



## *Balantidium coli*

*Balantidium coli* belongs to the **Phylum Ciliophora** and **Family Balantididae**.

- \* It is the only **ciliate protozoan** parasite of humans
- \* It is the **largest protozoan** parasite of humans.

Largest protozoan parasite residing in the large intestine of man: *Balantidium coli*.

### **Habitat**

*B. coli* resides in the large intestine of man, pigs, and monkeys.

### **Morphology**

#### **Trophozoite**

*B. Coli* occurs in 2 stages – trophozoite and cyst. The trophozoite lives in the large intestine, feeding on cell debris, bacteria, starch grains, and other particles.

\*The trophozoite is actively motile and is invasive stage of the parasite found in dysenteric stool.

At the anterior end, there is a groove (peristome) leading to the mouth (cytostome), and a short funnel shaped gullet (cytopharynx) .

\*Posteriorly, there is a small anal pore (cytophyge) .

\* The cilia around the mouth are larger (adoral cilia). The cell has 2 nuclei-a large kidney-shaped macronucleus and lying in its concavity a small micronucleus.

\*The cytoplasm has 1 or 2 contractile vacuoles and several food vacuoles.

#### **Cyst**

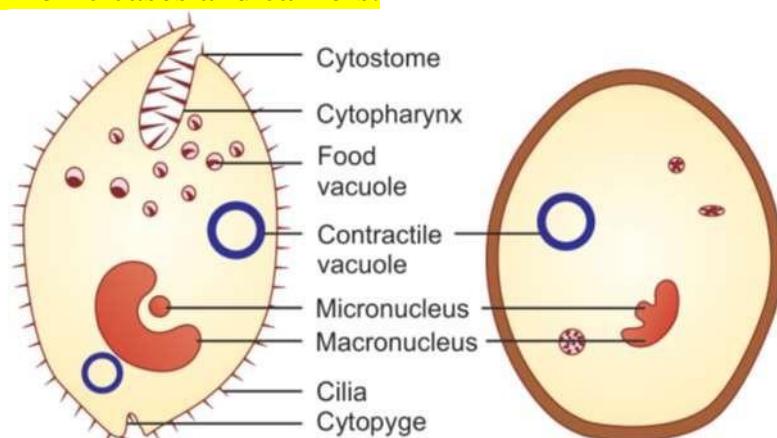
The cyst is spherical in shape and measures 40–60  $\mu\text{m}$  in diameter.

\* It is surrounded by a thick and transparent double layered wall.

\* The cytoplasm is granular. Macronucleus, micronucleus, and vacuoles are also present in the cyst.

\* The cyst is the infective stage of *B. coli*.

\* It is found in chronic cases and carriers.



## **Life Cycle**

*B. coli* pass its life cycle in one host only (monoxenous).

**Natural host:** Pig.

**Accidental host:** Man.

**Reservoirs:** Pig, monkey, and rat.

**Infective form:** Cyst.

**Mode of transmission:**

\* Balantidiasis is a zoonosis. Human beings acquire infection by ingestion of food and water contaminated with feces containing the cysts of *B. coli*.

\* Infection is acquired from pigs and other animal reservoirs or from human carriers.

\* Once the cyst is ingested, **excystation** occurs in the small intestine.

\* From each cyst, a single trophozoite is produced which migrates to large intestine.

\* Liberated trophozoites multiply in the large intestine by **transverse binary fission**.

Sexual union by **conjugation** also occurs infrequently, during which reciprocal exchange of nuclear material takes place between two trophozoites enclosed within a single cyst wall.

\* **Encystation** occurs as the trophozoite passes down the colon or in the evacuated stool. In this process, the cell rounds up and secretes a tough cyst wall around it.

\* The cysts remain viable in feces for a day or 2 and may contaminate food and water, thus it is transmitted to other human or animals.

## **Clinical Features**

Most infections are asymptomatic.

\* Symptomatic disease or **balantidiasis** resembles amoebiasis causing diarrhea or dysentery with abdominal colic مغص, nausea, and vomiting.

## **Laboratory Diagnosis**

Stool Examination, Biopsy, Culture.

## **Helminths**

### **General Features**

#### **Introduction**

The helminthic parasites are **multicellular** (metazoa) **bilaterally symmetrical** animals having **3** germ layers (**triploblastic metazoa**) and belong to the kingdom Metazoa.

\* The term 'helminth' (Greek *helmins*- 'worm') originally referred to intestinal worms, but now comprises many other worms, including tissue parasites as well as many free-living species.

\* Helminths, which occur as parasite in humans belong to 2 phyla:

\* **Phylum Platyhelminthes:** It includes 2 classes:

\* Class – Cestoda (tapeworms)

\* Class – Trematoda (flukes or digenleans)

\* **Phylum Nemathelminthes** – It includes class **nematoda** and 2 subclasses:

\* Subclass – Adenophoraea (Aphasmidia)

\* Subclass – Secernentea (Phasmidia).

\* The differences between cestodes, trematodes, and nematodes.

## Phylum Platyhelminthes

The platyhelminths are **tape-like**, dorsoventrally flattened worms.

- They either lack alimentary canal (as in cestodes) or their alimentary canal is incomplete, lacking an anus (as in trematodes).
- Body cavity is absent, viscera is suspended in gelatinous matrix.
- They are mostly **hermaphrodites (monoecious)**.
- Phylum Platyhelminthes includes 2 classes:
- Class: Cestoda
- Class: Trematoda.

### Class Cestoda

Cestodes have tape-like, **dorsoventrally flattened**, segmented bodies.

- They do not possess an alimentary system.
- The head carries suckers and some also have hooks.
- They possess scolex, neck, and proglottids.
- They are monoecious and body cavity is absent.
- They are oviparous.

### Class Trematoda

Trematodes have \_ flat or \_ fleshy, leaf-like unsegmented bodies.

- The alimentary canal is present but is incomplete i.e., without an anus.
- They possess suckers but no hooks.
- The sexes are separate in the schistosomes, while the other \_flukes are hermaphroditic.
- They are oviparous.

## Phylum Nemathelminthes (Nematoda)

Nematodes are elongated, **cylindrical** worms with an un segmented body. They possess a relatively well-developed complete alimentary canal, with an anus.

- Body cavity is present.
- The head does not have suckers or hooks, but may have a buccal capsule with teeth or cutting plates.
- The sexes are separating (**diecious**).
- They are either oviparous or larviparous.

## Differences between Cestodes, Trematodes, and Nematodes

	Cestodes	Trematodes	Nematodes
Shape	Tape-like, segmented	Leaf-like unsegmented	Elongated, cylindrical, unsegmented
Head end	Suckers present; some have attached hooks	Suckers are present but no hooks	Hooks and sucker absent. Well-developed buccal capsule with teeth or cutting plates seen in some species
Alimentary canal	Absent	Present but incomplete, no anus	Complete with anus
Body cavity	Absent, but inside is filled with spongy undifferentiated mesenchymatous cells, in the midst of which lie the viscera	Same as cestodes	Present and known as <b>pseudocele</b> . Viscera remains suspended in the pseudocele
Sex	Not separate: hermaphrodite (monoecious)	Not separate: hermaphrodite except <i>Schistosoma</i>	Separate (diecious)
Life cycle	Requires 2 host except <i>Hymenolepis</i> (1 host) and <i>Diphyllobothrium</i> (3 host)	Requires 3 host except schistosomes (2 host)	Requires 1 host except filarial worms (2 host) and <i>Dracunculus</i> (2 host)

## Important Features of Helminths

### Adult Worms

Helminths have an outer protective covering, the **cuticle** or integument, which may be tough and armed with spines or hooks. The cuticle of live helminths is resistant to intestinal digestion.

- The mouth may be provided with teeth or cutting plates. Many helminths possess suckers or hooks for attachment to host tissues.
- They do not possess organs of locomotion, but in some species the suckers assist in movement.
- **Locomotion** is generally by muscular contraction and relaxation.
- Many helminths have a primitive nervous system.
- The excretory system is better developed.
- The greatest development is seen in the reproductive system.

### Eggs

**monoecious** (with functioning male and female sex organs in the same individual) or **diecious** (the two sexes, male and female, separate). In the hermaphroditic helminths, both male and female reproductive systems are present in the same worm and self-fertilization as well as **cross-fertilization** take place. (e.g. *Taenia solium*) In the diecious species, males and females are separate, the male being smaller than the female. (e.g. *Ascaris lumbricoides*) Rarely, the female is **parthenogenic**, being able to produce fertile eggs or larvae without mating with males (e.g. *Strongyloides*). The **eggs** or **larvae** are produced in enormous numbers— as many as 200,000 or more per female per day. Various helminths have distinct morphology of eggs, which can be used to differentiate the helminths (discussed in the respective chapters).

## Larval Forms

There are various larval forms of helminths found in man and other hosts. These forms are as follows:

**Cestodes** The various larval forms are cysticercus, coenurus, coracidium, cystercercoid, procercoid, hydatid cyst, and plerocercoid forms.

**Trematodes** The various larval forms are miracidium, cercaria, redia, metacercaria, and sporocyst.

**Nematodes** The various larval forms are micro-laria, -lariform larva, and rhabditiform larva.

## Life Cycle

**Cestodes** They complete their life cycle in 2 different hosts, except *Hymenolepis nana*, which completes its life cycle in a single host and *Diphyllobothrium latum* which completes its life cycle in 3 hosts.

**Trematodes** They complete their life cycle in 1 definitive host (man) and 2 intermediate hosts. Fresh water snail or mollusc act as first intermediate host and fish or crab act as second intermediate host except schistosomes which require 2 hosts - 1 definitive host (man) and other intermediate host (snail).

**Nematodes** Nematodes require only 1 host to complete their life cycle except filarial nematodes and *Dracunculus medinensis*, which complete their life cycle in 2 hosts.

## ***Taenia saginata and Taenia solium***

### **Common Name**

*Taenia saginata* - Beef tapeworm

*Taenia solium* - Pork tapeworm

### **Habitat**

The adult worms of both *T. saginata* and *T. solium* live in the human small intestine, commonly in the jejunum.

### **Morphology**

**Adult Worm of *T. saginata*** The adult *T. saginata* worm is opalescent white in color, ribbon-like, dorsoventrally flattened, and segmented, measuring 5–10 m in length.

-The adult worm consists of head (scolex), neck, and strobila (body).

**Scolex:** The scolex (head) of *T. saginata* is about 1–2 mm in diameter, quadrate in cross-section, bearing 4 hemispherical suckers situated at its four angles. They may be pigmented. The scolex has no rostellum or hooklets (which are present in *T. solium*). *T. saginata* is, therefore called the **unarmed tape worm**. The suckers serve as the sole organ for attachment. The neck is long and narrow.

-The **Strobila (trunk)** consists of 1000 to 2000 proglottides or segments—immature, immature and gravid.

-The gravid segments are nearly four times as they are broad, about 20 mm long and 5 mm broad. The segment contains male and female reproductive structures. The testes are numerous, 300 to 400 (twice as many as in *T. solium*). The gravid segment has 15 to 30 lateral branches (as against 7 to 13 in *T. solium*). It differs from *T. solium*

also in having a prominent vaginal sphincter and in lacking the accessory ovarian lobe. The common genital pore opens on the lateral wall of the segments.

-The gravid segments break away and are expelled singly, actively forcing their way out through the anal sphincter. As there is no uterine opening, the eggs escape from the uterus through its ruptured wall.

## Eggs

Eggs of both species are indistinguishable.

-The egg is **spherical**, measuring 30–40  $\mu\text{m}$  in diameter.

-It has a thin hyaline embryonic membrane around it, which soon disappears after release.

-The **inner embryophore** is radially striated and is yellow-brown due to **bile staining**.

-In the center is a fully-developed embryo (**oncosphere**) with 3 pairs of hooklets (**hexacanth embryo**).

-The eggs do not float in saturated salt solution.

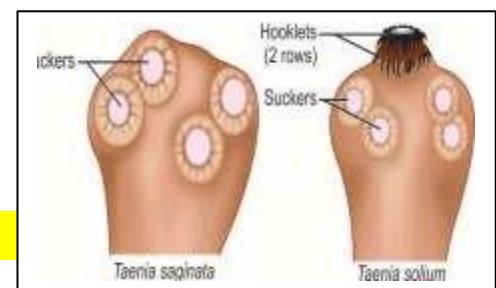
-The eggs of *T. saginata* are infective only to cattle and not to humans, whereas the eggs of *T. solium* are infective to pigs and humans too.

## Larva

The larval stage of *Taenia* is called as **cysticercus**.

-Cysticercus bovis is the larva of *T. saginata*.

-Cysticercus cellulosae is the larva of *T. solium*



## Cysticercus bovis

- It is the larval form of *T. saginata*.
- The name cysticercus is derived from the Greek, *kystis-bladder and kerkos-tail*.
- The larva (cysticercus bovis) is **infective stage** for humans.
- The cysticercus is an ovoid, milky-white opalescent fluid-filled vesicle measuring about 5 mm  $\times$  10 mm in diameter, and contains a single invaginated scolex (**bladder worm**).
- The cysticerci are found in the cardiac muscles, diaphragm and tongue of infected cattle.
- They can be seen on visual inspection as shiny white dots in the **infected beef (measly beef)**.
- Cysticercus bovis is unknown in humans.

## Cysticercus cellulosae

- It is the larval form of *T. solium* and also the **infective form** of the parasite.
- It can develop in various organs of pig as well as in man.
- The cysticercus cellulosae or '**bladder worm**' is ovoid opalescent milky-white, measuring 8–10 mm in breadth and 5 mm in length.
- The scolex of the larva, with its suckers, lies invaginated within the bladder and can be seen as a thick white spot. It remains viable for several months.