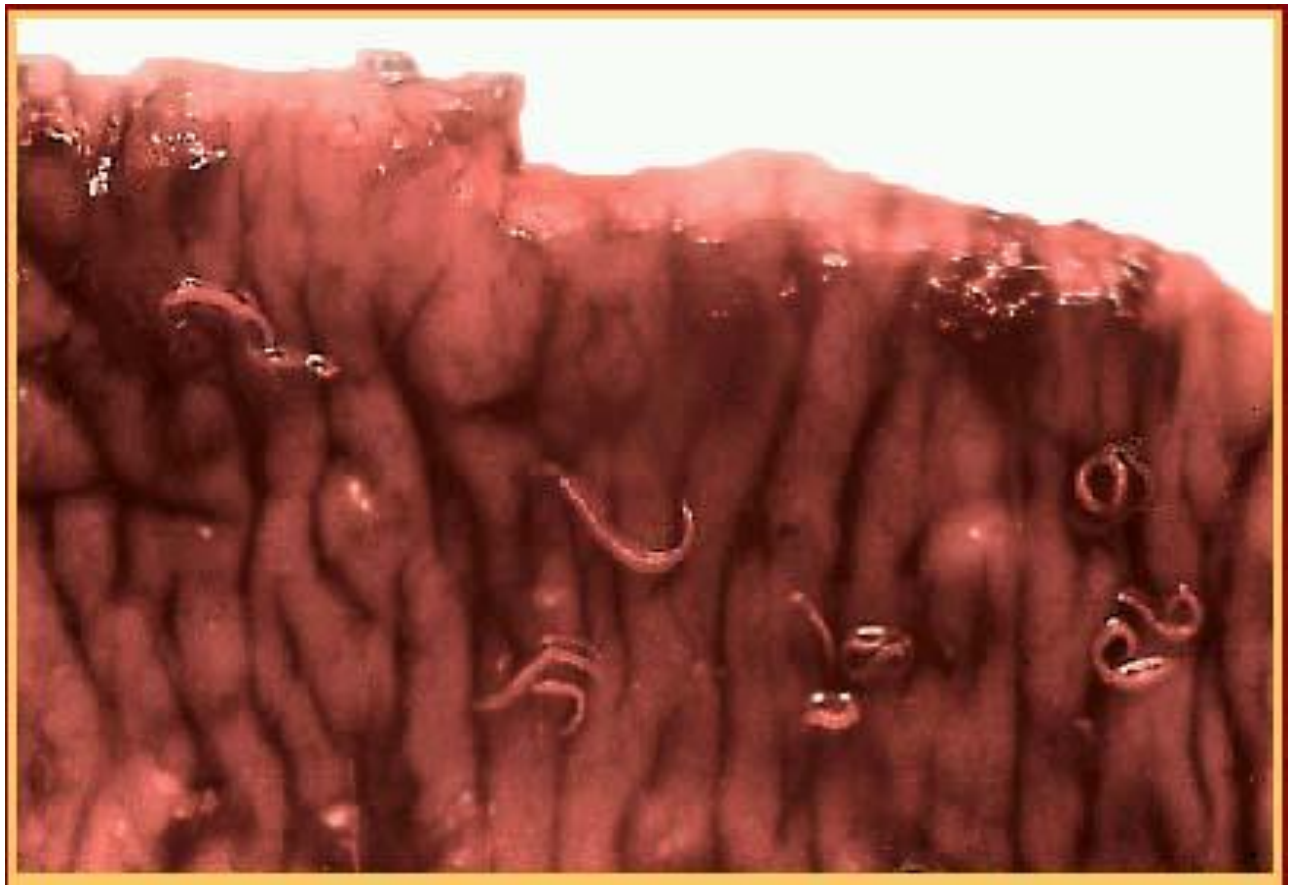
# Adults in intestinal mucosa

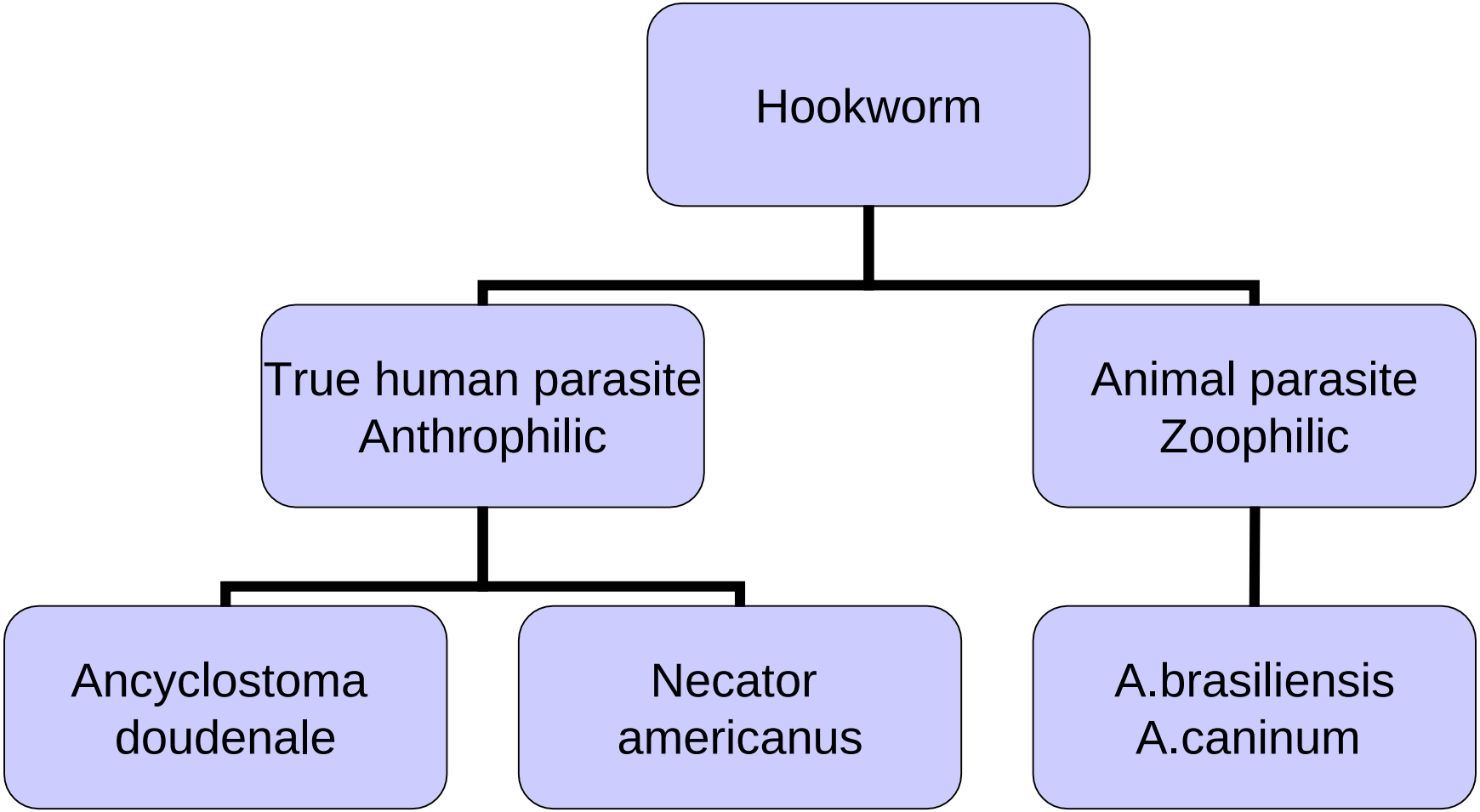


# Hook worm

# What's there in name…Hookworm

- The old world = Ancylostoma doudenale
  - Ancylos = hooked
  - Stoma = mouth
- The new world = Necator americanus-
  - American hookworm
  - American murderer
- Necator = murderer

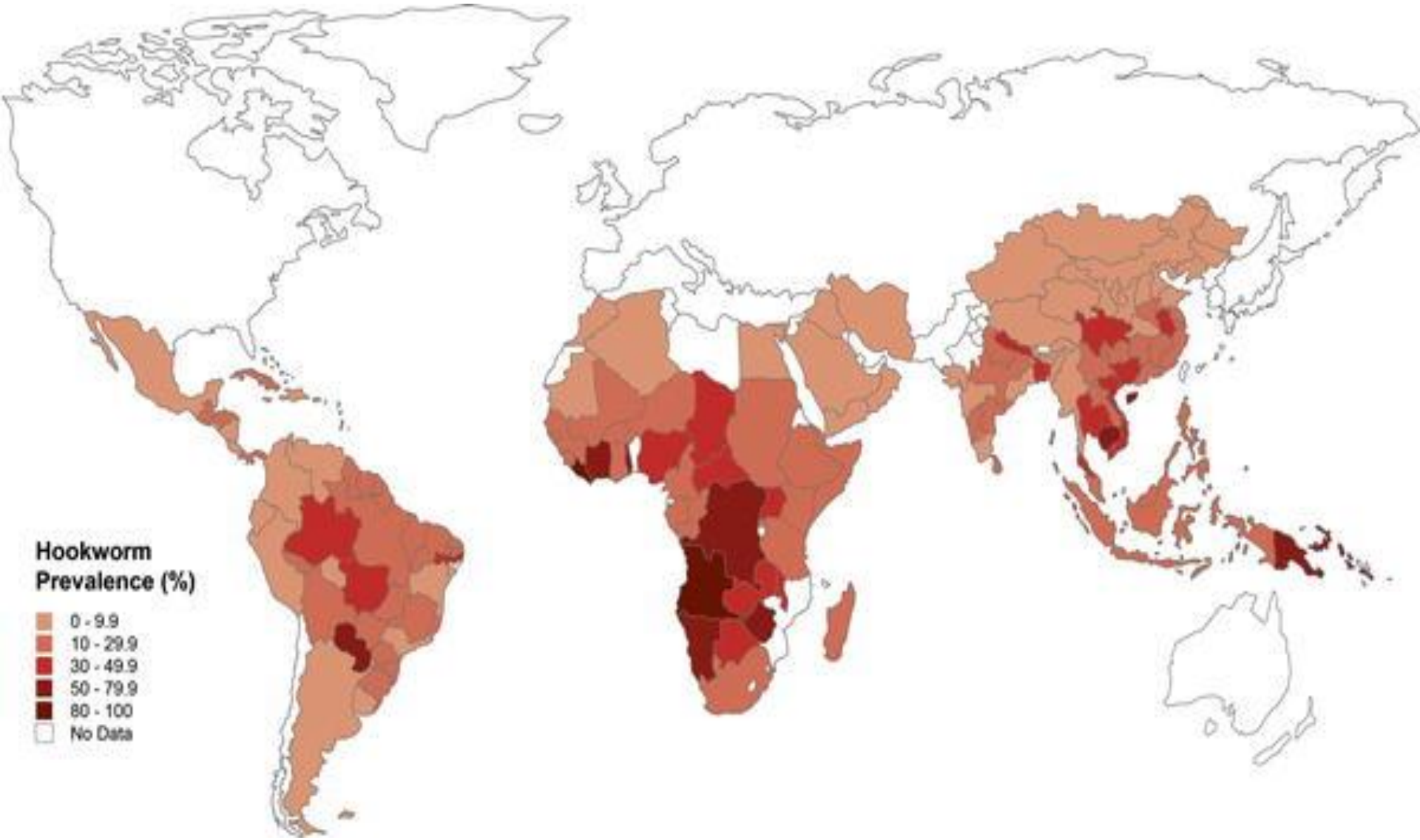
# Classification:



# Geographical distribution

- Infection is prevalent all over the world
- Necator –
  - predominantly found in USA
  - Also found in other parts of world
- Ancylostoma –
  - not found in USA
  - far more common than Necator
- In India –
  - A.doudenale – Punjab & U.P ( More common in Northern India )
  - Necator – Throughout India ( More common in southern India)

# Hookworm prevalence



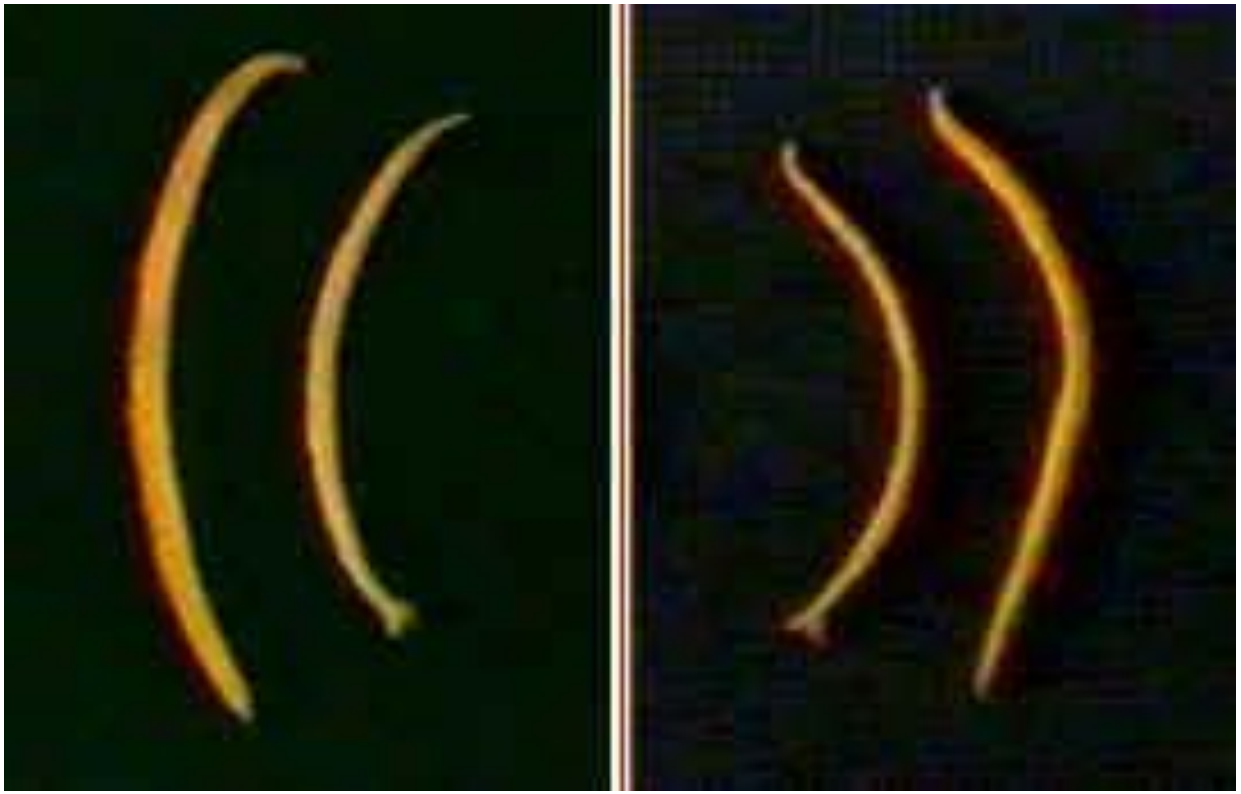
# Habitat

- Adult worm lives in small intestine of man
  - Jejunum
  - Less common in duodenum
  - Rarely in ileum

# Morphology

- **Adult worm :**
  - **Pale pink or greyish white**
  - **curved cylindrical worm with concavity on dorsal aspect**
  - **Size : Female – up to 15 mm, Male- up to 10 mm**
  - **Anterior end – bend slightly dorsally hence called hook worm, bend is in same direction as general body curvature**

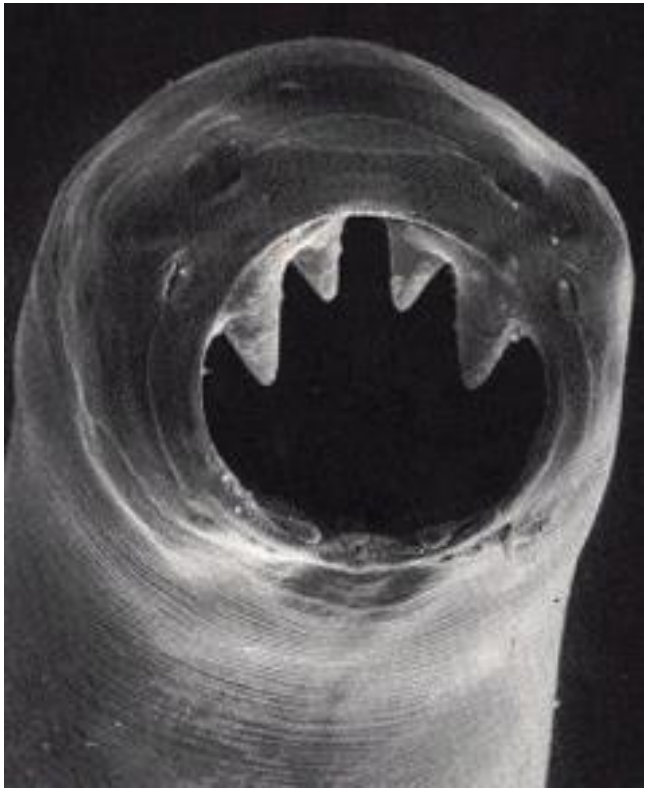
# Differences between two hookworms



Adults of A. duodenale  Adults of N. americanus

# Morphology

- Mouth : large and possess 4 hook like teeth on ventral surface & 2 smaller knob like teeth on dorsal surface, mouth opens dorsally

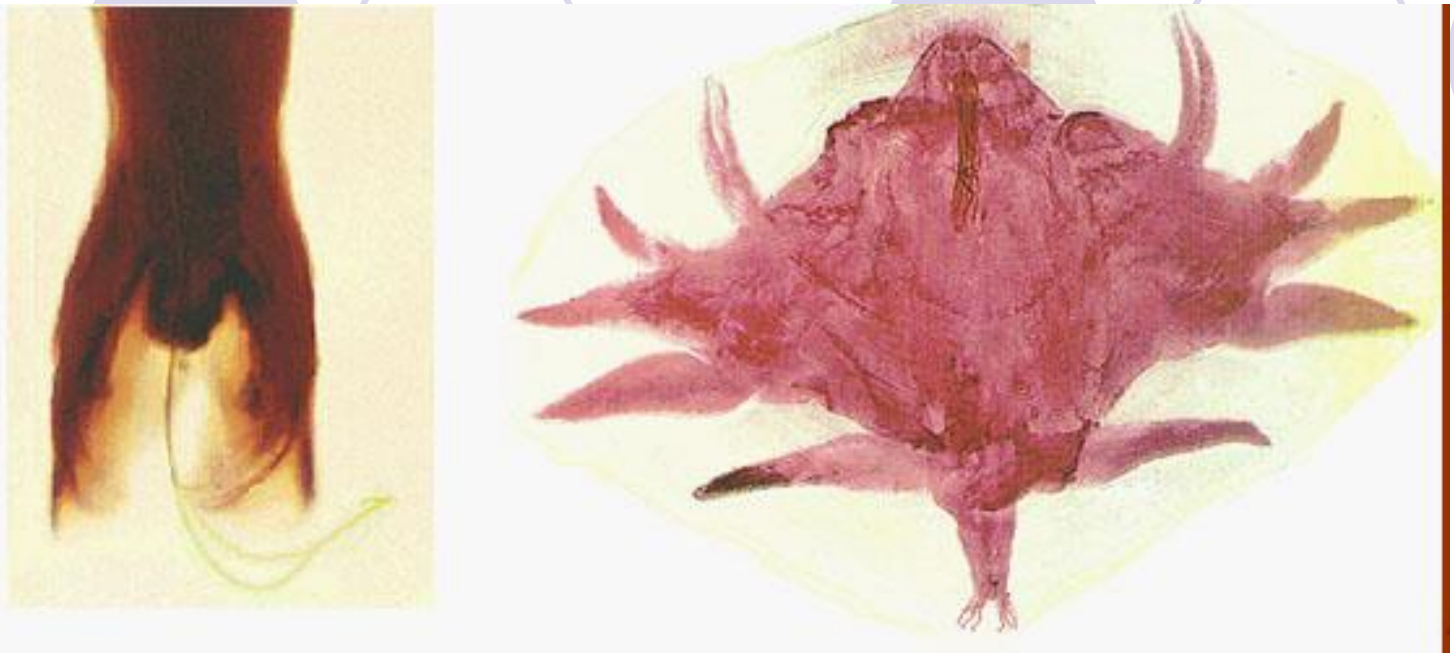


# Male

- Posterior end is expanded (like umbrella) into a copulatory bursa supported by fleshy rays

- Copulatory bursa
  - 2 lateral lobes – number of rays - 12
  - 1 dorsal lobe – not split - number of ray - 1
- Total number of rays – 13

- 2 copulatory spicules project from bursa, cloaca opens in bursa at posterior end



♦Left picture: Copulatory bursa and spines of N. americanus(a side view);

♦Right picture: copulatory bursa of A. duodenale(a top view)

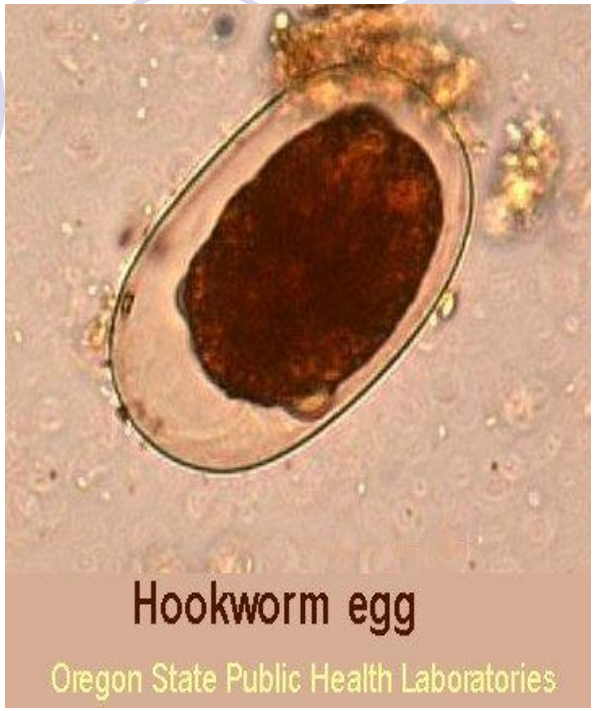
# Female

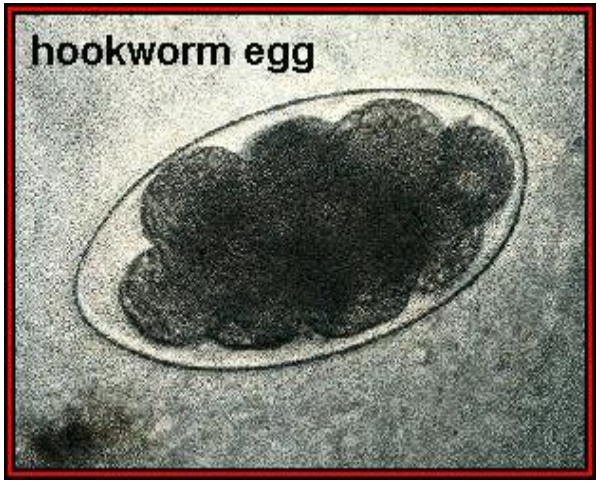
- Posterior end is cone shaped with sub terminal anus situated ventrally
- Vulva opens ventrally at junction of middle & posterior third of body
- During copulation worm assumes “Y” shaped position

| | Male | Female |
|---|---|---|
| Size | Smaller<br>8-10mm × 0.45 mm | Larger<br>10-15 mm ×0.6 mm |
| Posterior end | Expanded in an umbrella like fashion | tapering |
| Genital pore | Posteriorly, opens with cloaca | At junction of posterior and middle third of body |

# Eggs

- **Oval or elliptical – 65 µ × 40 µ**
- **Colorless ( not bile stained )**
- **Surrounded by a thin transparent shell**
- **Contains a segmented ovum with 4 blastomeres**
- **Clear space between egg shell & segmented ovum**
- **Floats in saturated salt solution**



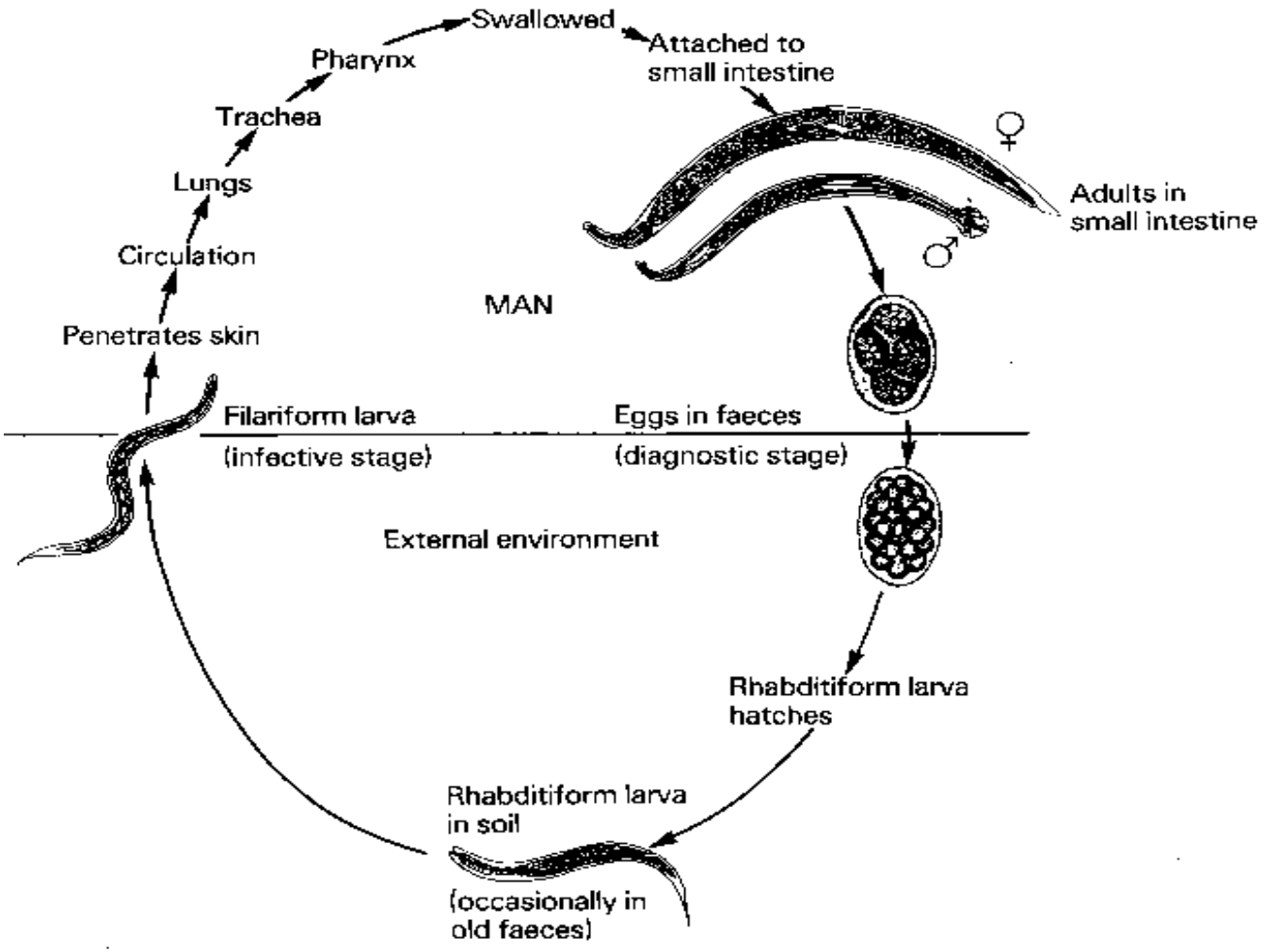



# Life Cycle

1. Final host: man
2. Inf. Stage: Filariform larva
3. Portal of entry : by penetration of skin
4. Mode of infection : walking bare foot on faecally contaminated soil
5. Site of inhabitation: small intestine
6. Life span: Ad 15years, Na 3-7years
7. Blood-lung migration: →

**skin, cavum, right heart, lungs**

# Life cycle of hookworm



# Site of entry of larva

- Thin skin between toes
- Dorsum of foot
- Inner side of sole
- In case of agricultural workers, skin of hand

# Moulting in hookworm

- Larvae moult 4 times
- In soil
  - Moult twice – Rhabditiform larvae to acquire mouth parts suited for penetration
- In pharynx 3rd moulting occurs to get temporary buccal capsule
- 4th moulting takes place in jejunum to acquire regular buccal cavity

# Clinical syndromes

- Effects due to migrating larva
- Effects due to adult worm
  - Severity of symptoms depends on worm burden
    - Clinical manifestation are light - if < 5 egg/mg of faeces
    - Significant anemia develops- if > 20 eggs/mg of faeces

# Effects due to migrating larva

- Ground itch
  - At site of penetration – larva gives rise to severe itching
  - An erythematous papular rash develops which become vesicular
  - Scratching may lead to secondary bacterial infection
  - Condition is called as “Ground itch” or “ancyclostomal dermatitis”
  - Self limiting state – lasts for 2-4 weeks only

- Loeffler’s syndrome :
  - Larvae when break out from pulmonary capillaries – enter alveoli, minute hemorrhages occur – with secondary infiltrate
  - Clinical pneumonitis develops with massive infection
  - It is more common with ascariasis

# Effects due to adult worm

- Acute infection
  - Gastro intestinal symptoms – abdominal pain, nausea, vomiting and diarrhea
- Chronic infection
  - Hypochromic microcytic anemia – Iron deficiency anemia
  - Symptoms of anemia includes – hyperdynamic circulation, pallor, retardation of growth, listlessness, edema of subcutaneous tissue and effusion in serous cavities

# Causes of anemia

- Adult worm in jejunum -suck blood by prominent buccal capsule, esophagus has got pumping action sucking blood continuously
- They frequently migrate in intestine in search of new sites for blood sucking, leaving behind small bleeding lesions
- Worm secrets anticoagulant substance so bleeding continues for prolonged period
- Degree of anemia is proportional to –
  - **Worm burden, availability of dietary iron, body iron store**

# Blood loss in hookworm infection

- 0.2 ml / worm / day – A.doudenale
- 0.03 ml / worm / day – N.americanus

# Laboratory diagnosis

- Direct evidence
  - Demonstration of eggs in stool by direct microscopy or by concentration technique
- Indirect evidence
  - Blood examination
  - Detection of anemia

# Stool examination

- If examination made immediately
  - Characteristic eggs with 4 blastomeres will be seen
  - No differences between eggs of Necator and Ancyclostoma
  - < 5 eggs / cover slip – light infection
  - > 20 eggs / preparation – heavy infection
- If delay occurs > 24 hours
  - Larvae will hatch out
  - Has to be differentiated from strongyloides larva

# Concentration method

- Sedimentation technique
  - Formal-ether technique
- Floatation technique
  - Saturated sodium chloride method
  - Zinc sulfate method

# Formal – ether technique

- Mix 1 gm of stool – 10 ml of 10 % formal-saline – left for 10 min
- Strained through wire gauze or gauze piece in centrifuge tube
- Add 3 ml of ether to filtrate
- Centrifuge at 2000 rpm for 2 min
- Allow to settle
- Decant supernatant fluid with debris
- Make cover slip preparation from deposit
- Count the number of eggs

# Saturated sodium chloride technique

- 1/4$^{th}$ of a 25 ml test tube is filled with saturated salt solution
- Add 1 gm of stool
- Mix and add more salt solution
- Tube is kept in vertical position – any debris collected on top is removed
- Tube is filled up to top (rim of tube)
- Cover slip is placed over it so that it is in contact with fluid
- Preparation is allowed to stand for 30-40 min
- It is lifted carefully by a straight pull upwards and placed on a slide face downwards
- Examine & count number of eggs

# Stoll's egg counting technique

- Add 3 gm of faeces + 42 ml of water (1:15 dilution) in a rubber stopper glass tube, Close tube & mix thoroughly
- 0.15 ml of suspension is examined microscopically for counting eggs
- The numbers are multiplied by 100 – to give number of eggs / gm of faeces
- Multiplication factor :
  - Semi formed – 2 unformed soft – 3
  - Unformed watery – 4 fluid - 5

# Indirect evidence

- Occult blood – positive
- Eosinophilia – may be present
- Anemia – Hypochromic microcytic
- Hb, PCV, MCV, MCHC – all ↓

# Treatment

- Anthelminthic drugs
  - Mebendazole
    - 100 mg BD  for 3 days
  - Albendazole
    - 400 mg single dose
  - Pyrantel pamoate
    - 10 mg/kg body weight as a single dose
    - Max 1 gm
- Treatment of anemia

# Creeping eruption

- Also called as “ Cutaneous larva migrans”
- Seen in species of Ancyclostoma which are not adapted to human
  - A.brasiliensis & A.caninum
- After penetrating skin layers they cannot proceed to normal development
- Wander in skin layers aimlessly producing itchy reddish papule along path traversed by larvae

# Difference b/w Necator & Ancyclostoma

| | A.doudenale | N.americanus |
|---|---|---|
| Size | Larger & thick | Smaller & slender |
| Anterior end | Bends in same body direction | Opposite direction |
| Buccal capsule | 4 hook like ventral teeth<br>2 knob like dorsal | 4 chitinous plates – 2 on ventral & 2 on dorsal |
| Copulatory bursa | Dorsal ray single | Dorsal ray split from base |

| | **A.doudenale** | **N.Americanus** |
|---|---|---|
| Number of rays | 13 | 14 |
| Vulval opening (ventrally) | At junction of middle & posterior 3rd | At junction of middle & anterior 3rd |
| Filariform larva | Longer | short |
| Pathogenicity | More | Less |
| Blood loss /day | 0.2 ml / worm | 0.03 ml / worm |