Medical Laboratory Techniques Department
Lecture 15 : *Ascaris lumbricoides* (Nematoda)
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Ascaris lumbricoides

Common Name: Roundworm

History and Distribution

Ascaris lumbricoides has been observed and described from very ancient times, when it was sometimes confused with the earthworm.

- Its specific name *lumbricoides* is derived from its resemblance with earthworm (*Lumbricus*, meaning *earthworm* in Latin).
- It is the most common of human helminthes and is distributed worldwide. A billion people are estimated to be infected with roundworms. The individual worm burden could be very high, even up to over a thousand.

Habitat

Adult worms live in the small intestines (85% in jejunum and 15% in ileum).

*A.*lumbricoides is the largest nematode parasite in the human intestine.

Morphology

Adult Worm

They are large **cylindrical** worms, with **tapering** ends, the anterior end being more pointed than the posterior.

- They are pale pink or flesh colored when freshly passed in stools, but become white outside the body.
- The mouth at the anterior end has **3** finely toothed lips, 1 **dorsal** and **2 ventrolateral.**

Male Worm

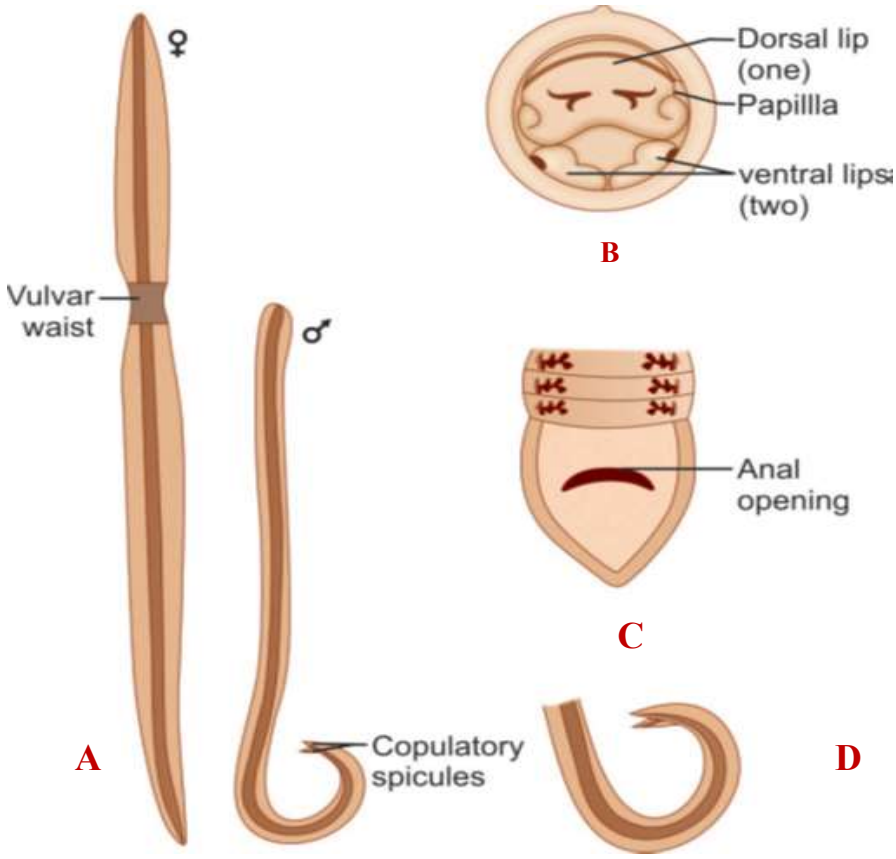
- The adult male worm is little smaller than female. It measures 15–30 cm in length and 2–4 mm in thickness.

- Its posterior end is curved ventrally to form a hook and carries 2 copulatory spicules.

Female Worm

The female is larger than male, measuring 20–40 cm in length and 3–6 mm in thickness.

- Its posterior extremity is straight and conical.
- The vulva الفرج is situated mid-ventrally, near the junction of the anterior and middle thirds of the body. A distinct groove is often seen surrounding the worm at the level of the vulvar opening. This is called the vulvar waist خصر الفرج or genital girdle حزام الاعضاء التناسلية and is believed to facilitate mating يسهل التزاوج. The vulva leads to a single vagina, which branches into a pair of genital tubules that lie convoluted ملتفة through much of the posterior two-thirds of the body. The genital tubules of the gravid worm contain an enormous number of eggs as many as 27 million at a time.



***A. lumbricoides*. A. Adult female and male worms; B. Anterior end of worm. head-on view, showing 1 dorsal and 2 ventral lips with papillae; C. Posterior end of female, showing anal opening, a little above the conical tip; D. Posterior end of male, showing 2 copulatory spicules(s)**

A single worm lays up to 200,000 eggs per day. The eggs are passed in feces.

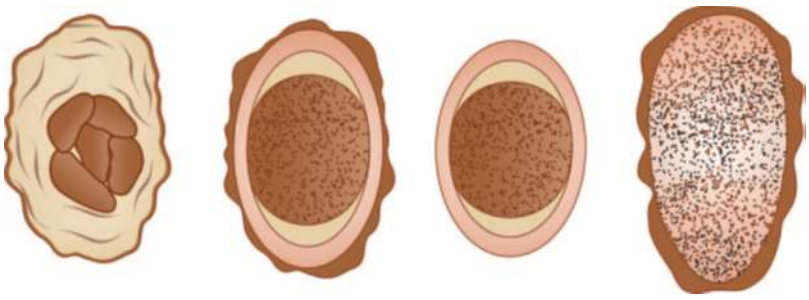
Egg

Two types of eggs are passed by the worms; fertilized and unfertilized.

- The fertilized eggs, laid by females, inseminated تخصب by mating with a male, are embryonated and develop into the infective eggs.
- The unfertilized eggs, are laid by un inseminated غير ملقحة female. These are non-embryonated and cannot become infective.

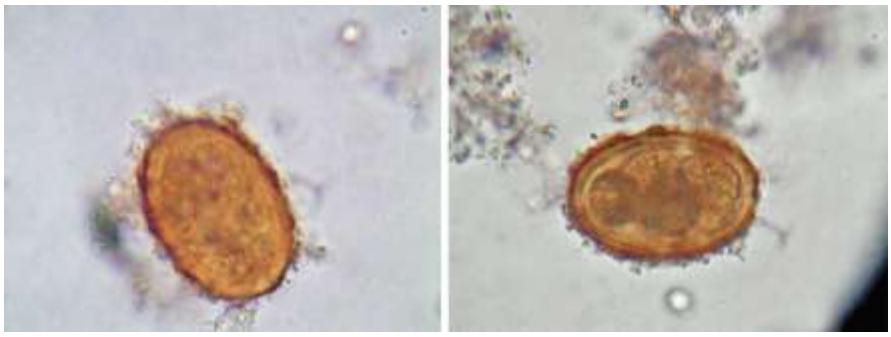
Features of Round Worm Egg

Type of egg	Main feature
Unfertilized egg (Fig. 20.4A)	• Ellipitical in shape • Narrower and longer • 80 µm × 55 µm in size • Has a thinner shell with an irregular coating of albumin • Contains a small atrophied ovum with a mass of disorganized highly refractile granules of various size • Does not float in salt solution
Fertilized eggs (Fig. 20.4B)	• Round or oval in shape • Size 60–75 µm × 40–45 µm • Always bile-stained • Golden brown in color • Surrounded by thick smooth translucent shell with an outer coarsely mammiliated albuminous coat, a thick transparent middle layer and the inner lipoidal vitelline membrane • Some eggs are found in feces without the outer mamillated coat. They are called the decorticated eggs (Fig. 20.3C) • In the middle of the egg is a large unsegmented ovum, containing a mass of coarse lecithin granules. It nearly fills the egg, except for a clear crescentic area at either poles • Floats in saturated solution of common salt



A B C D

Types of *Ascaris* eggs found in stools. A. Fertilized egg surface focus, showing outer mamillary coat; B. Fertilized egg, median focus, showing unsegmented ovum surrounded by 3 layers of coats; C. Decorticated fertilized egg, the mamillary coat is absent; D. Unfertilized egg, elongated, with atrophic ovum.



A.Unfertilized egg of *Ascaris*; B. Fertilized egg of *Ascaris*

Note: Stool samples may show both fertilized and unfertilized eggs, or either type alone.

Life Cycle

Life cycle of *Ascaris* involves only 1 host.

Natural host: Man. There is no intermediate host.

Infective form: Embryonated eggs

Mode of transmission

- Infection occurs when the egg containing the **infective rhabditiform** larva is swallowed. A frequent mode of transmission is through fresh vegetables grown in fields manures سماد الحقول with human feces ('night soil'). Infection may also be transmitted through contaminated drinking water.
- Children playing about in mud طين can transmit eggs to their mouth through dirty fingers (**geophage**) اكل التراب, where soil contamination is heavy due to

indiscriminate defecation التغوط العشوائي, the eggs sometimes get airborne along with windswept dust and are inhaled يستنشق. The inhaled eggs get swallowed.

Development in Soil

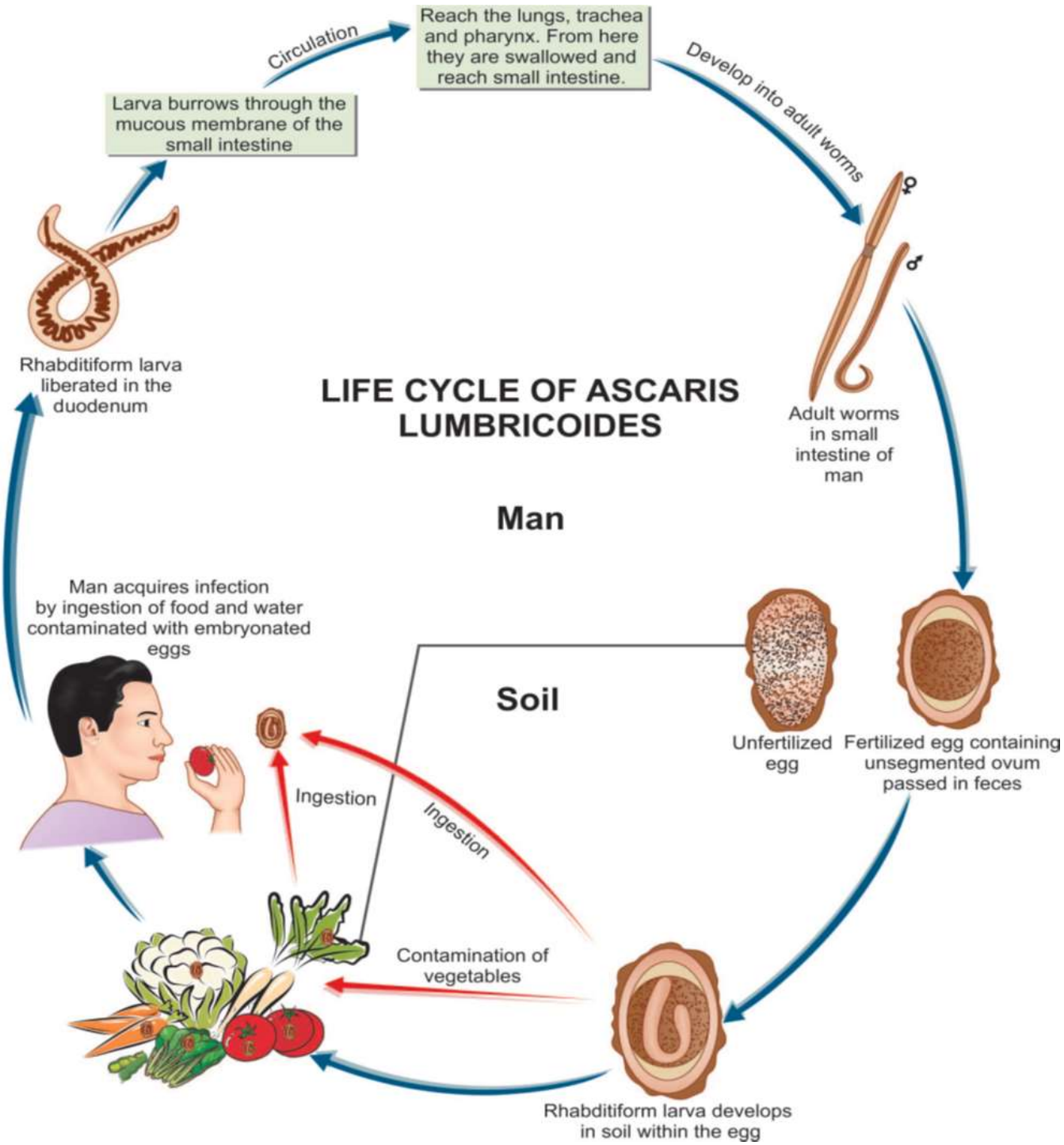
The fertilized egg passed in feces is not immediately infective. It has to undergo a period of incubation in soil before acquiring infectivity.

- The eggs are resistant to adverse conditions and can survive for several years.
- The development of the egg in soil depends on the nature of the soil and various environmental factors. A heavy clayey soil التربه الطينية and moist shady location الظل الرطب, with temperature between 20C° and 30C° are optimal for rapid development of the embryo.
- The development usually takes from **10–40 days**, during which time the embryo **moults twice** and becomes the infective rhabditiform larva, coiled up within the egg ملفوفة داخل البضة.

Development in Man

When the swallowed eggs reach the duodenum, the larvae hatch out.

- The rhabditiform larva, about 250 µm in length and 14 µm in diameter are actively motile.
- They penetrate the intestinal mucosa, enter the **portal vessels** and are carried to the **liver**. They then pass via the hepatic vein, inferior vena cava الوريد الاجوف السفلي, and the right side of the heart and in about **4 days** reaches the **lungs**, where they grow and **moult twice**.
- After development in the lungs, in about **10–15 days**, the larvae pierce the lung capillaries and reach the alveoli الحويصلات الهوائية. They crawl up or are carried up the respiratory passage to the throat الحنجرة and are swallowed.
- The larvae **moult finally** and develop into adults in the upper part of the **small intestine**. They become sexually mature in about **6–12 weeks** and the gravid females start laying eggs to repeat the cycle.
- The adult worm has a lifespan of 12–20 months.



Pathogenicity and Clinical Features

Disease caused by *A. lumbricoides* is called as *ascariasis*.

- Clinical manifestations in ascariasis can be caused either by the migrating larvae or by the adult worms.

Symptoms due to the Migrating Larvae

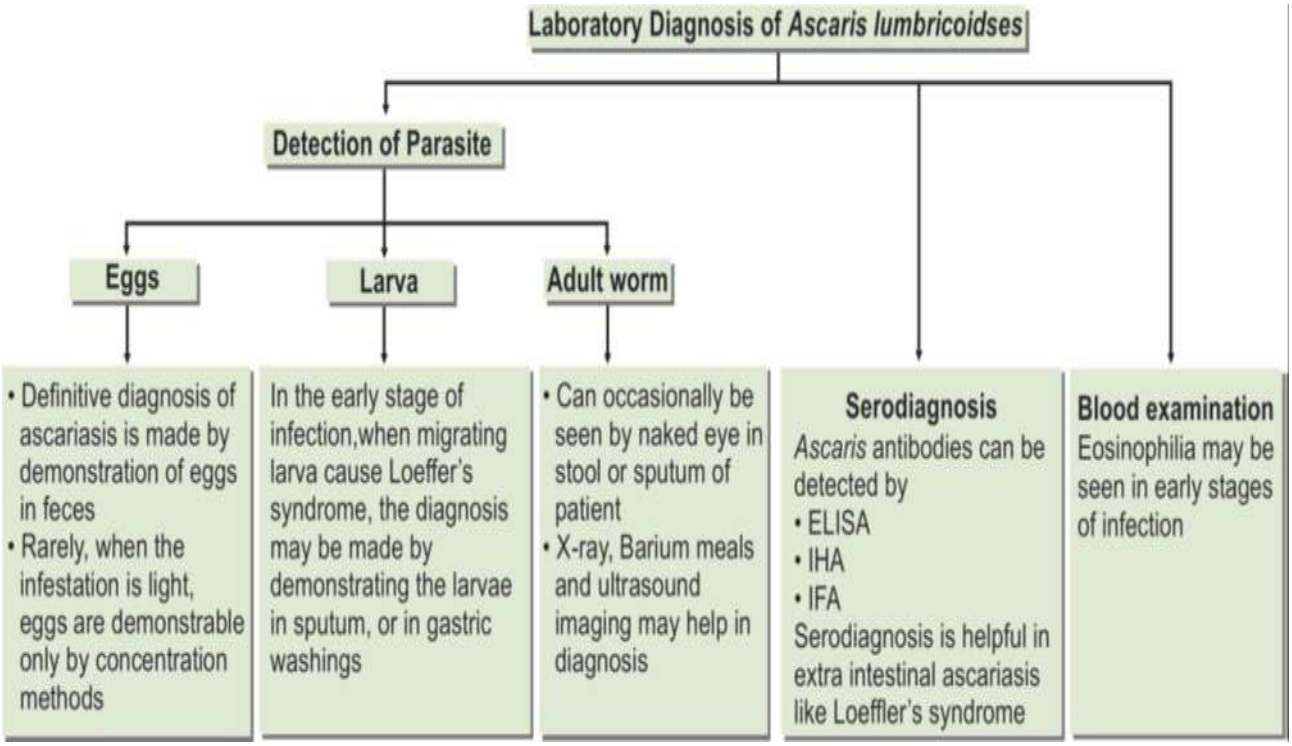
The pathogenic effects of larval migration are due to allergic reaction and not the presence of larvae as such. Therefore, the initial exposure to larvae is usually asymptomatic, except when the larval load is very heavy.

- When reinfection occurs subsequently, there may be intense cellular reaction تفاعل خلوي حاد to the migrating larvae in the lungs, with infiltration of eosinophils, macrophages, and epithelioid cells.
- *Ascaris* pneumonia الالتهاب الرئوي (migrating larvae in the lungs) is characterized by low grade fever, dry cough, asthmatic wheezing ازيز ربو , urticarial شرى , eosinophilia.
- The sputum is often blood-tinged ملطخ بالدم. The larvae may occasionally be found in the sputum, but are seen more often in gastric washings. This condition is called Loeffler's syndrome.

Symptoms due to the Adult Worm

- **protein-energy malnutrition and vitamin A deficiency**
  Patients have loss of appetite فقدان الشهية and are often listless الفتور. Abnormalities of the jejuna mucosa are often present, including broadening and shortening of villi, elongation of crypts, and round cell infiltration of lamina propria. These changes are reversed when the worms are eliminated.
- **The toxic effects** are due to hypersensitivity to the worm antigens and may be manifested as fever, urticaria, angioneurotic edema عصبية وعائية وذمة, wheezing, and conjunctivitis التهاب الملتحمة.
- **The mechanical effects** are the most important manifestations of ascariasis. Mechanical effects can be due to masses of worms causing luminal occlusion انسداد or even a single worm infiltrating into a vital area. The worms may be clumped together into a mass, filling the lumen, leading to volvulus التواء المعي, intussusceptions الانغماد المعوي, or intestinal obstruction and intestinal perforation الانثقاب المعوي.
- Ectopic ascariasis (Wanderlust) The worm may wander up or down along the gut. Going up, it may enter the opening of the biliary or pancreatic duct causing acute biliary obstruction or pancreatitis. It may enter the liver parenchyma, where it may lead to liver abscesses. The worm may go up the esophagus and come out through the mouth or nose. It may crawl into the trachea and the lung causing respiratory obstruction or lung abscesses. Migrating downwards, the worm may cause obstructive appendicitis التهاب الزائدة الدودية الانسدادي.

Laboratory Diagnosis



Key points of *Ascaris lumbricoirdes*

- *A. lumbricoides* is the largest nematode infecting human.
- Adult worm is cylindrical resembling an earth worm.
- Male is little smaller than female. Posterier end of male is curved ventally to form a hook with 2 copulatory spicules. Posterior end of female is conical and straight.
- Fertilized eggs are bile-stained, round or oval, surrounded by a thin translucent wall with outer mammillated coat containing a large unsegmented ovum. Unfertilized eggs are elliptical, longer with a outer thinner irregular mammillated coat, containing a small atrophied ovum and refractile granules.
- **Natural host:** Man
- **Infective form:** Embryonated egg containing rhabditiform larva.
- **Clinical features:** Spoliative action–protein and vitamin A deficiency. Toxic action–utricaria and angioneurotic edema. Mechanical action–intestinal obstruction, intussusception, volvulus, intestinal perforation. In Lungs–Ascaris can cause pneumonia (Loeffler's syndrome).
- **Diagnosis:** Demonstration of eggs in stool, finding of larvae in sputum, finding of adult worm in stool or sputum.
- **Treatment:** Albendazole, mebendazole, ivermectin, or pyrantel pamoate.