ASCARIS LUMBRICOIDES

ANCYLOSTOMA & NECATOR

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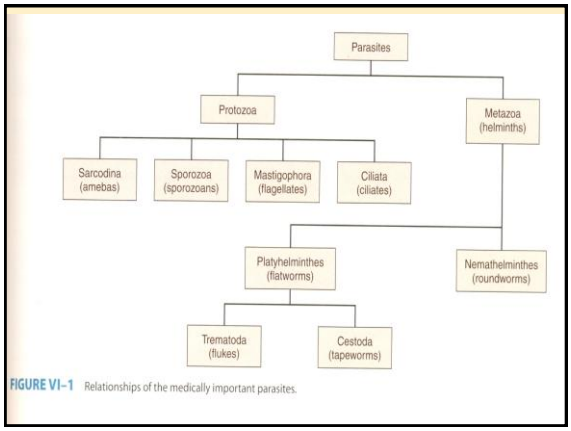


FIGURE VI–1 Relationships of the medically important parasites.

Taxonomic Classification Of Helminths

Sub kingdom	Phylum	Class	Genus – examples
Metazoa	Nemathehelminthes Round worms; appear round in cross section, they have body cavities, a straight alimentary canal and an anus	Nematodes	Ascaris (roundworm) Trichuris (whipworm) Ancylostoma & Necator (hookworm) Enterobius (pinworm or threadworm) Strongyloides
	Platyhelminthes Flat worms; dorsoventrally flattened, no body cavity and, if present, the alimentary canal is blind ending	Cestodes Adult tapeworms are found in the intestine of their host They have a head (scolex) with sucking organs, a segmented body but no alimentary canal Each body segment is hermaphrodite	Taenia (tapeworm)
		Trematodes Non-segmented, usually leaf-shaped, with two suckers but no distinct head They have an alimentary canal and are usually hermaphrodite and leaf shaped Schistosomes are the exception	Fasciolopsis (liver fluke) Schistosoma (not leaf shaped!)

NEMATODES (ROUND WORMS)

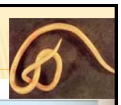


TABLE 56–1 Features of Medically Important Nematodes

Primary Location	Species	Common Name or Disease	Mode of Transmission	Endemic Areas	Diagnosis	Treatment
Intestines	*Enterobius*	Pinworm	Ingestion of eggs	Worldwide	Eggs on skin	Mebendazole or pyrantel pamoate
	Trichuris	Whipworm	Ingestion of eggs	Worldwide, especially tropics	Eggs in stools	Mebendazole
	Ascaris	Ascariasis	Ingestion of eggs	Worldwide, especially tropics	Eggs in stools	Mebendazole or pyrantel pamoate
	Ancylostoma and *Necator*	Hookworm	Larval penetration of skin	Worldwide, especially tropics (*Ancylostoma*), United States (*Necator*)	Eggs in stools	Mebendazole or pyrantel pamoate
	Strongyloides	Strongyloidiasis	Larval penetration of skin, also autoinfection	Tropics primarily	Larvae in stools	Ivermectin
	Trichinella	Trichinosis	Larvae in undercooked meat	Worldwide	Larvae encysted in muscle; serology	Thiabendazole against adult worm
	Anisakis	Anisaklasis	Larvae in undercooked seafood	Japan, United States, Netherlands	Clinical	No drug available
Tissue	*Wuchereria*	Filariasis	Mosquito bite	Tropics primarily	Blood smear	Diethylcarbamazine
	Onchocerca	Onchocerciasis (river blindness)	Blackfly bite	Africa, Central America	Skin biopsy	Ivermectin
	Loa	Loiasis	Deer fly bite	Tropical Africa	Blood smear	Diethylcarbamazine
	Dracunculus	Guinea worm	Ingestion of copepods in water	Tropical Africa and Asia	Clinical	Thiabendazole prior to extracting worm
	Toxocara larvae	Visceral larva migrans	Ingestion of eggs	Worldwide	Clinical and serologic	Albendazole or mebendazole
	Ancylostoma larvae	Cutaneous larva migrans	Penetration of skin	Worldwide	Clinical	Thiabendazole

ASCARIS LUMBRICOIDES

Introduction

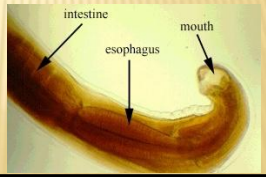
- Two species, one in humans and the other in pigs
- ***Ascaris lumbricoides*** - humans
- Phylum Nematoda
- Also known as "Giant round worm"
- Spreads by fecal pollution of environment
- **No Intermediate Host Involved**
- Man is the only host

PREVALENCE

- Most common helminthic human infection - Worldwide
- High prevalence in underdeveloped countries that have poor sanitation
- Occurs during rainy months, tropical and subtropical countries
- A common cream colored roundworm
- An estimated 1 billion people are infected
  - 1 out of 4 people in the world

General Characteristics

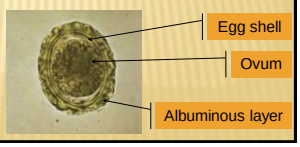
- Natural habitat is human intestine
- Obtain nourishment from semi digested food of the host
- Infection starts from ingestion of eggs
- Children get infection from hand - mouth while playing in contaminated soil or dirt eating



Morphology Of Eggs

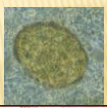
Fertilized egg

- Round or oval
- Measures 60-75 X 40-50 µm
- Brown (Bile stained)
- **Covering**
  - Inner thick, smooth, translucent shell
  - Outer albuminous coat which is thrown into rugosities(thick external layer)
- Contain → large fertilized, unsegmented ovum, with a clear cresentic area at each poles



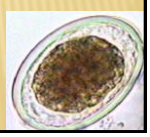
Un-fertilized egg

- Female is capable of liberating eggs even if not fertilized**:**
- Elliptical (elongated and larger than fertilized egg
- measures between 80 X 50 µm
- Brown (Bile stained)
- **Covering** is similar, but thinner than in fertilized eggs
- Contain → small atrophed ovum with mass of refractile granules of various sizes
- **Significance** either host is harbouring only female or mating has not occur



Decorticated egg

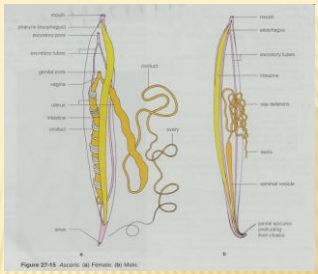
- normal fertile eggs may lack the mammillated layer



Morphology Of Worms

Adult worm

- Elongated, cylindrical & tapered ends, ant thin then post.
- Female is larger in size and has a genital girdle
- Length 25 to 35 cm (giant round worm), max diameter 3-4 mm
- **Ant. end**: Characterized by three large rounded lips
- **Post. end**: in **Males-** curved, genital pores open into cloaca from which 2 curved copulatory spicules protrude. In **Female** – conical & straight. Anus open subterminally on ventral aspect. Vulvar opening at junct. of anterior & middle third of body on midventral aspect
- Ovaries are extensive, contain up to 27 million eggs at a given time
- Female lays eggs into host intestine
  - 200,000 per day passed out in host feces
- Feed on semi-digested contents in the gut
- Evidence shows that they can bite the intestinal mucus membrane & feed on blood and tissue fluids



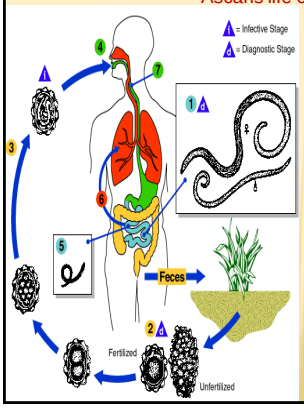
A pair of female and male worms

Notice the vulvar waist (arrow) of the female worm and the coiled end of the male worm

Modes Of Transmission

- Definitive host
  - Humans or pigs
- Intermediate Host
  - None
- Mainly via **ingestion** of water or food (raw vegetables or fruit in particular) contaminated with *A. lumbricoides* eggs
- Children playing in **contaminated soil** may acquire the parasite from their hands
- Occasionally by **inhalation** of contaminated dust
- Transmission can also occur via placenta

Ascaris life cycle



- Fully embryonated eggs are swallowed and L2 hatches in the stomach and penetrate stomach or duodenal mucosa
- Larvae enter blood stream and leave through alveoli into lung
- Larvae molt several times in the lungs L3/L4 move up and get swallowed
- 2-3 months after infection the adult worms start laying eggs (200,000 daily)
- Adult life span – 01 year
- Eggs are shed with the feces and embryonate within 2-3 weeks

Life Cycle - Descriptive

- Females lay **eggs** in small intestine → feces
- After 14 days, **L1 filariform** larvae develop in eggs
- Ingestion of raw fruits or vegetables contaminated with eggs
- When ingested, larvae escape by way of operculum (eggs hatch) in small intestine, - **L2 rhabditiform** larvae
- L2 penetrate/burrow through the intestinal wall, enter portal blood stream, migrate to liver, heart or lungs in 1-7 days
- From lungs, they are coughed up and swallowed
- Reach the small intestine
- Moult twice to become **L4** larvae
- Mature and mate, and complete their life cycle

Pathology

Migration of larvae

- Major damage occurs during larval migration rather than from the presence of the adult worm in the intestine.
- Some larvae migrate to **ectopic sites** and dependent upon number and location, cause various inflammatory responses, leading to very **severe allergic reactions**
  - Spleen, liver, lymph nodes, heart, kidney, brain and spinal cord
- Transplacental migration can also occur
- **In the lungs…Loeffler's pneumonia**

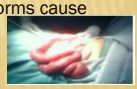
Symptoms

Symptoms associated with larval migration

- Migration of larvae in lungs may cause **blood tinged sputum (that may contain larvae)/ eosinophilic pneumonia, cough (Loeffler's Syndrome)**
- Breathing difficulties and fever
- Complications caused by parasite proteins that are highly **allergenic - asthmatic attacks**, **pulmonary infiltration** and **urticaria (hives)**

Symptoms associated with adult worms in the intestine

- Usually asymptomatic (85%)
- Vague **abdominal discomfort**, **nausea** in mild cases
- **Malnutrition** (protein malnutrition, Vit A deficiency) in host especially in children in severe cases
- Heavy worm loads can retard physical and mental development
- Sometimes fatality may occur when mass of worms cause **intestinal obstruction**



Symptoms associated with worm migration

- Worms retain motility, do not attach
- Migration of adult worms may cause signs and symptoms of **perforation**, **peritonitis**, **appendicitis** or **extrahepatic biliary obstruction**
- Severe **inflammatory reactions** mark the migratory route
- **Dermatological** and **allergic reactions** can occur

Complications

- Intestinal obstruction, volvulus, intussusception
- Obstruction of intrahepatic and extrahepatic bile ducts
- Peritonitis caused by intestinal perforation
- Chronic pancreatitis
- Acute or chronic appendicitis
- Pneumonitis, bronchitis and asthma

Intestinal blockage in heavy infections - intestinal obstruction. Worms may knot up causing blockage which may be fatal

Laboratory Diagnosis

- **Specimens**- stool, vomitus, (sputum, blood, serum.)
- **Macroscopic identification**
  - Of adults passed in stool or through the mouth or nose
- **Larval worms**
  - Detection in sputum
- **Stool Microscopy**
  - Eggs may be identified on direct stool examination
- **Blood examination**
  - Eosinophilia can be found, particularly during larval migration through the lungs

- **Imaging**
  - In heavily infested individuals, particularly children, large collections of worms may be detectable on **plain film of the abdomen** or with **barium emulsion** – ingested by worm-cast an opaque string like shadow
- **Ultrasound**
  - Ultrasound exams can help to diagnose hepatobiliary or pancreatic ascariasis
  - Single worms, bundles of worms, or pseudotumor-like appearance
  - Individual body segments of worms may be seen

- **Endoscopic Retrograde Cholangiopancreatography (ERCP)**
  - A duodenoscope with a snare to extract the worm out of the patient

Treatment

- **Albendazole**
  - A single oral dose of 400 mg
- **Mebenazole**
  - 100 mg orally twice daily for 3 days
- **Piperazine**
- **Pyrantel pamoate**
- **Ivermectin**
- **Levamisole**

Prevention

- Good hygiene is the best preventive measure
- Avoid contacting soil that may be contaminated with human feces
- Wash hands with soap and water before handling food
- Wash, peel or cook all raw vegetables and fruits before eating
- Periodic mass treatment of children with **single doses of mebendazole or albendazole.** Helps reduce transmission in community but does not protect from reinfection
- Prevention of reinfection poses a substantial problem since this parasite is abundant in soil

ANCYLOSTOMA & NECATOR

ANCYLOSTOMA DUODENALE

- Geographic distribution
  - Wide spread in tropical & subtropical zones
  - Temperate & humid climate is favourable
  - Ancylostoma is found in Europe around the Mediterranean, on the West coast of South America and in parts of China and India
  - Necator is found over much of the western hemisphere, Africa and South East Asia
  - More than a billion people infected

- Habitat
  - Adult lives in jejunum and duodenum of man (the definitive host)
  - No intermediate host
  - Eggs passed in faeces not infective to man
  - Infective larvae found in soil & water.
- Mode of transmission
  - Infective larvae penetrates skin

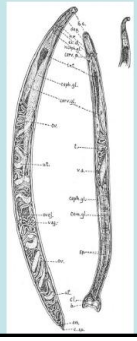
MORPHOLOGY

Adults: They look like an odd piece thread and are about 1cm. They are white or light pinkish when living. ♀**is slightly larger than**♂. The male's posterior end is expanded to form a copulatory bursa.

Adult female *Ancylostoma duodenale*

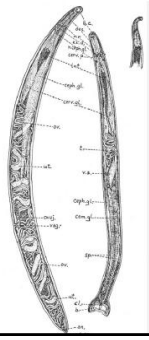
About 1.2 cm x 600 um

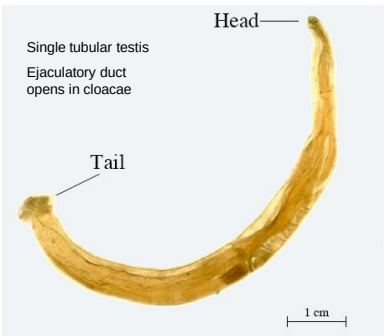
Cylindrical
Creamy white
Blood may be visible
Head dorsally bent
Club shaped oesophagus
Intestine straight tube



Adult male *Ancylostoma duodenale*

1 cm x 500 um

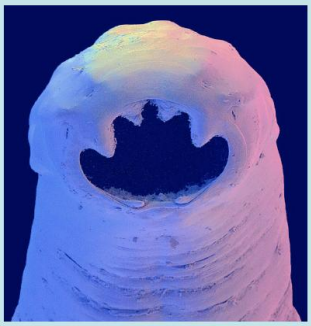




Single tubular testis

Ejaculatory duct opens in cloacae

Adult *Ancylostoma duodenale*



Oval aperture

Two teeth on each side ventrally

Outer one larger

U-shaped gap

Ventral glands ducts near teeth

Adult *Necator americanus*

Cutting organs are two plates

Ant end more bent

Produces less number of eggs

Takes less blood

Site of vulva different than ancylostoma

RHABDITIFORM LARVA

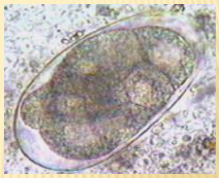
- First stage larva
- Immature: 270 x 15um.
- Long buccal cavity
- Small genital primordium.

Filariform larva

- Mature infective form
- 700 um
- Long buccal cavity.
- Small genital primordium.
- Long esophagus.
- Pointed tail

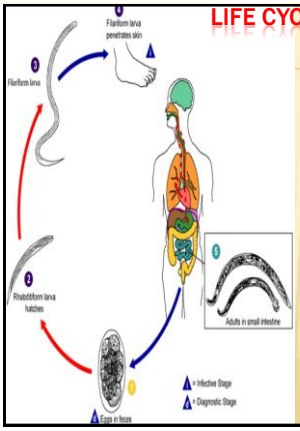
OVUM

Oval or can-shaped with a thin hyaline shell; they measure 60-75 by 36-40 µm



Embryonated eggs. The motile larva can be observed within the thin hyaline shell

LIFE CYCLE



- Adult worms live in the small intestine and female lay 5000-10000 eggs a day over 5 years
- Eggs are passed with the feces
- Larvae develop outside the body and molt twice
- The filariform or L3 larvae move in search for a host
- Penetrate the skin, enter blood vessels and leave the circulatory system into the alveoli
- The lavae move up the trachea into the esophagus, are swallowed and finally reach the intestine, where they molt twice more before they reach maturity

Clinical Features

- **Skin penetration** and associated secondary bacterial infection can result in "ground itch"
- **Pulmonary phase** is usually asymptomatic but may cause bronchitis, pneumonia and eosinophilia
- **Intestinal phase**: May cause anorexia, abd pain etc. Worms attach to the mucosa and feed on blood. Worms continuously move to new places exacerbating bleeding

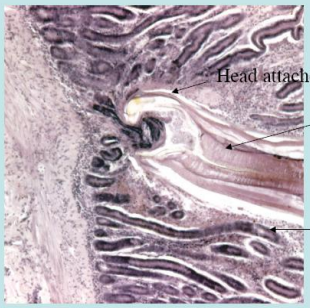
Clinical Features

- The main concern with hook worm disease is blood loss
- 0.03 ml to 0.26 ml per worm, up to 200 ml per day in heavy infections
- In order to do all this, the worm has evolved a set of powerful anti-coagulants even more effective than those of the medical leech.
- Chronic heavy infection results in iron deficiency anaemia
- Anemia leads to weakness and fatigue in adults

- Together with malnutrition infection can severely stunt growth and development in children

Histological section of adult hookworm attached to villus of small intestine

Adult worms suck blood and feed on villus tissue.



Diagnosis

- Direct microscopy of faecal smear revealing hook worm eggs is diagnostic.
- Formal ether concentration technique
- Saturated salt floatation technique may be used.

Hookworm adult as seen on endoscopy

Eggs

- Ancylostoma and Nectar americanus eggs are indistinguishable
- Shape is oval, size 60 µm x 40 µm.
- Colourless with thin transparent shell.
- Usually discharged in faeces at 4-8 cell stage.
- Rhabditiform larva may be seen in the egg if the specimen is more than 12 hrs old.
- Larva may hatch if specimen >24 hrs old.

Treatment

Drug	Adult	Pediatric
Albendazole	400 mg once	400 mg once
Mebendazole	100 mg bid X 3 days or 500 mg once	100 mg bid X 3 days or 500 mg once
Pyrantel pamoate	11 mg/kg (max 1 gm) X 3 days	11 mg/kg (max 1 gm) X 3 days

24

CONTROL MEASURES

- Sanitary disposal of feces
- Treatment of all known infected people esp high risk groups (agricultural workers and children)
- Wearing shoes in endemic areas
- Mass de-worming of school aged children