Lymphatic Filariasis

- *Wuchereria bancrofti*
- *Brugia malayi*
- Lymphatic filariasis
  - 119 million infected
- Elephantiasis
  - Manifestation of lymphatic filariasis
Morphology I

- Adult: White and thread-like. Two rings of small papillae on the head.
  - Female: 5~10cm in length
  - Male: 2.5~4cm and a curved tail with two copulatory spicules.
Wuchereria
Morphology
Adults of *Wuchereria bancrofti*

Adults occur in the lymphatic vessels
Distribution of *Wuchereria bancrofti*

- Broad equatorial belt
- Africa, Middle East, Southeast Asia, Indo-Pacific islands, Parts of Australia and South America
Habitat

• Adults live in lymphatic ducts.
• Usually near major lymph glands in lower half of body
• Release juveniles (microfilariae) into lymph
• Microfilariae carried to blood stream
**Wuchereria bancrofti**

- **Females release juveniles into lymph (ovoviviparous)**
- **microfilariae swept into blood stream**
- **Mosquitoes ingest microfilariae with blood meal**
**Wuchereria bancrofti**

- Penetrate stomach of mosquito
- Develop in thoracic muscles
- Develop into filariform juveniles
**Wuchereria bancrofti**

- Migrate to the proboscis
- Injected into human with blood meal
- Mature in lymphatic ducts
Periodicity

- Microfilariae in peripheral blood at periodic intervals
- *Wuchereria bancrofti*
  - In peripheral blood between 10:00pm-2:00am
  - In blood of deep tissues during the day
  - Coincides with feeding time of intermediate hosts
Microfilariae of *Wuchereria bancrofti*

Nocturnal periodicity of microfilariae
Phases of Pathogenesis

2. Inflammatory (Acute) Phase
   Caused by antigens from adult worms
   Inflammation due to bacterial infection
   Adults interfere with lymph flow
   - Lymphedema
   - Inflammation of lymph channels
   - Inflammation of lymph nodes
   - Symptoms:
     - Chills
     - Fever
     - Swollen and painful lymph nodes
     - Swelling of reproductive organs
   - Lasts 5-7 days
Phases of Pathogenesis

3. Obstructive (Chronic) Phase

- Lymph ducts become blocked
- Fibrosis of infected areas
- Swelling
  - Accumulation of lymph
  - Elephantiasis: accumulation of lymph in extremities, fibrosis, and thickening of skin.
- Chyluria (lymph in the urine)
Affected Areas

- Legs
- Scrotum
- Arms
- Brest
Pathology of *Wuchereria bancrofti*

Obstructive phase photos
Impacts

• Rarely fatal
• Disfiguring
  – 40 million people
• Disability
  – Daily functions
  – Sexual disability
• WHO: second leading cause of permanent and long-term disability in the world (after leprosy)
• Social impacts
Wuchereria
Diagnosis

- History
- Symptoms
- Microfilariae in blood

Demonstration of microfilariae in blood
PCR diagnosis
Microfilariae of *Wuchereria bancrofti*

Microfilariae are seen in blood smears and are DIAGNOSTIC
blood microfilaria

1 – direct examination (thick or thin smear)

2 – Knotts concentration technique

3 – millipore filtration

4 – antigen capture
Treatment and Prevention

- **Diethyl-carbamazine and Ivermectin**
  - Kills adults and microfilariae
- **Edematous limbs**
  - Pressure bandages
  - Surgical removal of elephantoid tissue

Elimination of mosquitoes.
Protection of people from mosquitoes biting.
Brugia malayi

Causes Malayan filariasis

Distribution - Orient, South Pacific, and Southern Asia to India – overlaps with *Wuchereria bancrofti* - but does not occur in Africa or South America
Brugia malayi

Morphology and life cycle is similar to that of Wuchereria bancrofti.
Brugia malayi

Pathology - Adults live in lymphatic vessels of the arms and legs and cause elephantiasis in these regions
Brugia malayi microfilaria, thick film (hematoxylin stain) micro
Onchocerca volvulus

Causative agent of Onchocerciasis or River Blindness

DISTRIBUTION – Areas of Africa, Arabia, Guatemala, Mexico, Venezuela and Colombia
GEOGRAPHIC DISTRIBUTION OF ONCHOCERCIASIS
Onchocerca volvulus

Morphology

10 cm
Adults of *Onchocerca volvulus*

Skin nodule cut open to reveal adults coiled together

Microscopic section showing adults and scar tissue reaction around them forming the nodule
Microfilariae of *Onchocerca volvulus*

Unsheathed microfilariae occur in the skin, never the bloodstream
1. Adults live in coiled masses encapsulated under the skin.
2. Females produce microfilariae

- Microfilariae of *Onchocerca* NEVER invade the bloodstream.
Life Cycle of *Onchocerca volvulus*

3. Microfilariae in the skin are ingested by the black fly intermediate host, *Simulium damnosum*, when a blood meal is taken.
Life Cycle of *Onchocerca volvulus*

- Nodules are most common below the waist in region of Africa.

- Nodules are on the head and above the waist in Central & South America.
Life Cycle of *Onchocerca volvulus*

4. Parasites develop to J₃’s in the musculature of the black fly and migrate to the mouthparts.

5. J₃’s are inoculated into the skin when black fly bites.

Adults mature in a year within subcutaneous nodules.
Onchocerca volvulus

Life Cycle

Black fly
Simulium damnosum
Simulium
Pathology of *Onchocerca volvulus*

**ADULTS** cause onchocercomas

Nodules are about ½ -1 inch in diameter.

Nodules are relatively benign and cause only some disfigurement.
Onchocerca volvulus
Skin Nodules
Pathology of *Onchocerca volvulus*

MICROFILARIAE cause 3 severe problems. This is the only filarial worm in which microfilariae are pathogenic!

1. Microfilariae in the skin cause severe dermatitis
   - skin becomes thickening, discoloration, and cracking.
   - leading to secondary bacterial infections
   - itching is so severe some people have committed suicide
This woman has leopard skin and onchocercal skin lesions on both legs.
Pathology of *Onchocerca volvulus*

3. Microfilariae invade the eye

- blindness occur as microfilariae die in the eye

- fibrosis causes clouding of cornea and aqueous and vitreous humors resulting in blindness

- fibrosis of the eye is a slow development and most affected persons are adults over 40 years old!
Pathology of *Onchocerca volvulus*

In many parts of Africa, the sighted young are responsible for leading the older blind adults.
Diagnosis of *Onchocerca volvulus*

(1) Microfilaria in skin snips!

- snip must be bloodless so as to not to confuse with microfilariae that may be circulating in the bloodstream.

(2) Adult worms in excised skin nodule.
Onchocerca volvulus
Diagnosis

- History
- Symptoms
- Microfilaria in nodules
Onchocerca volvulus

TREATMENT

Ivermectin!
*Simulium* spp.
The vector of onchocerciasis in the old and New Worlds.
An infected female blackfly takes a blood meal from a host. The host’s skin is stretched by the fly’s apical teeth and cut by its mandible.

Onchocerciasis is linked with fast flowing rivers where *Simulium* blackflies breed.
Loa loa

Geographic Distribution
Loa loa
Progressive Keratitis
Loa loa (the “eye worm”)
Loa loa adult in Calabar swelling x section
Calabar swelling
THANK YOU!
Heartworms (*Dirofilaria immitis*):
**Stages of *Dirofilaria immitis***

**Adult male:** 20-12 cm long

**Adult female:** 30-35 cm long

**Adults coiled in right side of dog heart**

**Unsheathed microfilaria in dog blood - DIAGNOSTIC**
Heartworms (*Dirofilaria immitis*):

- **Mosquito bites dog or cat and transmits infective larvae.**
- **Microfilariae develop in mosquito to infective larvae.**
- **Mosquito ingests microfilariae with blood meal.**
- **Female adult worms release microfilariae in blood.**
- **Larvae mature into adults in heart.**
Pathology of *Dirofilaria immitis*

**PATHOLOGY** caused by adult worms.

First signs of infection involve exercise intolerance

- due to inadequate blood supply to lungs
- infected dogs cough, have shortness of breath, and tire rapidly.

2. Eventually the dog suffers congestive heart failure—usually after a period of exercise.
Dirofilaria immitis

PREVENTION - chemoprophylaxis

2 drugs are used: ivermectin (in Heartgard) and milbemycin oxime (in Sentinel and Interceptor)
Human Cases of *Dirofilaria immitis*

HUMAN INFECTIONS of *Dirofilaria immitis* are rare.

Larvae are killed by the host reaction and scar tissue nodules form in lungs around worms

- Symptoms are coughing and chest pain.

In only 4 cases were adult worms recovered from the human heart. These were found incidentally at autopsy and were not related to the death of the patient.