Helminthology – Nematodes Hookworm

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Classification of Nematodes

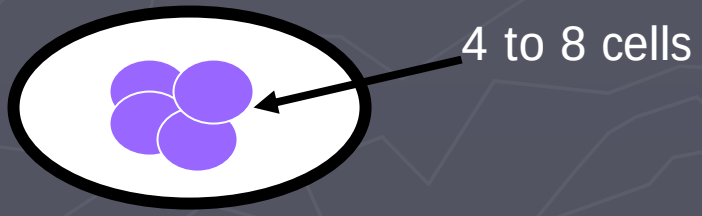
Subclass	Order (suborder)	Superfamily	Genus and Species	Probable prevalence in man
Secernentea	Strongylida	Ankylostomatoidea	Ankylostoma douodenale	716 million
			Necator americanus	
			A caninum	Thousands
			A braziliense	Thousands
			A ceylanicum	Rare
			Ternidens diminutus	Thousands
			Oesophagostomum apiostomum	Rare
			Syngamus laryngeus	Rare

General Information

- Two major species; Ankylostoma duodenale (old world), Necator Americanus (new world)
- Others; A caninum, A braziliense, A ceylanicum
- Prevalence – Africa, Asia, Central America, South America, Caribbean Islands, SE US

General Recognition Features

- Size
  - Necator americanis – male 7-9 mm, female 10-18 mm
  - Ankylostoma duodenale – male 8-11 mm, female 10-15 mm
- Structure
  - NA has a fused copulatory spicule vs AD
  - AD totally dorsally flexed. NA is dorsally flexed but with a ventral flex near the head
  - Two sets of reproductive organs
  - Distinctive mouth parts
  - Copulatory bursa ray patterns are distinctive
- Eggs
  - Thin shelled
  - 60-75 um X 35-40 um



General Recognition Features

- Structure
  - NA has a fused copulatory spicule vs AD
  - AD totally dorsally flexed. NA is dorsally flexed but with a ventral flex near the head
  - Two sets of reproductive organs
  - Copulatory bursa ray patterns are distinctive for male worms

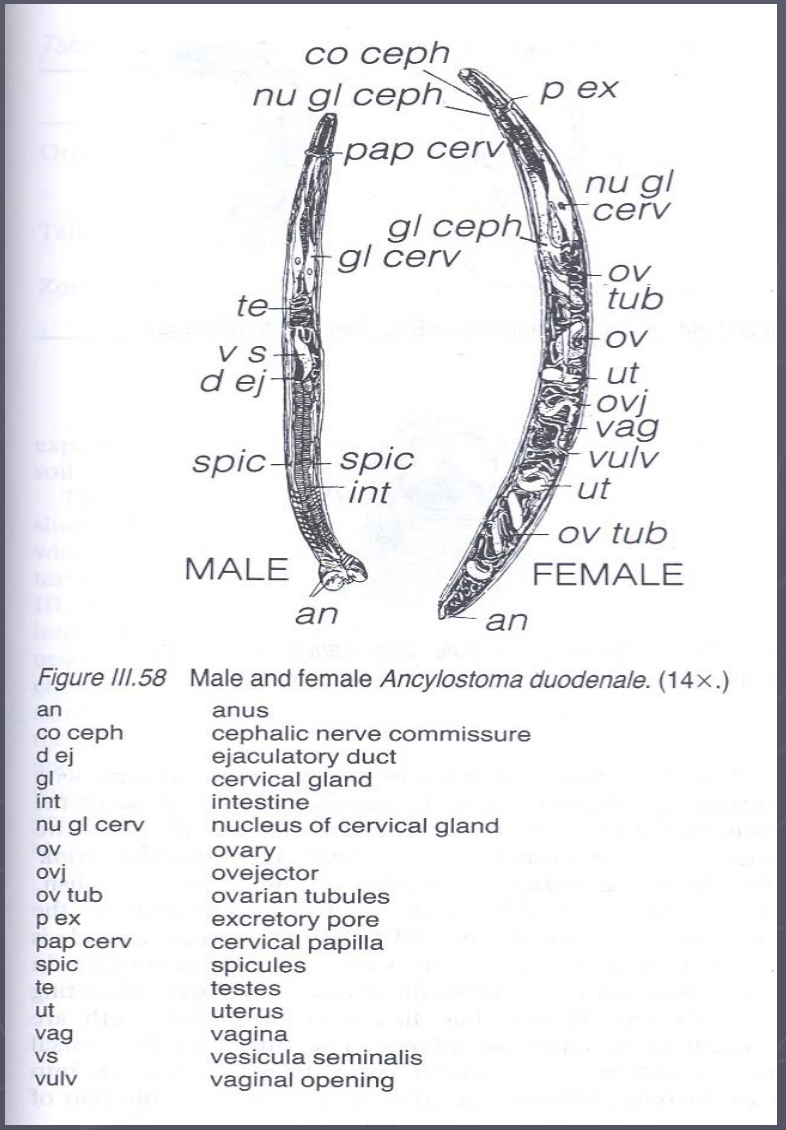


Figure III.58 Male and female *Ancylostoma duodenale.* (14×.)

an	anus
co ceph	cephalic nerve commissure
d ej	ejaculatory duct
gl	cervical gland
int	intestine
nu gl cerv	nucleus of cervical gland
ov	ovary
ovj	ovejector
ov tub	ovarian tubules
p ex	excretory pore
pap cerv	cervical papilla
spic	spicules
te	testes
ut	uterus
vag	vagina
vs	vesicula seminalis
vulv	vaginal opening

From Manson's Tropical Disease, 20th Edition, Saunders, pp 1621

General Recognition Features

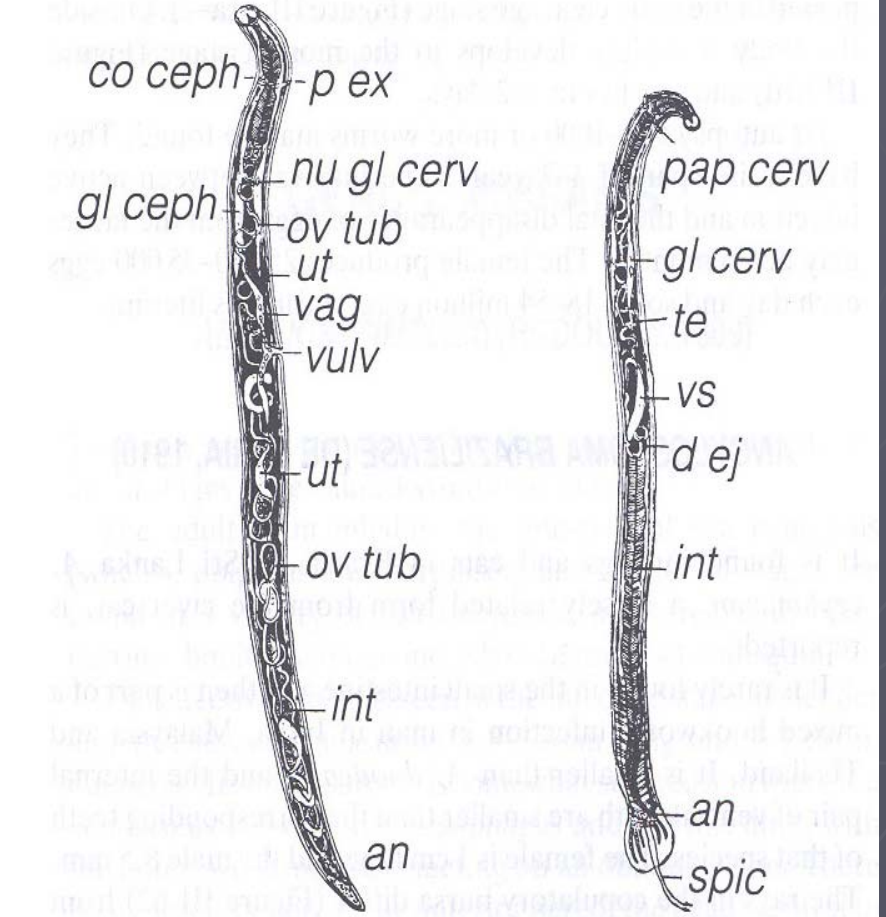
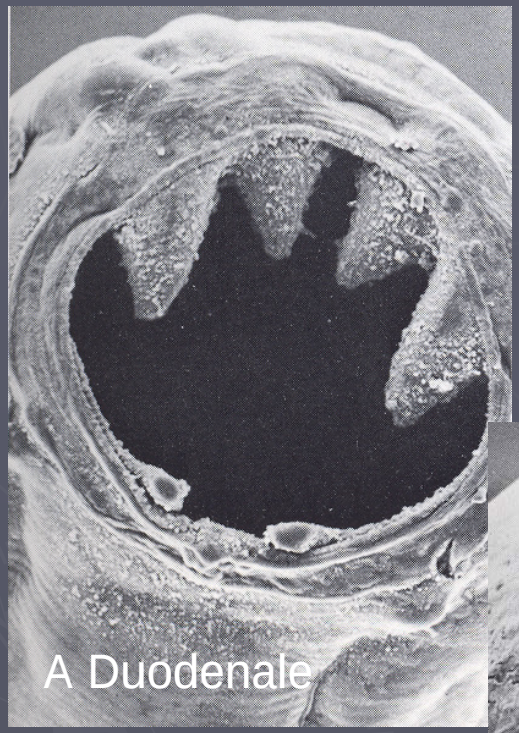
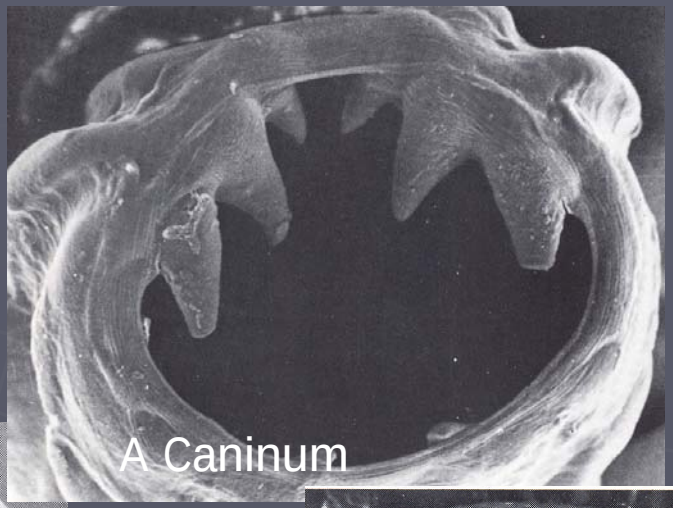


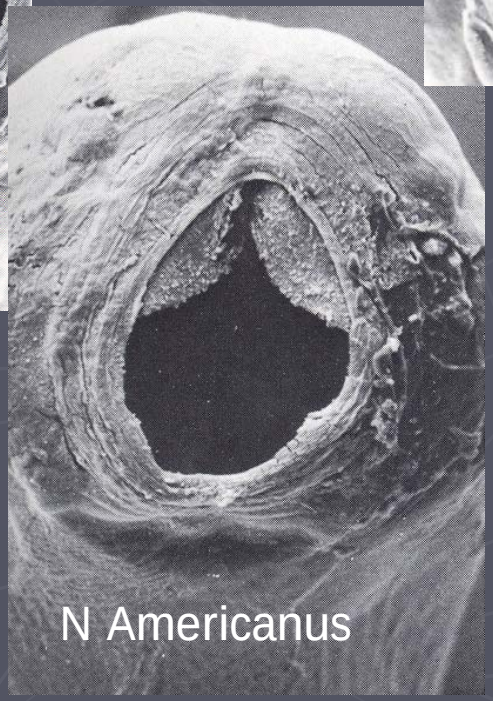
Figure III.63 *Necator americanus.* (12×.) Key as for Figure III.58.

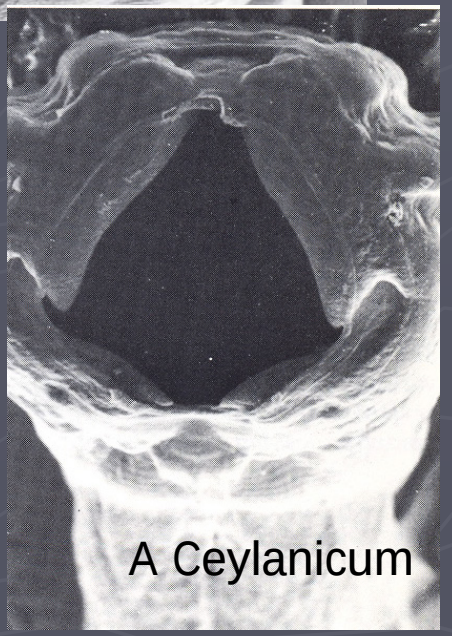
From Manson's Tropical Disease, 20th Edition, Saunders, pp 1622

General Recognition Features


A Duodenale


A Caninum


N Americanus


A Ceylanicum

From a Color Atlas of Tropical Medicine and Parasitology, 2nd edition, Yearbook Medical Publishers, pp 148-149

General Recognition Features

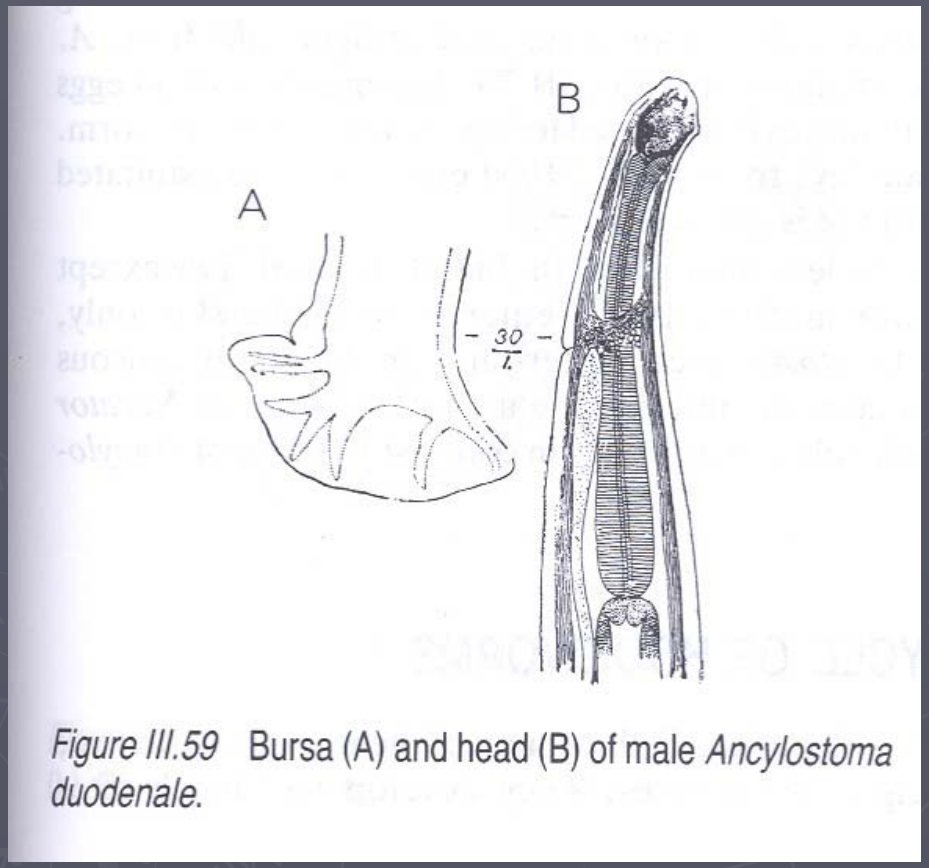


Figure III.59 Bursa (A) and head (B) of male *Ancylostoma duodenale.*

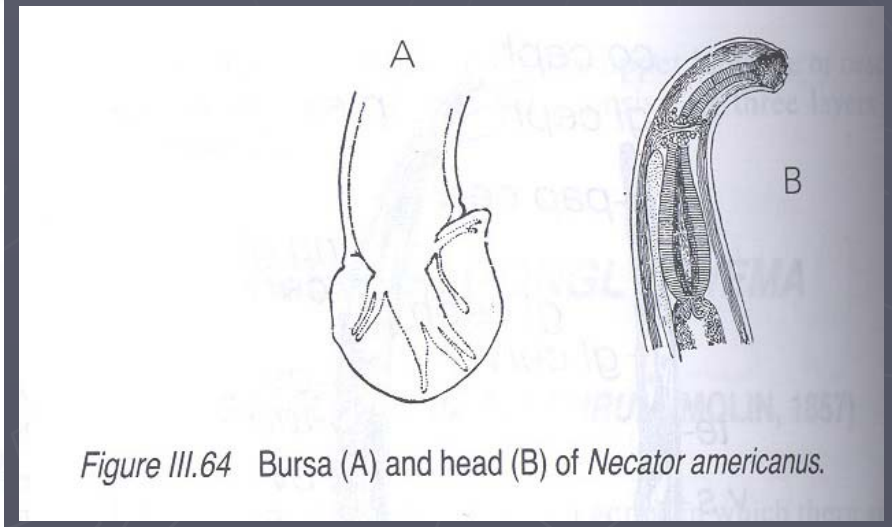
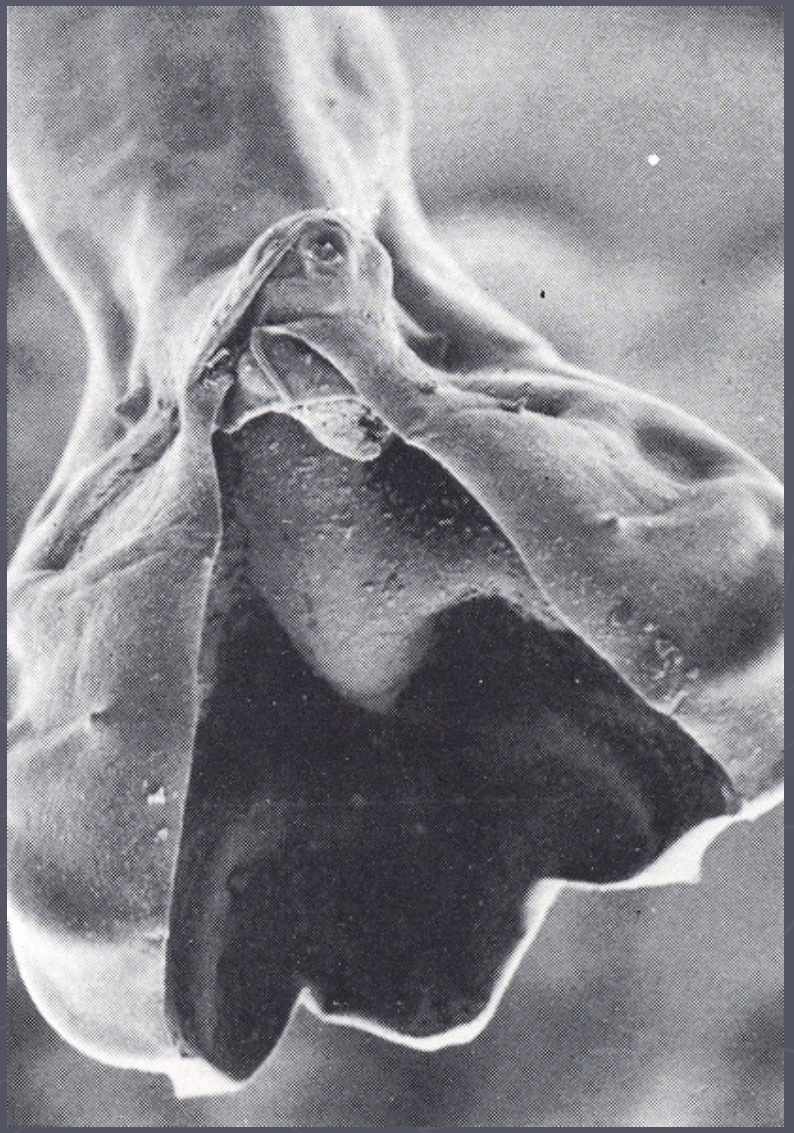


Figure III.64 Bursa (A) and head (B) of *Necator americanus.*

From Manson's Tropical Disease, 20th Edition, Saunders, pp 1621-1622

General Recognition Features



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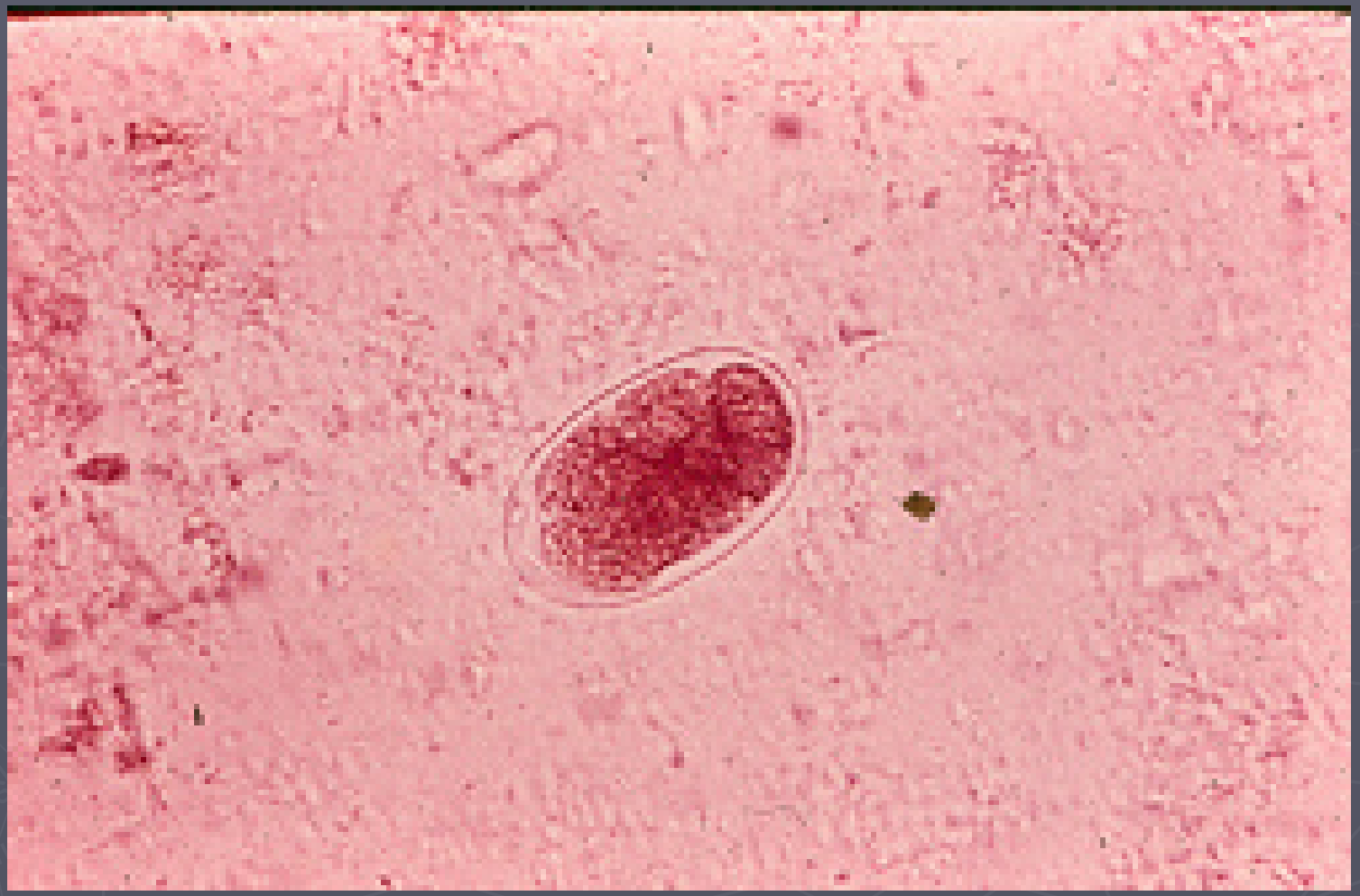


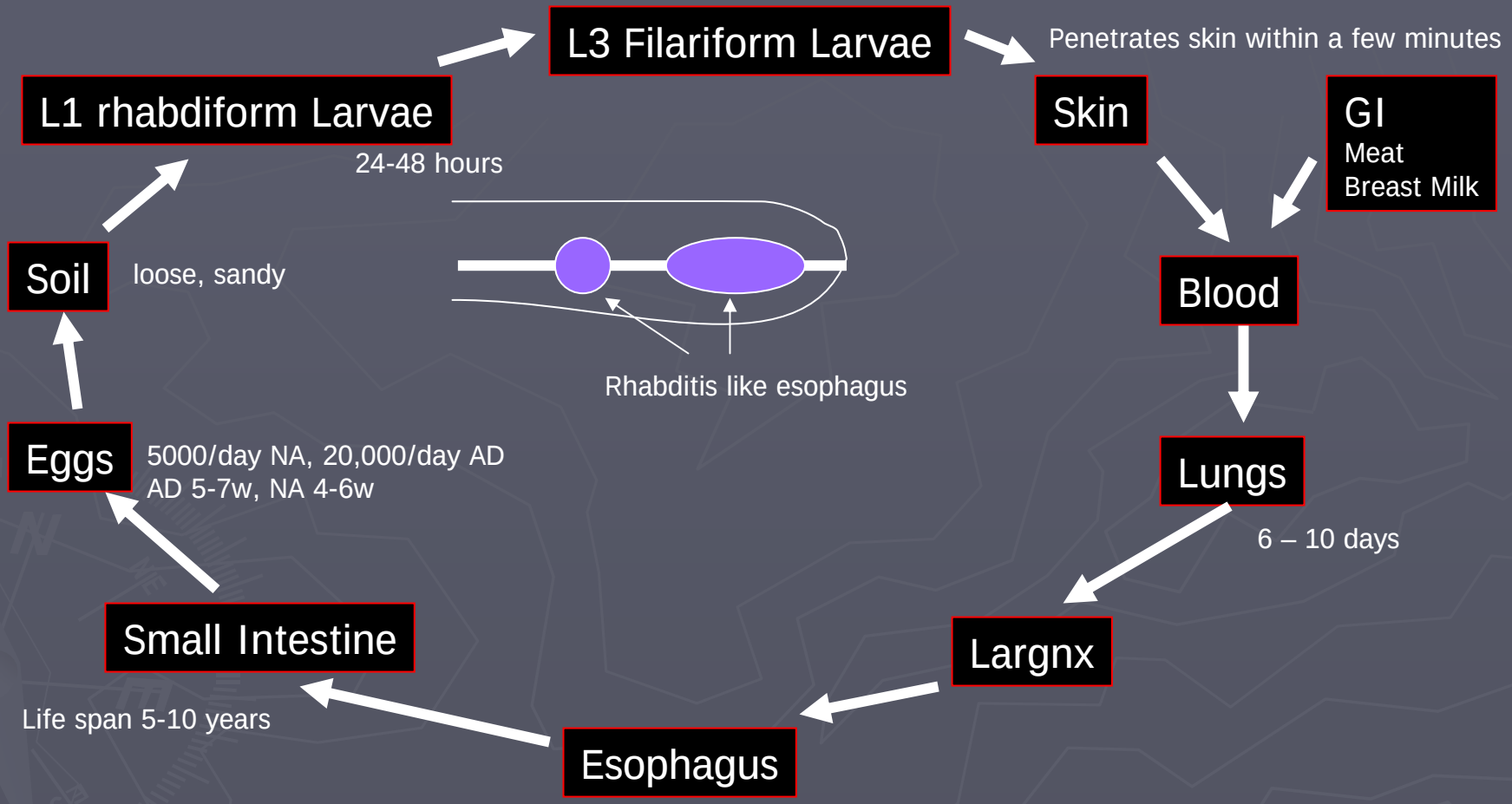
Life Cycle

- Definitive host – man
- Stage leaving the body – fertile eggs
- Infectious stage for the definitive host – L3 larvae

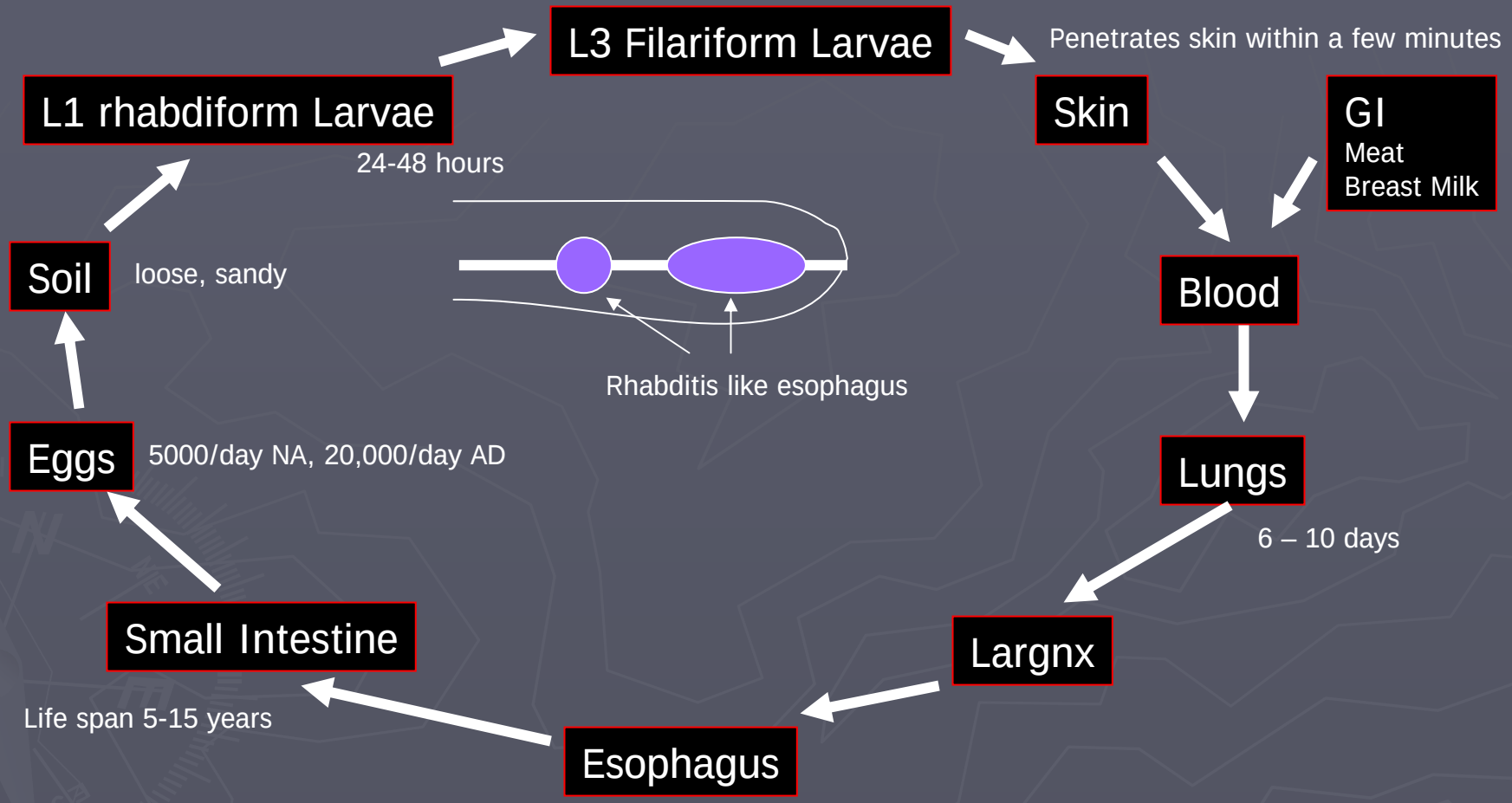
Prepatency and Incubation Period

- Prepatency – 8-12 weeks
- Incubation period – 4-12 weeks

Life Cycle


L3 Filariform Larvae
Penetrates skin within a few minutes
L1 rhabdiform Larvae
24-48 hours
Skin
GI
Meat
Breast Milk
Soil
loose, sandy
Blood
Rhabditis like esophagus
Eggs
5000/day NA, 20,000/day AD
AD 5-7w, NA 4-6w
Lungs
6 – 10 days
Small Intestine
Largnx
Life span 5-10 years
Esophagus

Life Cycle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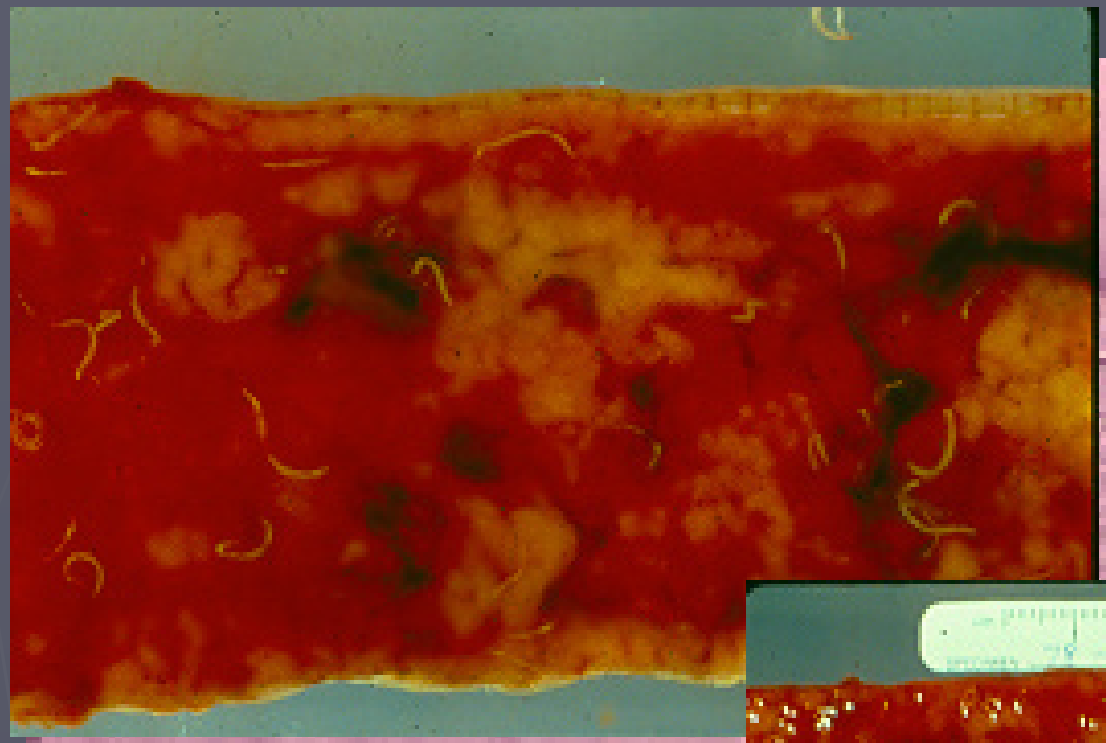

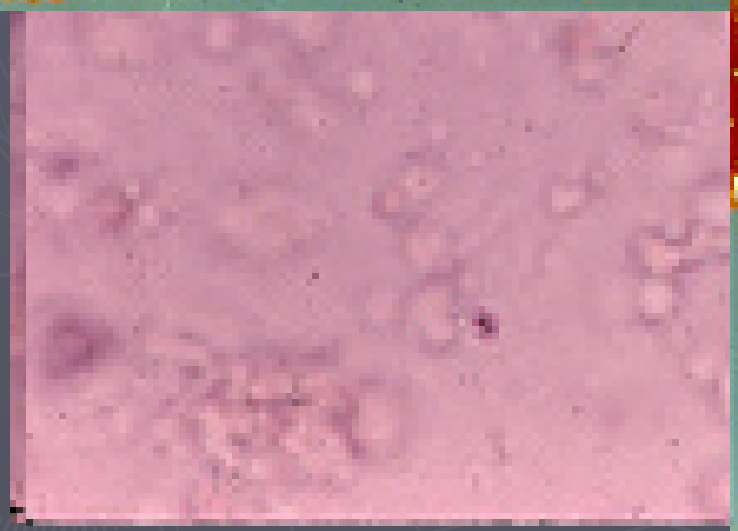

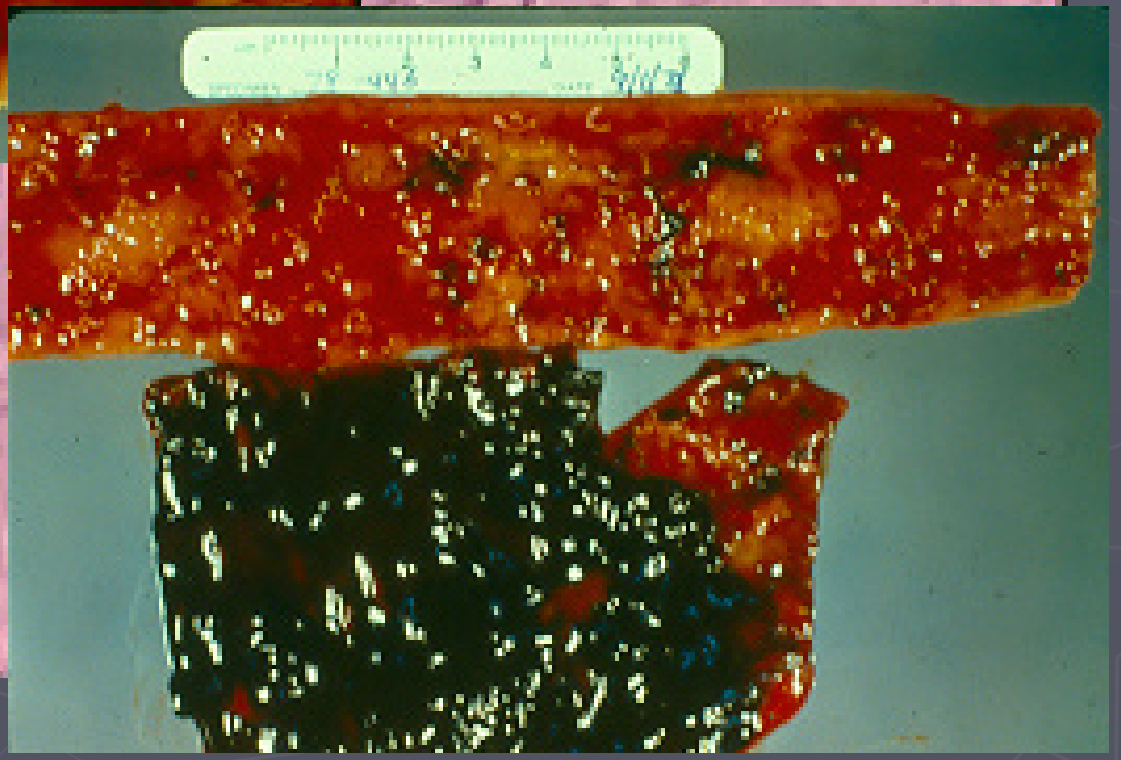

Signs and Symptoms

- Ground itch due to vesiculation and pustulation at the entry site
  - Exposed portions of the body usually the soles of the feet or hands
- Asthma and bronchitis caused by migration of the larvae through the lungs
  - 1-2 weeks associated with dry cough and wheezing
- Established infection associated with hookworm disease

Established Infection

- Light infection (≤100 worms)
  - Mild anemia
  - Fatique
  - Lassitude
  - Digestive disturbances
  - Eosinophilia

Established Infection

- Heavy infection (≥400 worms) –
  - Fatique
  - Lassitude
  - Eosinophilia
  - Epigastric apin
  - Perverted taste – pica, geophagy
  - Hematochezia / melena
  - Anemia
  - Edema associated with hypoalbuminemia
  - Heart failure
  - Hypothermia
  - Retinal hemorrhages
  - Irregular fever
  - Growth failure

Wakana disease

- Associated with oral infection with AD in Japan
- No larvae are found in the lung
- Has cough, dyspnea, eosinophilia, nausea and vomiting
- Seen one to several days after ingestion of larvae
- Etiology is not known

Infantile Disease

- Mostly reported from China
- Mainly caused by A Duodenale
- Transmission – trans-mammary, laying infants on infected soil, and rarely trans-placental
- Signs and symptoms – diarrhea, hematochezia / melena, anorexia, vomiting, pallor, massive hemorrhage
- Mortality – 12%

Diagnosis

- Eggs in the stool
  - Heavy infection – Direct stool smear with saline or potassium iodide saturated with iodine
  - Light infection – Concentration techiques (Kato-Katz, Beaver direct smear, Stoll egg counting techique)
  - Late prepatent period Charcot Leyden crystals and eosinophils may be seen in the feces similar to whipworm
  - > 20 eggs / mg associated with anemia in NA vs > 5 eggs / mg with AD


Trichuris trichuria
Hookworm

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

Adverse Reactions

Albendazole	Occasional: diarrhea, abdominal pain Rare: leukopenia, alopecia, increased serum transaminase levels
Mebendazole	Occasional: diarrhea, abdominal pain Rare: leukopenia, agranulocytosis, hypospermia
Pyrantel pamoate	Occasional: GI distrubances, headache, dizziness, rash, fever

Control Measures

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