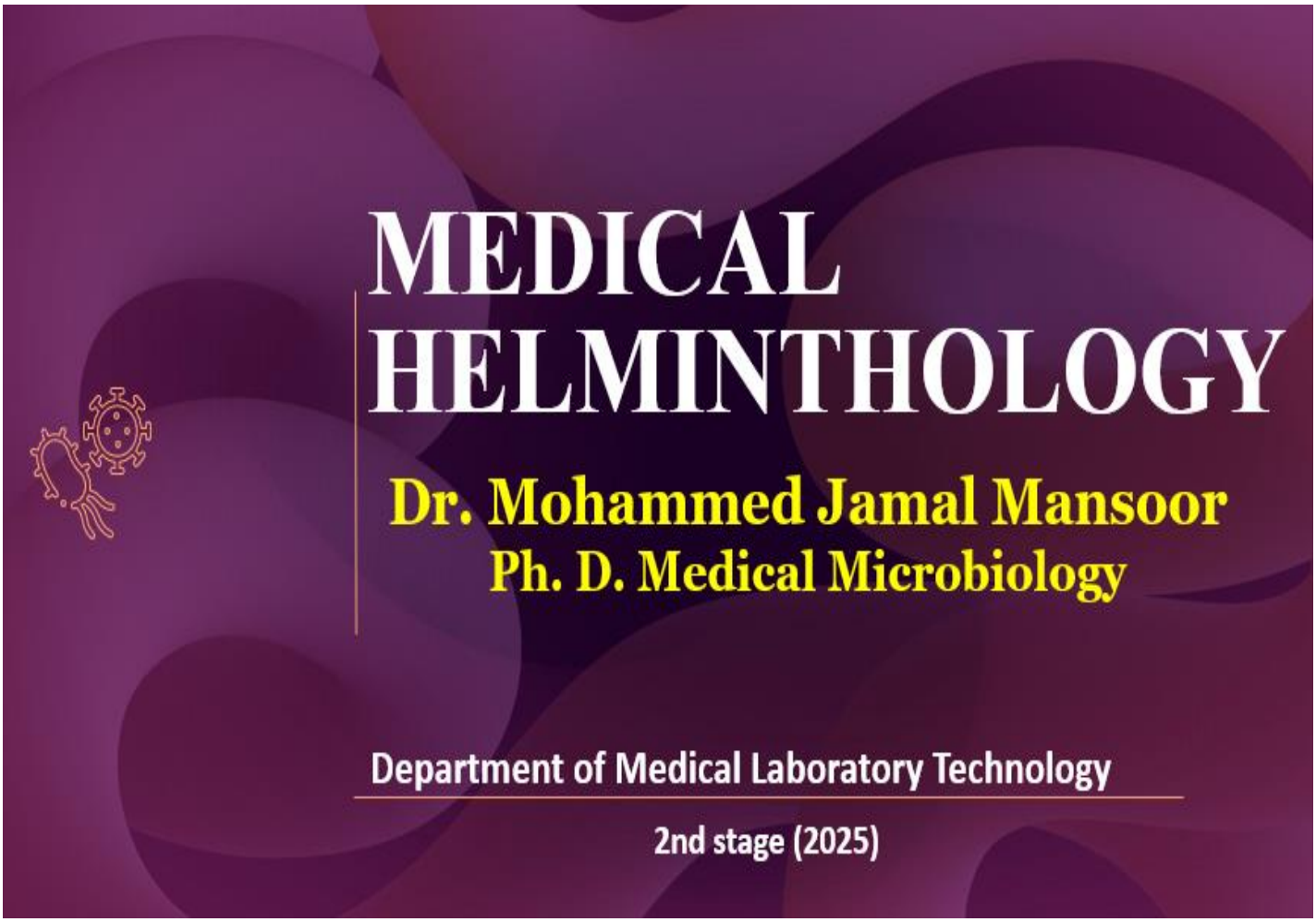
MEDICAL
HELMINTHOLOGY
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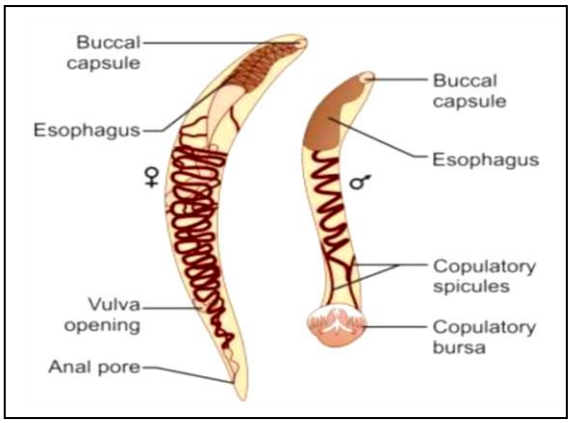
2nd stage (2025)

Lec.11,12 *Ancylostoma duodenale & Necator American*

Common name: Hook worm



*They are stout cylindrical worms, **pale pink** or **greyish white**, but may appear **reddish brown** due to ingested blood.*

- **The mouth is not at the tip but directed dorsally. The prominent buccal capsule, reinforced with a hard chitin-like substance carries two pairs of hook-like teeth ventrally and a dental plate with a median cleft dorsally.**

Adult male:

- Worm is about 8 to 11 mm in length
- There are two long retractile bristle-like copulatory spicules

Adult female:

- Is larger, 10 to 13 mm long and thick.

Egg

- Oval or elliptical
- colorless, not bile stained
- 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.

HABITAT

The adult worms live in the small intestines of infected persons, mostly in the jejunum

Transmission

- **When a person walks barefooted on soil containing the filariform larvae, they penetrate the skin and enter the subcutaneous tissue. The common sites of entry are the skin between the toes.**
- **Rarely infection may take place by the oral route, the filariform larvae being carried on contaminated vegetables or fruits.**

Life cycle

- Humans are **the only natural host**. Eggs freshly passed in feces are not infective for humans. When deposited in the soil, the embryo develops inside the eggs.
- In about 2 days, a rhabditiform larva, hatches out of the egg. It feeds on **bacteria** and **other organic matter** in the soil, grows in size and moults twice, on the 3rd and 5th days after hatching to become **the third-stage Infective filariform larva**, with a sharp pointed tail.
- The filariform larvae are non-feeding. They can live in the soil, grass or other vegetation for about 5 weeks, waiting for their hosts.
- When a person walks **barefooted on soil** containing the **filariform larvae**, they **penetrate the skin** and enter the subcutaneous tissue.
- In the subcutaneous tissue the larvae enter **the venues** and are carried in circulation to **the right heart** and to **the lungs**. In the lungs. they break out of the capillaries to reach **the alveoli**, from where they migrate up the respiratory tract to **the epiglottis**. They crawl over the epiglottis to the pharynx and **are swallowed**.
- During migration or on reaching the jejunum, they moult and develop a **temporary buccal capsule** by which they get attached to the gut mucosa. They feed and grow in size, undergo a fourth and final moulting, develop the buccal capsule and grow into adults.
- **It takes usually about 6 weeks to 6 months from the time of infection for the adult worms to become sexually mature and start laying eggs.**

The clinical features

1- Clinical disease may be due to larvae or adult worms
2- When the filariform larvae enter the skin, they cause severe local itching and secondary bacterial infection may follow
3- The worms attach themselves to the gut mucosa by their buccal capsules, they suck into their mouth a portion of intestinal villi.
4- Adult *Ancylostoma* can suck about 0.2 ml blood a day, this chronic blood loss leads to iron deficiency anemia.
5- Infection may cause epigastric pain, vomiting, and diarrhea, the stool being reddish or black. This is more often seen in the acute stage, when the infection is heavy.

Laboratory diagnosis

- Demonstration of the eggs in faeces by direct microscopy or by concentration methods is the diagnostic test. In stool samples examined 24 hours or more after collection, the eggs may have hatched and rhabditiform larvae may be present.

Necator American	*Ancylostoma duodenale*
Smaller	Larger
Anterior curvature in opposite direction to body curve	The anterior in adult female is curvature uniform with body curve
Has a smaller buccal capsule with two pairs of semilunar cutting plates instead of teeth	Has two pairs of hook-like teeth ventrally and a dental plate with median cleft dorsally
Copulatory: Has a paired dorsal ray, making a total of 14 rays, Copulatory spicules are fused at the tip	*Copulatory:* Has a single dorsal ray with a split end making a total of 13 rays, Copulatory spicules are separate
The lifespan is longer being about 4- 20 years	The lifespan is shorter being about 2-7 years

Questions

Q: What is the color of Ancylostoma duodenale and Necator americanus worms?
a) reddish brown
b) pale pink
c) Greyish white
d) all of the above

Q: What gives *Ancylostoma duodenale* and *Necator americanus* the name "hookworm"?
a) Their stout cylindrical shape
b) Their pale coloration
c) Their constricted and dorsally bent anterior end
d) Their dorsal aspect being convex

Q: What structure carries hook-like teeth in *Ancylostoma duodenale* and *Necator americanus*?
a) Buccal capsule
b) Dental plate
c) Ventral aspect
d) Dorsal aspect

Q: How does the male worm's posterior end differ from the females?
a) It is conoid with a subterminal anus.
b) It is expanded into a copulatory bursa supported by fleshy rays.
c) It contains two intricately coiled ovarian tubes.
d) It has a ventrally located vulva.

Q: What is the function of the copulatory spicules in the male worm?
a) To support the copulatory bursa
b) To help in distinguishing between different species
c) To project from the bursa
d) To open the vulva

Q: Where is the vulva located in the female worm?
a) At the anterior end
b) At the posterior end
c) Ventrally at the junction of the middle and posterior thirds of the body
d) Dorsally at the junction of the middle and posterior thirds of the body

Q: How do filariform larvae typically enter the human body?
a) Through ingestion of contaminated food or water
b) Through contact with infected animals
c) Through penetration of the skin, especially between the toes
d) Through inhalation of contaminated air

Q: What is the role of the filariform larvae in the human body after penetrating the skin?
a) They migrate to the brain.
b) They enter the bloodstream and travel to the liver.
c) They travel to the intestines and develop into adults.
d) They migrate to the lungs and then to the epiglottis.

Q: How do filariform larvae reach the respiratory tract after entering the human body?
a) They travel directly from the skin to the lungs.
b) They are carried by the bloodstream to the lungs.
c) They crawl through the digestive system to the respiratory tract.
d) They are coughed up from the lungs and swallowed.

Q: The filariform is the infective form of :
A- Schistosoms japonicum B- Hymenolepis nano
C- Taenia solium D- Necator americanus
E- Wychereria bancrofti

Q: Statements that concerning with *Ancylostoma duodenale* is correct:
A- Old world hook worm B- Usually enter man orally
C- Female has capulatory bursa D- Diagnose by scotch tape technique
E- Cestoda

Q: Which of the following stages of *Ancylostoma duodenale* is infective to human beings:
A- Rhabditiform B- Filariform larva C- Cyst

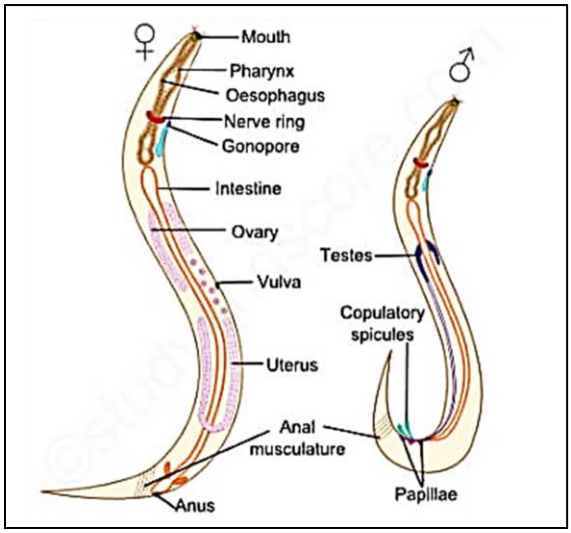
Lec.13 Filarial worm

Slender thread-like worms (Latin, *filum*—thread) which are **transmitted by the bite of blood-sucking insects.** مهمة

In the bodies of infected vertebrate hosts, they occur **both as adults and the embryos**, which are known as **microfilariae**. In some species, the **microfilariae retain their egg membranes** which envelope them as a sheath. These are known as **sheathed 'microfilariae**, in **contrast** to others which **rupture their egg membranes** and come out as **unsheathed 'or naked microfilariae.**

Lymphatic filariasis

Wuchereria bancrofti

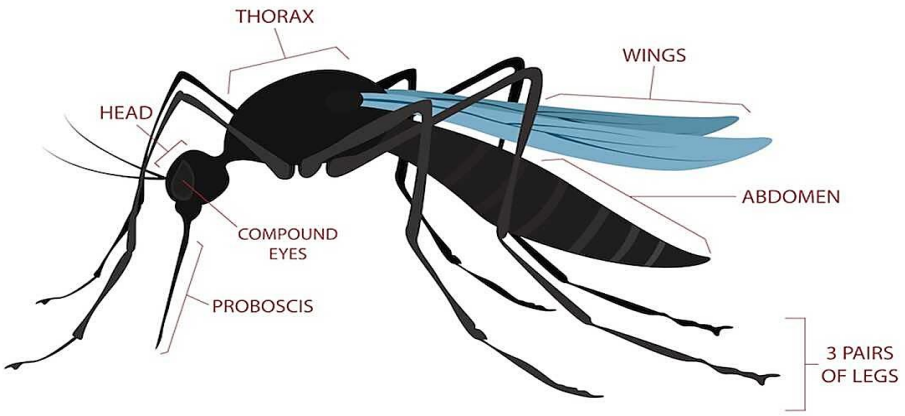


Morphology

- The adults are **whitish**, **translucent**, **thread-like** worms with smooth cuticle and **tapering ends.**
- The female is larger than the male.
- **Males and females remain coiled together** usually in the abdominal and inguinal lymphatics and in the testicular tissues. The adult worms live for many years, probably 10 to 15 years or more.
- The worm is **ovoviviparous**. The embryo (microfilaria) is released encased in its elongated egg-shell, which persists as a *sheath*.
- The microfilaria has a **colorless**. it is actively motile and can move forwards and backwards within the sheath.

Life Cycle

- **Humans are the definitive host. No animal host or reservoir is known.**
- **The intermediate host is the female mosquito *Culex* sp.** مهم
- **Microfilariae do not multiply or development in the human body. If they are not taken up by a female vector mosquito, they die.**
- When a vector mosquito feeds on a carrier, the **microfilariae** are taken in with the **blood meal** and **reach the stomach of the mosquito.**
- **They penetrate the stomach wall and migrate to the thoracic muscles where they development.**
- **During the next 2 days**, they become **the first-stage larva** which is a **sausage-shaped form with a spiky tail.**
- **Within a week**, it **moults once or twice**, **increases in size and becomes the second-stage larvae**, **in another week**, it develops its internal structures and becomes the **elongated third-stage filariform larva (actively motile)**. This is ***the infective larva***. **It enters the proboscis of the mosquito. When a mosquito with infective larvae in its proboscis feeds on a person, the larvae get deposited, usually in pairs, on the skin near the puncture site.**

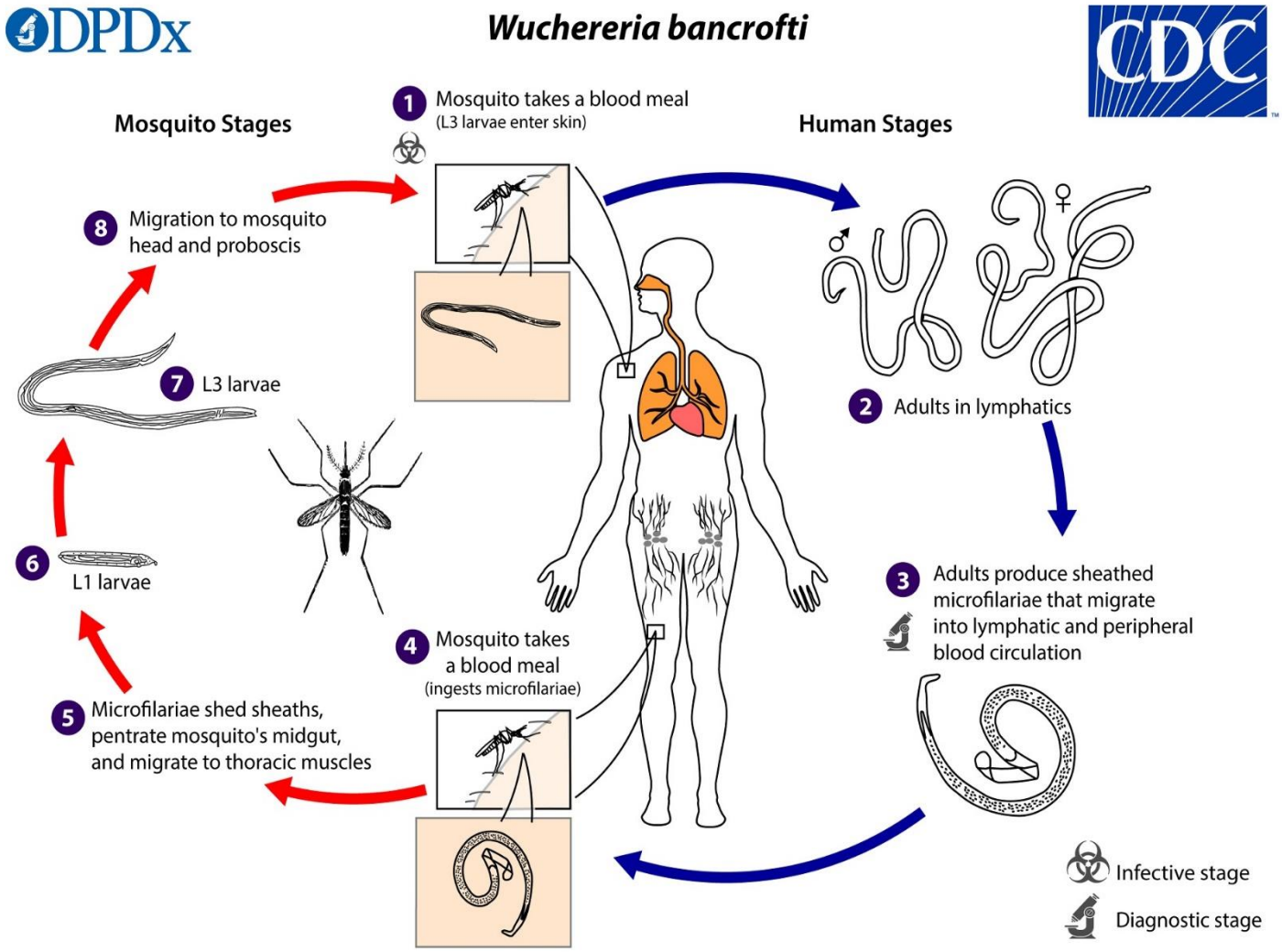


- The **larvae** enter through the **puncture wound or penetrate the skin** by themselves.

- **After penetrating the skin**, the **third-stage larvae enter the lymphatic vessels** and are carried usually to **abdominal or inguinal lymph nodes**, where they develop into adult forms. There is no multiplication at this stage and only one adult develops from one larva male or female.

- **They become sexually mature in about 6 months and mate. The gravid female worm releases large numbers of microfilariae.**

- **They pass through the thoracic duct and pulmonary capillaries to the peripheral circulation**



Pathogenicity

- Cause disease Lymphatic filariasis

- The typical manifestations of filariasis are caused by the adult worms **blocking lymph nodes** and **vessels**, either **mechanically** or more commonly due to **allergic inflammatory reactions** to worm antigens and secretions.
- The worms inside lymph nodes and vessels may cause **granuloma formation** and **calcification**.

Diagnosis:

- The **diagnosis of filariasis depends** on the **clinical features**.
- The **laboratory tests that can be used for diagnosis include the following**:

- Detection of microfilaria in peripheral blood.

- Detection of the adult worm in biopsy specimens.

-Skin tests with filarial antigens.

-Serological tests.

Treatment: Diethylcarbamazine (DEC)

Questions

Q: The 'filariform' is infective form of

A- Schistosoma japonicum
B- Hymenolepis nano
C- Necator americanus
D- *Wuchereria bancrofti*
E- *Taenia solium*

Q: What is the primary mode of transmission for filarial worms?

a) Direct contact with infected hosts
b) Ingestion of contaminated food or water
c) Transmission through the bite of blood-sucking insects
d) Airborne transmission

Q: What are the embryos of filarial worms commonly referred to as?

a) Larvae
b) Microfilariae
c) Nematodes
d) Ova

Q: Where do adult filarial worms usually reside within the vertebrate host's body?

a) Brain tissues
b) Intestinal tract
c) Lymphatic system
d) Respiratory system

Q: Which term describes the reproductive method of filarial worms?

a) Viviparous
b) Oviparous
c) Ovoviviparous
d) Parthenogenesis

Q: What is the definitive host for *Wuchereria bancrofti*?

a) Mosquitoes
b) Humans
c) Animals
d) Fish

Q: Which mosquito species serves as the intermediate host for *Wuchereria bancrofti*?

a) Anopheles sp.
b) Aedes sp.
c) Culex sp.
d) Culiseta sp.

Q: Where do microfilariae develop after being ingested by a female vector mosquito?
a) Digestive system
b) Salivary glands
c) Stomach
d) Thoracic muscles

Q: Where do the third-stage larvae typically develop in adult forms within the human body?
a) Muscular tissues
b) Digestive system
c) Lymphatic vessels, especially abdominal or inguinal lymph nodes
d) Respiratory system

Q: How long does it take for the filarial worms to become sexually mature and mate?
a) 1 month
b) 3 months
c) 6 months
d) 12 months

Q: What is the route taken by the microfilariae after being released by gravid female worm?
a) They migrate to the brain
b) They pass through the digestive system
c) They pass through the thoracic duct and pulmonary capillaries to reach the peripheral circulation
d) They remain in the lymph nodes

Q: What are the typical manifestations of filariasis primarily caused by?
a) Direct damage by the adult worms
b) Blockage of blood vessels
c) Mechanical blockage of lymph nodes and vessels
d) Allergic inflammatory reactions to worm antigens and secretions

Q: Which of the following is NOT a method used for the diagnosis of filariasis?
a) Demonstration of microfilaria in peripheral blood
b) Demonstration of the adult worm in biopsy specimens
c) PCR testing for genetic material of the worm
d) Skin tests with filarial antigens