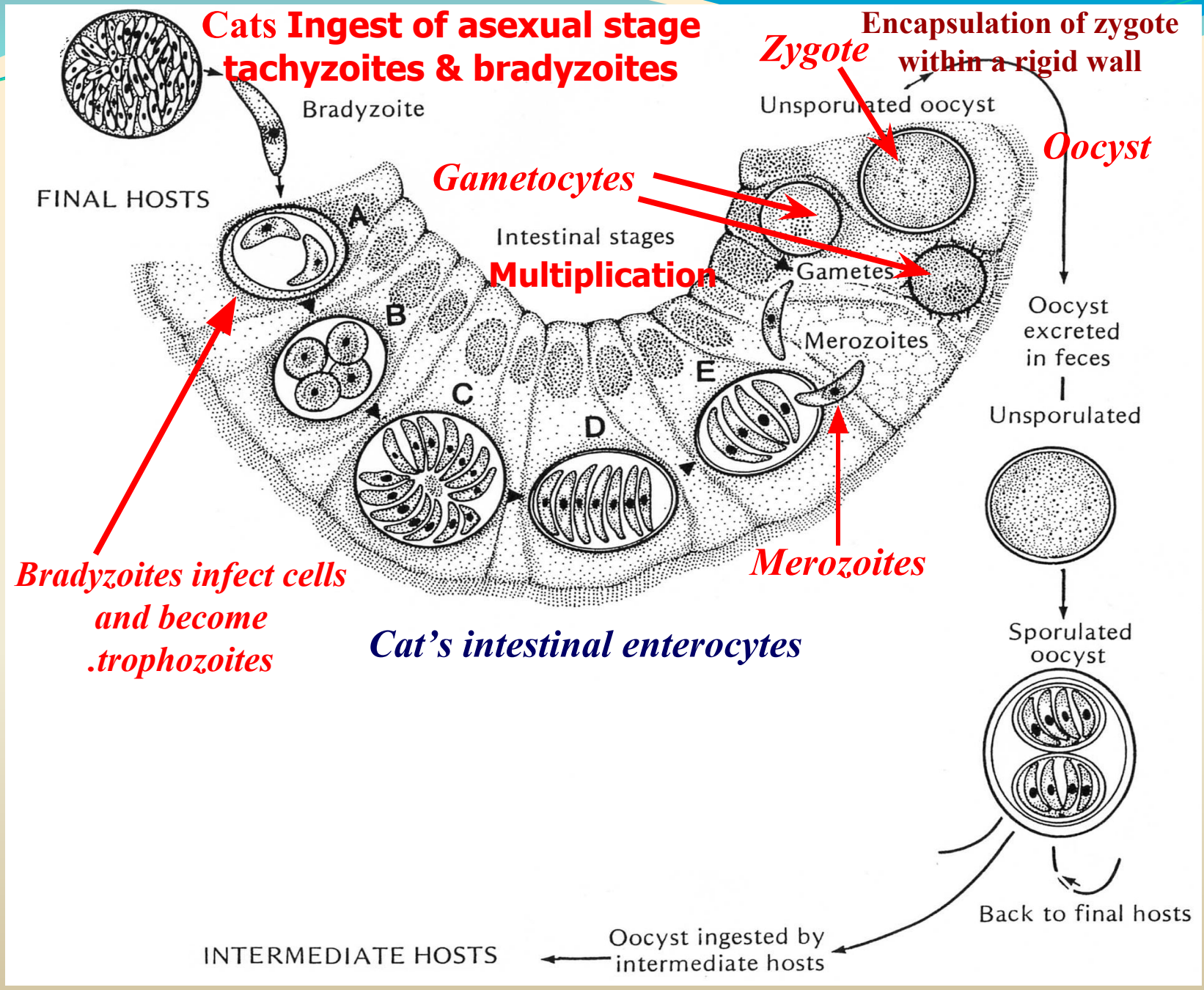


Bradyzoites

Oocysts






Cats Ingest of asexual stage tachyzoites & bradyzoites
Bradyzoite
FINAL HOSTS
Zygote
Encapsulation of zygote within a rigid wall
Unsporulated oocyst
Oocyst
Gametocytes
Intestinal stages
Multiplication
Gametes
Merozoites
A
B
C
D
E
Oocyst excreted in feces
Unsporulated
Sporulated oocyst
Back to final hosts
Bradyzoites infect cells and become .trophozoites
Merozoites
Cat's intestinal enterocytes
INTERMEDIATE HOSTS
Oocyst ingested by intermediate hosts

- -Cats get infected by ingestion of cysts **(bradyzoites)** in flesh. Decystation occurs in the small intestine, and the organisms penetrate the submucosal epithelial cells where they undergo several generations of mitosis, finally resulting in the development of micro- (male) and macro- (female) gametocytes. Fertilized macro-gametocytes develop into oocysts that are discharged into the gut lumen and excreted.
- **- Oocysts** sporulate in the warm environment and are infectious to a variety of animals including rodents and man.
- - Sporozoites released from the oocyst in the small intestine penetrate the intestinal mucosa and find their way into macrophages where they divide very rapidly (hence the name **tachyzoites)** and form a cyst which may occupy the whole cell. The infected cells ultimately burst and release the tachyzoites to enter other cells, including muscle and nerve cells, where they are protected from the host immune system and multiply slowly (bradyzoites). These cysts are infectious to carnivores (including man). Unless man is eaten by a cat, it is a dead-end host.

- When a cat ingests meat containing tissue cysts, the cyst wall is dissolved by the proteolytic enzymes in the stomach and small intestine, releasing the bradyzoites. The bradyzoites, which are a slow multiplying stage, penetrate the epithelial cells of the small intestine and initiate the formation of numerous asexual generations before the sexual cycle (gametogony, the production of gametes) begins .After the male gamete fertilizes the female gamete, two walls are laid down around the fertilized zygote to form the oocyst, which is excreted in the feces in an unsporulated stage

Symptoms:

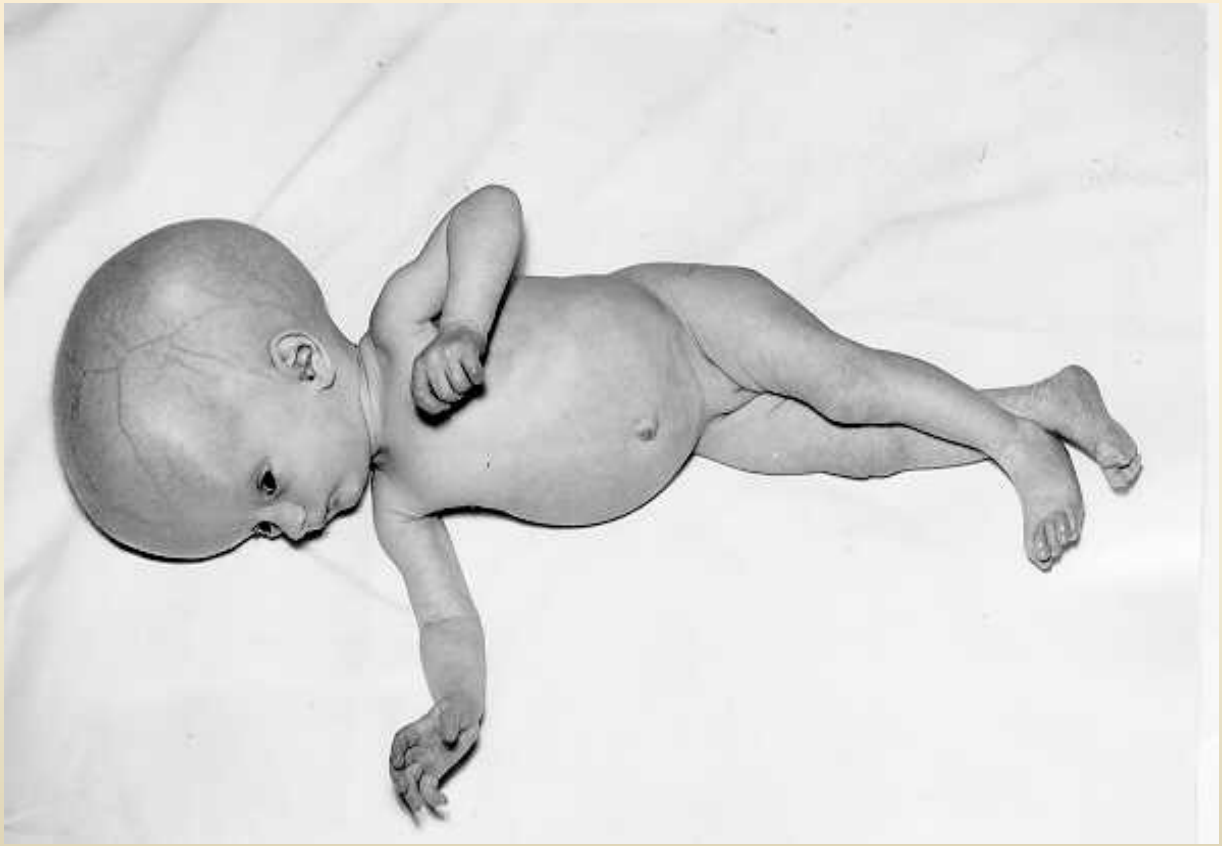
Toxoplasma gondii usually parasitizes both definitive and intermediate hosts without producing clinical signs. In humans, severe disease is usually observed only in congenitally infected children and in immunosuppressed individuals, including patients with acquired immune deficiency syndrome (AIDS).

- **Postnatally** acquired infections may be local or generalized and are rarely severe in immunocompetent individuals.
- Lymphadenitis is the most common manifestation in humans. Any node can be infected, but the deep cervical nodes are the most commonly involved. Infected nodes are tender and discrete but not painful; the infection resolves spontaneously in weeks or months. Lymphadenopathy may be accompanied by fever, malaise, fatigue, muscle pains, sore throat, and headache.
- Encephalitis is an important and severe manifestation of toxoplasmosis in immunosuppressed patients including patients with AIDS. Symptoms may include headache, disorientation, drowsiness, reflex changes, and convulsions. Coma and death may ensue.

Prenatally acquired *T gondii* often infects the brain and retina and can cause .a wide spectrum of clinical disease

•Mild disease may consist of slightly diminished vision

• Severely diseased children may exhibit a classic tetrad of signs: retinochoroiditis, hydrocephalus, convulsions, and intracerebral calcifications.
• Hydrocephalus is the least common but most dramatic lesion of congenital toxoplasmosis .Ocular disease is the most common sequela



Congenital toxoplasmosis is a problem in 1-5/1000 pregnancies

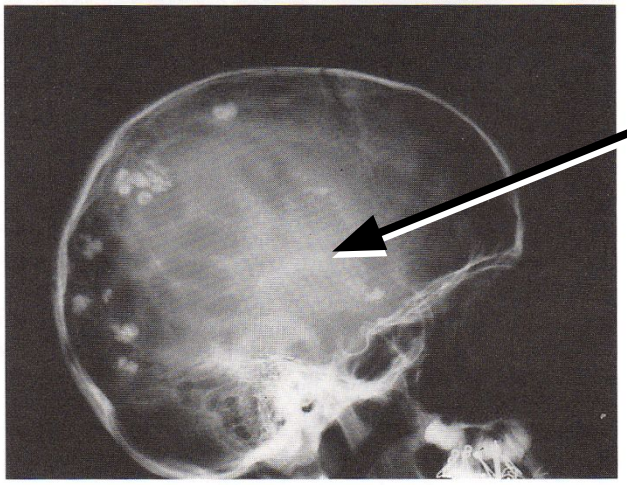


Fig. 16.10 Intracerebral calcification discovered fortuitously in a 10 year old girl, on a dental panoramic radiograph asked for by a dentist. The girl had unilateral retinochoroiditis and an IQ of 80. (Courtesy of Dr J. Couvreur).

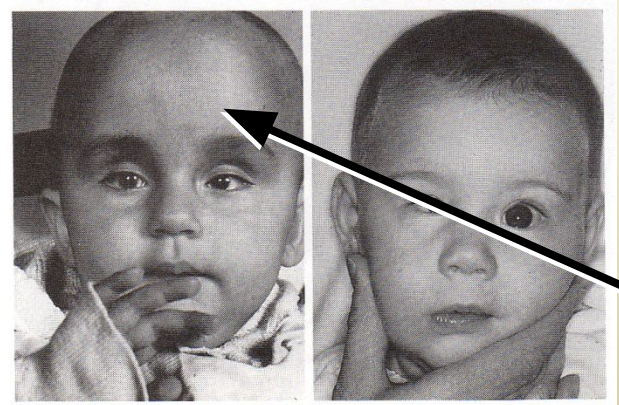


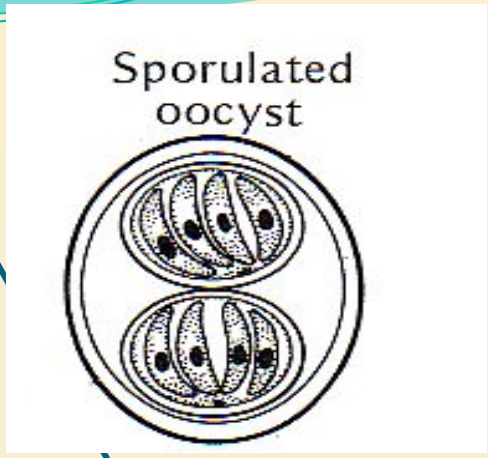
Fig. 16.9 Congenital toxoplasmosis in children. Hydrocephalus with bulging forehead (left) and microophthalmia of the left eye (right). (Courtesy of Dr J. Couvreur).

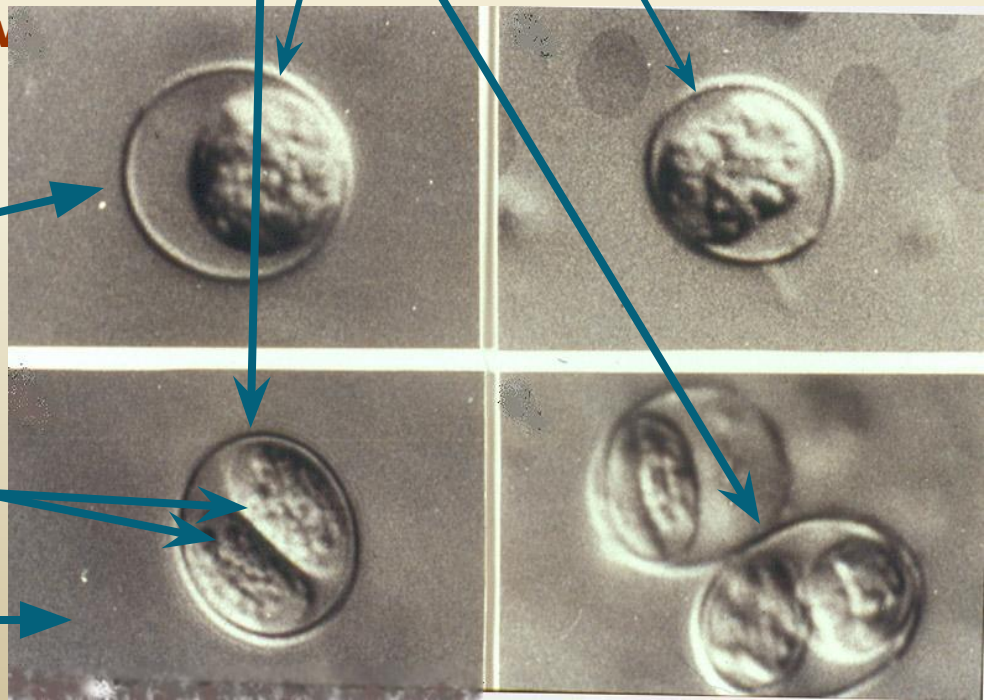
.Intracerebral calcification *

- If a woman is infected for the **first** time during pregnancy the parasite can cross the placenta and cause .fetal disease
- Both the* **probability** and **severity** of the disease depend on when the infection takes place during .pregnancy
- **Early:** low transmission, but severe disease
- **Late:** high transmission, more .benign symptoms
  - **.Hydrocephaly**

THE OOCYST

- The **oocyst** is noninfectious before sporulation.
- Unsporulated oocysts are subspherical to **spherical**.
- Sporulated oocysts are subspherical to **ellipsoidal**.
- Each oocyst has **two** ellipsoidal **sporocysts.**
- Each **Sporocyst** contains **four** **sporozoites** .
- Shedding occurs 3-5 days after ingestion of tissue cysts
- **Sporulated oocyst remain infectiv**



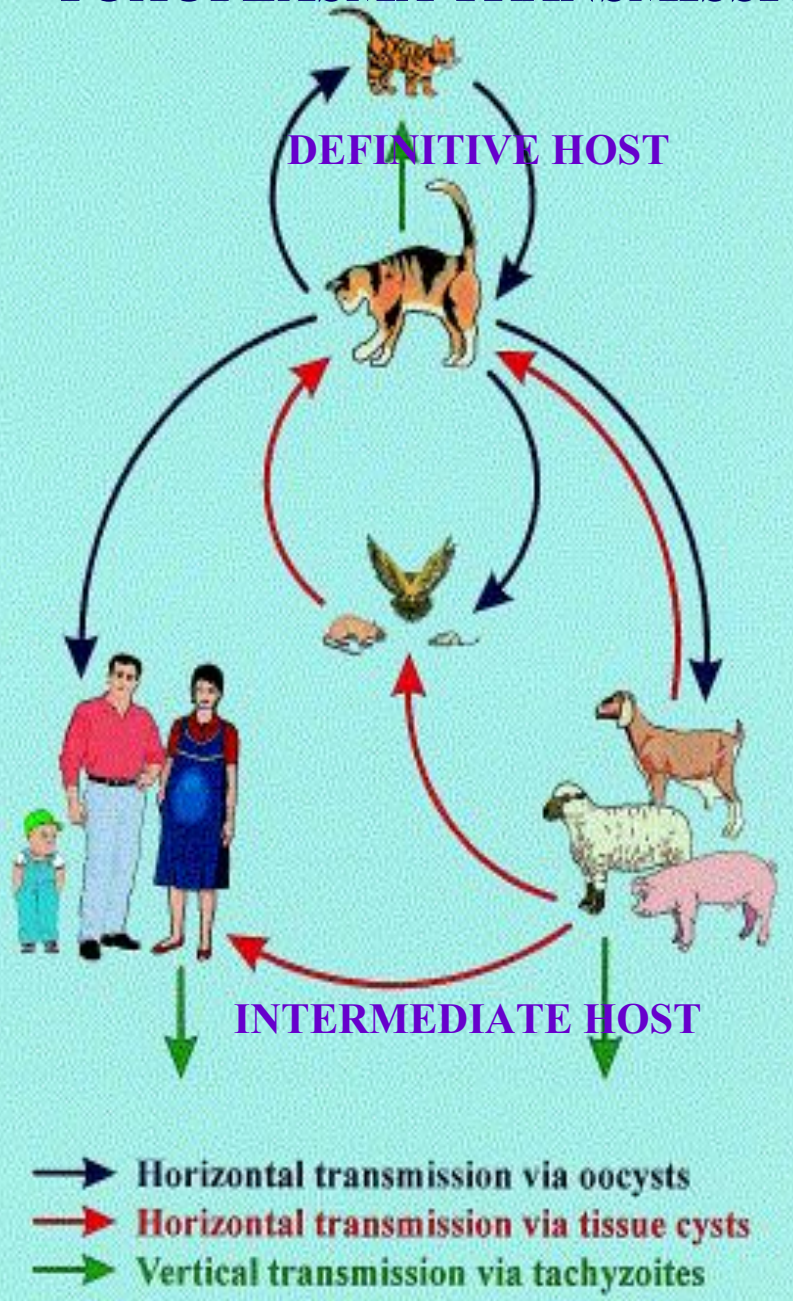


Unsporulated oocysts

Two sporocysts

Sporulated oocysts

TOXOPLASMA TRANSMISSION



: Sources of infection

- Contaminated water or food by oocysts
- Undercooked meat.
- Mother to fetus.
- Organ transplant (rare).
- Blood transfusion (rare).

Ingestion of tachyzoites and bradyzoites (cysts) in flesh of infected host.

Immunology

Both humeral and cell mediated immune responses are stimulated in normal individuals. Cell-mediated immunity is protective and humeral response is of diagnostic value.

Diagnosis

Suspected toxoplasmosis can be confirmed by isolation of the organism from tonsil or lymph gland biopsy.

Treatment

In the acute stage of the disease, drugs will not eradicate infection when active multiplication of the parasite occurs. Sulfonamides and pyrimethamine (Daraprim) are two drugs widely used to treat toxoplasmosis in humans.

They act synergistically by blocking the metabolic pathway involving p-aminobenzoic acid and the folic-folinic acid cycle, respectively. These two drugs usually are well tolerated by the patient, but sometimes thrombocytopenia, leukopenia, or both may develop.

These effects can be overcome without interrupting treatment by administering folinic acid and yeast because the vertebrate host can utilize presynthesized folinic acid, whereas *T gondii* cannot. The commonly used sulfonamides, sulfadiazine, sulfamethazine, and sulfamerazine, are all effective against toxoplasmosis. Generally, any sulfonamide that diffuses across the host cell membrane is useful in antitoxoplasmid therapy. Because sulfa compounds are excreted within a few hours of administration, they must be administered in daily divided doses.

Spiramycin, a drug used to treat pregnant women to minimize the effects of congenital toxoplasmosis, is not approved for toxoplasmosis in the United States. As yet, there are no effective drugs to kill tissue cysts.

- No killed vaccine is currently available to reduce or prevent congenital infections in humans and animals, but research to develop such an agent is under way.
- Pregnant women are advised to avoid cat litter and to handle uncooked and undercooked meat carefully.