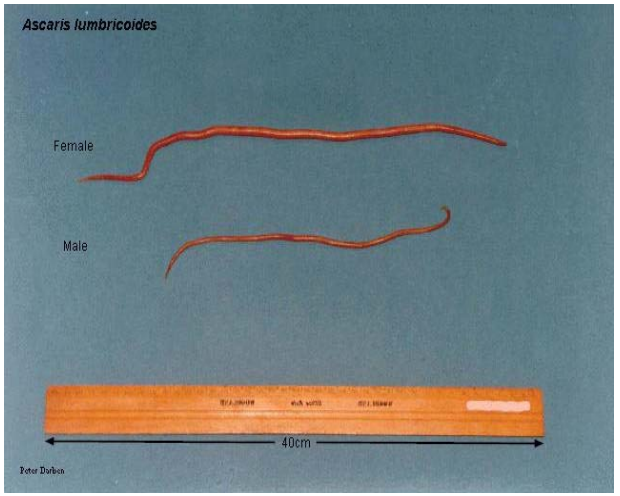
Nematodes

Nematodes – General Characters

- Non-segmented cylindrical worms tapering at both ends
- Possess cuticle
- Sexes are separate (diecious), male is smaller than female & its posterior end is curved ventrally
- Females are either
  - Viviparous (produce larvae/ embryos)
  - Oviparous (lay eggs) or
  - Ovo-viviparous (lay eggs which hatch immediately)
- Live in intestinal tract or tissues



Classification – Intestinal Nematodes

Small Intestine only	Ascaris lumbricoides (round worm)
	Necator americanus (american hook worm)
	Ancylostoma duodenale (hook worm)
	Strongyloides stercoralis
	Trichinella spiralis (trichina worm)
	Capillaria philippinensis
Caecum and Vermiform appendix	Enterobius vermicularis (pin worm)
	Trichuris trichiura (whip worm)

Classification – Tissue Nematodes

Lymphatic	Wuchereria bancrofti
	Brugia malayi
	Brugia timori
Subcutaneous	Loa loa (african eye worm)
	Onchocerca volvulus (blinding filaria)
	Dracunculus medinensis (thread worm)
Conjunctiva	Loa loa

Modes of Infection of Nematodes

1. Ingestion of –
   - Embryonated eggs contaminating food & drinks, e.g. *A.lumbricoides, E. vermicularis* & T. trichiura
   - Growing embryos in an intermediate host (infected cyclops) e.g. *D.medinensis*
   - Encysted embryos in infected pig's flesh e.g. *Trichinella spiralis*
2. Penetration of skin – filariform larvae bores through the skin e.g. *A.duodenale, S.stercoralis, N.americanus*
3. By blood sucking insects e.g. filarial worms
4. Inhalation of infected dust containing embryonated eggs e.g. *A.lumbricoides, E.vermicularis*

INTESTINAL NEMATODES

Ascaris lumbricoides (roundworm)

Adult worms	Male 15 to 30 cms Female 20 to 40 cms, oviparous
Eggs	60 µ, bile stained Albuminous coat with unsegmented ovum
Infective form	Embryonated eggs
Mode of transmission	Ingestion
Site of localization	Small intestine

The Life Cycle Of ROUNDWORMS

Ascaris Lumbricoides and Ascaris Suum

Adult males and females are in the small intestine.

↓

Females produce eggs that are passed in the host's feces. (A single female can produce 200,000 eggs per day.)

↓

Juveniles in eggs mature to the infective (second) stage.

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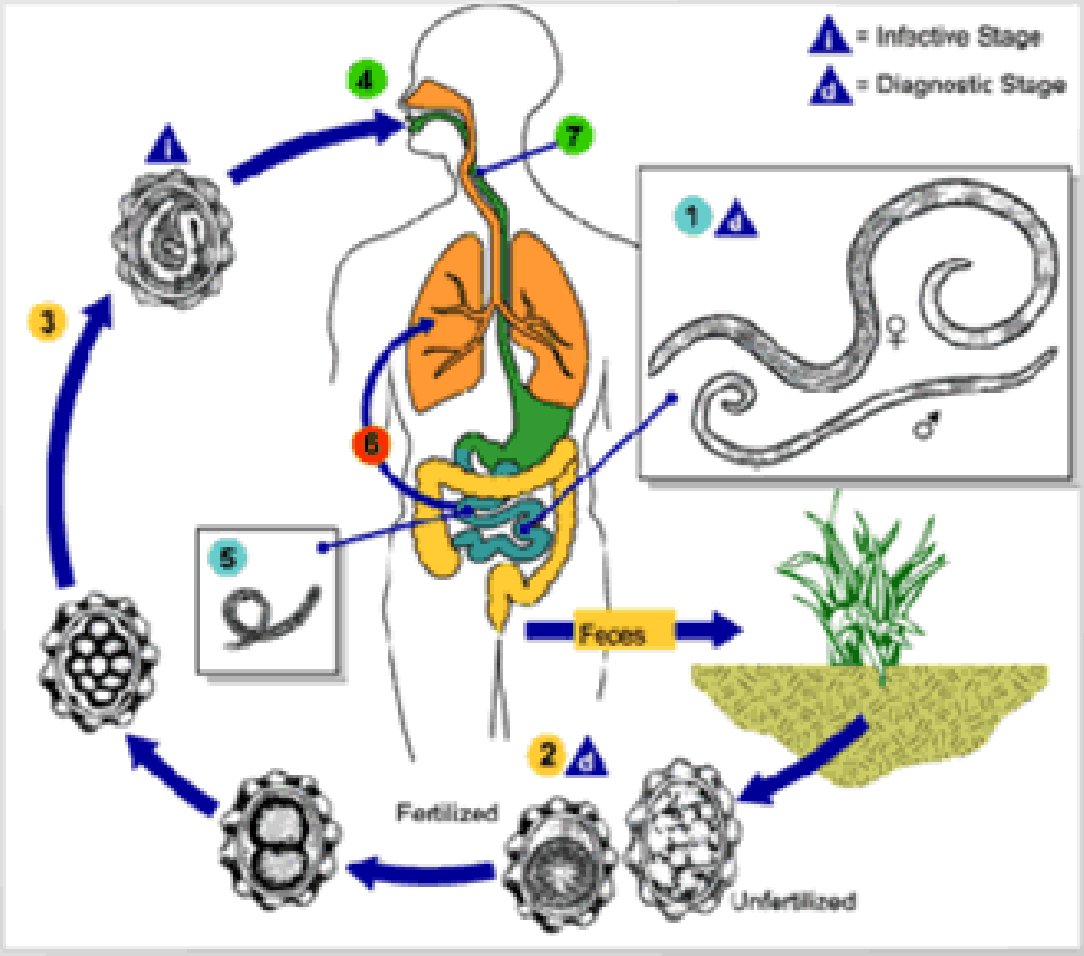
Eggs ingested by host and hatch in the small intestine. The juveniles penetrate the tissues of the intestine and enter the blood stream.



The juveniles are "coughed up" and swallowed. The juveniles complete their development in the small intestine.

↑

The third stage juveniles migrate from the pulmonary capillaries into the alveoli (air sacs).

↑

The juveniles migrate to the lungs and molt into third stage juveniles.

(Parasites and Parasitological Resources)

Life cycle

Adult worms (intestine)

Throat, swallow, small intestine

Unembryonated eggs (stool)

Right heart, lung, respiratory passage,

Embryonated eggs in 2-3 weeks in soil (infective form)

Penetrate intestine, reach liver

Rhabditiform larva hatches

Ingestion of eggs

Pathogenicity & Clinical Features

- Ascariasis – infection of *A.lumbricoides*
- Majority of infections are asymptomatic
- Clinical disease is largely restricted to individuals with a high worm load
- Symptoms divided into two groups: those produced by
  1. Migrating larvae
  2. Adult worms

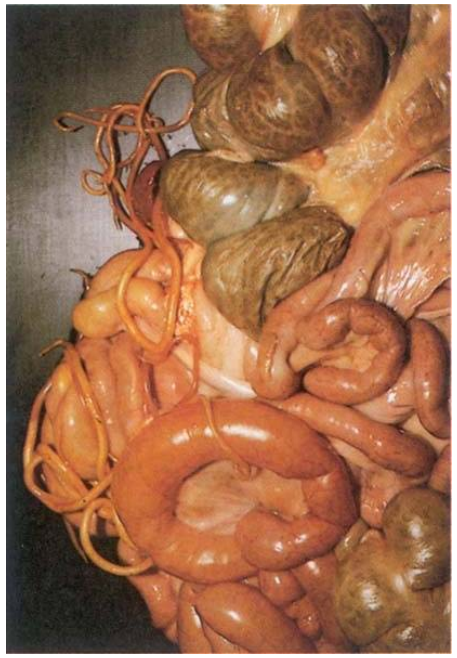
Symptoms & Complications

- Symptoms produced by Migrating larvae
  1. Pneumonia (loeffler's syndrome) – fever, cough, dyspnoea, blood tinged sputum that may contain larva, urticarial rash & eosinophilia

  2. Visceral larva migrans – if larvae enter systemic circulation (from pulmonary capillaries) to reach other organs like brain, spinal cord, heart, kidney.

Symptoms & Complications

- Symptoms produced by Adult worms
  1. **Abdominal discomfort**, anorexia, nausea & **diarrhoea**.
  2. **PEM, Vit. A deficiency** (night blindness)
  3. Intestinal **obstruction** (particularly in children 1-5 years), **intussusception** & **volvulus**
  4. **Penetration** through intestinal ulcer (**perforation**) – **peritonitis**
  5. **Hypersensitivity reactions** to worm Ags (toxic body fluids) – urticaria, edema of face, conjunctivitis, irritation of URT



Pathogenicity & clinical features

- Symptoms produced by Adult worms
  6. **Ectopic Ascariasis** – due to migration of worm up into the stomach. It may
     - be vomited out,
     - pass up through the oesophagus at night & comes out through mouth or nose,
     - enter larynx to cause asphyxia.
     - migrate to other organs and cause **appendicitis,** cholecystitis, biliary colic, cholangitis, pancreatitis

Laboratory Diagnosis

- Macroscopic - Direct detection of worm/s in stool or vomit
- Microscopic – direct examination of feces following floatation method: **bile stained eggs.** (eggs may not be seen at least 40 days after infection)
- Blood examination – **eosinophilia**.

Other modes of diagnosis

- Imaging – large collections of worms in abdomen
- USG - to diagnose hepatobiliary or pancreatic ascariasis
- Serology (Ab detection) – mainly reserved for epidemiological studies.

Treatment

- Mebendazole/ Albendazole – drug of choice but contraindicated in pregnancy & heavy infection
- Pyrantel pamoate – single dose
- Piperazine citrate - suspected intestinal or biliary obstruction since this drug paralyzes worms to aid expulsion.
- Levamisole

Prevention

- Good sanitation and personal hygiene

- Mass treatments with single dose mebendazole or albendazole for all school-age children every three to four months - serves dual function:
  - treats the children and
  - reduces the overall worm burden in the community

Ancylostoma duodenale (hook worm)

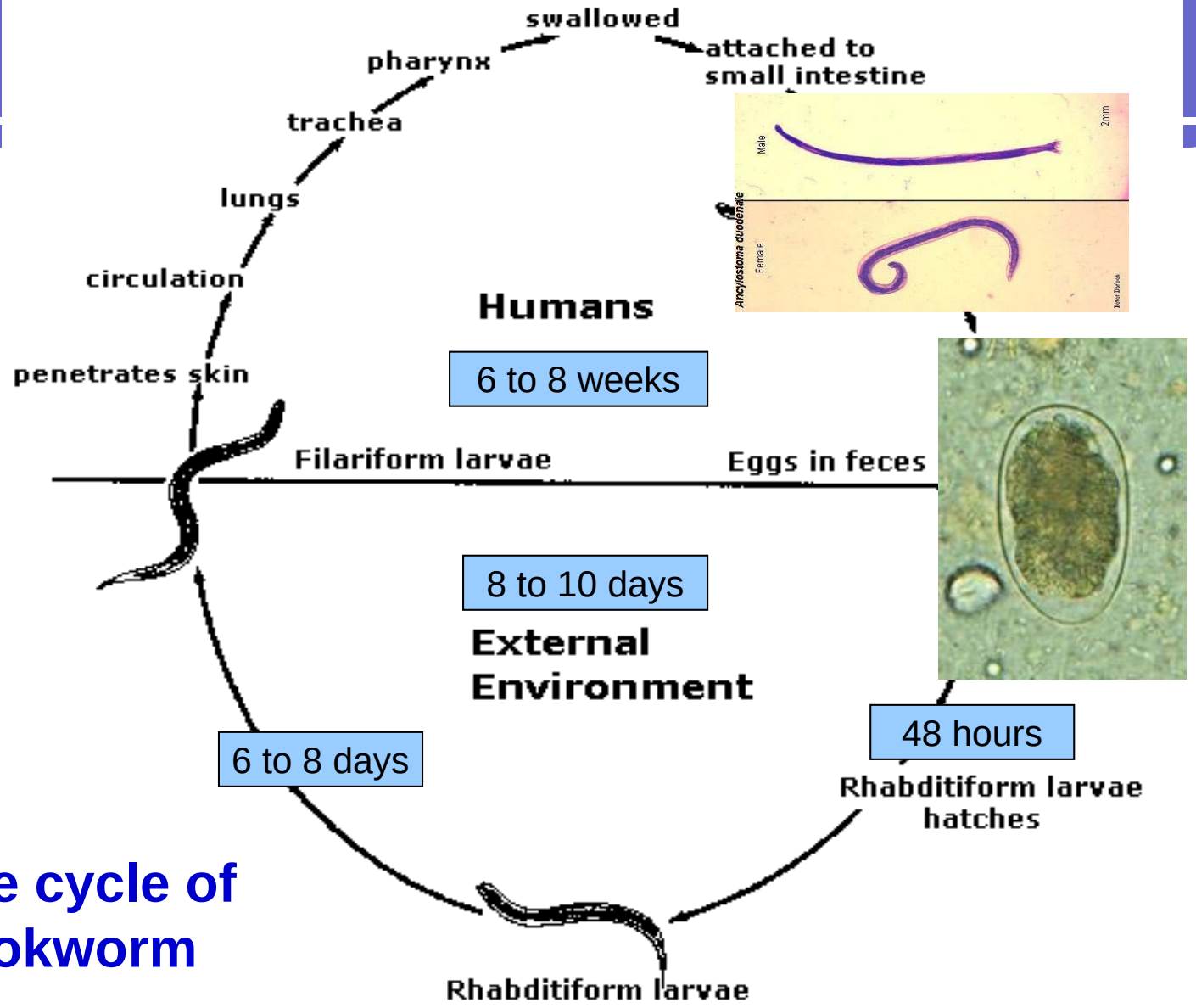
Adult worms	Male 8 -11mm Female 10-13 mm, oviparous
Eggs	60 µ, non bile stained (colorless) Segmented, 4 blastomeres
Infective form	3rd stage filariform larva
Mode of infection	Penetration into skin
Site of localization	Small intestine

Sites of skin penetration

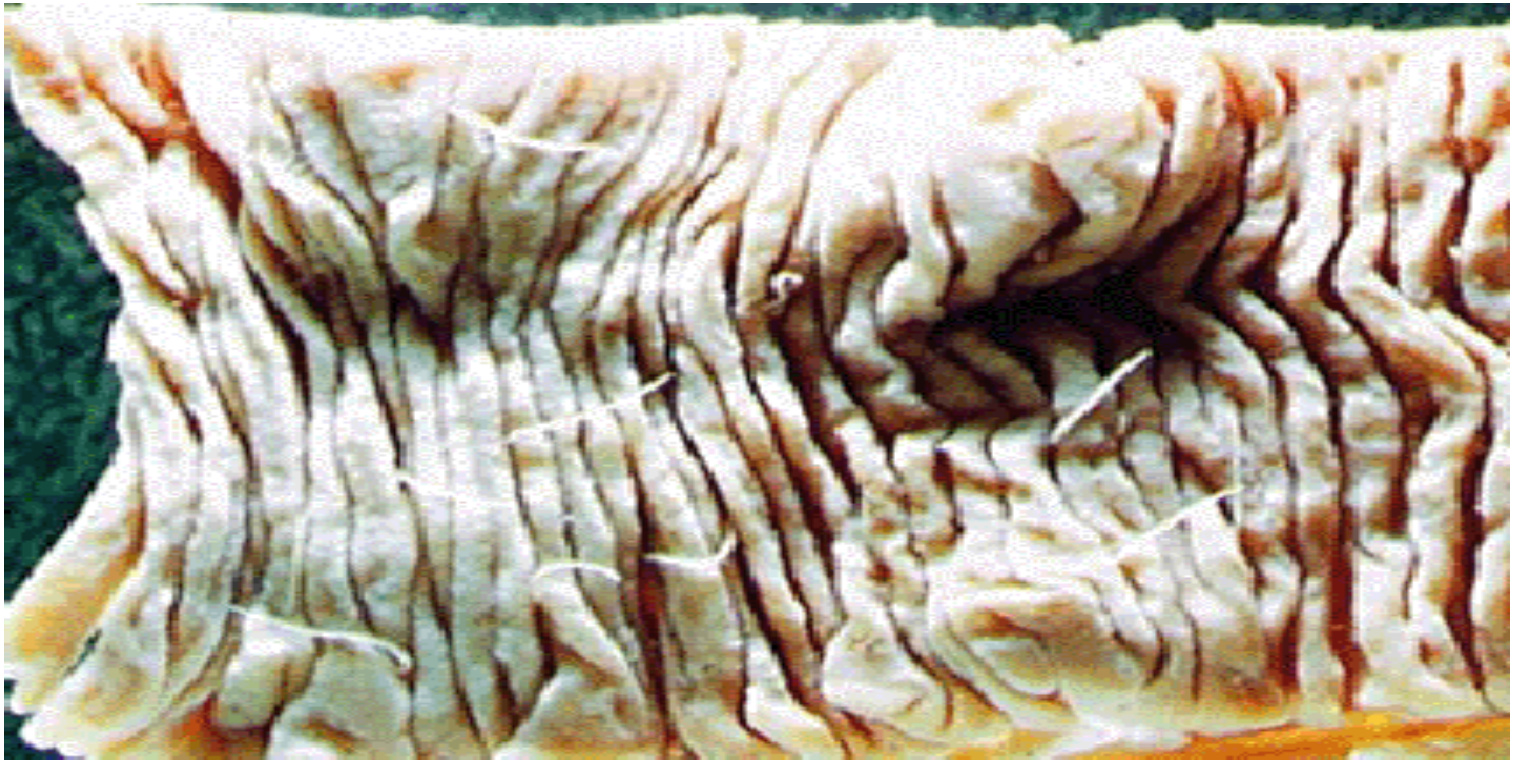
- Most common sites are:
  1. Thin skin between toes
  2. Dorsum of the feet
  3. Inner side of the soles

- Gardeners & miners – skin of hands

Life cycle of hookworm



Hook worms in the intestine



Pathogenicity & Clinical Features

- Ancylostomiasis or hookworm disease, characterised by iron deficiency anaemia
- Majority of infections are asymptomatic
- Symptoms develop in heavy infections and divided into two groups: those produced by
  1. Migrating larvae
  2. Adult worms

Symptoms produced by larvae

- Lesions in the skin:
  1. **Ancylostome dermatitis or Ground itch** – occurs at the site of entry (more common in necator), lasts for 2 to 4 weeks
  2. **Creeping eruption** – reddish itchy papule along the path traversed by filariform larvae (**larva migrans**)

- Lesions in the lungs – bronchitis & bronchopneumonia.

Symptoms produced by adult worm

- Epigastric pain, diarrhoea & vomiting during early phase of infection.
- Microcytic hypochromic (Iron deficiency) anaemia – due to chronic blood loss:
  - a single adult hookworm sucks 0.2ml of blood/ day
  - Hemorrhages from punctured sites

Clinical features of hookworm anemia

- Extreme pallor
- Abnormal appetite showing Pica or Geophagy – perverted taste for earth, mud or lime
- Epigastric tenderness with dyspepsia
- Constipation
- Puffy face with swelling of lower eyelids
- Pedal edema
- Growth retardation
- General appearance – pale plumpy with protuberant abdomen & dry lustreless hair.

Laboratory Diagnosis

- Stool examination – microscopy: non bile stained egg, segmented
- Occult blood in stool – positive
- Blood examination – anaemia, eosinophilia

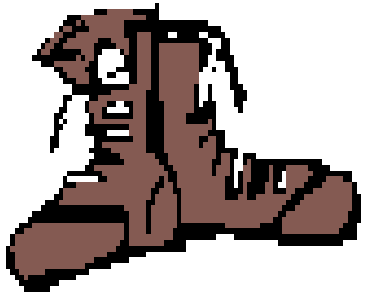
Treatment

- Mebendazole / Albendazole
- Pyrantel pamoate
- Oral iron replacement – ferrous sulphate 400mg tid
- Nutritional support

* If Hb is below 30%, then anemia should be treated first with Iron till Hb comes over 50%.

Prevention & Control

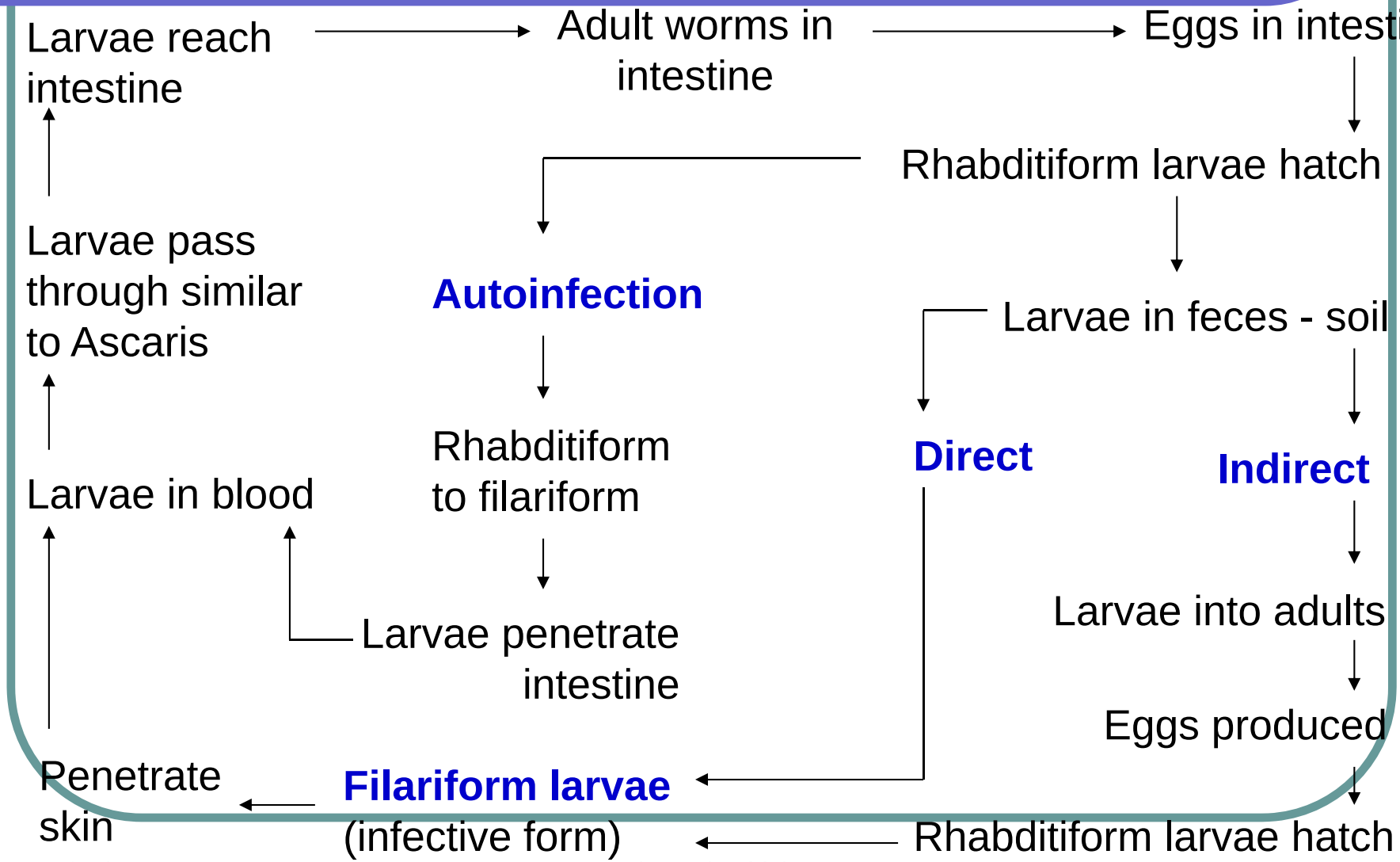
- Proper sanitation measures & sewage disposal
- Personal hygiene
- Personal protection – wearing boots & gloves
- Simultaneous treatment of carriers & diseased with wholesale treatment of community



Strongyloides stercoralis

Adult worms	2 - 2.5mm, ovoviviparous, eggs laid in the tissues
Free living worms	Moist soil
Infective form	Filariform larvae
Mode of transmission	Penetration / autoinfection
Site of localization	Wall of Small intestine, mainly duodenum & jejunum

Life cycle – S. stercoralis



Pathogenicity

1. Skin lesions (2 types) – “larva currens”
   - At the site of entry – urticarial rash
   - In the perianal region – linear, erythematous urticarial wheal

2. Pulmonary lesions – due to migrating larva
   - Alveolar hemorrhages
   - Bronchopneumonia

3. Intestinal lesions - “burrowing lesions”
   - Epigastric pain
   - Diarrhoea with blood & mucus
   - Nausea
   - Weight loss

Important terms to know

- Autoinfection – filariform larva
  1. In the Intestinal lumen
  2. Perineal & perianal skin penetration

- Hyperinfection – can result in autoinfection
  1. Steroids or Immunosuppressive therapy
  2. Malignancy
  3. Malnutrition
  4. Pregnancy
  5. Puerperium
  6. AIDS

- Persistence of infection – due to autoinfection

Laboratory Diagnosis

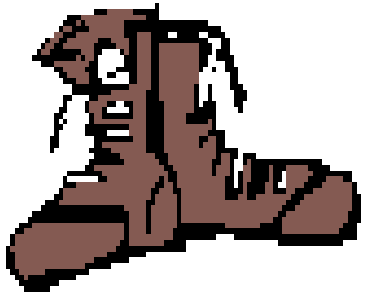
- Stool examination – rhabditiform larva
- Culture – larva
- ELISA – to detect Abs

Treatment & Prevention

- Potentially life threatening disease – treat even if its asymptomatic

- Thiabendazole for 2 days

  Disseminated strongyloidosis – 5 to 7 days.



Trichinella spiralis (Trichina Worm)

Adult worms (smallest nematode infecting man)	Male 1.4 – 1.6 mm Female 3 - 4 mm, viviparous
Infective form	Encysted larvae (100µ) in striated muscles of pig
Mode of transmission	Ingestion of improperly cooked pork
Site of localization	Small intestine
Commonly involved muscles	Diaphragm, Intercostals, Deltoid, Pectoralis major, Biceps

Life Cycle – T spiralis

Encysted larva in pig muscles (infective form)

Eating under-cooked pork

Larva released in small intestine

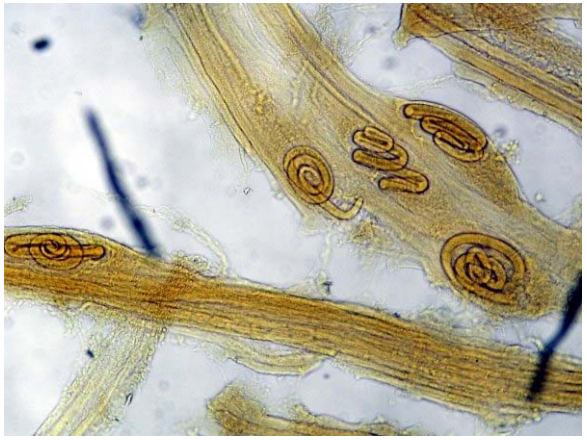
40 hrs

Develop into adult worms

Female deposits larva in intestinal mucosa

Larva enters circulation

Larva deposit and encyst in striated muscles

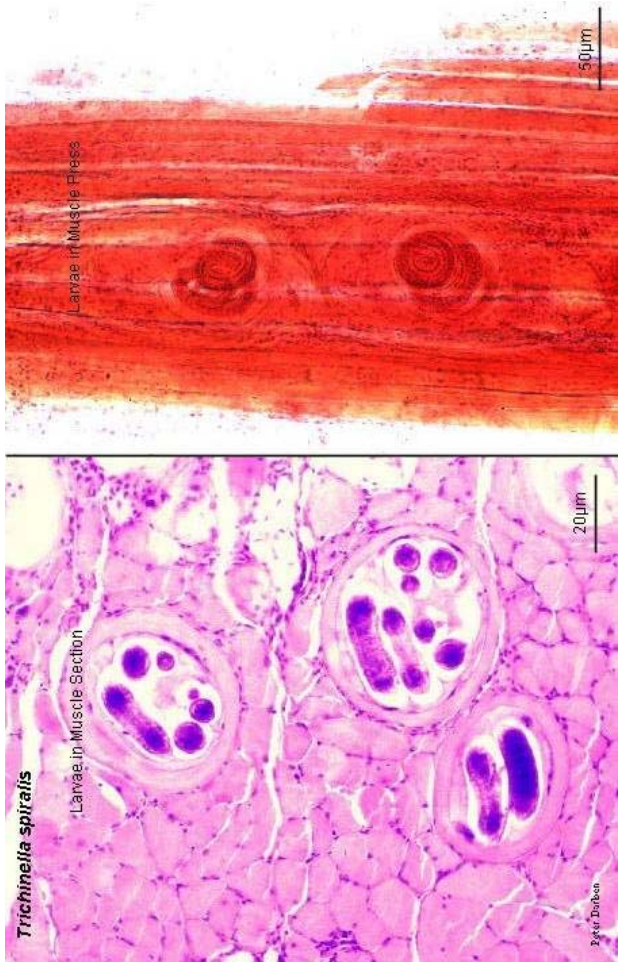


Pathogenicity

- Trichinelliasis / Trichinosis – clinical features depends on the stage:
  1. **Stage of intestinal invasion**: 5-7 days, pain in abdomen, nausea, vomiting, diarrhoea
  2. **Stage of larval migration**: fever, urticarial rash, splinter hemorrhages, periorbital & facial edema
  3. **Stage of encystation**: asymptomatic in light infections; myalgia, weakness in heavy infections
- Complications – during migration:
  - myocarditis, encephalitis

Laboratory Diagnosis

- Muscle biopsy – encysted larva
- Blood – eosinophilia between 2nd & 4th week
- Serology – to detect specific Abs by:
  1. Bentonite flocculation test
  2. Latex agglutination test



Treatment & Prevention

Treatment

- Thiabendazole & Mebendazole – adult worms
- Corticosteroids – complications

Prevention

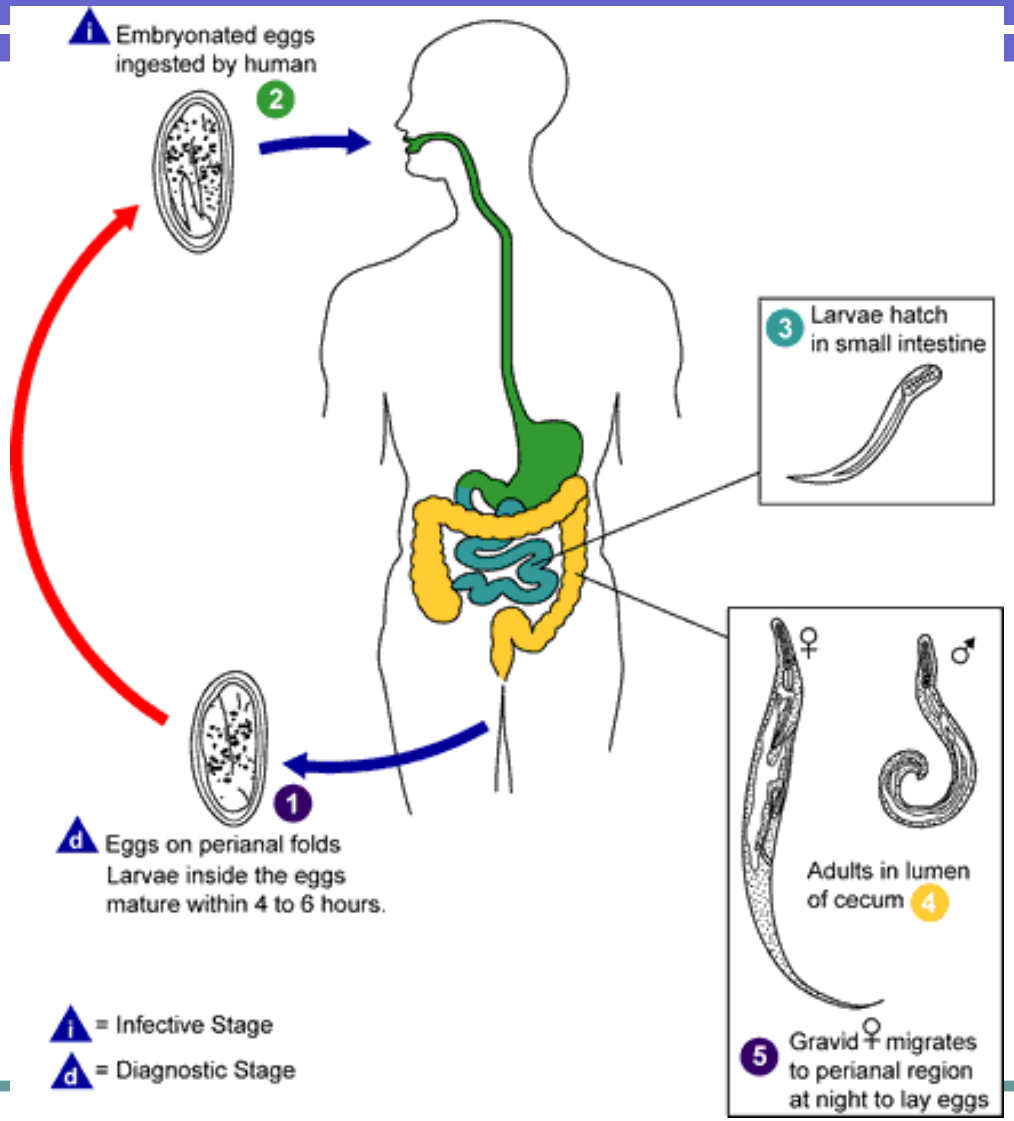
- Proper cooking of pork or proper storage
- Avoidance of feeding bits & refuse from slaughter houses & farms to pigs – breaks life cycle.

Enterobius vermicularis

(Pin Worm, Seatworm)

Adult worms	Male 2 - 5 mm Female 8 -13 mm, oviparous
Eggs	60 µ, non bile stained Plano-convex with coiled embryo
Infective form	Embryonated egg
Mode of transmission	Ingestion, Autoinfection
Site of localization	Large intestine – caecum & appendix

Life cycle – *E. vermicularis*

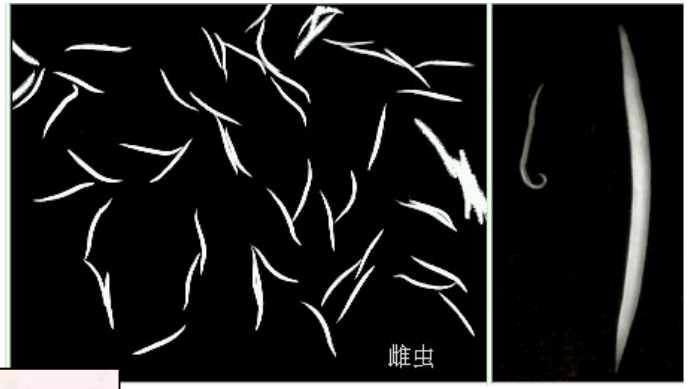


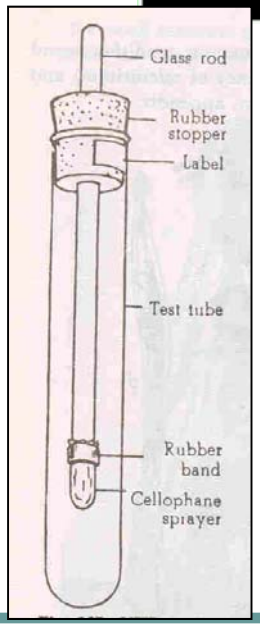
Clinical features

- Due to migration of worm - Perianal, perineal & vaginal itching (pruritis) worsens at night.
- Insomnia and restlessness
- Nocturnal enuresis

Laboratory Diagnosis & Treatment

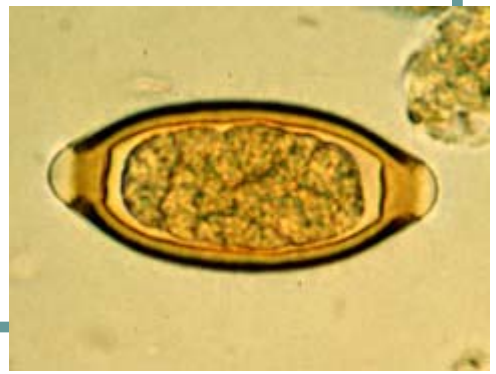
- Detection of adult worms in-
  - Feces
  - Perianal region
- NIH swab – scrapings from perianal region
- Microscopy – non bile stained eggs
- Mebendazole, pyrantel pamoate



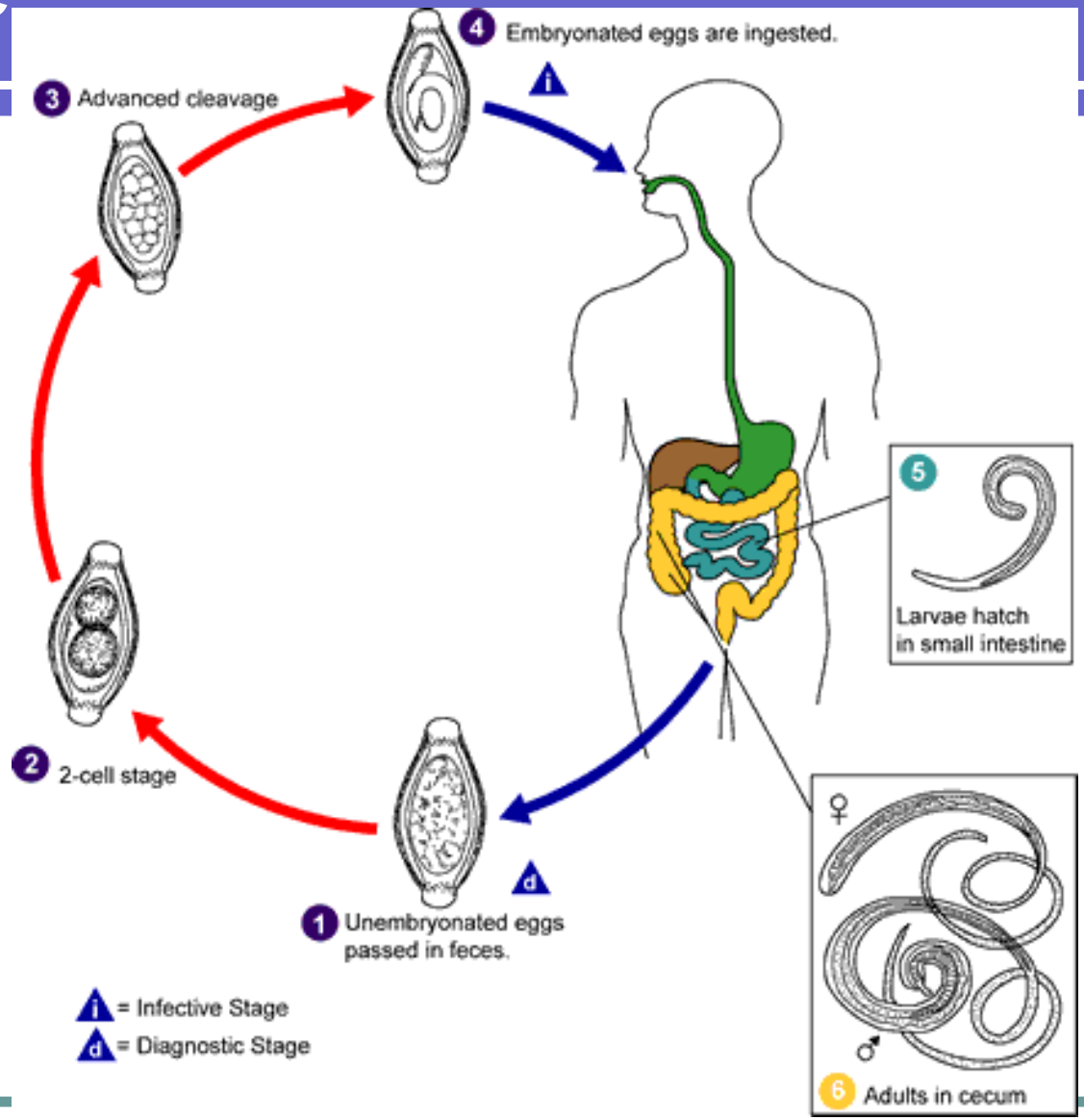


Trichuris trichiura (Whip Worm)

Adult worm	30 – 50 mm
Eggs	60 µ, bile stained Barrel-shaped with Mucus plug at each pole Unsegmented ovum
Infective form	Mature embryonated eggs
Mode of transmission	Ingestion
Site of localization	Large intestine - caecum



Life cycle


4 Embryonated eggs are ingested.
i
3 Advanced cleavage
5
Larvae hatch
in small intestine
2 2-cell stage
d
1 Unembryonated eggs
passed in feces.
♀
♂
6 Adults in cecum
i = Infective Stage
d = Diagnostic Stage

Clinical features

- Infection – Trichuriasis
- Symptoms depend on worm burden
  - Less than 10 worms – asymptomatic
  - Heavier infections –
    1. chronic **profuse mucus and bloody diarrhea** with **abdominal pains** and edematous rectum
    2. malnutrition, **weight loss** and anemia

Laboratory diagnosis & Treatment

- Stool examination – bile stained eggs with bipolar mucus plugs
- Treatment – albendazole / mebendazole
- Prevention –
  - Proper disposal of night soil
  - Prevention of consumption of uncooked vegetables & fruits .

Key to the diagnosis of Intestinal Nematodes