

# Parasitic infection

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# Introduction

- What is the difference between
  - *Symbiosis*
  - *Commensalism*
  - *parasitism*

# Introduction

- Symbiosis : when two species are dependent on each other for food and protection
- Commensalism: a mutual association in which both organisms may benefit, or at least one benefits but does no harm to the other
- Parasitism: one species (the host) does not benefit from the relationship, impact it is injured

# Introduction

The three major disease causing parasite groups are:

- Protozoan diseases
  - Giardiasis, amebiasis, malaria
- Helminthic infections
  - Ascariasis, Enterobiasis, hookworm, strongyloidiasis, and cestodiasis
- Ectoparasitic infestations
  - Head and body lice

# Host-parasitic relationship

- Parasites have made metabolic and other defensive adaptations over time to increase their ability to survive host defenses
  - have allowed them to utilize the host's biochemical systems to synthesize necessary cellular components
- **Cestodes** possess highly developed reproductive systems that allow them to transfer easily to new hosts
- Cestodes are completely host-dependent for all nutrients (lack of digestive system)

# Host-parasitic relationship

- **Tapeworms:** use specialized suckers that enable them to obtain blood and vital nutrients from their host
- **Entamoeba histolytica:** is able to invade and utilize its specialized proteolytic enzyme to erode the GI mucosa
- **Ascaris:** can perforate the bowel wall, cause intestinal obstruction, and invade the appendix and bile duct
- **Malarial parasites** destroy red blood cells by multiplying inside them

# Host-parasitic relationship

- The extent of parasites injury depends on
  - parasite load,
  - nutritional status and
  - immunologic competence of the host
- E.g E. coli is considered commensal because it subsists on the bacterial flora of the gut and does not cause any harm to the host

# GIARDIASIS

- *Giardia lamblia* (*G. intestinalis* or *G. duodenalis*), is the most common intestinal parasite responsible for diarrheal syndromes throughout the world
- *G. lamblia* has been identified as the first enteric pathogen in children in developing countries, with prevalence rate of 15%-30%
- There are two stages in the life cycle of *G. lamblia*: the **cyst** and **trophozoite**
- *G. lamblia* is found in the small intestine, the gallbladder, and in biliary drainage



# Pathophysiology

- Giardiasis is caused by ingestion of *G. lamblia* cysts in fecally contaminated water or food
- The protozoan excysts in the low gastric pH to release the trophozoite
- Colonization and multiplication of the trophozoite lead to
  - inflammation of duodenal mucosal leading to malabsorption
  - localized edema,

# Pathophysiology

- Achlorhydria, hypogammaglobulinemia, or deficiency in IgA predispose to giardiasis.
- Individuals with HIV infection and AIDS may have higher carriage rates than the general population.
- Some patients may develop lactose intolerance after chronic giardiasis.

# Clinical presentation

## **Acute Onset**

- Diarrhea, cramp-like abdominal pain, bloating, and flatulence
- Malaise, anorexia, nausea, and belching

## **Chronic Symptoms**

- Diarrhea: Foul-smelling, profuse, light-colored, and greasy stools
- Weight loss, steatorrhea, and vitamin B12 and fat-soluble vitamin deficiencies
- Constipation alternating with diarrhea

# Diagnosis

- Examination of fresh stool or a preserved specimen during the acute diarrheal phase
- Fresh stool may show trophozoites, whereas preserved specimens yield cysts
- Enzyme linked immunosorbent assay (ELISA)
- direct fluorescent antibody (DFA)
- Identification of the *Giardia antigen*.

# Treatment

- General management
  - patients should receive adequate oral or intravenous fluids to maintain hydration,
  - correct electrolyte abnormalities, and
  - provide oral, enteral, or parenteral nutrition

# Treatment

Pharmacologic agent	Adult	Children
Metronidazole	250 mg orally every 8 hours × 5-10 days	15 mg/kg orally every 8 hours × 5-7 days (maximum 250 mg/dose)
Tinidazole	2 grams × 1 dose with food	≥3 years: 50 mg/kg orally × 1 dose with food (maximum 2 grams) 1-3 years: 100 mg orally every 12 hours with food × 3 days
Nitazoxanide	500 mg orally every 12 hours with food × 3 days	4-11 years: 200 mg orally every 12 hours with food × 3 days ≥12 years: 500 mg orally every 12 hours with food × 3 days

# Treatment

- **Alternative drugs include**
- albendazole 400 mg daily for 5 days,
- paromomycin 25 to 35 mg/kg/day in three divided doses for 1 week, and
- quinacrine 100 mg three times a day
- **Pregnancy**
- Paromomycin is a safe agent in all trimesters
- Metronidazole has been used in the second and third trimesters of pregnancy

# AMEBIASIS

- *E. histolytica* is the major causative organism in amebiasis
- Invasive amebiasis is almost exclusively the result of ingesting *E. histolytica* cysts found in fecally contaminated food or water
- The highest incidence is found in institutionalized mentally retarded patients, sexually active homosexuals, AIDS patients, and new immigrants from endemic areas



# Pathophysiology

- Cysts and trophozoites are passed in feces
- Excystation occurs in the small intestine and trophozoites are released, which migrate to the large intestine
- N:B due to protection conferred by their walls, the cysts can survive days to wks in external environment and are responsible for transmission
- Trophozoites passed in the stool are rapidly destroyed once outside the body, and if ingested would not survive due to gastric environment

# Pathophysiology

- In many cases, the trophozoites remain confined to the intestinal lumen (non invasive infection)
- In some patients the trophozoites invade the intestinal mucosa or, through the bloodstream, extraintestinal sites such as the liver, brain, and lungs

# Pathophysiology

- *E. histolytica* invades mucosal cells of colonic epithelium, producing the classic flask-shaped ulcer in the submucosa
- The trophozoite toxin has a cytocidal effect on cells.
- If the trophozoite gets into the portal circulation, it will be carried to the liver, where it produces abscess and periportal fibrosis.
- Liver abscesses are more common in men than women

# Pathophysiology

- Amebic ulcerations can affect the perineum and genitalia, and abscesses may occur in the lung and brain.
- Erosion of liver abscesses can result in peritonitis.
- Liver abscesses that are located in the right lobe can spread to the lungs and pleura.
- Pericardial infection, may be associated with extension of the amebic abscesses from the liver.

# Clinical presentation

- Review of the patient's history should include the following:
  - recent travel, type of foods ingested (eg, salads or unpeeled fruit), the nature of water and fluid consumed
- **Intestinal Disease**
- Symptoms may range from malaise to severe abdominal cramps, flatulence, and non bloody or bloody diarrhea (heme-positive in 100% of cases) with mucus

# Clinical presentation

- May have low-grade fever, but this may be absent in many patients
- Eosinophilia is usually absent, although mild leukocytosis is not unusual
- **Amebic Liver Abscess**
- May present with high fever with significant leukocytosis with left shift,
- anemia, elevated alanine aminotransferase, and
- dull abdominal pain on palpation

# Clinical presentation

- **Physical findings:**
- Right upper quadrant pain, hepatomegaly and liver tenderness,
- (Note: Erosion of liver abscesses may present as peritonitis.)

# Diagnosis

- Intestinal amebiasis
- Presence of *E. histolytica* cysts or trophozoites in fresh stool or from a specimen obtained by sigmoidoscopy
- Sensitive techniques are available to detect *E. histolytica* in stool: antigen detection, antibody test (ELISA) and PCR
- Endoscopy with scrapings or biopsy and stained slides may provide more definitive diagnosis of amebiasis



# Diagnosis

- Diagnosis for liver abscess includes
- serology and liver scans (using isotopes by ultrasound or CT or MRI; however, none of these are specific for liver abscess.
- In rare instances, needle aspiration of hepatic abscess may be attempted using ultrasound guidance

# Treatment

- Different regimens have been suggested depending on the category of amebiasis:
  - asymptomatic cyst passers,
  - intestinal amebiasis, and
  - amebic liver abscess
- Adjunctive treatment includes electrolyte replacement, antibiotic therapy and nutritional support
- Large hepatic abscesses or amebic pericarditis may require
  - needle aspiration, percutaneous catheter drainage, or, rarely, surgery before drug therapy

# Treatment

- Metronidazole and tinidazole are **tissue-acting agents**;
- Paromomycin, iodoquinol, and diloxanide furoate are **luminal amebicides**
- N:B A luminal acting agent, may be too poorly absorbed to be effective in the tissue.
- In the asymptomatic cyst passer, it is necessary to eradicate the causative agent from the **lumen** to prevent intestinal amebiasis or the development of amebic liver abscess.
- diloxanide furoate 20 mg/kg/ day in three doses for 10 days.

# Treatment

- Asymptomatic Cyst Passer
- Paromomycin: 25 to 35 mg/kg/day three times daily for 7 days
- Iodoquinol 650 mg three times daily for 20 days (adults)
  - Children 30-40 mg/kg/day orally every 8 hours × 20 days
- Paromomycin is the preferred luminal agent in pregnant patients.

# Treatment

- **Intestinal/Amebic Liver Abscess**
- **Metronidazole** 500-750 mg three times daily for 7-10 days, followed by the luminal agents indicated above.
  - Pediatric dose is 35-50 mg/kg/day in divided doses
- **Tinidazole** 2 grams daily × 3 days
  - Pediatric dose is 50 mg/kg for 3 days

# HELMINTHIC DISEASES

- Include three groups of organisms:
  1. Roundworms or nematodes,
  2. flukes (trematodes), and
  3. tapeworms (cestodes)
- Populations at risk include institutionalized patients, daycare centers, and homosexuals

# Nematodes

- **Hookworm Disease**
- Infective larvae enter the host in contaminated food or water or penetrate the skin and migrate to the small intestine.
- The adult worm attaches to GI mucosa and causes injury by lytic destruction of the tissue.
- over a period of time, the adult worm can cause anemia and hypoproteinemia in the host.
- Diagnosis is by detection of eggs or larvae in stool.

# Treatment

- Mebendazole (Vermox), is the DOC
- It is also active against ascariasis and enterobiasis
- **Dose 100 mg twice daily for 3 days**
- Alternative: albendazole 400 mg as SD



# Ascariasis

- The causative agent is *Ascaris lumbricoides*
- Migration of the worm into the lungs produces **pneumonitis**, fever, cough, eosinophilia, and pulmonary infiltrates.
- It can also cause abdominal discomfort, intestinal obstruction, and appendicitis.
- Diagnosis is made by detection of the characteristic eggs in the stool or passed worms.

# Treatment

- Mebendazole 100 mg orally twice daily for 3 days is the drug of choice
- An alternative agent is pyrantel pamoate

# Enterobiasis/ pinworm

- Is caused by *Enterobius vermicularis*.
- most common manifestation is **cutaneous irritation** in the perianal region,
  - resulting from the migrating female or the presence of eggs
- The intense pruritus may lead to dermatitis and secondary bacterial infections.
- Diagnosis is made by the use of a perianal swab which will aid in egg identification.

# Enterobiasis

- **Treatment**
- pyrantel pamoate 11 mg/kg (maximum:1 g) as a single dose that can be repeated in 2 weeks.
- Mebendazole 100 mg as a single dose (This may be repeated in 2 weeks)
- Albendazole

# Cestodiasis/Tapeworm

- Caused by species of the flatworms and include, pork tapeworm (*Taenia solium*) and the beef tapeworm (*T. saginata*).
- The tapeworm attaches itself to the mucosal wall of the upper jejunum by the scolex (mouth parts) and by two to four cup-shaped suckers
- Since the parasite **lacks a digestive system**, it obtains all nutrients directly from the host.
- The scolex, proglottids (segments), and eggs are specific for each species and used for identification of tapeworms.

# Cestodiasis/Tapeworm

- Tapeworm infections are caused by ingestion of poorly **cooked meat** that contains the larva or cysticerci.
- Cysticerci, when released from the contaminated meat by host digestive juices, mature in the host jejunum.
- The larvae can penetrate the bowel and migrate through the bloodstream to infect different organs, including the **CNS (neurocysticercosis)**.

# Treatment

- T. saginata and T. solium:
- praziquantel 5 to 10 mg/kg as a single dose
- cysticercosis and neurocysticercosis
  - anticonvulsants (neurocysticercosis can cause seizures), and
  - anthelmintic (albendazole 400 mg twice daily for 5 to 30 days)

# Outcome Evaluation

- Morbidity and disease due to helminthic infections is related to the intensity of infection.
- major adverse effects of helminthic
  - malnutrition, fatigue, and diminished work capacity
- The most serious complication of cysticercosis is neurocysticercosis that can cause strokes and seizures



# ECTOPARASITES

- A parasite that lives on the outside of the body of the host is called an ectoparasite
- Three types of human lice belong to two genera: Pediculus and Phtirus
  - Pediculus humanus capitis causes head lice
  - Pediculus humanus corporis causes body lice
  - Phthirus pubis causes pubic lice

# Pathophysiology and Clinical Presentation

- Female lice deposit eggs on the hair. The eggs remain firmly attached to the hair, and
- In about 10 days, the lice hatch to form nymphs, which mature in 2 weeks
- The larva and adults feed on the blood of the host.
- Pubic or crab lice are found on the hair around the genitals (may found in eyelashes, beards, and axillae).
- Patients usually complain of severe pruritus from papular lesions produced by the bite of the louse

# Treatment

- For head lice: permethrin 1%, 5% cream/lotion
- is applied to the scalp after the hair has been dried following a shampooing.
  - stay on for 10 minutes. The hair then should be rinsed thoroughly
- Other topical preparations for lice are 0.5% malathion, 5% benzyl alcohol, and 0.5% ivermectin
- All bedding and clothes should be sterilized by boiling or washing in the hot water

# Scabies

- Infection usually affects
  - the interdigital and popliteal folds, axillary folds,
  - the umbilicus, and the scrotum
- Patients will complain of severe itching and an inability to sleep and may have excoriations in the interdigital web spaces, wrists, elbows, buttocks, groin, and scalp
- Excoriations may lead to secondary bacterial infections

# Treatment

- **Permethrin 5% cream**
- The skin should be scrubbed thoroughly in a warm soapy bath using a soft brush to remove all scabs
- The lotion is then applied to the whole body, avoiding the face, mucous membranes, and eyes
- The application should be left on for 8 to 14 hours before bathing
- All close contacts should be checked and treated appropriately

# Treatment

- Benzyl benzoate is an irritant and should be avoided in children;
  - it is also less effective than Permethrine
  - Application of crotamiton can be used to control itching after treatment
- Other agent oral ivermectin 200 mcg/kg as a SD, which may be repeated in 2 weeks
- Topical corticosteroids and antihistamines may be used to decrease pruritus