LESSON №14

PHYLUM NEMATHELMINTHES. BIOHELMINTS

Trichinella SPIRALIS

Disease: trichinellosis.

*Geographic distribution: w*orldwide; most common in parts of Europe and the United States.

Localization in human body: striated muscles.

Morphology: Females are 2.2 mm in length; males 1.2 mm, ***viviparous.***

Mode of transmission: by means eating of undercooked meat containing encysted larvae.

Life Cycle:

Adult worms and encysted larvae develop within a single vertebrate host, and an infected animal serves as a definitive host and potential intermediate host.

Host: carnivorous and omnivorous animals, human.

Trichinellosis is caused by the ingestion of undercooked meat containing encysted larvae of Trichinella species 1. After exposure to gastric acid and pepsin, the larvae are released from the cysts 2 and invade the small bowel mucosa where they develop into adult worms 3. The life span in the small bowel is about four weeks. After 1 week, the females release larvae 4 that migrate to striated muscles where they encyst 5 (fig.1).

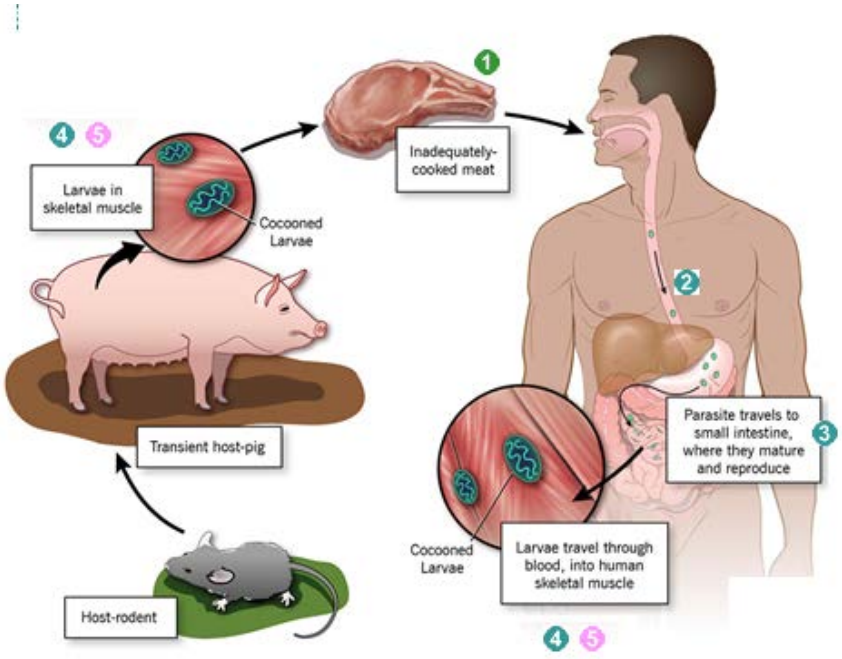

Fig. 1. Life cycle of Trichinella spiralis

Pathogenesis:

- ✓ light infections may be asymptomatic.
- ✓ intestinal invasion can be accompanied by gastrointestinal symptoms (diarrhea, abdominal pain, vomiting).

- ✓ larval migration into muscle tissues (one week after infection) can cause periorbital and facial edema, conjunctivitis, fever, myalgias, splinter hemorrhages, rashes, and peripheral eosinophilia.
- ✓ larval encystment in the muscles causes myalgia and weakness, followed by subsidence of symptoms.

Diagnosis:

- ✓ serologic test.
- ✓ muscle biopsy.

Prevention and control:

- ✓ by properly cooking pork.
- ✓ by feeding pigs only cooked garbage.
- ✓ pork inspection in slaughter houses.

DRACUNCULUS MEDINESIS

(**GUINEA WORM)**

Disease: dracunculiasis.

Geographic distribution: India, Pakistan, Iran, Arabia, East and West Africa.

Localization in human body: subcutaneous tissues.

Morphology: adult: thread-like; cylindrical body; male: about 3 cm in length; posterior end coiled; female: about 30-100 cm in length; swollen anterior end; hooked posterior end; larva (or embryo): 600 x 20 u; rhabditiform tapering tail (1/2 body).

Mode of transmission: by drinking unfiltered water containing ***Cyclops*** (small crustaceans) which are infected with larvae of *D. medinensis.*

Life Cycle (fig.2)*: Definitive host* – human. *Intermediate host* – cyclop.

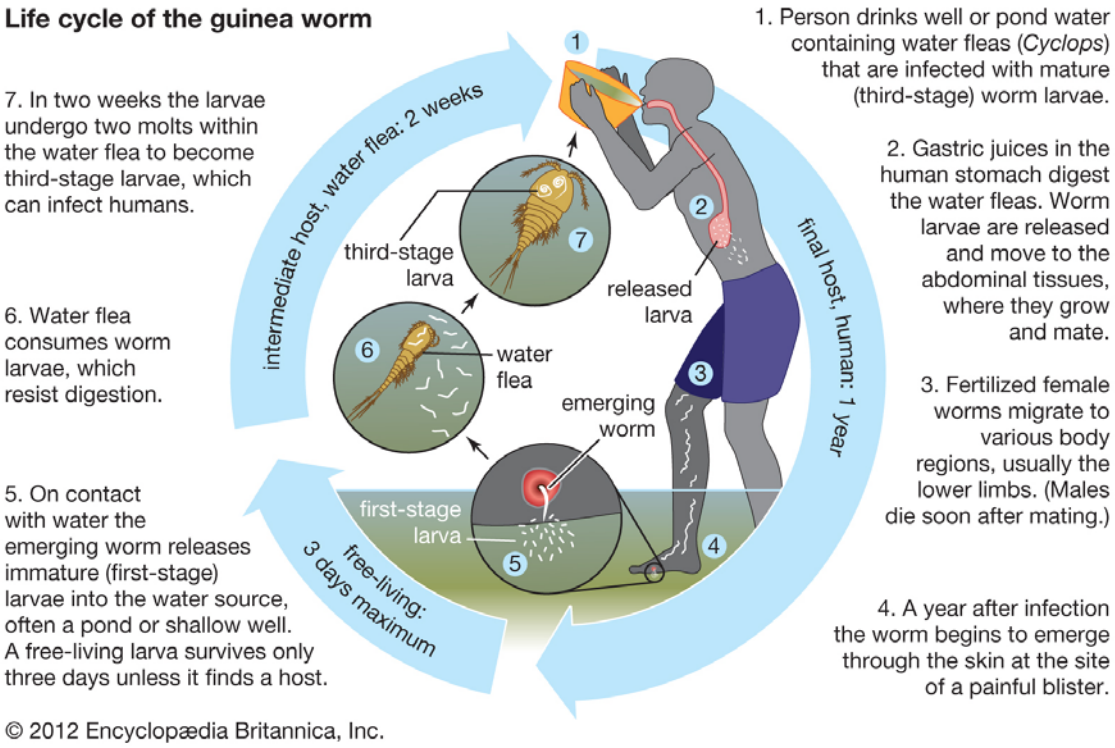

Fig. 4. Life cycle of D. medinensis

Pathogenesis: the clinical manifestations are localized but incapacitating. The worm emerges as a whitish filament (duration of emergence: 1 to 3 weeks) in the center of a painful ulcer, accompanied by inflammation and frequently by secondary bacterial infection.

Diagnosis: **t**he clinical presentation of dracunculiasis is so typical, and well known to the local population, that it does not need laboratory confirmation. In addition, the disease occurs in areas where such confirmation is unlikely to be available. Examination of the fluid discharged by the worm can show rhabditiform larvae.

Prevention and control: do not drink fresh water.

FAMILY FILARIIDAE

In members of this family, the main characteristics are lack of buccal capsule, and in male worms the shape and size of spicules. In their life cycle larvae which are called microfilariae are laid inside uterus of the worm. Larvae will normally migrate to the blood and lymphatic circulation. Microfilariae will reach to the subcutaneous connective tissues or peripheral blood.

There are some species of the family Filariidae causing human infection:

Wuchereria bancrofti.

Brugia malayi.

Onchocerca volvulus.

Loa loa.

WUCHERERIA BANCROFTI

120 million people are infected by ***Wuchereria bancrofti***. Out of the 120 million more than 30 % are severely incapacitated by the disease. Over one billion people in over 80 countries are at risk of getting infected.

Disease: lymphatic filariasis, elephantiasis.

Geographic distribution: tropical Asia (mostly in India), Africa, the Pacific and the Americas (mostly in Brazil, Haiti, Guyana and the Dominican Republic.

Localization in human body: lymphatics and lymph nodes.

Morphology: female - 80 to 100 mm in length and 0.24 to 0.30 mm in diameter, males - about 40 mm by .1 mm. Adults produce microfilariae measuring 244 to 296 μm by 7.5 to 10 μm.

Mode of transmission: parasite is carried from person to person by mosquitoes.

Life Cycle:

Definitive host – human.

Vector – different species of mosquitoes which depends on geographical distribution. Among them are: *Culex, Anopheles, Aedes.*

During a blood meal, an infected mosquito introduces third-stage filarial larvae onto the skin of the human host, where they penetrate into the bite wound ❶. They develop in adults that commonly reside in the lymphatics ❷. The female produce microfilariae which are sheathed and have nocturnal

periodicity. The microfilariae migrate into lymph and blood channels moving actively through lymph and blood ❸. A mosquito ingests the microfilariae during a blood meal ❹. After ingestion, the microfilariae lose their sheaths and some of them work their way through the wall of the proventriculus and cardiac portion of the mosquito's midgut and reach the thoracic muscles ❺. There the microfilariae develop into first-stage larvae ❻ and subsequently into third-stage infective larvae ❼. The third-stage infective larvae migrate through the hemocoel to the mosquito's prosbocis ❽ and can infect another human when the mosquito takes a blood meal ❶ (fig.5).

Pathogenesis: Wuchereria bancrofti infection is usually ***asymptomatic***. Some people can develop ***lymphedema***, swelling, which is prevalent in the legs, but sometimes also in the arms, genitalia and breasts. The swelling and decreased flow of the lymph fluid will expose the body to skin and lymph system infections. Over time the disease causes thickening and hardening of the skin, a condition called ***elephantiasis*** which can be fatal.

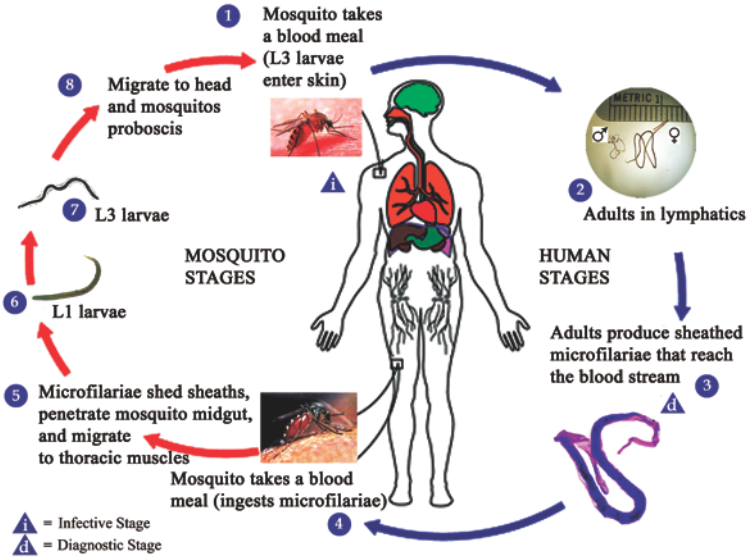

Fig. 5. Life cycle of Wuchereria bancrofti (Brugia malayi) (from http://www.cdc.gov).

***Diagnosis*:**

- ✓ examination of a fresh blood sample taken at night, and finding actively motile microfilariae (microfilariae may also be detected in the thick drop).
- ✓ samples from palpable lymph nodes.
- ✓ serological tests.

Prevention and control:

- ✓ avoid infective mosquitoes between dusk and dawn (the time when they mostly feed).
- ✓ mosquito net can be applied all around your bed.
- ✓ mosquito repellent applied on your skin.
- ✓ use of long trousers and sleeves might keep the mosquitoes away.
- ✓ mass treatments are given to whole communities in some endemic countries.

BRUGIA MALAYI

Disease: lymphatic filariasis.

Geographic distribution: is limited to Asia.

Localization in human body: lymphatics and lymph nodes.

Morphology: female - 43 to 55 mm long, male are smaller - 14 to 23 mm; mirofilariae are sheathed, with an average length of 220 microns, and have a column of nuclei that extends into the caudal region.

Mode of transmission: by mosquitoes genera *Mansonia* and *Aedes.*

Life Cycle:

Definitive host – human.

Vector – mosquitoes genera *Mansonia* and *Aedes.*

During a blood meal, an infected mosquito introduces third-stage filarial larvae onto the skin of the human host, where they penetrate into the bite wound ❶. They develop into adults that commonly reside in the lymphatics ❷. Female produce microfilariae, which migrate into lymph and enter the blood stream reaching the peripheral blood ❸. A mosquito ingests the microfilariae during a blood meal ❹. After ingestion, the microfilariae lose their sheaths and work their way through the wall of the proventriculus and cardiac portion of the midgut to reach the thoracic muscles ❺. There the microfilariae develop into first-stage larvae ❻ and subsequently into third-stage larvae ❼. The third-stage larvae migrate through the hemocoel to the mosquito's proboscis ❽ and can infect another human when the mosquito takes a blood meal ❶ (fig.5).

Pathogenesis: brugian filariasis is more sever than filariasis due to ***W. bancrofti.***

Diagnosis: **like *W. bancrofti.***

Prevention and control: **like *W. bancrofti.***

ONCHOCERCA VOLVULUS

Disease: onchocerciasis (river blindness).

Geographic distribution: mainly in Africa, with additional foci in Latin America and the Middle East.

Localization in human body: lymph nodes, subcutaneous connective tissues.

Morphology: females - 33 to 50 cm in length and 270 to 400 µm in diameter, males - 19 to 42 mm by 130 to 210 µm; microfilariae, measuring 220 to 360 µm by 5 to 9 µm and unsheathed, have a life span that may reach 2 years.

Mode of transmission: during a blood meal, an infected blackfly (genus *Simulium*).

Life Cycle:

Definitive host – human.

Vector - blackfly (genus *Simulium*).

During a blood meal, an infected blackfly (genus *Simulium*) introduces third-stage filarial larvae onto the skin of the human host, where they penetrate into the bite wound ❶. In subcutaneous tissues the larvae ❷ develop into adult filariae, which commonly reside in nodules in subcutaneous connective

tissues ❸. Adults can live in the nodules for approximately 15 years. Some nodules may contain numerous male and female worms. In the subcutaneous nodules, the female worms are capable of producing microfilariae. They are occasionally found in peripheral blood, urine, and sputum but are typically found in the skin and in the lymphatics of connective tissues ❹. A blackfly ingests the microfilariae during a blood meal ❺. After ingestion, the microfilariae migrate from the blackfly's midgut through the hemocoel to the thoracic muscles ❻. There the microfilariae develop into first-stage larvae ❼ and subsequently into third-stage infective larvae ❽. The third-stage infective larvae migrate to the blackfly's proboscis ❾ and can infect another human when the fly takes a blood meal ❶ (fig.6).

Pathogenesis: Onchocerciasis can cause pruritus, dermatitis, onchocercomata (subcutaneous nodules), and lymphadenopathies. The most serious manifestation consists of ocular lesions that can progress to blindness.

Diagnosis: by the finding of microfilariae in skin snips or adults in biopsy specimens of skin nodules.

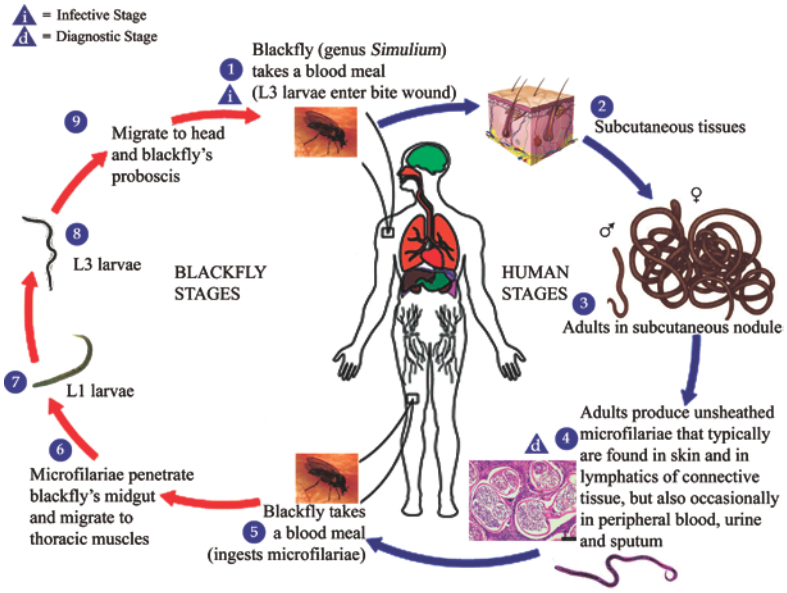

Fig. 6. Life cycle of Onchocerca volvulus(from http://www.cdc.gov).

Prevention and control:

- ✓ use of insecticides to reduce the vector population at breeding sites.
- ✓ health education for avoiding contact with the black fly.

LOA LOA

Loiasis is endemic to 11 countries and 12 million Africans are infected.

Disease: loiasis, subcutaneous filariasis, Calabar swellings, African eye worm infection, Fugitive swelling.

Geographic distribution: central and western Africa.

Localization in human body: subcutaneous connective tissues.

Morphology: male is about 30–34 mm long and 0.35–0.42 mm thick; female about 40–70 mm long and 0.5 mm thick; microfilaria is about 0.25 mm long and 6–8 μm (micrometer = 0.001 mm) thick. It is

sheathed, its tail is tapered and its nuclei extend to the tip of the tail. It can only develop into a larva inside the intermediate host (deer fly).

Mode of transmission: by day-biting deer and mango flies (*Chrysops silacea* and *Chrysops dimidiata*).

Life Cycle:

Definitive host – human.

Vector - day-biting deer and mango flies (*Chrysops silacea* and *Chrysops dimidiata*).

During a blood meal, an infected fly introduces third-stage filarial larvae onto the skin of the human host, where they penetrate into the bite wound ❶. The larvae develop into adults that commonly reside in subcutaneous tissue ❷. Adults produce microfilariae which are sheathed and have diurnal periodicity. Microfilariae have been recovered from spinal fluids, urine, and sputum. During the day they are found in peripheral blood, but during the noncirculation phase, they are found in the lungs ❸. The fly ingests microfilariae during a blood meal ❹. After ingestion, the microfilariae lose their sheaths and migrate from the fly's midgut through the hemocoel to the thoracic muscles of the arthropod ❺. There the microfilariae develop into first-stage larvae ❻ and subsequently into third-stage infective larvae ❼. The third-stage infective larvae migrate to the fly's proboscis ❽ and can infect another human when the fly takes a blood meal ❶(fig.7).

Pathogenesis: loiasis can be asymptomatic; but sometime symptoms may occur:

- ✓ arthritis (joint pain).
- ✓ colonic lesion (damaged large intestine).
- ✓ inflammation, swelling and accumulation of fluid in testicles.
- ✓ lymphadenitis (infection of the lymph glands).
- ✓ membranous glomerulonephritis (kidney disease).
- ✓ peripheral neuropathy (damaged peripheral nervous system).
- ✓ retinopathy (damaged retina (thin layer on the back wall of the eye).

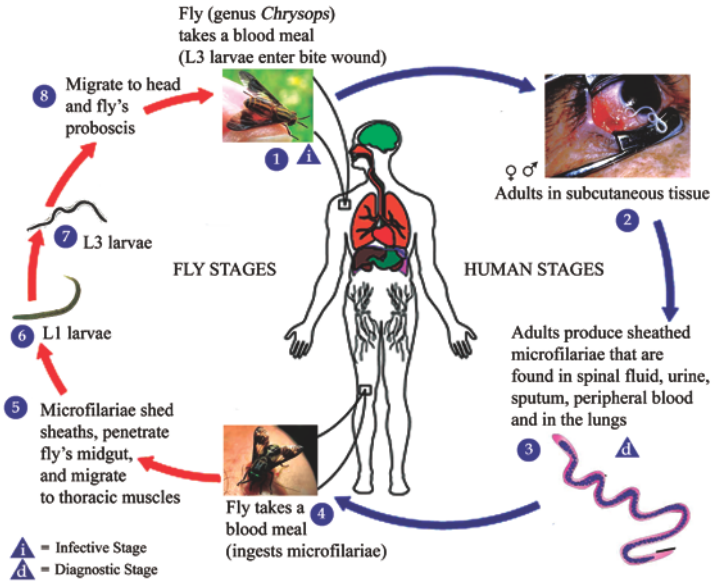

Fig. 7 Life cycle of Loa Loa (from http://www.cdc.gov).

Diagnosis:

- ✓ finding of microfilaria in peripheral blood smears or adults in the subconjunctiva (the blood sample needs to be taken during the day, when the microfilariae are travelling in the bloodstream).
- ✓ microfilariae have also been found in urine, sputum and spinal fluids.
- ✓ sometimes adult worms are seen migrating across the eye, but the short time (often only 15 minutes) for the worm's passage through the conjunctiva makes this observation less used.

Prevention and control:

- ✓ use of insecticides to reduce the vector population at breeding sites.
- ✓ health education for avoiding contact with fly.