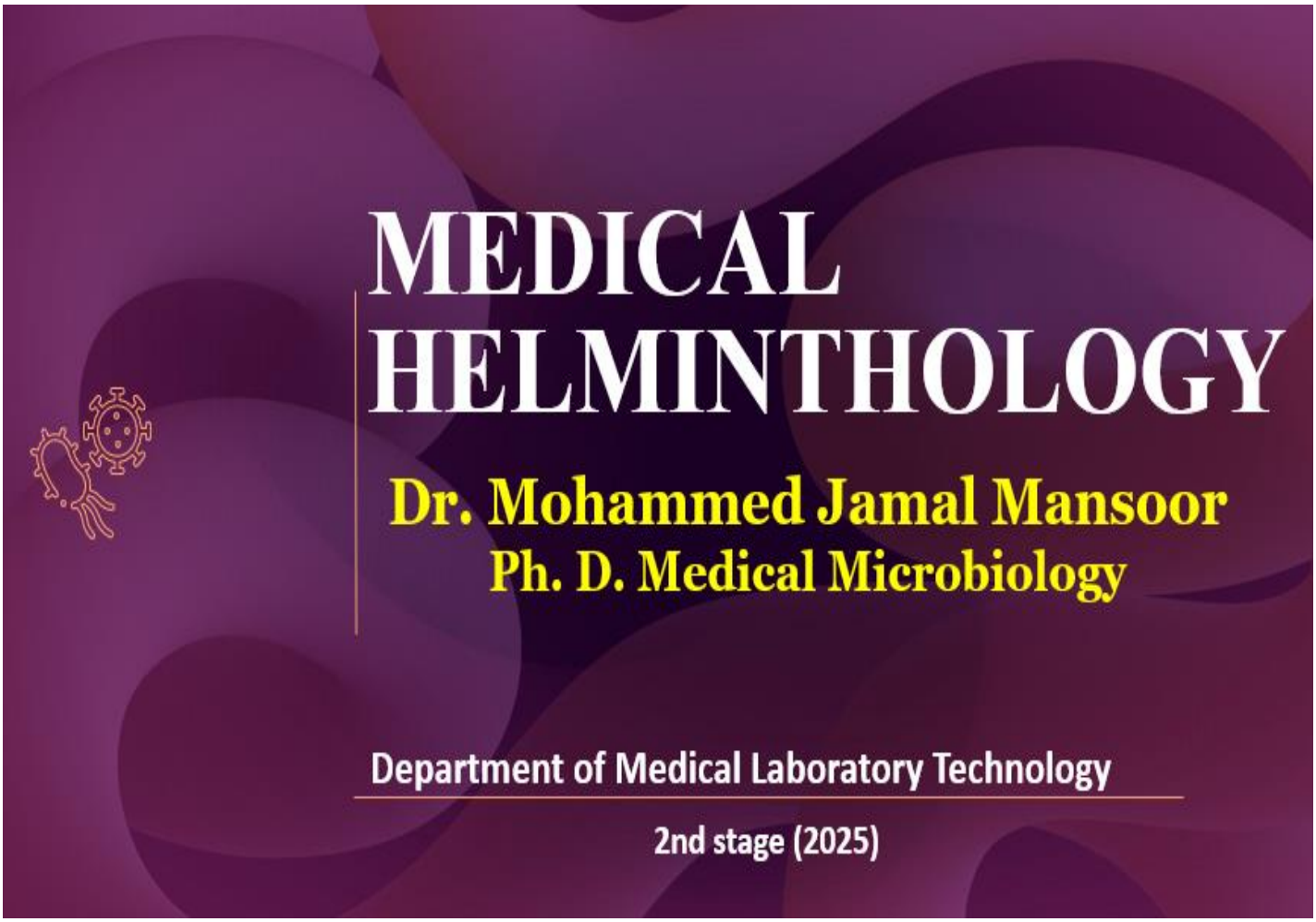

MEDICAL
HELMINTHOLOGY
Dr. Mohammed Jamal Mansoor
Ph. D. Medical Microbiology
Department of Medical Laboratory Technology
2nd stage (2025)

Lec.6 Nematodes

Nematodes are said to be the **most worm-like of all helminths**. This is because they generally resemble the common **earth worm in appearance** which is considered to be the prototype of "worms" However, taxonomically **earthworms are not nematodes** as they are **segmented worms of the Phylum Annelida.**

- **Nematodes** are **elongated**, **cylindrical**, **unsegmented** worms with **tapering ends**.

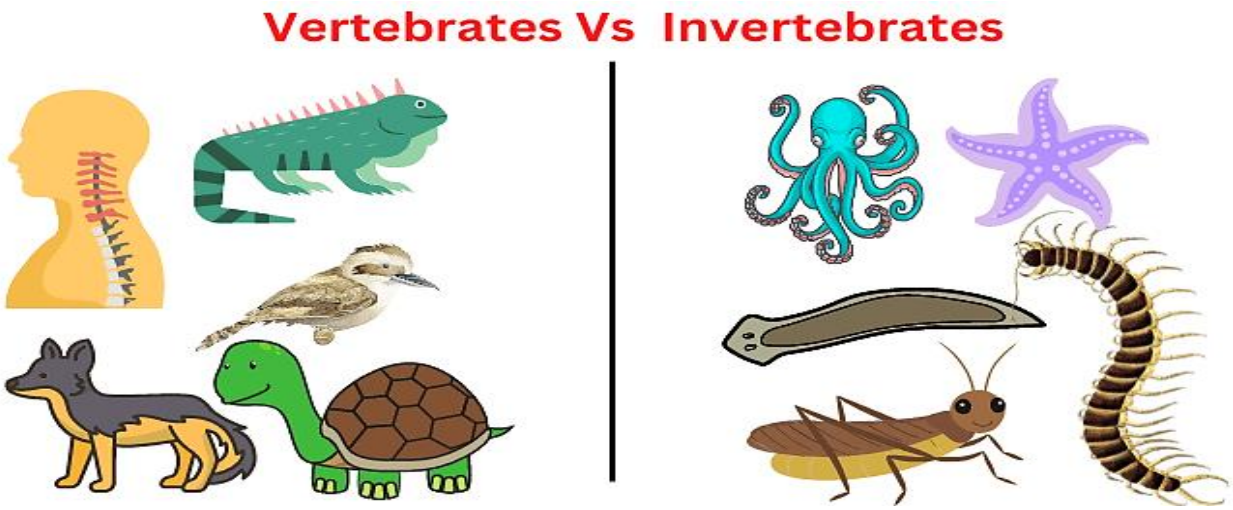
  The name _*nematode* means _*thread-like*' from _*nema* 'meaning _*thread*'.

- **Unlike trematodes and cestodes, all of which are parasitic**, most nematodes are free-living forms found in soil and water.

- The largest number of helminthic parasites of humans belong to the class of nematodes.

  There are an estimated **500,000** species of nematodes

- Several species are parasites of plants and are of **great economic importance**. Many nematodes parasitize invertebrate and vertebrate animals.



General Characteristics

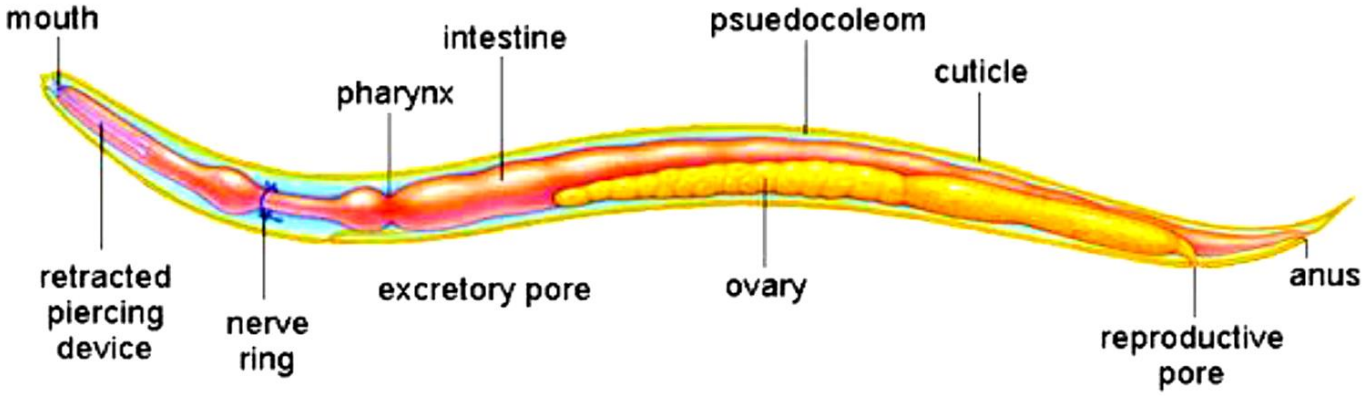
They are **cylindrical**, or **filariform** in **shape**, **bilaterally symmetrical** with a secondary **triradiate symmetry at the anterior end**.

- The adults vary greatly in **size**, from about a **millimeter** (*Strongyloides stercoralis*) to a meter (*Dracunculis medinensis*) in length.

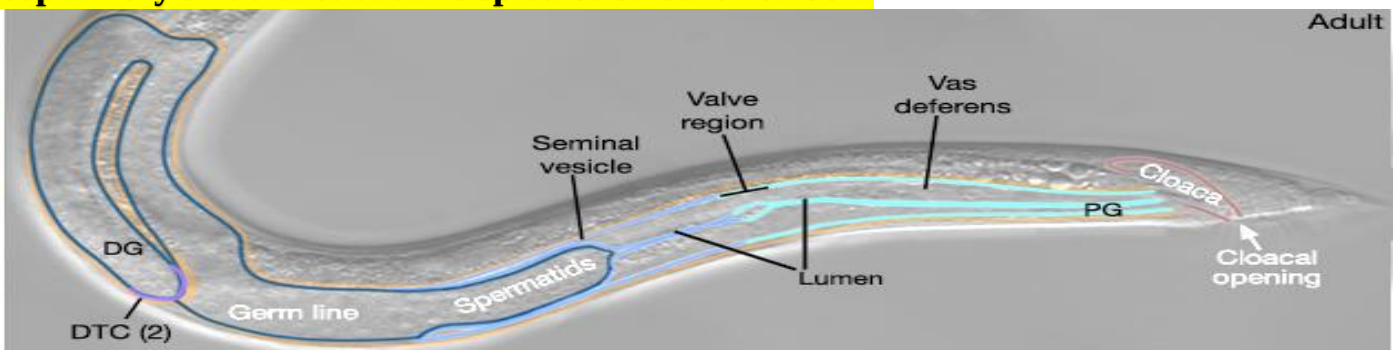
Male is generally **smaller than** **female** and its **posterior end is curved or coiled ventrally.**

Their body is covered with a **tough outer cuticle**, which may be **smooth** ملساء, **striated** مخططة, **bossed** مدببة, **or spiny** مشوكة. The **middle** layer is hypodermis and the **inner layer** is the somatic muscular layer. They move by **sinuous flexion** الانحناء المتعرج of the body.

- The body cavity is a pseudocele.
- **The digestive system is complete**, consisting of anteriorly placed mouth leading to the esophagus, which characteristically varies in shape and structure in different groups. The intestine is lined with a single layer of columnar cells and leads to the rectum, opening through the anus. In the male, the rectum and the ejaculatory duct open into the **cloaca**.



- Nematodes have simple excretory and nervous systems.
- The nematodes are **diecious** i.e., the sexes are separate.
- The **male reproductive system** consists of a single delicate tubule differentiated into testis, vas deferens, seminal vesicle, and ejaculatory duct, which opens into the cloaca. It also includes **copulatory structures such as spicules or bursa or both.**



- The female reproductive system consists of the ovary, oviduct, seminal receptacle, uterus, and vagina.
- Female nematodes may produce **eggs (oviparous)** or **larvae (viviparous).**
- Some lay **eggs containing larvae**, which immediately hatch out **(ovoviviparous)**.

The female nematodes may be divided as follows:

1 Oviparous (laying eggs):

⊛**Unsegmented eggs:** ***Ascaris*, *Trichuris***

⊛**Segmented eggs:** ***Ancylostoma*, *Necator***

⊛**Eggs containing larvae:** ***Enterobius***

2 Viviparous (producing larvae):

⊛***Trichinella*, *Wuchereria*, *Brugia*, *Dracunculus***

3 Ovo-viviparous (laying eggs containing fully formed larvae, which hatch out immediately):

⊛***Strongyloides*.**

Medical Helminthology – 2nd stage (2025)
Dr. Mohammed Jamal Mansoor
Department of Medical Laboratory Technology

Classification of Nematodes on the Basis of the Habitat of Adult Worms

Intestinal Human Nematodes الديدان الخيطية البشرية المعوية	Somatic Human Nematodes الديدان الخيطية البشرية الجسمية
Small Intestine الأمعاء الدقيقة 1 Ascaris lumbricoides (Common round worm) دودة الاسكارس (الدودة المستديرة الشائعة) 2 Ancylostoma duodenale (Old world Hook worm) الانكلستوما الاثناعشرية (خطاف العالم القديم) 3 Necator americanus (American or New World Hook worm) الفتاكة الامريكية (خطاف العالم الجديد او الامريكية) 4 Strongyloides stercoralis اسطوانية برازية 5 Trichinella spiralis الشعرينة الحلزونية 6 Capillaria philippinensis الشعارية الفلبينية **Large intestine الأمعاء الغليظة** 1 Trichuris trichiura (Whip worm) المسلكة الشعرية الراس (دودة سوطية) 2 Enterobius vermicularis (Thread or pin worm) الدودة الدبوسية	**Lymphatics الغدد اللمفاوية** 1 Wuchereria bancrofti 2 Brugia malayi 3 Brugia timori **Skin/subcutaneous tissue** الجلد / الأنسجة تحت الجلد 1 Loa loa اللوا اللوائية 2 Onchocerca volvulus كلابية الذنب الملتوية 3 Dracunculus medinensis (Guinea worm) التنينة المدينية (الدودة الغينية) **Mysentery المساريق** 1 Mansonella ozzardi المنسونيلة الاوزاردية 2 Mansonella perstans المنسونيلة اللجوجة **Conjunctiva الملتحمة** 1 Loa loa اللوا اللوائية

Q: Adult worms of ascaris lumbricoides lives in the.□
A- intestine
B- liver
C- heart
D- lung
E- brain
Q: large intestinal worm is:
A- Enterobius vermicularis
B- Ancylostoma duodenal
C- Trichuris tricura
D- Echinococcus granulosus
E- Ascaris lunbricoides
Q:Nematodes are differentiated from other worms by the following except :
A- Absent fragmentation
B- flat or fleshy leaf-like worm
C- Separate sexes
D- Cylindrical body
E- None of them
Q: Which one is nematode:
A- Echinococcus granulosus
B- Taenia solium
C- Taenia saginata
D- Ascaris lunbricoides
E- Diphyllobothrium latum
Q: Nematoda residing in large intestine:
A- Schistsoma haematobium
B- Fasciola hepatica
C- Trichuris
D- Teania solium
E- Teania saginata

Q: Ascaris lunbricoides :
A- pin worm
B- pork tape worm
C- beef tape worm
D- small cestoda

E- Nematode

Q: What is the meaning of the term "nematode"?
a) Earth-like
b) Thread-like
c) Worm-like
d) Segment-like

Q: What is the primary mode of movement for nematodes?
a) Crawling
b) Slithering
c) Flexion of the body
d) Jumping

Q: What is the significance of the outer cuticle in nematodes?
a) It provides a layer for gas exchange.
b) It serves as a sensory organ.
c) It protects the body and may have various textures.
d) It helps in locomotion.

Q: What is the term used to describe the reproductive system of nematodes?
a) Dioecious
b) Monogamous
c) Polygamous
d) Hermaphroditic

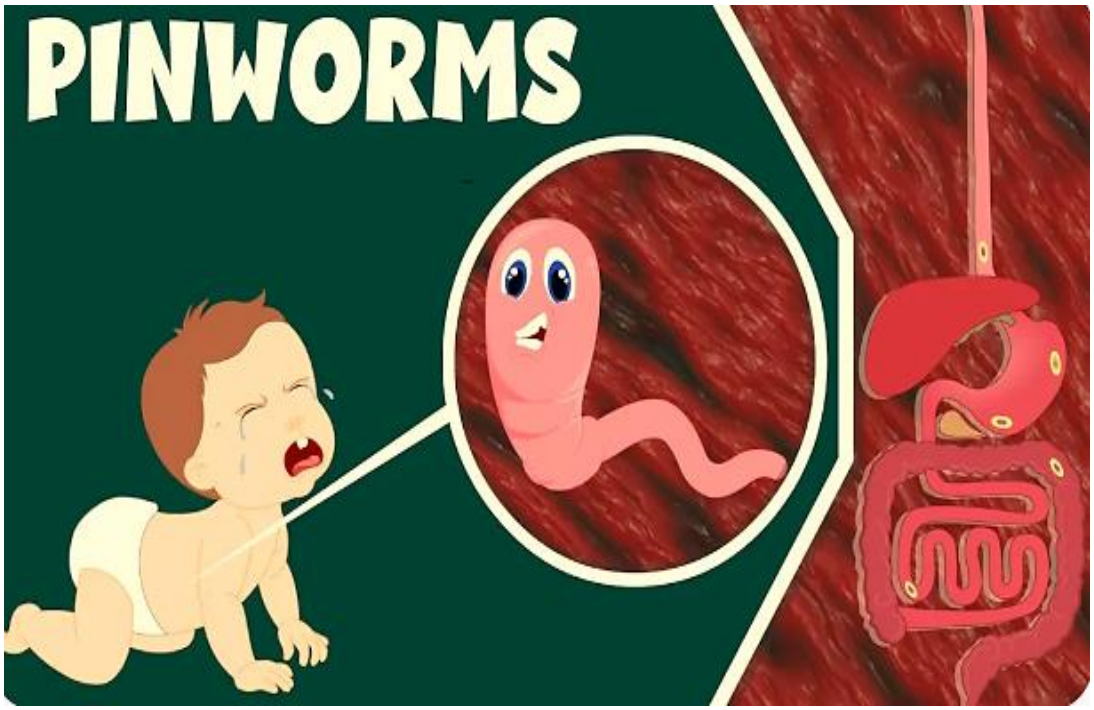
Q: What distinguishes ovoviviparous female nematodes from oviparous ones?
a) They lay eggs containing larvae, which hatch immediately.
b) They lay segmented eggs.
c) They lay unsegmented eggs.

d) They produce larvae directly.

Enterobius vermicularis

Common name: Pinworm, Seatworm, Threadworm

* *E. vermicularis* is considered to be **world's most common** parasite, which specially affects the **children**.



Habitat

Adult worms are found in the **caecum**, **appendix**, and **adjacent portion of ascending colon**.

Morphology

Adult Worm

The adults are **short**, **white**, **fusiform** worms with **pointed ends**, looking like **bits of white thread.**

* The mouth is surrounded by **3 wing-like cuticular expansions (cervical alae).**

الفم محاط بثلاث توسعات جلدية تشبه الجناح (الاجنحة العنقية)

* **Esophagus has a double-bulb المصباح structure, a feature unique to this worm.**

Female Worm

The **female** is **8–13** mm long and 0.3–0.5 mm thick.

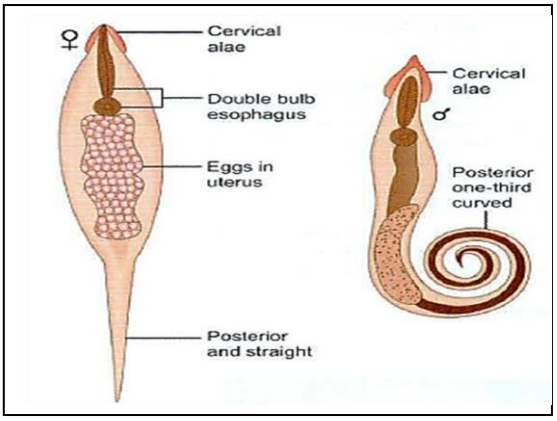
* The worm is **oviparous.**

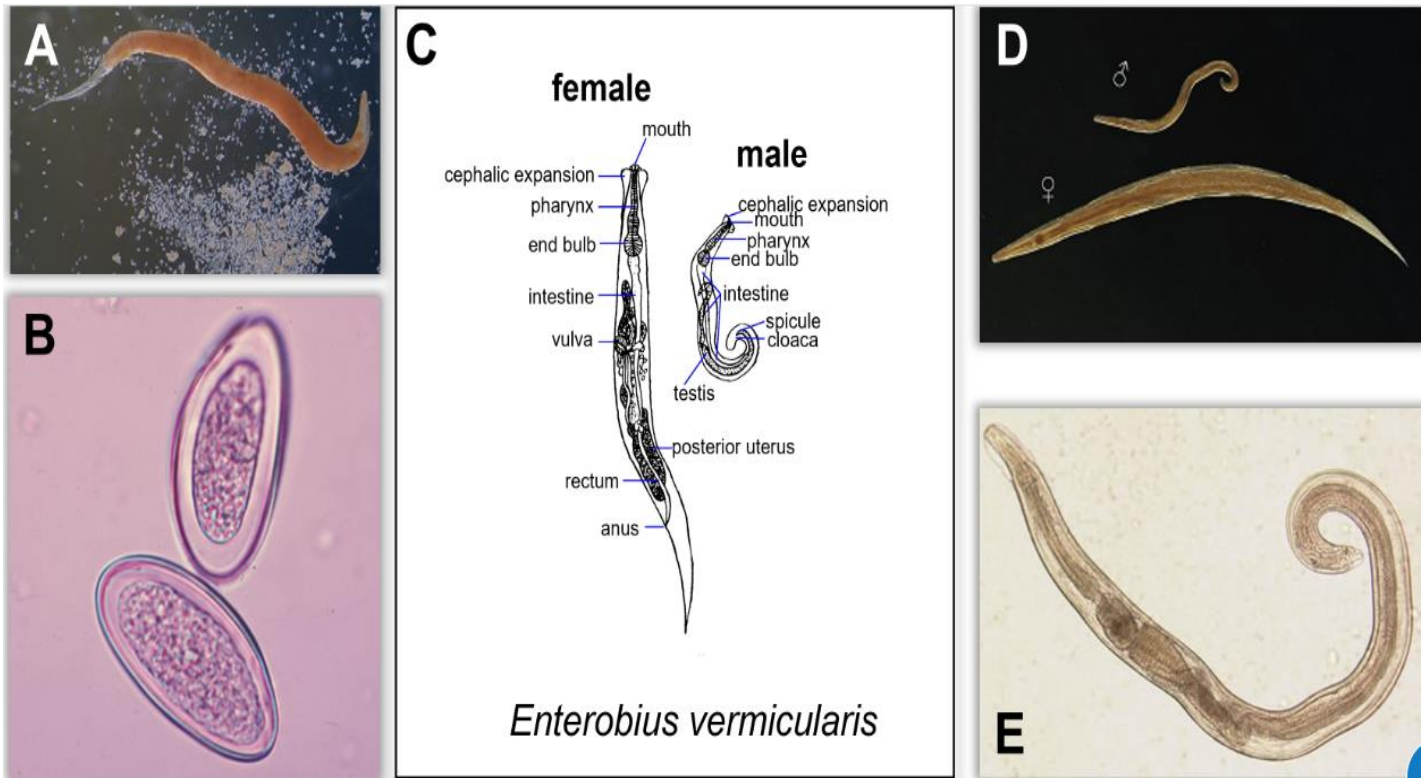
* **Females** survive for **5–12 weeks**.

Male Worm

The **male** worm is **2–5 mm** long and 0.1–0.2 mm thick.

***Males** live for about **7–8 weeks.**





Egg مهمة

The egg is **colorless** and **not bile-stained.**

* It **floats** in saturated salt solution.

* It has a characteristic shape, being **elongated ovoid**, attended on one side, and **convex on the other**

Life Cycle

E. vermicularis **is monoxenous (one host), passing its entire life cycle in the human host. It has no intermediate host and does not undergo any systemic migration.**

Natural host: Man

Infective form: Embryonated eggs.

* **Mode of infection:** Man acquires infection by **ingesting embryonated eggs containing larva** by means of

*** Contaminated fingers**

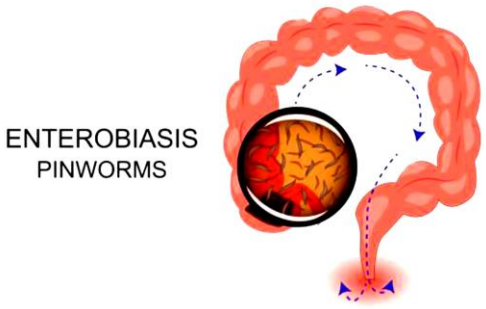
*** Autoinfection**

* Eggs laid on perianal skin containing infective larvae are swallowed and hatch out in the intestine.

*They **moul**t تنسلخin the **ileum** and enter the **caecum**, where they **mature into adults**.

* It takes from **2 weeks to 2 months** from the time the eggs are ingested, to the development of the gravid female, ready to lay eggs.

* The gravid female migrates down the colon to the rectum. **At night**, when the host is in bed, the worm comes out through the anus and crawls تزحف about on the perianal and perineal skin to lay its sticky eggs.



*The female worm may **wander** تتجول into the vulva, vagina and even into the uterus and fallopian tubes, sometimes reaching the peritoneum.

* The male is **seldom** (rarely) seen as it does **not migrate**. It usually **dies after mating and is passed in the feces.**

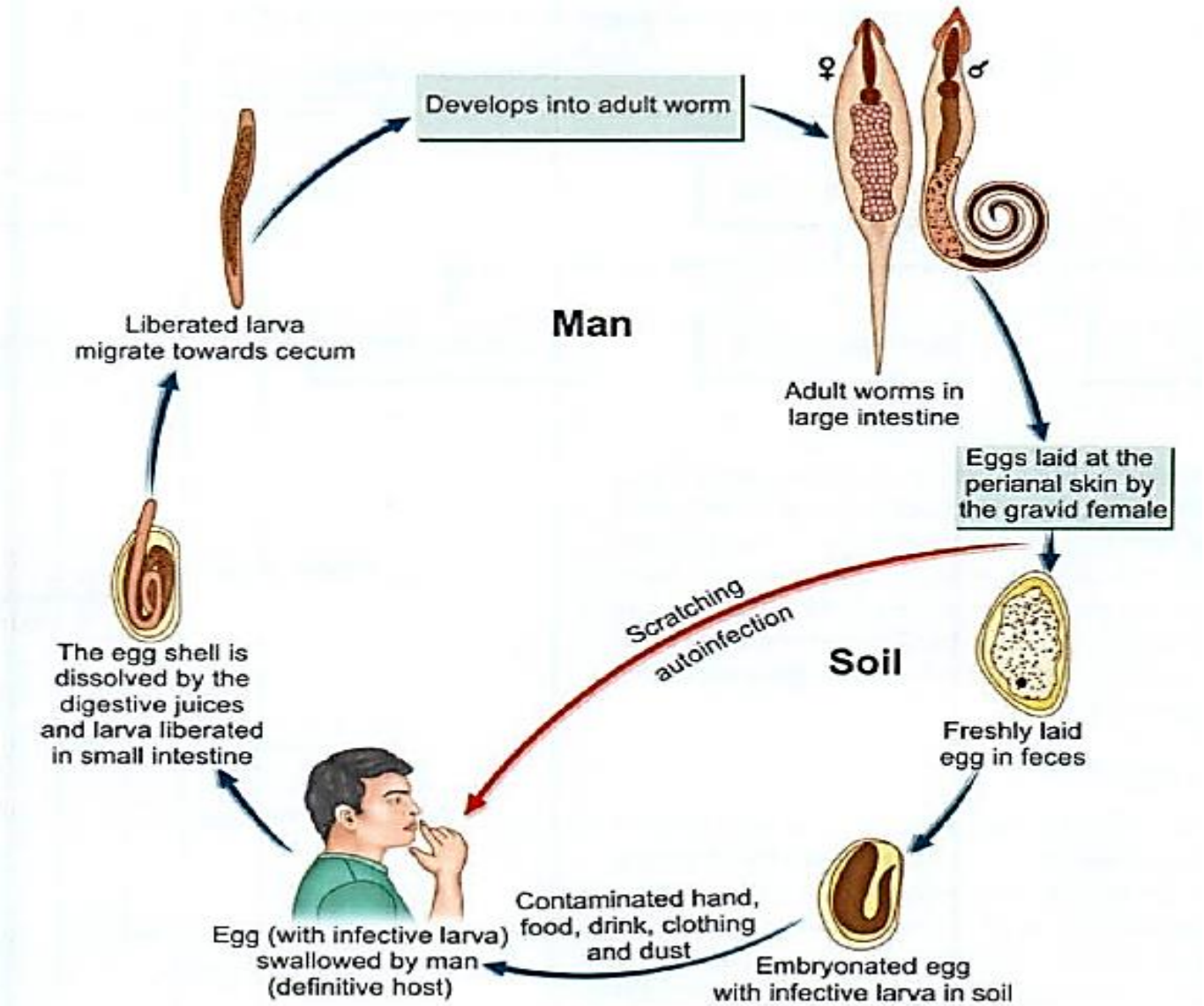


Fig. 3: Life cycle of *Enterobius vermicularis*

*__Autoinfection:__ Ingestion of eggs due to **scratching of perianal area** with **fingers leading** to **deposition of eggs under the nails**. **This type of infection is mostly common in children**. ***This mode of infection occurs from anus to mouth.***

* **Retroinfection:** In this process, the eggs laid on the peri-anal skin immediately hatch into the infective stage larva and migrate through the anus to develop into worms in the colon. ***This mode of infection occurs from anus to colon.***

Pathogenicity and Clinical Features

Enterobiasis occurs mostly in **children**. It is more common in females than in males **Why?**

About one-third of infections are asymptomatic.

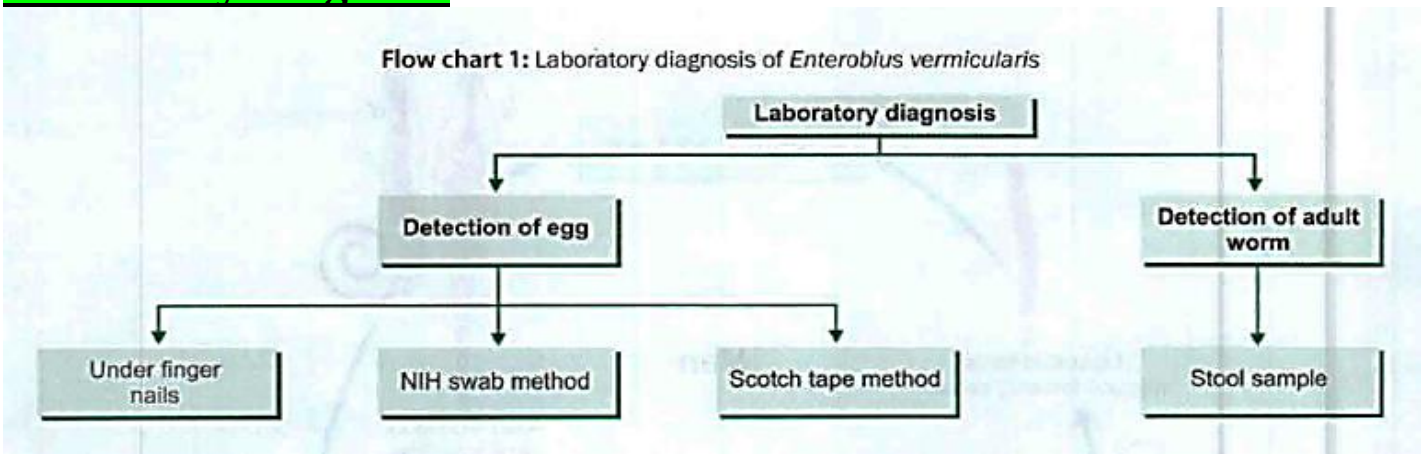
*The worm produces intense irritation and pruritus of the perianal and perineal area (**Pruritis ani**), when it crawls out of the anus to lay eggs. This leads to **scratching** and **Excoriation** (تَسَلُّخ الجلد؛ قَشْر الجلد) of the skin around the anus.

* As the worm migrates out at night, it **disturbs sleep**. **Nocturnal enuresis** سلس البول الليلي is sometimes seen.

* The worm crawling into the vulva and vagina causes irritation and a mucoid discharge. It may migrate up to the uterus, fallopian tubes and into the peritoneum. This may cause symptoms of **chronic salpingitis** التهاب البوق المزمن, **cervicitis, peritonitis, and recurrent urinary tract infections.**

* The worm is sometimes found in **surgically removed appendix** and has been claimed to be responsible for **appendicitis**.

Laboratory Diagnosis



Diagnosis depends on the demonstration of the eggs or adult worms.

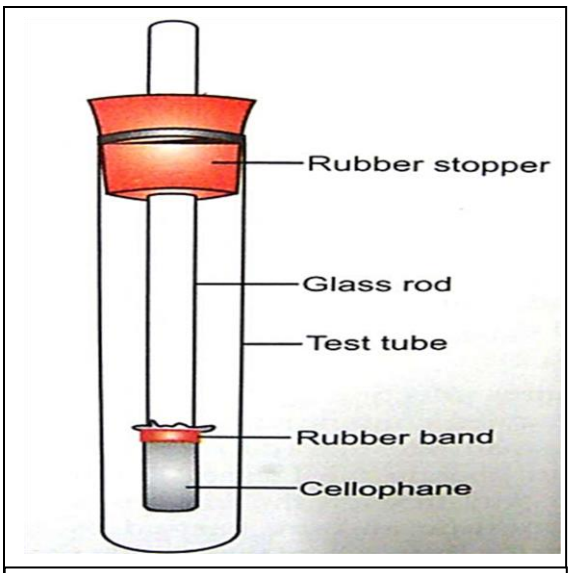
Demonstration of Eggs إيضاح البيوض

* Eggs are present in the feces only in a **small proportion** of patient and so **feces examination is not useful in diagnosis.**

* They are deposited in large numbers on the perianal and perineal skin at night and can be demonstrated in swabs collected from the site's early morning, before going to the toilet or bathing. **Swabs from perianal folds are most often positive.** * **The eggs may sometimes be demonstrated in the dirt collected from beneath the finger nails in infected children.**

NIH Swab Method مسحة المعاهد الوطنية للصحة

The **NIH swab** (named after National Institutes of Health, USA) has been **widely used for collection of specimens**. This consists of a glass rod at one end of which a piece of transparent cellophane is attached with a rubber band. The glass rod is fixed on a rubber stopper and kept in a wide test tube. The cellophane part is used for swabbing by rolling over the perianal area. It is returned to the test tube and sent to the laboratory, where the **cellophane piece is detached, spread over a glass side and examined microscopically**.



Scotch Tape Method

Another method for collection of specimens is with scotch tape **(adhesive transparent cellophane tape)** held **sticky side out**, on a wooden tongue depressor. The mounted tape is firmly pressed against the anal margin, covering all sides. **The tape is transferred to a glass slide, sticky side down, with a drop of toluene for clearing and examined under the microscope.**

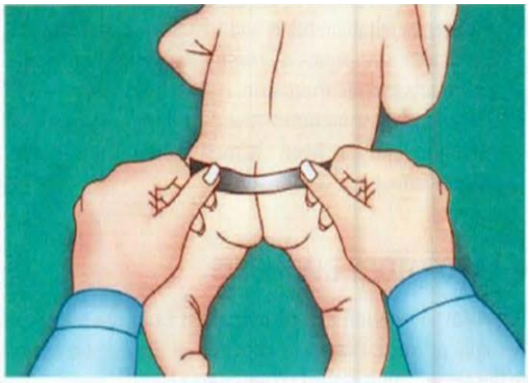


Fig. 5: Scotch tape method (press the sticky side of the tape against the skin across the anal opening)

Demonstration of Adult Worm

The adult worms may sometimes be noticed on the **surface of stools**.

* They may occasionally be found **crawling out of the anus while the children are a sleep**.

*They may be detected in **stools collected after an enema الحقنة الشرجية** and **may be in the appendix during appendicectomy**.

Treatment

Pyrantel pamoate (11 mg/kg once, maximum 1 g),

Albendazole (400 mg once) or **mebendazole** (100 mg once) can be used for **single dose therapy**, while **piperazine** has to be given **daily for one week**.

MULTIPLE CHOICE QUESTIONS

1. Most common presenting symptom of thread worm infection amongst the following is
a. Abdominal pain
b. Rectal prolapse
c. Urticaria
d. Vaginitis

2. Which one of the following does not pass through the lungs
a. Hookworm
b. *Ascaris*
c. *Strongyloides*
d. *Enterobius vermicularis*

3. Infection with which of the following parasites may cause enuresis
a. *Ascaris lumbricoides*
b. *Enterobius vermicularis*
c. *Trichinella spiralis*
d. *Wuchereria bancrofti*

4. History of mild intestinal distress, sleeplessness, itching, and anxiety is seen in **preschool child attending play school. Possible parasite agent causing these manifestations is**
a. *Trichomonas vagina/is*
b. *Enterobius vermicu/aris*
c. *Ascaris lumbricoides*
d. *Necator americanus*

5. The common name for *Enterobius vermicularis* is
a. Threadworm
b. Pinworm
c. Seatworm
d. Whipworm

6. Which of the following nematodes lays eggs containing larvae
a. *Trichinella spiralis*
b. *Enterobius vermicularis*
c. *Brugia malayi*
d. *Ascaris lumbricoides*

Q: Scotch tape used for diagnosis of
A- *Enterobius vermicularis*
B- *Echinococcus granulosus*
C- *T. Gondii*
D- *Entamoeba histolytica*
E- *Trichuris trichiura*

Q: The mod of infection by *Entrobius vermicularis* excepted one
A- Self infection
B- Inhalation
C- Through the skin migration
D- Retro infection
E- By swimming

Q: Adult worms of *ascaris lumbricoides* lives in the.
A- intestine
B- liver
C- heart
D- lung
E- brain

Q: large intestinal worm is:
A- Enterobius vermicularis
B- Ancylostoma duodenal
C- Trichuris tricura
D- Echinococcus granulosus
E- Ascaris lunbricoides

Q: Nematodes are differentiated from other worms by the following except:
A- Absent fragmentation
B- flat or fleshy leaf-like worm
C- Separate sexes
D- Cylindrical body
E- None of them

Q: Which one is nematode:
A- Echinococcus granulosus
B- Taenia solium
C- Taenia saginata
D- Ascaris lunbricoides
E- Diphyllobothrium latum

Q: Nematoda residing in large intestine:
A- Schistsoma haematobium
B- Fasciola hepatica
C- Trichuris
D- Teania solium
E- Teania saginata

Q: *Ascaris lunbricoides*:
A- pin worm
B- pork tape worm
C- beef tape worm
D- small cestoda
E- Nematode

Q: What is the meaning of the term "nematode"?
a) Earth-like
b) Thread-like
c) Worm-like
d) Segment-like

Q: What is the primary mode of movement for nematodes?
a) Crawling
b) Slithering
c) Flexion of the body
d) Jumping

Q: What is the significance of the outer cuticle in nematodes?
a) It provides a layer for gas exchange.
b) It serves as a sensory organ.
c) It protects the body and may have various textures.
d) It helps in locomotion.

Q: An infection with pinworms is called
A- Ascariasis
B- Trichinosis
C- Strongyloidiasis
D- Enterobiasis
E- Filariasis

Q: What is the term used to describe the reproductive system of nematodes?
a) Dioecious
b) Monogamous
c) Polygamous
d) Hermaphroditic

Q: What distinguishes ovoviviparous female nematodes from oviparous ones?
a) They lay eggs containing larvae, which hatch immediately.
b) They lay segmented eggs.
c) They lay unsegmented eggs.
d) They produce larvae directly.

Q: Pin worm
A- Enterobius vermicularis
B- Ascaris lumbricoides
C- Schistosoma japonicum
D- Diphyllobothrium latum

Q: Enterobius vermicularis habitat of adult worm
A- Mouth
B- Intestines
C- liver
D- Urogenital tract

Q: What is the common name for Enterobius vermicularis?

ⓐ Seatworm

ⓑ Roundworm

ⓒ whipworm

ⓓ Tapeworm

ⓔ Hookworm

Q: Where are adult pinworms commonly found in the human body?

ⓐ Stomach

ⓑ Colon

ⓒ Lungs

ⓓ Small intestine

ⓔ Liver

Q: Which unique feature characterizes the esophagus of Enterobius vermicularis?

ⓐ Single-bulb structure

ⓑ Quadruple-bulb structure

ⓒ Triple-bulb structure

ⓓ No distinct structure

ⓔ Long, straight structure

Q: How long do female pinworms typically survive?

ⓐ 1-2 weeks

ⓑ 5-6 weeks

ⓒ 9-10 weeks

ⓓ 3-4 weeks

ⓔ 7-8 weeks

Q: What is the size range of male pinworms?

ⓐ 2-5 mm long, 0.1-0.2 mm thick

ⓑ 2-3 mm long, 0.2-0.3 mm thick

ⓒ 3-4 mm long, 0.3-0.4 mm thick

ⓓ 4-5 mm long, 0.4-0.5 mm thick

Q: What is a characteristic feature of Enterobius vermicularis eggs?

ⓐ They are bile-stained.

ⓑ They sink in saturated salt solution.

ⓒ They are spherical in shape.

ⓓ They are red in color.

ⓔ They are elongated ovoid with one side flattened.

Q: Where do the larvae of Enterobius vermicularis mature into adults?

ⓐ Small intestine

ⓑ Colon

ⓒ Lungs

ⓓ Stomach

ⓔ Liver

Q: How long does it take for the eggs of Enterobius vermicularis to develop into gravid females ready to lay eggs?

ⓐ 1 week

ⓑ 1 month

ⓒ 3 months

ⓓ 2 weeks

ⓔ 2 months

Q: During which time of day does the female Enterobius vermicularis typically come out to lay eggs?

ⓐ Morning

ⓑ Evening

ⓒ Noon

ⓓ Afternoon

ⓔ Night

Q: Which mode of infection involves the ingestion of eggs due to scratching of the perianal area with fingers?

ⓐ Autoinfection

ⓑ Airborne transmission

ⓒ Waterborne transmission

ⓓ Retroinfection

ⓔ Direct infection

Q: What is the primary symptom associated with Enterobiasis?

ⓐ Abdominal pain

ⓑ Perianal pruritus

ⓒ Fever

ⓓ Joint pain

ⓔ Headache

Q: What is the primary method of laboratory diagnosis for Enterobiasis?

ⓐ Feces examination

ⓑ Urine analysis

ⓒ Swabs collected from perianal and perineal skin

ⓓ Blood test

ⓔ X-ray imaging

Q: What is the purpose of the scotch tape method in the diagnosis of Enterobiasis?

ⓐ To collect stool samples

ⓑ To collect blood samples

ⓒ To collect specimens from the perianal area

ⓓ To collect urine samples

Q: Which medication can be used for single-dose therapy in the treatment of Enterobiasis?

ⓐ Pyrantel pamoate

ⓑ Mebendazole

ⓒ Albendazole

ⓓ All of the above

Q: In which situation might adult Enterobius vermicularis worms be detected?

ⓐ During routine blood tests

ⓑ While collecting stool samples

ⓒ While the child is asleep and worms are crawling out of the anus

ⓓ During urine analysis