In this sheet we will continue talking about protozoa that affect the GI tract.

Balantidium coli

- Balantidium : it is a sack - Coli : it lives in the large intestine.
- Ciliated (it's the only ciliate that causes disease in the human beings)
- It's the largest of all protozoa that causes infections in human beings (80-100 microns), while amoeba between (20-40 microns)
- In the figure below we can see the two forms of this protozoa :
  a) trophozoite b) cyst

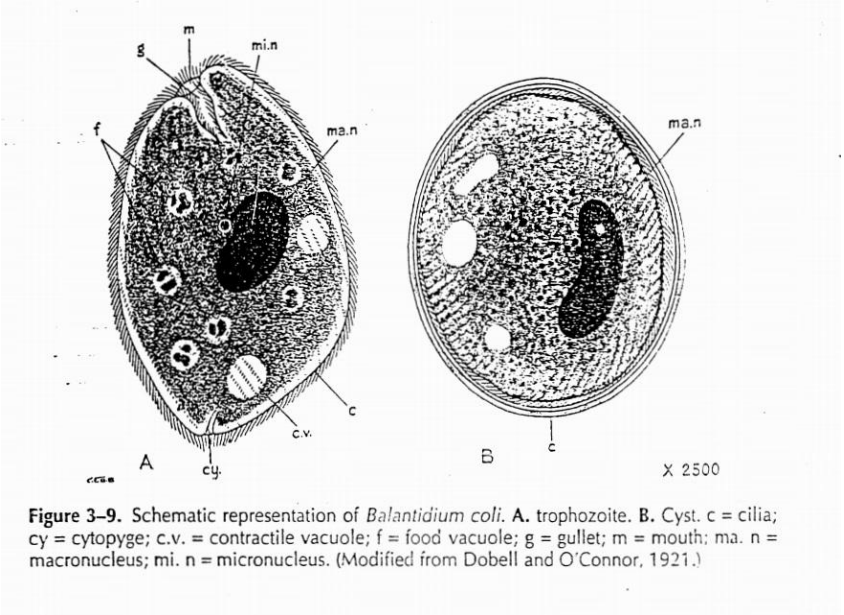


Figure 3–9. Schematic representation of *Balantidium coli*. **A.** trophozoite. **B.** Cyst. c = cilia; cy = cytopyge; c.v. = contractile vacuole; f = food vacuole; g = gullet; m = mouth; ma. n = macronucleus; mi. n = micronucleus. (Modified from Dobell and O'Connor, 1921.)

- The trophozoite:
  - it's ciliated
  - has an anterior opening like a mouth, called **cytosome**
  - has a posterior opening like an anal opening, called **cytopyge**
  - two nuclei:
    a) macronucleus: involved in regulating functions of the organs
    b) micronucleus: concerned with the reproduction
    *reproduction is usually asexual (binary fission), but sometimes sexualreproduction occur.
- The cyst :
  - ciliated but to a lesser extent than the trophozoite
  - we can see the **macronucleus**, but very rarely to see the **micronucleus**
- It is present in the large intestine, and causes **bloody diarrhea** (may be similar to amoebic dysentery)
- **Diagnosis**: we have to look for the cyst in the feces, and then we can start the treatment.
- The **Hog** is considered as a reservoir for B.Coli (not an intermediate host)
  so we can get the infection by fecal contamination from a human being's or a hog's feces, and because of that it is considered as a **Zoonosis or a zoonotic infection**.
  P.S. Zoonosis : infect humans but has as an animal reservoir.

the end of B.Coli

*The rest of the protozoa aren't really important and it has no significant in immuno-competent patients (may cause a mild diarrhea).
*But immuno-compromised patients (HIV) suffer from severe diarrhea which can be fatal (life-threatening)

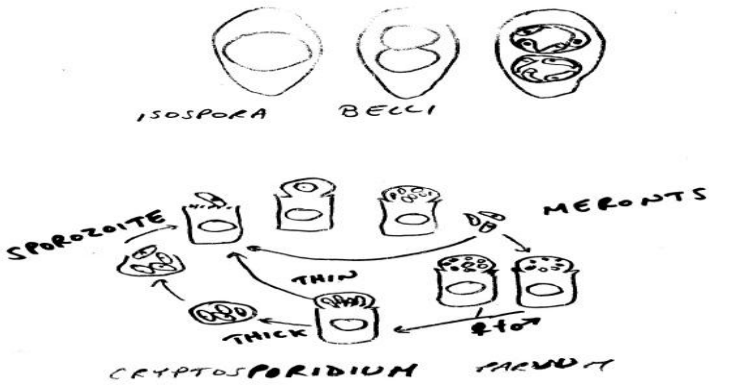
*They are coccidian which have sexual & asexual reproduction and specialized anterior organs to penetrate cells.
*They cause watery diarrhea which last for many days.
*We have 2 main types which affect the intestinal epithelial cells (intestinal worm) :

1) Isosopra belli

- In the feces it begins as **immature oocyst** (above-left) → it goes under maturation to have **mature oocyst** (above-right) which has **2 sporocytes**,
  → which will form in the end **4 sporozoites** → they will be **released** in the intestine → **infect** the epithelial cells of the small intestine → **replicate** there → give rise to **merozoites** which cause the disease (they are equivalent to trophozoites) → then merozoites will become an **oocyst** and pass within the feces**.**

  As a rule coccidian usually have two hosts:
  a) primary host: replicates in it by **sexual** reproduction
  b) intermediate host: replicates in it by **asexual** reproduction

  ex. Plasmodium (Malaria) is a coccidian which have two hosts (human beings & mosquitoes)
  ((but Isospora belli and the other type we will talk about (Cryptosporidium parvum) have only one host (human being) as an exception for this rule**.** So both cycles sexual & asexual occur in the same host, and merozoite divides asexually and forms oocyst to pass in the feces and infects other people without the need of intermediate host))



2)cryptosporidium parvum

It's a parasite which infects the intestinal epithelial cells.

- It well infect you if you eat the cysts (which contains 4 sporozoites in each one).
- They don't infect the cytoplasm. However, they are occupied within the plasma membrane. So, really they are in the apex of intestinal cells. It well divide there –in the apex of the cells- and produce merozoites which –in turn- is going to produce cysts containing sporozoites.

Now we have two types of cysts according to their wall:

1- **Thick wall oocysts**
   They well pass with the feces and well cause the infection of other people through fecal contamination.
2- **Thin wall oocysts**
   They well rapture within the intestine releasing sporozoites which well go and infect other epithelial cells.

Symptoms

-They usually produce watery diarrhea

-It's usually self limited in immunocompetent patients and there is no need for treatment unless the patient is suffering from severe dehydration because of diarrhea then hydration is necessary.

-However, the infection with this parasite in immunocompromised patients is a life-threatening condition. By that we have finished the protozoa that affect the GIT. And now we are going to talk about the helminthes.

Helminthes

we said previously that worms (helminthes) are divided into :

1- **Tapeworms**
2- **Trematodes (flukes)**
3- **Nematodes (roundworms)**

We are going to start with nematodes, and the worm we are going to talk about is called

Enterobius vermicularis (pinworm) also called threadworm & oxyuriasis.

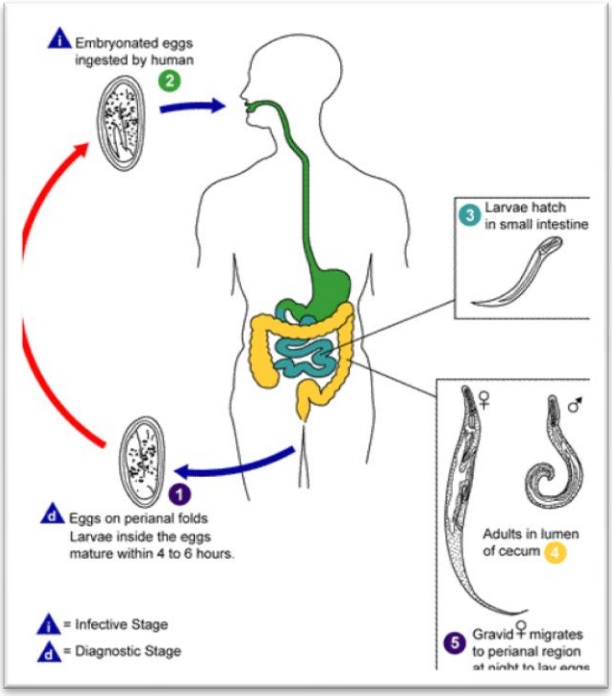
-They are very thin round worms.

-It's very small (about 8mm-1cm in length).

-It has a short life span (around 8 weeks).

- They have separate sexes (males and females worms).

- They copulate and produce fertilized eggs. These eggs are not laid in the intestine. However, the pregnant female goes to the anal opening and lays the eggs on the skin outside the lumen.



Now if you have a look on the life cycle of it you could see that the laid eggs –on the perennial skin- are already "**embryonated**" which means that they are mature and infectious.

The problem here that these eggs well cause irritation to the perennial skin leading the patient to scratch. And this etching is called **pleuritis ani.**

Now by that etching the patient could get the eggs below his nails, then he could either reinfect himself or infects other people. Usually this occurs with children so the people in danger of infection are other children in class or family members.

Now this route of infection makes it a very common disease specially in children. The problem is in some social concepts as mothers usually getting upset to know that her baby is infected with such a disease مدود :p as it's something related to the personal hygiene of the baby and family. However, there is nothing to be a shame of as it's very common in school children, and does not indicate anything about mother's or family's hygiene.

Note:
Enterobius vermicularis, pinworm infection, threadworm infection & oxyuriasis. All of them are different names for the same concept.

Symptoms

The main symptom of the disease is etching specially at night.

- Sometimes this etching is very severe and could alter the sleep habits of the child causing lack of sleep.

-Other than that, there are no adverse effects on the health of the child.

Diagnosis

- Usually you can guess the diagnosis from the history of the disease and sometimes if the mother was very observing she could see the worms on the skin! And if we have a lot of worms, we can observe them in feces.

- However, the real diagnosis is doing by putting a sticky material on a glass like tool then put it on the perennial skin allowing eggs to stick on it.

- After that you can put them under the microscope and examine them.

- The diagnosis of them is very easy as these eggs are look like coffee beans: one side is flat while the other is convex. And you can see the embryo in the middle.

Treatment : Vermox \Mebendazole

(we give two doses 10 days apart to eliminate the chance of reinfection –the patient swallows the eggs that might be present under his nails and the cycle gets repeated)

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2)Trichuris Trichiura

Whipworm مثل الكرباج

-anterior 3\5 is very thin and the posterior 2\5 is thick

-measures about 3-5 cm in length

-lives around and in the cecum in GIT

- the thin ant end is like a pin works to stick the worm into the mucosa of the intestine so it wont be flushed away with peristalsis

-lives 3ys or even more

-get nourished from mucosal secretions

-the eggs are v. characteristic (Lemon shaped eggs \or a tea tray shaped) and can't be missed-under the microscope

Life cycle

-the immature eggs are passed with feces (they are not infectious straight away) >> by defecation in the soil they become mature after 3-4 weeks in the soil >> children play with soil , catch the mature eggs >> swallow them >> go to the stomach >> to small intestine >>the shell disintegrates >> embryo comes out and goes to the cecum to cause the infection

The Disease :

If the worms were few in # >> asymptomatic

If the # is high enough >> abdominal pain \diarrhea \blood loss (not that big) because they might suck blood or by sticking themselves with the mucosa some bleeding might occur

Each worm makes you lose 0.005 ml of blood \day so in order to lose 5 ml you need 1000 worm (not that significant blood loss)

-in chronic cases it might cause iron-deficiency anemia (occult blood in the stool)

Occult blood >> is blood in stool that is not apparent for the naked eye and only detected by chemical means

-it's endemic in some areas :south east Asia , Africa (70-80% of the population might have it)

But not present in Jordan

3) Ascaris lumbricoides

-nematode

-big worm(up to 30 cm in length)

-pinkish, whitish , similar to earth worm

-v. muscular (uses it's muscles to prevent flushing by peristalsis)

-lives in small intestine

-since it's a nematode we have separate sexes

-live up to 2 years

Life cycle:

Female worm produces eggs some are fertilized and others are not (can produce up to 25 million eggs during a life-time) the non fertilized eggs are elongated and look empty while the fertilized ones are v. characteristic : they have a coarse mammillated albuminous covering (like a pineapple) , look brownish –yellowish (stained by bile)

- immature eggs are released with feces >> by defecation in the soil >> these eggs become mature and infectious after 4 weeks>> you catch them and eat them >>eggs go to the intestine but don't become worms immediately ,instead, the larvae *few microns* penetrates the wall of Small intestine >> they squeeze themselves into the capillaries >> to the portal circulation into the liver >> then they get access into the heart Through IVC >> to the lungs >> they stuck in the lungs because of their bigger size >> go into further maturation >> the get into the alveoli >> into the trachea >> into the pharynx >> you re-swallow them >> go into the intestine >> further maturation to become an adult worm the produces eggs and the cycle is repeated .

This is really a complicated life cycle !

Symptoms of Ascariasis :

Related to the # of worms : if you have only few ones in your gut the infection might pass without any symptoms or you might have abdominal pain and discomfort .

But as an infection it's not that serious

But eventually the worms die >> they come out with the feces ! so the patient comes to your clinic panicked from the WORMs that came out from his body !

Sometimes it deteriorates the health of the child by the toxins released from it and causes anorexia , malnourishment ..etc

Rare cases :

1)Sometimes the worms come out with vomit

2) come out from the nose during sleeping

3)if you have large number they might obstruct the intestine

4) might stuck in the appendix and cause appendicitis

5)might stuck in the ampulla of vater >> it will block the CBD and cause Jaundice

6) in infants it might come out from the umbilicus or the inguinal canal

Dx: Fecal examination (you look for the eggs)

Treatment : Piperazine , paralyzes the worm then it will be flushed out with feces

Visceral larvae margin

due to the presence of larvae that are not natral to the human host

It is mainly encountered in young children (playing with pets)

*Toxocara canis (dogs) and cati (cats)

- parasites of the cat and dog

-pass eggs in the faeces of the host to be eaten by other dogs or cats, where they hatch in the small intestine

migrate to blood, liver, lungs, bronchi, swallowed and mature in the small intestine.

- If the eggs are ingested by humans, the larvae become distributed in the organs of the body >> eosinophilic granulomas /inflammation.

symptoms :

Lesions >> liver consisting

increase in blood globulins.

but heavy severe infection has been known to cause death

Affection of the eye >> choroiditis or iritis (Nematode endophthalmitis).

Diagnosis: Actual demonstration of the larvae is the most definitive diagnosis.

Stool examination is of no use as the parasite never finishes its life cycle in the human.

HOOKWORMS :

- They are nematodes.

- They measure 1 cm in length.

- They are called "hookworms" because of their hooked anterior end.

Two main species pathogenic to Humans are :

1. Ankylostomaduodenale .

2. Necatoramericanus .

We can differentiate between them by 3 points :

1. Ankylostoma is present in the old world " Asia , Europe , Africa " . While Necator is present in the new world as its name implies.

2. Morphologically :Necator has a pair of semilunar cutting plates dorsally in the mouth with a concave dorsal median tooth." it has cutting edges or discs just like teeth " . While duodenale has hooks" two ventral pair of teeth "

3. Duodenale's life span is longer (5-6 years) , while Necator disappears in within 2 years .

Hookworms live in the GIT , in the small intestines

- The worm holds villus with its teeth and mouth , stays attached there .
- It feeds on blood and some of the fluids of tissues that are there .BUT mainly it feeds on blood.
- They can also move from one villus to another and by doing this , they leave a raw area which leads to bleeding .
- So that , the main pathology that maybe produced by hookworms is the LOSS OF BLOOD (either by feeding of worms on blood OR leaving a raw area) .

Note : Its believed that maybe around 1 million liters of blood are lost every day in the world because of these kinds of worms .

Eggs :

- Have a thin transparent shell .

- Its already embryonated when passed in the feces .(2-8 cell stage) . " Characteristic "

Life Cycle :

- Female and male copulate and produce eggs .

- Eggs reach the soil , giving rise there to larvae which are usually thick and are known as Rhabditiform larvae. These larvae feed on bacteria and debris in the soil and mature to the next stage which is Filariform Non feeding infective larvae that penetrates skin mainly the dorsum of feet or between the toes otherwise they die .

Note : Thigmotaxis is the attraction to skin .

Once they go in , they gain access to blood or lymphatics to lungs where they'll stick and have other maturation , then to trachea swallowed to settle in duodenum continuing the cycle.

Diagnosis :

Eggs in fresh feces (embryonated).

Symptoms :

- Itching

- Pneumonitis " if there's a lot of larvae "

- Malaise

- Eosinophilia

- Occult bleeding

* Main symptom is IRON DEFICIENCY ANEMIA