Medical Laboratory Techniques Department
Lecture 18 : Hookworm *(Ancylostoma duodenale)*
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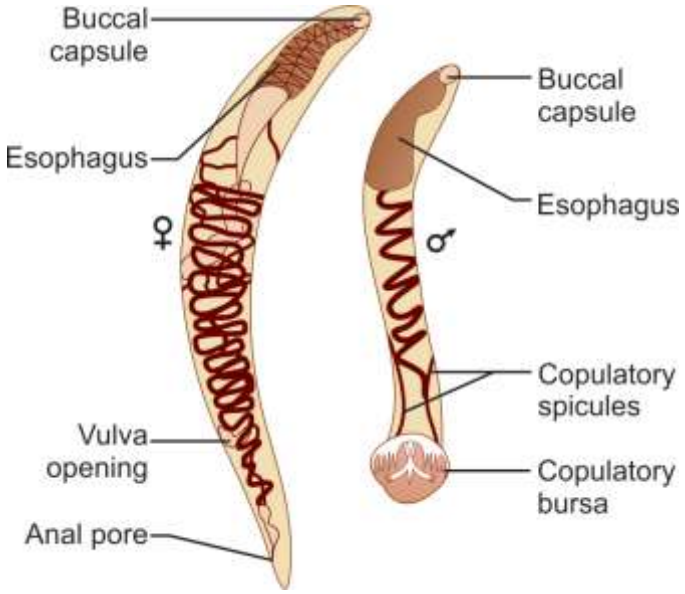
## *A. duodenale*

### Habitat

The adult worms live in the small intestines of infected persons, mostly in the **jejunum**, less often in the duodenum, and infrequently in the ileum.




**Adult worm of *A. duodenale* (male and female)**

### Morphology

### Adult Worm

They are relatively stout قوية cylindroid worms.

- They are pale pink or grayish white, but may appear reddish brown due to ingested blood.
- The body is curved with the dorsal aspect concave مقعر and the ventral aspect convex محدب. The anterior end is somewhat constricted منقبض and bent منحني dorsally in the same direction of general body curvature انحناء. This cervical curvature gave it the name hookworm.

- The mouth is not at the tip but directed dorsally. The prominent buccal capsule, reinforced محصنة with a hard chitin-like substance carries 6 teeth; 4 hook-like teeth ventrally, and 2 knob-like with a median cleft شق dorsally.

## Female Worm

The female worm is larger, 10 to 13 mm long and 0.6 mm thick.

Its hind end is conoid, with a subterminal anus situated ventrally.

- The vulva opens ventrally at the junction of the middle and posterior thirds of the body.
- The vagina leads to two intricately coiled ovarian tubes انبوبين مبيضيين ملتفين بشكل معقد which occupy the hind and middle parts of the worm.
- During copulation the male attaches its copulatory bursa to the vulva. The copulating pair therefore presents a **Y-shaped** appearance.
- Sexes are easily differentiated by their size, the shape of the posterior end and the position of the genital opening.

## Male Worm

The **male worm** is smaller than female worm 8-11 mm in length and 0.4 mm thick.

- The posterior end of the male is expanded يتوسع into a copulatory bursa which consists of **3 lobes**; 1 dorsal and 2 laterals. Each lobe is supported by **13 fleshy chitinous rays**, 5 each in lateral lobes and 3 in dorsal lobe: one dorsal and two extradorsal rays. The pattern of the rays helps in distinguishing between different species.
- There are 2 long قابلة للانقباض retractile شعيرات bristle-like **copulatory spicules** شويكات الجماع, the tips قمة of which project from the bursa الجراب.

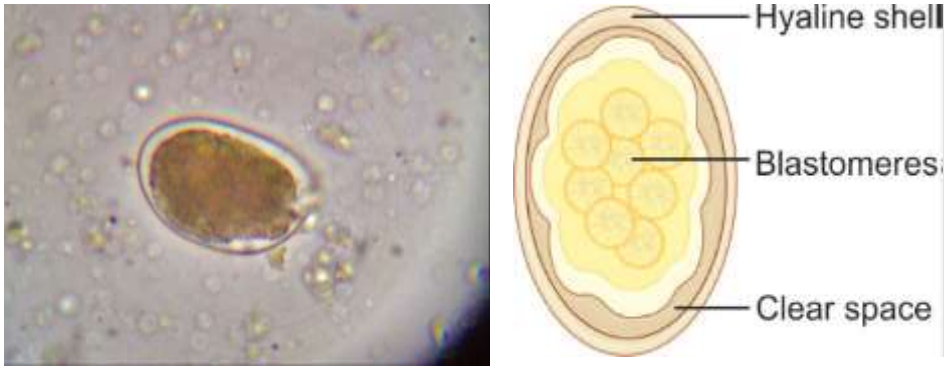
## Egg

The egg of hookworm is:

- Oval or elliptical, measuring 60 µm by 40 µm.
- Colorless, **not bile stained.**
- Surrounded by a thin transparent hyaline shell membrane.
- Floats in saturated salt solution.

- When released by the worm in the intestine, the egg contains an unsegmented ovum.
- During its passage down the intestine, the ovum develops. When passed in feces, the egg contains a segmented ovum, usually with **4 or 8 blastomeres**.

* There is a **clear space** between the segmented ovum and the egg shell.




**Egg of *A. duodenale*. A. As seen under microscope B. Schematic diagram**

A single female worm lays about 25,000–30,000 eggs in a day and some 18–54 million during its life time.

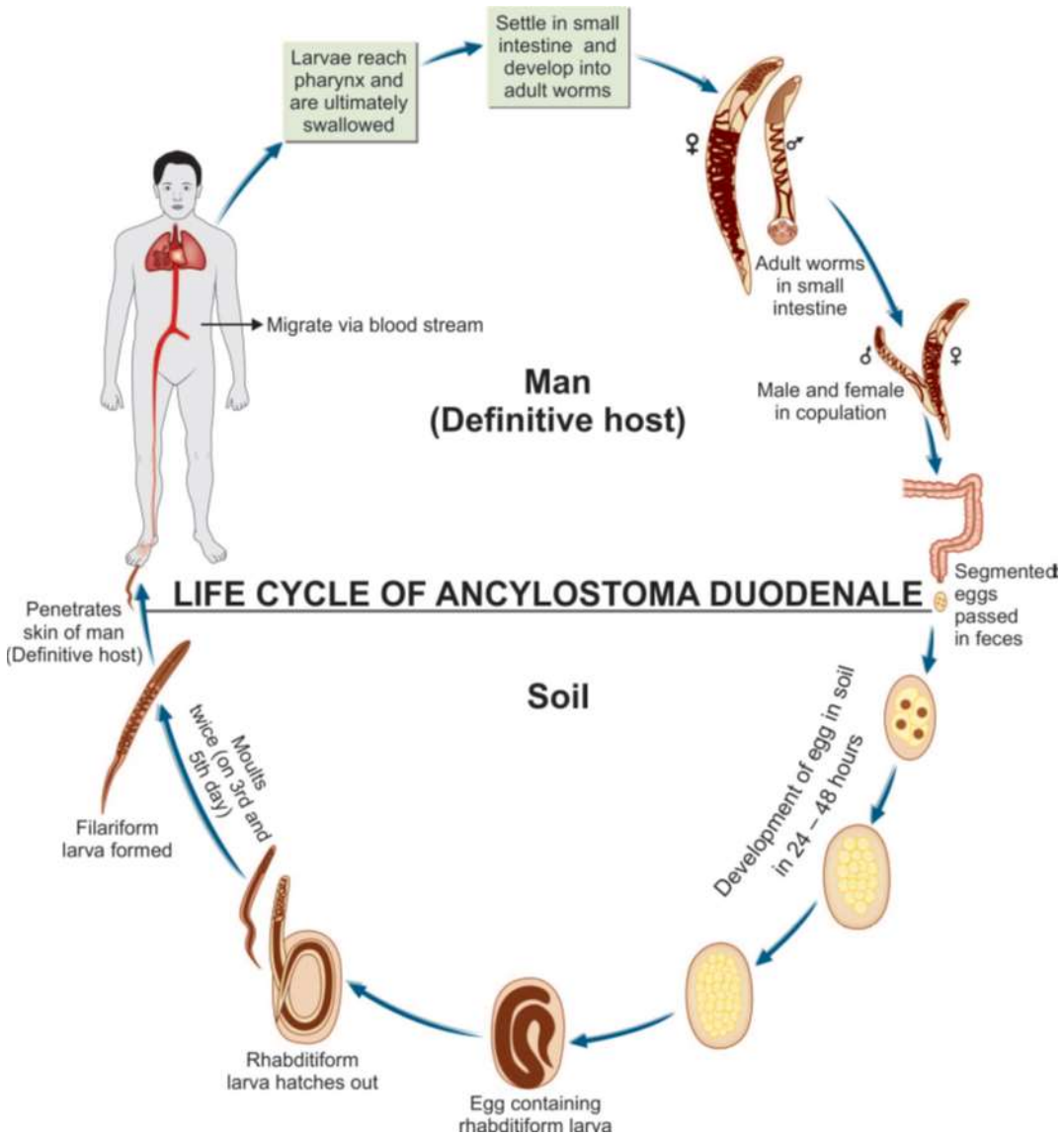
## Life Cycle

Life cycle of ancylostoma is completed in a **single host.**

**Definitive host:** Humans are the only natural host. No intermediate host is required like other helminths.

**Infective form:** Third stage _ filariform larva.

The eggs containing segmented ova with 4 blastomeres, are passed out in the feces of infected person. Eggs freshly passed in feces are not infective for humans.




When deposited in the soil, the embryo develops inside the eggs. Its development takes place optimally in sandy loamy soil with decaying vegetation under a moist, warm, shady environment.

* In about 2 days, a *rhabditiform larva*, measuring 250 µm in length, hatches out of the egg. It feeds on bacteria and other organic matter in the soil and grows in size.

* It moults twice, on the 3rd and 5th days after hatching to become the *third-stage infective _ lariform larva.*

* *Filariform larva* is about 500–600 µm long, with a sharp pointed tail. The _ lariform larva are non-feeding. They can live in the soil for 5–6 weeks, with their

heads waving in the air, waiting for their hosts. They can also ascend on blades of grass or other vegetation, being carried in capillary water on their surface. Direct sunlight, drying, or salt water can kill the larva.

## Mode of Infection

- When a person walks barefooted on soil containing the _ filariform larva, they penetrate the skin and enter the subcutaneous tissue. The common sites of entry are the skin between the toes, the dorsum of the foot ظهر القدم. In farm workers and miners عمال المزارع والمناجم, the larvae may penetrate the skin of the hands.
- Rarely, infection may take place by the oral route, the filariform larva being carried on contaminated vegetables or fruits. The larvae may penetrate the buccal mucosa to reach the venous circulation and complete their migration via the lungs.
- Tran mammary and transplacental transmission has been also reported for *Ancylostoma*, but not for *Necator*.
- Inside the human body, the larvae are carried along the venous circulation to the right side of the heart and to the lungs. Here, they escape from the pulmonary capillaries into the alveoli, migrate up the respiratory tract to the pharynx, and are swallowed, reaching their final destination small intestine.
- During migration or on reaching the esophagus, they undergo third moulting.
- They feed, grow in size, and undergo a fourth and final moulting in the small intestine and develop the buccal capsule, by which they attach themselves to the small intestine and grow into adults.
- There is no multiplication in the host and a single infective larva develops into a single adult, male or female.
- It takes usually about 6 weeks from the time of infection for the adult worms to become sexually mature and start laying eggs. But sometimes, there may be an arrest in development and the process may take much longer, 6 months or more.
- Alternatively, the larvae may be swallowed and may develop directly into adults in the small intestine without a tissue phase.

## Laboratory Diagnosis

- Demonstration of characteristic oval segmented hookworm eggs in feces by direct wet microscopy or by concentration methods is the best method of diagnosis. In stool samples examined 24 hours or more after collection, the eggs may have hatched and rhabditiform larvae may be present. These have to be differentiated from *Strongyloides* larvae.
- Adult hookworms may sometimes be seen in feces. Eggs of *A. duodenale* and *N. americanus* cannot be differentiated by morphology. Thus specific diagnosis can only be made by studying morphology of adult worms.

- Duodenal contents may reveal eggs or adult worms.
- Stool culture: Harada Mori method of stool culture is carried out to demonstrate third stage _ filariform larvae which helps in distinguishing *A. duodenale* and *N. americanus*.