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TEACHING OBJECTIVES

Epidemiology, morbidity and mortality
Morphology of the organism
Life cycle, hosts and vectors
Disease, symptoms, pathogenesis and site
Diagnosis
Prevention and control

PARASITOLOGY

CHAPTER ONE

INTESTINAL AND LUMINAL PROTOZOA

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A parasite is an organism that obtains food and shelter from another organism and derives all benefits from this association. The parasite is termed obligate when it can live only in a host; it is classified as facultative when it can live both in a host as well as in free form. Parasites that live inside the body are termed endoparasites whereas those that exist on the body surface are called ecto-parasites. Parasites that cause harm to the host are pathogenic parasites while those that benefit from the host without causing it any harm are known as commensals.

The organism that harbors the parasite and suffers a loss caused by the parasite is a host. The host in which the parasite lives its adult and sexual stage is the definitive host whereas the host in which a parasite lives as the larval and asexual stage is the intermediate host. Other hosts that harbor the parasite and thus ensure continuity of the parasite's life cycle and act as additional sources of human infection are known as reservoir hosts. An organism (usually an insect) that is responsible for transmitting the parasitic infection is known as the vector.

INTESTINAL AND UROGENITAL PROTOZOA

Intestinal and luminal protozoa significant to human health include

- *Entamoeba histolytica* (Amebae)
- *Balantidium coli* (Ciliates)
- *Giardia lamblia* and *Trichomonas vaginalis* (Flagellates)
- *Cryptosporidium parvum* and *Isospora belli* (Sporozoa)

AMEBIASIS (amebic dysentery, amebic hepatitis)

Etiology

E. histolytica is the major cause of amebic dysentery.

Epidemiology

0.5 to 50% of the population world wide harbors *E. histolytica* parasites with the higher rates of infection being in underdeveloped countries. 1 to 3% of the population of the USA are infected. Infection is associated with poor hygiene. Humans are the principal host, although dogs, cats and rodents may be infected.

Morphology

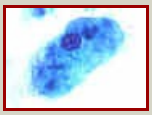
Trophozoite: This form has an ameboid appearance and is usually 15-30 micrometers in diameter, although more invasive strains tend to be larger. The organism has a single nucleus with a distinctive small central karyosome (Figure 1A,B). The fine granular endoplasm may contain ingested erythrocytes (Figure 1C). The nuclear chromatin is evenly distributed along the periphery of the nucleus.

Cyst: *Entameba histolytica* cysts are spherical, with a refractile wall; the cytoplasm contains dark staining chromatoidal bodies and 1 to 4 nuclei with a central karyosome and evenly distributed peripheral chromatin (Figure 2).

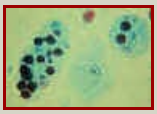
Life cycle

Infection occurs by ingestion of cysts on fecally contaminated food or hands. The cyst is resistant to the gastric environment and passes into small intestine where it decysts. The metacyst divides into four and then eight amoebae which move to the large intestine. The majority of the organisms are passed out of the body with the feces but, with larger bolus of infection, some amebae attach to and invade the mucosal tissue forming "flask-shaped" lesions (bomb craters). The organisms encyst for mitosis and are passed through with feces (Figure 3). There are no intermediate or reservoir hosts.

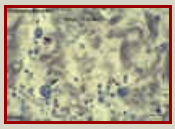
Figure 1

A  B 

A, B: Trophozoites of Entamoeba histolytica. Trichrome stain. The trophozoites are elongated (up to 60 µm in length), as they tend to be in diarrheal stool. (In non diarrheal stool, they are more rounded, and measure 15-20 µm.) The nuclei show a centrally placed karyosome with a uniformly distributed peripheral chromatin.
CDC DPDx Parasite Image Library

C  Trophozoites of Entamoeba histolytica. Trichrome stain. Two diagnostic characteristics are seen here: two of the trophozoites have ingested erythrocytes, and the nuclei have typically a small, centrally located karyosome, as well as thin, uniform peripheral chromatin.
CDC DPDx Parasite Image Library

 Entamoeba histolytica cyst and trophozoite, haematoxylin stained
© Dr Peter Darben, Queensland University of Technology clinical parasitology collection. Used with permission

 Entamoeba histolytica trophozoites in section of intestine (H&E)
© Dr Peter Darben, Queensland University of Technology clinical parasitology collection. Used with permission

 Parasitic amoeba (Entamoeba histolytica) causes amebic dysentery & ulcers (vegetative trophozoite stage). Amebic dysentery is spread by fecal contamination of food and water and is most common where sanitation is poor.
© Dennis Kunkel Microscopy, Inc. Used with permission

Figure 2

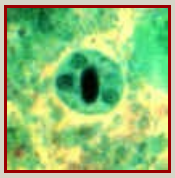
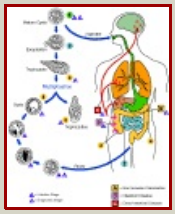
A  B  Cysts of Entamoeba histolytica, stained with trichrome (A) and iodine (B). Each cyst has 4 nuclei, of which 3 (in A) and 2 (in B) are visible in this focal plane (the fourth nucleus is coming into focus in D). The nuclei have characteristically centrally located karyosomes. The cyst in A contains a large chromatoid body. Entamoeba histolytica cysts measure 12-15 µm
CDC DPDx Parasite Image Library

Figure 3

 Life cycle of *Entamoeba histolytica*

Infection by Entamoeba histolytica occurs by ingestion of mature cysts (1) in fecally contaminated food, water, or hands. Excystation (2) occurs in the small intestine and trophozoites (3) are released, which migrate to the large intestine. The trophozoites multiply by binary fission and produce cysts (4) , which are passed in the feces. Because of the protection conferred by their walls, the cysts can survive days to weeks in the external environment and are responsible for transmission. (Trophozoites can also be passed in diarrheal stools, but are rapidly destroyed once outside the body, and if ingested would not survive exposure to the gastric environment.) In many cases, the trophozoites remain confined to the intestinal lumen (A: non-invasive infection) of individuals who are thus asymptomatic carriers and cysts passers. In some patients the trophozoites invade the intestinal mucosa (B: intestinal disease), or, through the bloodstream, extraintestinal sites such as the liver, brain, and lungs (C: extra-intestinal disease), with resultant pathologic manifestations. It has been established that the invasive and noninvasive forms represent separate species, respectively E. histolytica and E. dispar, which are morphologically indistinguishable. Transmission can also occur through fecal exposure during sexual contact (in which case not only cysts, but also trophozoites could prove infective).
CDC DPDx Parasite Image Library

Symptoms

Acute: Frequent dysentery with necrotic mucosa and abdominal pain.

Chronic: Recurrent episodes of dysentery with blood and mucus in the feces. There are intervening gastrointestinal disturbances and constipation. Cysts are found in the stool. The organism may invade the liver, lung and brain where it produces abscesses that result in liver dysfunction, pneumonitis, and encephalitis.

Pathology

Intestinal ulcers (craters/flasks - figure 4) are due to enzymatic degradation of tissue. The infection may result in appendicitis, perforation, stricture granuloma, pseudo-polyps, liver abscess (figure 4); sometimes brain, lung and spleen abscesses can also occur. Strictures and pseudo-polyps result from the host inflammatory response.

Immunology

There is an antibody response after invasive infection (liver abscess or colitis) but it is of questionable significance in immunity, as there is recurrence of enteric episodes in these patients.

Diagnosis

Symptoms, history and epidemiology are the keys to diagnosis. In the laboratory, the infection is confirmed by finding cysts in the stool (Figure 1). *E. histolytica* infection is distinguished from bacillary dysentery by the lack of high fever and absence PMN leukocytosis.

Distinction must be made from other non-pathogenic intestinal protozoa (*e.g.*, *Entamoeba coli, Entamoeba hartmanni, Dientamoeba fragilis, Endolimax nana, Iodamoeba buetschlii, etc.*). (Figure 5)

Treatment

Iodoquinol is used to treat asymptomatic infections and metronidazole is used for symptomatic and chronic amebiasis, including extra-intestinal disease.

Figure 4


Gross pathology of liver containing amebic abscess
CDC/Dr. Mae Melvin; Dr. E. West of Mobile, AL DPDx Parasite Image Library

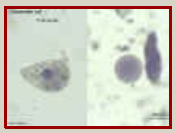

Gross pathology of amebic abscess of liver. Tube of "chocolate" pus from abscess.
CDC/Dr. Mae Melvin; Dr. E. West of Mobile, AL

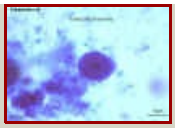

Histopathology of a typical flask-shaped ulcer of intestinal amebiasis
CDC/Dr. Mae Melvin

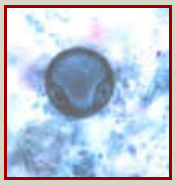
Figure 5


Entamoeba coli: Trophozoite, stained in trichrome, showing a characteristically large, eccentric karyosome, and a coarse, vacuolated cytoplasm. The trophozoites of E. coli measure usually 20-25 µm, but they can be elongated (as is the case here) and reach 50 µm.
DPDx Parasite Image Library

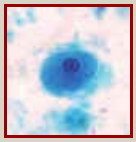

Cysts of *Entamoeba coli*, wet mount in iodine. Mature cysts typically have 8 nuclei, and measure usually 15 to 25 µm (range 10 to 35 µm). The cyst in the figure shows 5 nuclei visible in this focal plane.
DPDx Parasite Image Library

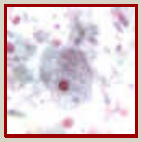
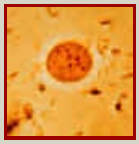

Entamoeba coli cyst and trophozoite, haematoxylin stained

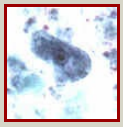
 Entamoeba coli trophozoite, trichrome stained

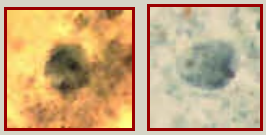
 Entamoeba coli: Trophozoite, stained in trichrome, showing a characteristically large, eccentric karyosome, and a coarse, vacuolated cytoplasm. The trophozoites of E. coli measure usually 20-25 µm, but they can be elongated (as is the case here) and reach 50 µm.
CDC DPDx Parasite Image Library

 Entamoeba hartmanni: Cyst, with one nucleus visible at this focal plane; again rather similar to cysts of E. histolytica, but differentiated by their smaller size (5-10 µm compared to 10-20 µm)
CDC DPDx Parasite Image Library

A  B  Entamoeba hartmanni: A, B: Trophozoites stained in trichrome : the trophozoites of E. hartmanni are rather similar to those of E. histolytica, with a small, often centrally located karyosome, fine peripheral chromatin, and finely granular cytoplasm; the main difference is in their small size: 5-12 µm compared to 10-60 µm for E. histolytica. Note that in (A) the trophozoite has ingested a yeast, not an erythrocyte. (Ingestion of erythrocytes is pathognomonic of E. histolytica.) CDC DPDx Parasite Image Library

A  B  C  Endolimax nana: Trophozoite stained in trichrome (A) and cysts stained in iodine (B) and in trichrome (C). Note in the trophozoite the characteristically large blot-like karyosome, and the lack of peripheral chromatin. The cysts are mature, they contain four nuclei that are much smaller than the nuclei of the trophozoites and do not have peripheral chromatin. The trophozoites are usually 8-10 µm in size, while the cysts are usually 6-8 µm.
CDC DPDx Parasite Image Library

A  B  C  Iodamoeba bütschlii: Trophozoites stained in trichrome (A) and in hematoxylin-eosin (B), and cyst stained in trichrome (C). Note the large karyosomes in the trophozoites, and in (B) the karyosome surrounded by refractile achromatic granules. In the cyst (C), a large mass of glycogen pushes the nucleus aside. The trophozoites are usually 12-15 µm in size, and the cysts are usually 10-12 µm.
CDC DPDx Parasite Image Library

 Dientamoeba fragilis trophozoites, trichrome stain. Dientamoeba fragilis is not an ameba, but a flagellate! It must be however morphologically differentiated from the amebas. The nucleus is a cluster of granules, with no peripheral chromatin. Size range 5-15 µm. This species has no cyst stage.
Images contributed by Georgia Department of Public Health/CDC DPDx Parasite Image Library

GIARDIASIS (lambliasis)

Etiology
Giardia lamblia (a flagellate)

Epidemiology
Giardia has worldwide distribution and is not uncommon in South Carolina. It is the most frequent protozoan intestinal disease in the US and the most common identified cause of water-borne disease associated with breakdown of water purification systems, drinking from contaminated streams, travel to endemic areas (Russia, India, Rocky Mountains, etc.) and day care centers.

Morphology

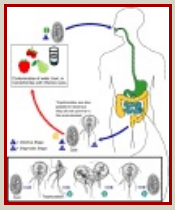
Trophozoite: *Giardia* is a 12 to 15 micrometer, half pear-shaped organism with 8 flagella and 2 axostyles arranged in a bilateral symmetry. There are two anteriorly located large suction discs. The cytoplasm contains two nuclei and two parabasal bodies (Figure 7).

Cyst: *Giardia* cysts are 9 to 12 micrometer ellipsoidal cells with a smooth well-defined wall. The cytoplasm contains four nuclei and many of the structures seen in the trophozoite.

Life cycle (Figure 6)

Infection occurs by ingestion of cysts, usually in contaminated water. Decystation occurs in the duodenum and trophozoites (trophs) colonize the upper small intestine where they may swim freely or attach to the sub-mucosal epithelium via the ventral suction disc. The free trophozoites encyst as they move down stream and mitosis takes place during the encystment. The cysts are passed in the stool. Man is the primary host although beavers, pigs and monkeys are also infected and serve as reservoirs.

Figure 6



Life cycle of *Giardia lamblia*

Cysts are resistant forms and are responsible for transmission of giardiasis. Both cysts and trophozoites can be found in the feces (diagnostic stages) 1. The cysts are hardy, can survive several months in cold water. Infection occurs by the ingestion of cysts in contaminated water, food, or by the fecal-oral route (hands or fomites) 2. In the small intestine, excystation releases trophozoites (each cyst produces two trophozoites) 3. Trophozoites multiply by longitudinal binary fission remaining in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral sucking disk 4. Encystation occurs as the parasites transit toward the colon. The cyst is the stage found most commonly in non-diarrheal feces 5. Because the cysts are infectious when passed in the stool or shortly afterward, person-to-person transmission is possible. While animals are infected with *Giardia*, their importance as a reservoir is unclear.

CDC DPDx Parasite Image Library

Symptoms

Early symptoms include flatulence, abdominal distension, nausea and foul-smelling bulky, explosive, often watery, diarrhea. The stool contains excessive lipids but very rarely any blood or necrotic tissue. The more chronic stage is associated with vitamin B_{12} malabsorption, disaccharidase deficiency and lactose intolerance.

Pathology

Covering of the intestinal epithelium by the trophozoite and flattening of the mucosal surface results in malabsorption of nutrients.

Immunology

There is some role for IgA and IgM and there is increased incidence of infection in immunodeficient patients (*e.g.* AIDS).

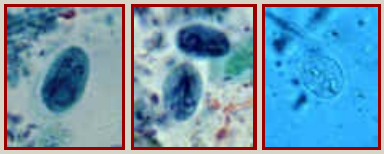
Diagnosis

Symptoms, history, epidemiology are used in diagnosis. *Giardia* caused dysentery is distinct from other dysenteries due to lack of mucus and blood in the stool, lack of increased PMN leukocytes in the stool and lack of high fever. Cysts in the stool and trophs (Figure 7) in the duodenum can be identified microscopically after content has been obtained using a string device (Enterotest®). Trophs must be distinguished from the non-pathogenic flagellate *Trichomona hominis*, which is an asymmetrical flagellate with an undulating membrane.

Treatment

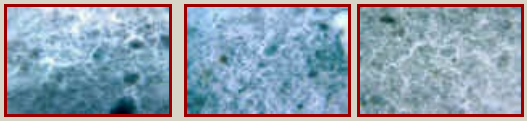
Metronidazole is the drug of choice.

Figure 7



Cysts of Giardia lamblia,stained with iron- hematoxylin (A, B) and in a wet mount (C; from a patient seen in Haiti). Size: 8-12 µm in length. These cysts have two nuclei each (more mature ones will have four).

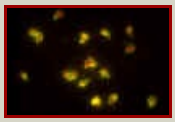
CDC



Giardia lamblia cyst. Chlorazol black.

CDC/Dr. George R. Healy

 Giardia lamblia cyst. Iodine stain.
CDC DPDx Parasite Image Library

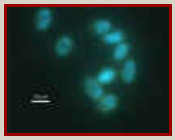
 Giardia lamblia. Indirect fluorescent antibody stain. Positive test.
CDC/Dr. Govinda S. Visvesvara gsv1@cdc.gov

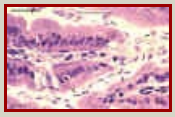
 Giardia lamblia. Indirect fluorescent antibody stain. Negative test.
CDC/Dr. Govinda S. Visvesvara gsv1@cdc.gov

 *Giardia lamblia* - a human parasite of the gastrointestinal tract. The organism is spread by direct contact or through contaminated food and water. *Giardia* spp. are pear-shaped, with hair-like flagella for motility. They cause the disease giardiasis (or lambliasis), an infection of the small intestine most common in tropical areas. *Giardia* spp. attaches by means of sucking discs to microvilli in the human intestine. Abdominal cramps, swelling, diarrhea and nausea may occur.
© Dennis Kunkel Microscopy, Inc. Used with permission

 Protozoa Infection in Human Intestine sp. (Giardia) sp.
© Dennis Kunkel Microscopy, Inc. Used with permission

 Giardia - Fluorescent Antibody (FA) Staining
Photo Credit: H.D.A. Lindquist, U.S. EPA

 DAPI staining of giardia: This nucleic stain enables the visualization of the nuclei. Both Giardia and Cryptosporidium have up to 4 nuclei that can be seen if intact.
Photo Credit: H.D.A. Lindquist, U.S. EPA

 Giardia trophozoites in section of intestine (H&E)
© Dr Peter Darben, Queensland University of Technology clinical parasitology collection. Used with permission

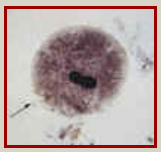
OTHER INTESTINAL PROTOZOA

Balantidium coli and *Cryptosporidium (parvum)* are both zoonotic protozoan intestinal infections with some health significance. *Isospora belli* is an opportunistic human parasite.

Balantidium coli

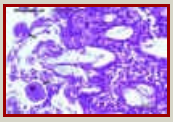
This is a parasite primarily of cows, pigs and horses. The organism is a large (100 x 60 micrometer) ciliate with a macro- and a micro-nucleus (Figure 8). The infection occurs mostly in farm workers and other rural dwellers by ingestion of cysts in fecal material of farm animals. Man-to-man transmission is rare but possible. Symptoms and pathogenesis of balantidiasis are similar to those seen in entamebiasis, including intestinal epithelial erosion. However, liver, lung and brain abscesses are not seen. Metronidazole and iodoquinol are effective.

Figure 8

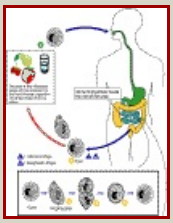

A

B
Balantidium coli trophozoites. These are characterized by: their large size (40 µm to more than 70 µm) the presence of cilia on the cell surface - particularly visible in (B) a cytostome (arrows) a bean shaped macronucleus which is often visible - see (A), and a smaller, less conspicuous

micronucleus
CDC

C  Balantidium coli trophozoites in section of intestine (H&E)

D  Balantidium coli cyst and trophozoite

D  Life cycle of *Balantidium coli*
Cysts are the parasite stage responsible for transmission of balantidiasis 1. The host most often acquires the cyst through ingestion of contaminated food or water 2. Following ingestion, excystation occurs in the small intestine, and the trophozoites colonize the large intestine 3. The trophozoites reside in the lumen of the large intestine of humans and animals, where they replicate by binary fission, during which conjugation may occur 4. Trophozoites undergo encystation to produce infective cysts 5. Some trophozoites invade the wall of the colon and multiply. Some return to lumen and disintegrate. Mature cysts are passed with feces 1.
CDC DPDx Parasite Image Library

Cryptosporidium parvum

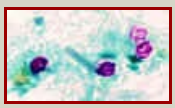
C. parvum is a small round parasite measuring 3 to 5 micrometers which is found in the gastrointestinal tract of many animals and causes epidemics of diarrhea in humans via contaminated food and water (Figure 9). Humans are infected by ingestion of *C. parvum* oocysts containing many sporozoites. The sporozoites are released in the upper GI tract and attach to the gut mucosal cells where they divide to produce merozoites. The merozoites invade other mucosal cells and further multiply asexually. Some of the merozoites differentiate into male and female gametocytes and form an oocyst in which they multiply and differentiate into sporozoites. The mature oocyst is excreted with fecal material and infects other individuals (Figure 10).

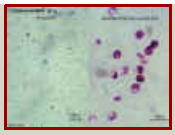
When a large number of humans in a community have diarrhea, the most likely cause is *C. parvum*. A small bolus of infection may cause mild diarrhea, whereas a larger intake of organisms may cause more pronounced symptoms including copious watery diarrhea, cramping abdominal pain, flatulence and weight loss. Severity and duration of symptoms are related to immuno-competence. In AIDS patients, the organism may cause prolonged, severe diarrhea and the organisms may invade the gallbladder, biliary tract and the lung epithelium. There is no approved effective treatment for cryptosporidiasis, although paromycin is used as an investigational drug.

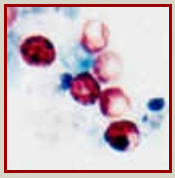
There are a variety of antibody tests for detection but many of these detect other species of *Cryptosporidium* than *C. parvum.* Sensitive polymerase chain reaction tests are available for *C. parvum* detection in environmental and animal samples.

Figure 9

 Oocysts of Cryptosporidium parvum, in wet mount, seen with differential interference contrast (DIC) microscopy. The oocysts are rounded, 4.2 µm - 5.4 µm in diameter. Sporozoites are visible inside the oocysts, indicating that sporulation has occurred. (In comparison, oocysts of Cyclospora cayetanensis, another important coccidian parasite of humans, are twice larger and are not sporulated - do not contain sporocysts - upon excretion.)
CDC

 Oocysts of Cryptosporidium parvum stained by the acid-fast method. Against a blue-green background, the oocysts stand out in a bright red stain. Sporozoites are visible inside the two oocysts to the right.
CDC

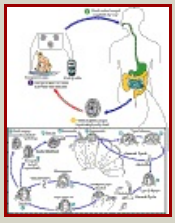
 Cryptosporidium sp. oocysts, unstained and Modified Kinyoun's acid fast stain

 Oocysts of Cryptosporidium parvum stained by the acid-fast method. This image shows that the staining can be variable. In particular, infections that are resolving can be accompanied by increasing numbers of non acid-fast oocysts “ghosts”.
CDC

These oocysts are stained with a fluorescent-labeled antibody, making identification easier. However, many antibodies label all species of *Cryptosporidium*

 Reported cases of Cryptosporidiosis, United States 1997
USFDA

Figure 10

 Life cycle of *Cryptosporidium*
(from: Juranek DD. Cryptosporidiosis. In: Hunter’s Tropical Medicine, 8th edition. Strickland GT, Editor.)

Sporulated oocysts, containing 4 sporozoites, are excreted by the infected host through feces and possibly other routes such as respiratory secretions (1). Transmission of *Cryptosporidium parvum* occurs mainly through contact with contaminated water (e.g., drinking or recreational water). Occasionally food sources, such as chicken salad, may serve as vehicles for transmission. Many outbreaks in the United States have occurred in waterparks, community swimming pools, and day care centers. Zoonotic transmission of *C. parvum* occurs through exposure to infected animals or exposure to water contaminated by feces of infected animals (2). Following ingestion (and possibly inhalation) by a suitable host (3), excystation (a) occurs. The sporozoites are released and parasitize epithelial cells ((b), (c)) of the gastrointestinal tract or other tissues such as the respiratory tract. In these cells, the parasites undergo asexual multiplication (schizogony or merogony) ((d), (e), (f)) and then sexual multiplication (gametogony) producing microgamonts (male) (g) and macrogamonts (female) (h). Upon fertilization of the macrogamonts by the microgametes ((i)), oocysts ((j), (k)) develop that sporulate in the infected host. Two different types of oocysts are produced, the thick-walled, which is commonly excreted from the host (j), and the thin-walled oocyst (k), which is primarily involved in autoinfection. Oocysts are infective upon excretion, thus permitting direct and immediate fecal-oral transmission.
Note that oocysts of *Cyclospora cayetanensis*, another important coccidian parasite, are unsporulated at the time of excretion and do not become infective until sporulation is completed. Refer to the life cycle of *Cyclospora cayentanensis* for further details.
CDC DPDx Parasite Image Library

Isospora belli

I. belli is a rare infection of normal humans, although it is being seen in increasing numbers in AIDS patients. The infection occurs via the oro-fecal route. The infective stage of the organism is an oval oocyst (Figure 11) which, upon ingestion, follows the same course as *C. parvum*. The disease produces symptoms similar to those of giardiasis. In normal individuals, mild infections resolve themselves with rest and mild diet and heavier infections can be treated with sulpha drugs. The treatment may have to be carried on for a prolonged period in AIDS patients.

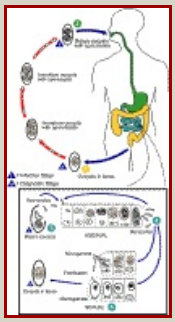
Figure 11


A

B

C Oocysts of Isospora belli. The oocysts are large (25 to 30 µm) and have a typical ellipsoidal shape. When excreted, they are immature and contain one sporoblast (A, B). The oocyst matures after excretion: the single sporoblast divides in two sporoblasts (C), which develop cyst walls, becoming

sporocysts, which eventually contain four sporozoites each.
Images contributed by Georgia Division of Public Health/CDC DPDx Parasite Image Library


Life cycle of Isospora belli

At time of excretion, the immature oocyst contains usually one sporoblast (more rarely two) 1. In further maturation after excretion, the sporoblast divides in two (the oocyst now contains two sporoblasts); the sporoblasts secrete a cyst wall, thus becoming sporocysts; and the sporocysts divide twice to produce four sporozoites each 2. Infection occurs by ingestion of sporocysts-containing oocysts: the sporocysts excyst in the small intestine and release their sporozoites, which invade the epithelial cells and initiate schizogony 3. Upon rupture of the schizonts, the merozoites are released, invade new epithelial cells, and continue the cycle of asexual multiplication 4. Trophozoites develop into schizonts which contain multiple merozoites. After a minimum of one week, the sexual stage begins with the development of male and female gametocytes 5. Fertilization results in the development of oocysts that are excreted in the stool 1. *Isospora belli* infects both humans and animals.
CDC DPDx Parasite Image Library

LUMINAL PROTOZOA

TRICHOMONIASIS

Etiology
Trichomonas vaginalis (a flagellate)

Epidemiology
Trichomonas vaginalis has a world-wide distribution; incidence is as low as 5% in normal females and as high as 70% among prostitutes and prison inmates.

Morphology
The trophozoite form is 15 to 18 micrometers in diameter and is half pear shaped with a single nucleus, four anterior flagella and a lateral flagellum attached by an undulating membrane. Two axostyles are arranged asymmetrically (Figure 12). The organism does not encyst.

Life cycle
T. vaginalis colonizes the vagina of women and the urethra (sometimes prostate) of men. Infection occurs primarily via sexual contact, although non-venereal infections are possible. The organism does not encyst and divides by binary fission which is favored by low acidity (pH > 5.9; the normal pH is 3.5 to 4.5). There is no non-human reservoir.

WEB RESOURCES
CDC - Trichomoniasis Fact Sheet

Symptoms
T. vaginalis infection is rarely symptomatic in men, although it may cause mild urethritis or occasionally prostatitis. In women, it is often asymptomatic, but heavy infections in a high pH environment may cause mild to severe vaginitis with copious foul-smelling yellowish, sometimes frothy discharge (Figure 12).

Pathology
The organism causes contact-dependent damage to the epithelium of the infected organ.

Diagnosis
Clinical suspicion may be confirmed by finding the organism in Giemsa-stained smears (Figure 12) of vaginal discharge or, in difficult cases, by cultivation of a swab sample in Diamond's medium. Trophozoites must be distinguished from the non-pathogenic flagellate *Trichomona hominis*.

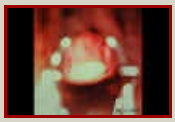
Treatment
Metronidazole (although teratogenic) is effective in both males and females. Vinegar douche may be useful. Personal hygiene and the use of condoms are helpful.

Figure 12


Trichomonas vaginialis - Trophozoites
CDC DPDx Parasite Image Library


Trichomonas vaginialis - Trophozoites
CDC


Two trophozoites of Trichomonas vaginalis from culture. The four flagella and single nucleus are visible. The dark median rod is the axostyle which is characteristic of the trichomonads
© Ohio State University/P.W. Pappas/S.M. Wardrop


Trichomonas vaginialis - Vaginal discharge
CDC


Trichomonas - Stained vaginal secretion
CDC


Trichomonas vaginalis trophozoite, Pap stain
© Dr Peter Darben, Queensland University of Technology clinical parasitology collection. Used with permission


Trichomonas vaginalis - parasitic protozoan that causes trichomoniasis (vegetative phase called trophozoite).
© Dennis Kunkel Microscopy, Inc. Used with permission


Figure 13 Life cycle of Trichomonas vaginalis
Trichomonas vaginalis resides in the female lower genital tract and the male urethra and prostate ❶, where it replicates by binary fission ❷. The parasite does not appear to have a cyst form, and does not survive well in the external environment. *Trichomonas vaginalis* is transmitted among humans, its only known host, primarily by sexual intercourse ❸.
DPDx Parasite Image Library

Summary				
Organism	**Transmission**	**Symptoms**	**Diagnosis**	**Treatment**
Entameba histolytica	Oro-fecal	Dysentery with blood and necrotic tissue. Chronic: abscesses	Stool: cysts with 1-4 nuclei and/or trophs. Trophs in aspirate.	GI: Iodoquinol or Metronidazole Abscess: Metronidazole
Giardia lamblia	Oro-fecal	Fowl-smelling, bulky diarrhea; blood or necrotic tissue rare.	Stool: typical old man giardia troph and/or cyst.	Iodoquinol or Metronidazole.
Balantidium coli	Oro-fecal; zoonotic	Dysentery with blood and necrotic tissue but no abscesses.	Stool: ciliated trophs and/or cysts.	Iodoquinol or Metronidazole.
Cryptosporidium	Oro-fecal	Diarrhea	Ooocysts in	Paromycin

parvum			stool	(investigational)
Isospora belli	Oro-fecal	Giardiasis-like	Ooocysts in stool	Sulpha drugs
Trichomonas vaginalis	Sexual	Vaginitis; occasional urethritis/prostatitis.	Flagellate in vaginal (or urethral) smear.	Mebendazole; vingar douche; steroids

 Return to the Parasitology Section of Microbiology and Immunology On-line

This page last changed on Tuesday, February 24, 2015
Page maintained by Richard Hunt