

Parasitic Nematodes

Phylum: Nematelminthes (Round Worms)

Class: Nematoda

It's estimated that more than 80,000 species are parasites of vertebrates the species parasitic in humans range in length from 2 mm (*Stroglyoides stercoralis*) to more than a meter (*Dracunculus medinensis*).

✧ The sexes are usually separate, the male which is smaller than female.

♂ Commonly has a curved posterior end and in some species copulatory specula's and bursa.

✧ The adult nematode is an elongate cylindrical worm and they are bilaterally symmetrical.

✧ The anterior end may be equipped with hooks, teeth, plates, setae, and papilla for purposes of abrasion, attachment and sensory response.

✧ The supporting body wall consists of ...

1. An outer hyaline non cellular cuticle.
2. A subcuticular epithelium.
3. A layer of muscle cells.

✧ The body cavity is pseudocoele in which the viscera are suspended.

✧ The digestive system consists of the anteriorly placed mouth which is usually surrounded by lips or papillae and in some species is equipped with teeth or plates mouth leading to esophagus which characteristically varies in shape structure in deferent groups which are useful for species identification.

The intestine lead to rectum opening through the anus. In the male the rectum and the ejaculatory duct open into cloaca.

Nematodes have simple excretory and nervous system:-

The nervous system consists of a ring of connected ganglia surrounding the esophagus.

The excretory system consists of two lateral canals that lie in the lateral longitudinal cords.

✧ The male reproductive system consists of a single delicate tubule differentiated into testis, Vasdeferens, Seminal vesicle and ejaculatory duct which opens into the cloacae.

The female reproductive system consists of ovary, oviduct, seminal receptacle, uterus and vagina .

✧ Nematodes may produce egg (oviparous) or larvae (viviparous). Some lay eggs containing larvae which immediately hatch out (ovoviviparous).

✧ The life cycle consists typically of four larvae stages and the adult form.

Round worms are classified according to final habitat of adult.

Adult round worm grouped in 2 categories ...

I – Intestinal round – worms.

II – Tissue round – worms.

I – The intestinal round – worms, these in which adults live in lumen of intestine. They include 8 worms as follows ...

1. *Ascaris lumbricoides*.
2. *Enterobius vermicularis*. (large intestine)
3. *Ancylostoma duodenale*
4. *Necator americanus*
5. *Strongyloids stercoralis*.
6. *Trichocephalus trichurus* (large intestine)
7. *Trichinella spiralis*.
8. *Trichostrongylus colubriformis*.

II –Tissue round – worm: adult live lagged in tissues (filarial worm + one medina: Drancunculus) ...

- a. Lymphatic: Wuchereria, Brugia.
- b. Subcutaneous: Loa Loa, onchocerca, Drancunculus.
- c. Mesentery: Mansonella.
- d. Conjunctiva: Loa loa.

Mode of infection.

1 – By ingestion ...

- a. **Eggs:** Ascaris, Enterobius, Trichuris.
- b. **Larvae with intermediate host:** Dracunculus.
- c. **Encysted larvae:** Trichinella in muscle.

2 – By penetration of skin: Ancylostoma, Necator, strongyloides.

3 – By blood sucking insect: filarial.

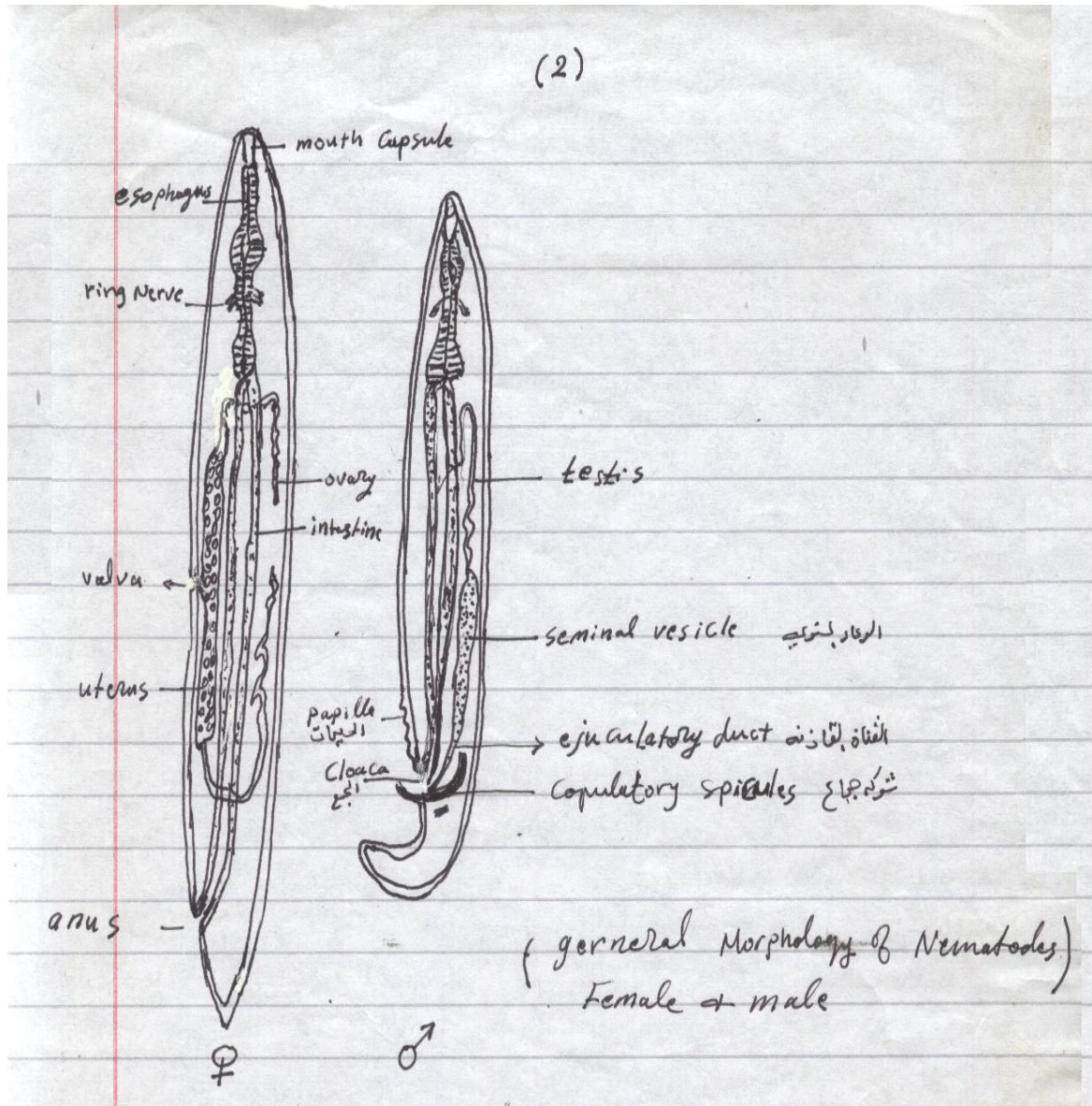
4 – By inhalation of dust containing Eggs: Ascaris, Enterobius.

Pathogenicity ...

✂ The effect of parasite nematodes upon the host depend upon the host depends upon the species and location of the parasite.

✂ The Number of parasite present or the intensity of in faction ...

- Adult worms in the intestine lead to local irritation, some degree of invasion of the intestinal wall or mucosal damage from blood sucking.
- Asingl adult Ascaris worm may penetrate the bowel or obstruct the bile duct. In large numbers they can cause intestinal obstruction.
- The larvae of contain species may produce local and general reaction during their invasion migration and development in the host.



We are deal with "intestinal Nematodes" which have an important in medical field (intestinal Nematodes) .

1 – *Ascaris Lumbricoides* (Round worm), Ascariasis داء الصفريات

Is the largest nematode parasite in the human intestine it is the commonest of human helminthes and distributed world wide.

The adult worms live in the small intestines of infected persons. They are cylindrical worms with tapering ends, the anterior ends being more pointed than posterior. The mouth at the anterior end has three finely denticulated lips, one dorsal and two ventrolateral.

✧ The male has posterior end is curve of ventrally to form a hook and carries two copulatory spicules.

✧ The female is larger its posterior extremity is straight and conical. The valva is situated mid ventrally.

✧ The vulva leads to a single vagina, which branches into a pair of genital tubules.

✧ The genital tubules of the gravid worm contain an enormous number of eggs as many as 27 million at a time; a single worm lays up to 200,000 eggs per day.

✧ Two types of eggs are passed by worm. The fertilized eggs lay by females inseminated by mating with a male, are embryonated and develop into the infective eggs.

✧ The uninseminated female also lays eggs, but these are non embryonated and cannot become infective, these are called unfertilized eggs.

✧ The fertilized ascaris egg is spherical or ovoid and consisting of three layers (outer mamillated albuminoidal coat, a thick transparent middle layer and the inner lipoidal vitelline membrane). Some eggs are found in faces with out the outer mamillated coat, they are called the decorticated eggs.

✧ The unfertilized egg has thin shell with irregular maxillary coat.

✧ The fertilized egg when passed in faces is not immediately infective. It has to undergo a period of incubation in soil before acquiring infectivity.

✧ The eggs are resistant to adverse conditions and can survive for several years.

✧ When the swallowed eggs reach the duodenum, the larvae hatch out. They penetrate the intestinal mucosa, enter the portal vessels and are carried to the liver.

From liver → to right heart → lung (break out into alveoli where they grow and molt twice).

Then they are carried up the respiratory passage to the throat and are swallowed.

The larvae molt and develop into adults in the upper part of the small intestine.

They become sexually mature in about 6 to 12 weeks and the gravid females start laying eggs.

Pathology and symptomatology.

✧ The usual infection consisting of 10 – 20 worms, often goes unnoticed by the host, and is discovered only on routine stool examination or by the discovery of an adult worm passed spontaneously in the stool.

✧ Abdominal pain, an eosinophilia is present during the larval Migration.

✧ During the lung migration the larvae may produce host sensitization that results in allergic manifestations such as pulmonary infiltration,

. Asthmatic attacks.

. Edema of the lips.

✧ Large numbers of larvae simultaneously migrating through the lungs may cause a serious hemorrhagic pneumonia.

✧ The worms may carry intestinal bacteria to these sites and stimulate the production of abscesses.

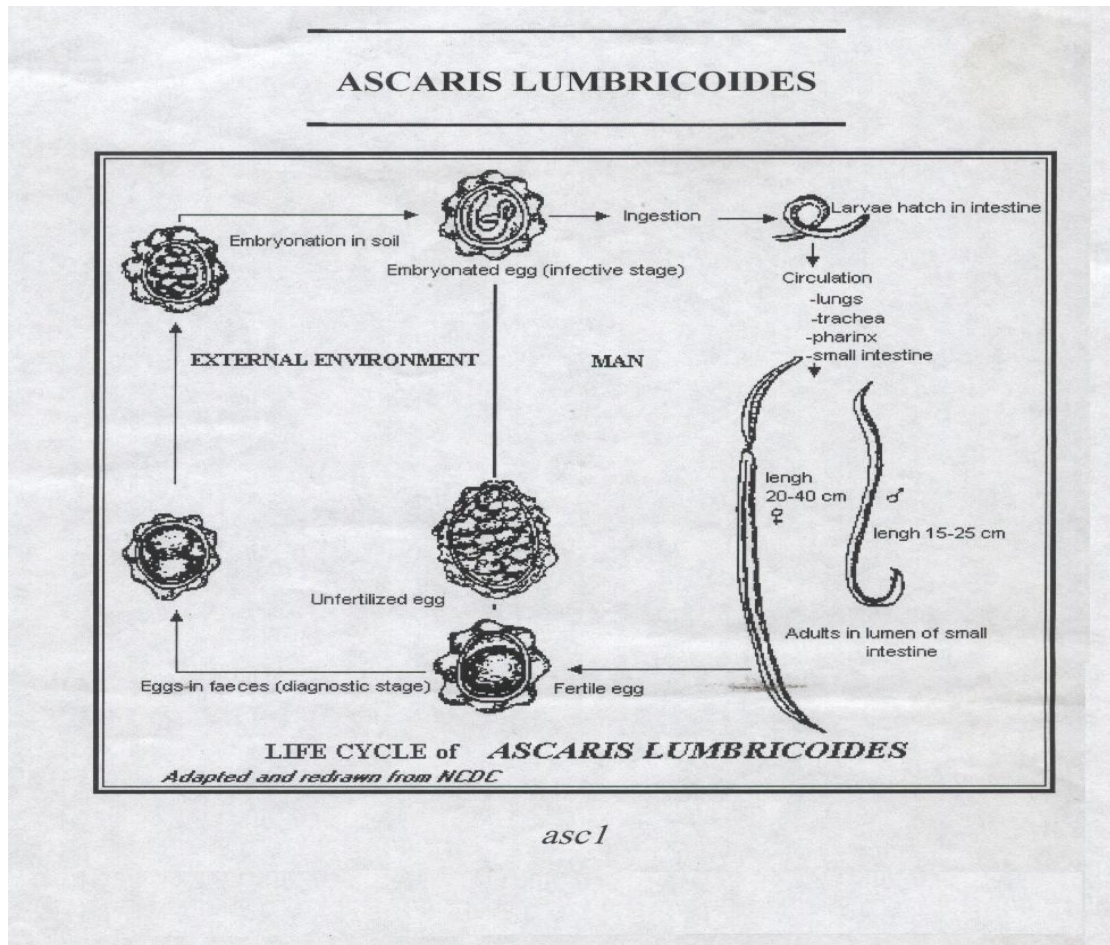
✧ The worms may penetrate the intestinal wall migrate into the peritoneal cavity, and produce peritonitis.

Diagnosis ...

- Diagnosis is made by finding eggs in feces.
- If direct examination is negative, concentration technique may be employed.
- The adult worm may be detected radiological.

Treatment...

- Piperazin citrate is safe and very effective in ascariasis. In single dose. Two – day course of 75 mg/kg daily.
- Albendazole in single dose of 400 mg.
- Mebenduzol (vermox) in a dosage of 100 twice for 3 days.
- Pyrantel pumoate (combantrin) in a single dose of 10 mg/kg body weight.



Hook worms الديدان الشصية

Hook worms disease is prevalent throughout the tropics and subtropics.

The species in man include ...

1. *Ancylostoma duodenale* & and spp. ملقوة الأثنى عشري
2. *Necator americanus*. الفتاكة الأمريكية

✧ **The morphology:** Adult hook worms are small cylindrical, fusiform, grayish white nematodes; the females are larger than the male's A. *duodenale* is larger than *N. americanus*. The worm female reproduces a relatively thick cuticle. There are single male and paired female reproductive organs.

The posterior end of the male has a broad caudal bursa with rib like rays which is used for attachment to the female during copulation.

The chief morphologic differences in the species are in the "shape, buccal capsule, and male bursa". The vulva is located anterior to the middle of the body in *Necator* and posterior in *Ancylostoma*. In the buccal capsule *N. americanus* has a conspicuous dorsal pair of cutting plates while *A. duodenale* has two ventral pairs of teeth.

✧ **Transmission** ... of hook worm's infection is spread by faecal pollution of the soil. Infection occurs when infective larvae penetrate the skin.

✧ **Habitat** ... adults live in small intestine of man (Jejunum and ileum) rarely in duodenum.

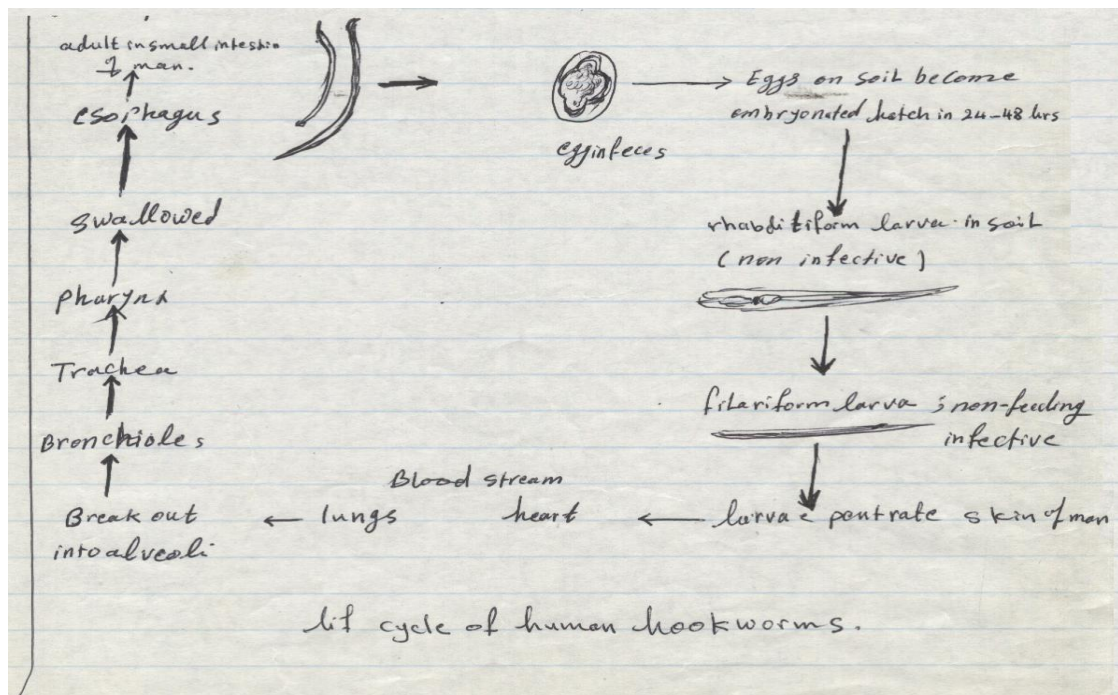
✧ **Female** ... with tapering caudal end.

✧ **Bursa** ... of ♂ *A. duodenale* which have two long retractile bristle-like copulatory spicules, the tips of which project from the bursa.

While in *Necator* the copulatory specula's are fused at the ends to form a barbed tip.

Life cycle ...

The life cycles of the several species of hook worm is similar. Eggs pass immature with faces and pass a period in the soil for maturation. Larvae develop in the soil and pass through the rhabditiform (non-infective) and filariform (infective) larvae... man gets infected by penetration of this filariform larvae through his skin (or the interdigital skin of the toes of barefooted persons) to a venule or a lymphatic to right side of heart → to lungs and squeezes itself through capillaries to pass to alveoli → creeping up wards to reach epiglottis → to esophagus & then to stomach & small intestine it takes a time to change to adult with a well developed buccal capsule and lays about 20,000 eggs daily .



Pathogenesis and symptomatology ...

The patient suffers from 3 successive phases according to the track of migration of parasite.

1. Skin phase ...

- Itching and swelling of skin of host in the sites of penetration of larvae (ground itch or Ancylostoma dermatitis).
- Points of entry change to blisters or pustules which clear within 2 weeks unless.
- Being, secondary infection.

2. Lung phase ...

- Filariform larvae cause minute hemorrhagic lesions with slight cough.
- In heavy infection, verminous pneumonia.

3. Intestinal phase ...

- When adults are found attached to intestine sucking blood and causing lytic deterioration of tissue at points of attachment.

- Minute ulcers are formed and bleeding at point of attachment.
- Ulcers liable to secondary infection.
- So gastrointestinal disturbances accompanied with anemia & squeals (endocrine and nervous disturbance).

Diagnosis ...

To detect infection of man by adult or soil to find filariform larvae.

1 – Defection of adult is by the presence of egg in stools by ...

a) Smear method. **b)** Flootation method.

2 – Detection of filariform larvae soil, by...

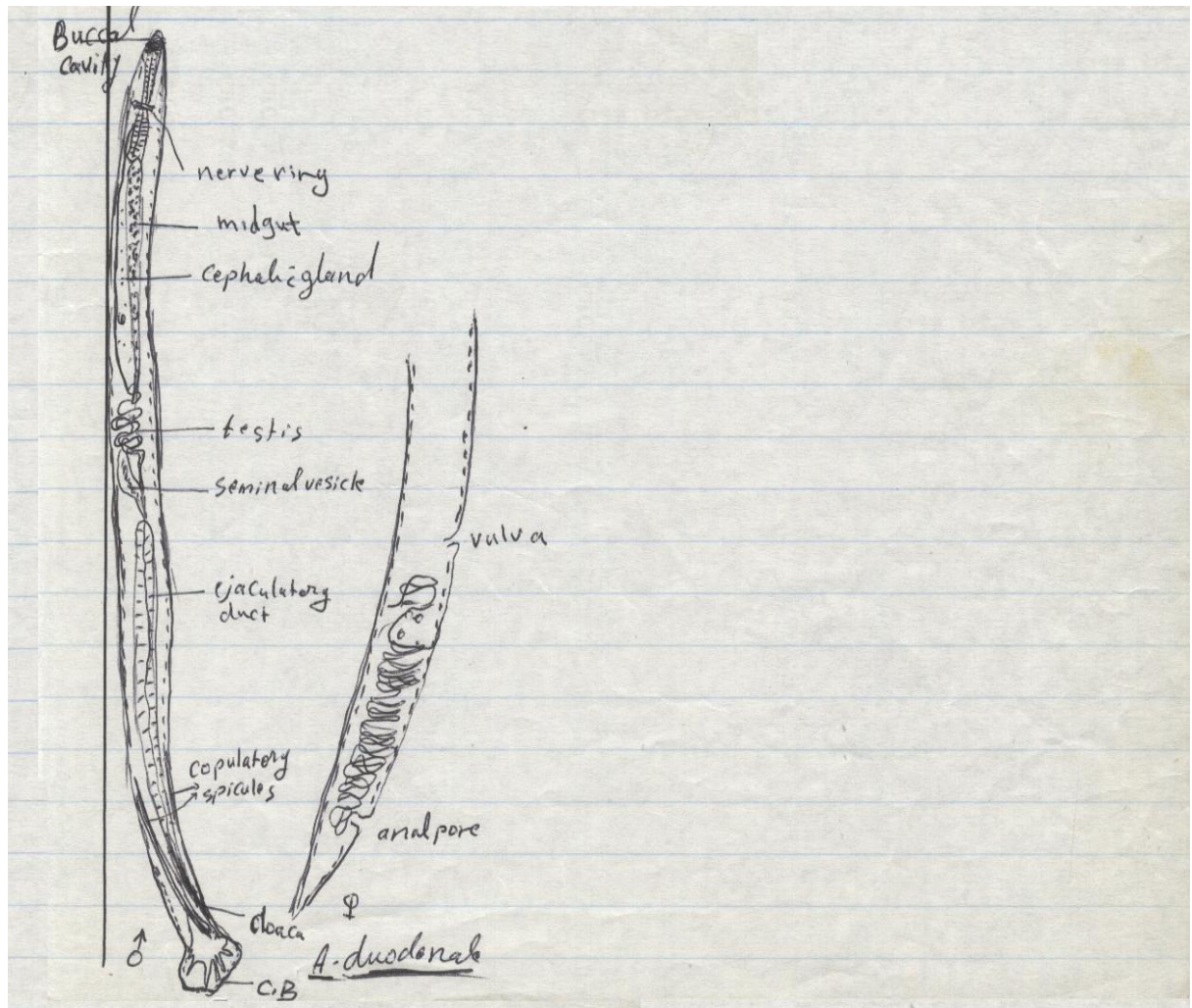
Baer man's technique (used to separate others nematode larvae as strongyloides).

Necator americanus – American hook worm..

Diagnostic. Morphology similar to *A. duodenale* but differs in ...

- Buccal capsule provide with 2 pairs of lancets instead of teeth.
- Head strongly curved.
- Male copulatory bursa lying in the same plane of body.
- In copula, both sexes appear T. shaped because valve of the female is at about middle of body. In *Ancylostoma*, they appear Y. shaped due to presence of vulva at the posterior half.

*Habitat, life cycle diagnoses pathogenic, treatment & control as in *A. duodenale*.



***Strongyloides stercoralis* ...**

Disease ... Strongyloidiasis , cochin – china diarrhea .

Habitat ...

1. Parasitic adult, in small intestine (duodenum and Jejunum)
fertilized female embedded in mucosa, where lay ova.
2. Free living adult: when present in the soil.

Diagnostic morphology ...

1- Parasitic female: longer and slender than free living female. Vulva at about the end of 2/3 of body esophagus cylindrical.

2 – free living female : small and stout . valve at about middle of body , ventrally , Gravid uterus divergent . esophagus rhabditiform .

Parasitic female colorless Sumatrans parent filariform nematode with finely striated cuticle . there is an esophagus occupying a quarter of the body which has two bulbs divided by a constriction .

3 – parasitic or free living males : with pointed ventrally curved tails with specula's .

Life cycle ...

This parasite has three types of life cycle ...

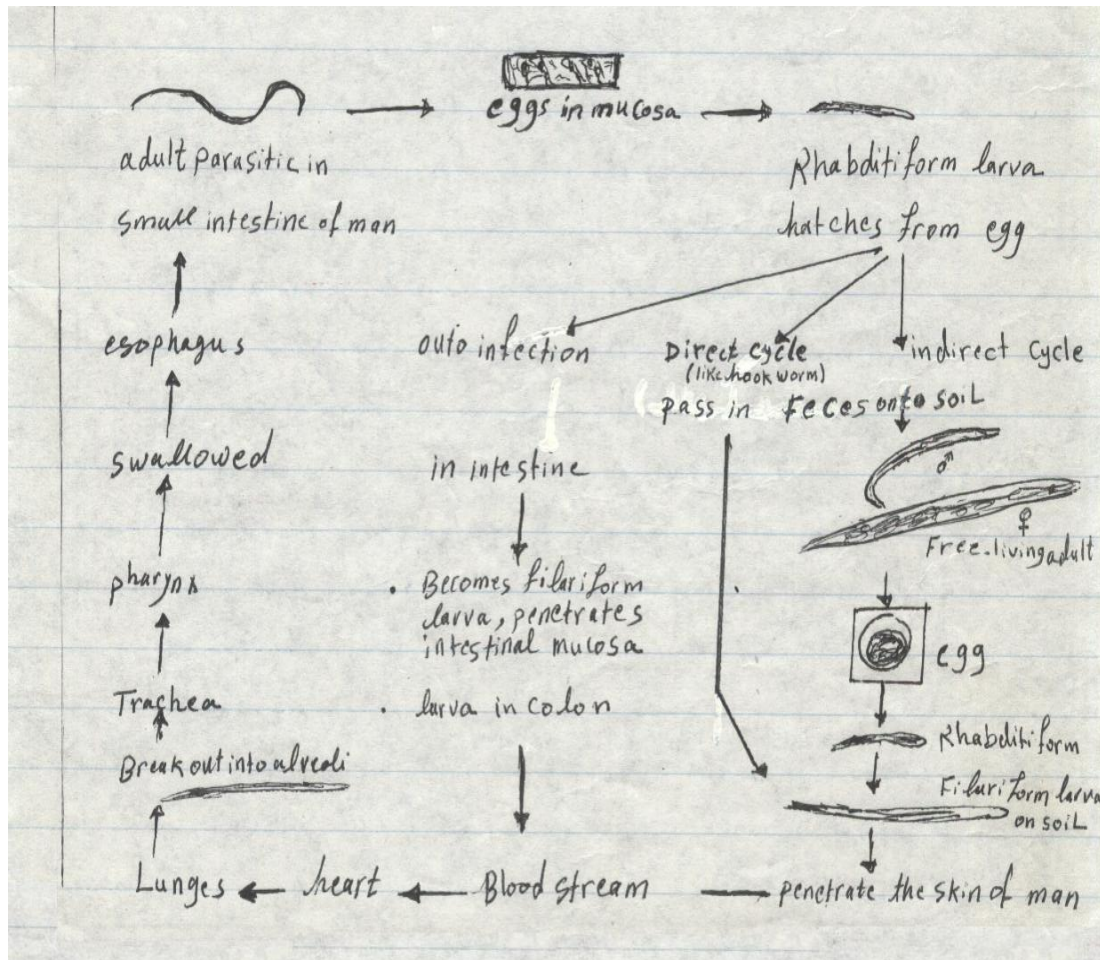
1- Direct cycle , like hook worm , after short feeding period of 2 to 3 days in soil .

The rhabditiform larva molts into a long , slender , nonfeeding , infective , filariform larva penetrate the human skin , enter the venous circulation and pass through the right heart to the lungs where they penetrate into the alveoli , from the lungs the parasites (adolescent) ascend to glottis , are swallowed and reach to upper part of the small intestine , where they develop in to adults . Mature ovipositing females develop in about 28 days after the initial infection .

2 – Indirect cycle ... In the indirect cycle the rhabditiform larvae develop into sexually mature , free living males and females in the soil . after fertilization the free living female produces eggs that developing rhabditiform larvae , these may become infection filariform larvae within a few days and enter new hosts , or they may repeat the free – living generating .

3 – Autoinfection ... at times the larvae may develop rapidly into the filariform stage in the intestine and , they penetrating the intestinal mucosa or the per anal skin , ... establish a development cycle within the

host . (Autoinfection explains persistent strangulation in patients living in non endemic areas) .



Clinical feature ...

- Strongyloidosis is generally benign and asymptomatic .
- A blood eosinophilia and larvae in stools being the only indication of infection .
- But it may sometimes cause clinical manifestations , which may be severe and even fatal , particularly in these with defective immune response .

The a clinical disease may be classified as ...

- ✧ **Cutaneous ...** - dermatitis (may be) .
- allergic response .

- ✧ **pulmonary ...** - during escape of the larvae from the pulmonary pulmonary capillaries hemorrhages occur .
 - Bronchopneumonia may be present .
 - in some go on to chronic bronchitis and asthmatic symptoms .
 - larvae may be found in the sputum .

✧ **Intestinal ...** mucus diarrhea is after present . severe disease seen in the immune compromised is known as hyper infection .. particularly in those with cellular defects extensive internal re – infection take place , leading to on or moves number of adult worms in the intestine and lungs and larvae in various tissues and organs this is known as hyper infection .

- | | | |
|------------------------------|---|--|
| Predispose to this condition | } | <ul style="list-style-type: none"> * malnutrition . * AIDS . * Immune suppressive drugs . * other situation in which cell mediated Immunity is defective . |
|------------------------------|---|--|

Diagnosis ...

- Demonstration of the rhabditiform larvae in freshly passed stools is the most important method of specific diagnosis .
- Larvae may sometimes be present in sputum and gastric aspirates .
- Diagnosis may be facilitated by stool culture . the larvae develop into free – living forms .
(multiply in charcoal cultures set up with stools) .
- Microscopy after concentration – as formal ether technique .
- The hairy string test (Enterotest capsules) .
- Scrological tests have been described , using strong yloides or filarial antigens . complement fixation

. Indirect haemagglutination

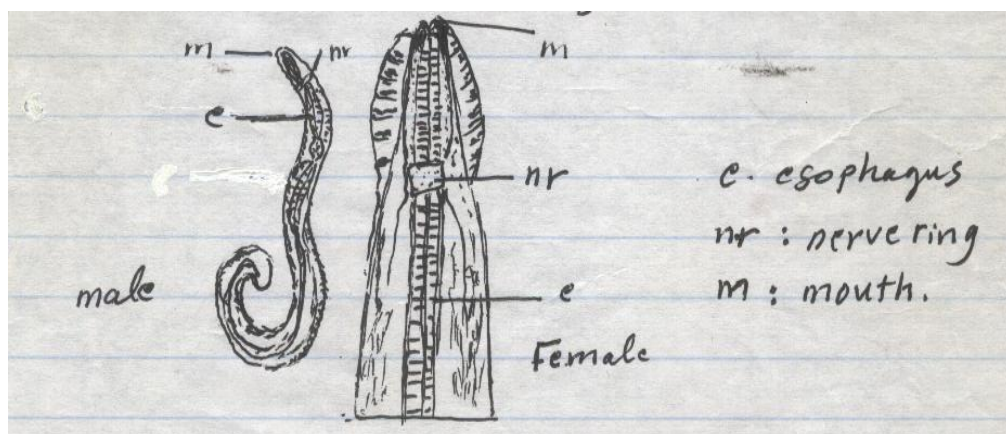
. ELISA → most promising

Treatment ... thiabendazole
Mebeudazole
Ivermectin

} are effective

Pin worm ... thread , seat worm – *Enterbius vermicularis* .

- **Geographical distribution** ... cosmopolitan .
- **Habitat** ... caecum , ileum , Appendix , colon .
- **Transmission** ... orally by contaminated hand , food drink , autoinfection very frequent .
- **Diseases** ... Enterobiasis , oxyuriasis .
- **Morphology** ... the small adult female worm (8 – 13 mm) has a cuticular alar expansion (wing lik) at the anterior end , there is no buccal cavity but a prominent double esophageal bulb , and along pointed tail . the uteri of the gravid female are distended with eggs . the male 2 to 5 mm in length with a curved tail and a single specula , is seldom seen . (the male worm usually dies after fertilization) .



Life cycle ...

E. vermicularis is monoxenous , passing its life cycle in human most .
it has no intermediate host .

Infection stage ... ova (egg) asymmetrical (D) shape embryo eggs are mature containing infection larvae . there is no migratory phase , when eggs swallowed , they hatch in the stomach releasing larvae → to duodenum where moult twice to reach maturity → after fertilization , inales die and female migrate down to caecum and remain till egg maturity (the gravid females , containing from 11.000 to 15.000 mg and the eggs mature and are infection several hours after passage) .

After that gravid females direct to the colon , then to the rectum . During night , female pass out of anus to lay ova .

The duration of the cycle from the ingestion the egg to per anal migration of the gravid female may be as short as 4 to 6 weeks .

✧ **Transmission ...** * hand to mouth from scratching the parianal areas or from handling contaminated fomites .

* Inhalation of airborne eggs indult .

✧ **pathogen city ...** 1. Minute ulcerations associated with inflammation .

2. worms may infect appendix resulting in parasitic appendicitis .

common symptom 3. Presence of gravid females and egg in the peri – ana (purities)

peri – anal area cause coetaneous irritation , intense Itching , followed by secondary infection .

4. if worms reach vagina , they cause inflammation and irritation a accompanied with vaginal discharge

* abdominal pain .

Diagnosis ...

- Stool examination by finding the adult worms or eggs (eggs in stool very rare) .
- Parianal scraping (moving before bathing or defecation) .
- Cellotape slid . (ova & adult worm) .

Trichuris trichiura whip worm الدودة السوطية شعيرية الرأس

Disease ... Trichuriasis , trichocephalosis , whip worm infection .

Habitat ... large intestine (Appendices , caecum , ileum , colon) .

Geographical distribution ... cosmopolitan .

Morphology and life cycle.

People are the principal hosts of *T. trichiura* the morphologic characteristics of parasite are ...

- 1) an attenuated whip like anterior , three fifths traversed by narrow esophagus resembling a string of beads .
- 2) a more robust posterior , two fifths containing the intestine and a single set of me productive organ .
- 3) the bluntly rounded posterior end of the female and the female and the coiled posterior extremity of the male with its single specula and retractile sheath .

The number of eggs produced per day by a female at 3000 to 50.000 the eggs lemon shaped with plug like , one on each side .

They have a yellowish outer and a transparent inner shell . the fertilized eggs are unregimented at ovipositor . Embryonic development take place out side the host . (An unhatched infective , first stage larvae is produced in 3 weeks in favorable environment – warm , moist , shaded soil . the egg are less resistant to heat , clod than those of *Ascaris lumbricoides*) .

When the embryonated egg is ingested by humans , the activated larvae escapes from the weakened egg shell in the upper small intestine and penetrates an intestinal villus , where it remain 34 days . upon reaching adolescence , it gradually passes down to the cecum.

Whip like anterior portion embed in the intestinal mucosa of the host .
the developmental period from the ingested egg to ovipositing adult
cavers about 30 to 90 days .

The prevalence of whip worm infection is high , but its intensity is
usually light . children are more frequently infected than adult the
heaviest infections are in young children .

Pathogen city ...

Patients with very heavy chronic Trichuris infection present a
characteristic clinical picture consisting of ..

1. Frequent small blood streaked diarrheal stools .
2. Abdominal pain and tenderness .
3. Nausea and vomiting .
4. Anemia due to bleeding .
5. Weight loss .
6. Occasional rectal prolapsed with worms embedded in the mucosa .

- Headache and slight fever may occurs .

- Hemoglobin levels as low as 3 gm per 100 ml .

• Transmission : oral by contaminated soil . food etc .

• Infective stage .. ova after 3 – 5 week after discharge in soil .

• Diagnosis ...- stool examination – egg – by finding

the characteristic lemon shaped eggs , which has also
a thick shell with two mucoid plugs , one on each
side .

- floatation method .

- protoscope .

Treatment . mebendazole (vermox) is the drug of choice in dosage of 100
mg twice daily for 3 days .

