Onchocerciasis
aka River blindness
Barbora Rimkus

Image from Goodwin, L. (2018)
Worm image from Osei-Atwewoana et al. (2007)
Hyper-endemic (prevalence ≥ 20%)

Hypo-endemic (prevalence < 20%)

Endemic countries

Non-endemic countries

120 million people world-wide are at risk of infection. 99% are in 31 African countries.

Global infections:

- 20.9 million (estimate)
  - 14.6 million had skin disease
  - 1.2 million had vision loss

Disease distribution: Onchocerciasis
Parasitic species: *Onchocerca volvulus*

- **Phylum:** Nematoda
- **Class:** Secernentea
- **Order:** Spirurida
- **Family:** Onchocecidae

- Only species in genus to infect humans
  - obligate parasite

- Five-stage lifecycle with two hosts
  - sole definitive host: humans
  - intermediate host: black flies of genus *Simulium*
    - vector that transmits disease

- Contribution to pathology
  - Adults: very little
  - microfilariae (1st larval stage): majority
**Adults characteristics**

- White, opalescent, and transparent
- Sexual size dimorphism
  - larger females (30-80cm); males (3-5cm)
- Live in subcutaneous tissue
  - 8-15 years
- Coil together → nodules
  - females encapsulated
  - males migrate (mating)
- Females release *microfilariae*
  - 1,300-1,900/day for ~10 years
Microfilariae characteristics

- Anatomy
  - 220-360 μm
  - anucleate tail

- Settle mainly in skin (definitive host)
  - occasionally migrate into eyes and other tissues (lymphatic, connective)
  - survive ~2 years

- If die in definitive host
  - inflammatory reaction
  - significant pathologies: blindness

- If ingested by intermediate host
  - continue through life cycle

Image from Njamnshi, A. et al. (2004)
Blackfly vector

- Most common species: *Simulium damnosum*

- Anatomy: female vs male
  - Female mouth parts used to cut/suck blood
    - apical teeth

- Lay eggs in highly oxygenated H₂O
  - larval development (aquatic stage)

- Crepuscular feeding

- Only females are hematophagic
  - pool feeders
  - obtain nutrients to produce eggs
O. volvulus life cycle

Microfilariae (MF)

Definitive (d) host

Intermediate (i) host

Human

Simulium fly

Fly takes blood meal

MF ingested

Fly takes blood meal

MF migrate to skin

Females release MFs

Adults reproduce in subcutaneous nodules

L3 larvae (infective)

Migrate through the hemocoel to proboscis

L3 larvae enter through bite wound

Live in tissues ~ 1 week

~ 1 week

7-15 months to mature into adults

L4 larvae

L5 larvae (juvenile worms)
 Symptoms and pathologies

• Adult worms
  - Symptom (S): subcutaneous masses
  - Pathology (P): coiling of adults into nodules

• Microfilariae (MF)
  - $S_1$: Pruritic dermatitis = itching, rashes, skin lesions
  - $P_1$: death of MF $\rightarrow$ inflammatory response
  - $S_2$: eye lesions, keratitis, blindness
  - $P_2$: death of MF (in eye) damage tissue; continued reproduction $\rightarrow$ blindness

Treatment and prevention

- Ivermectin
  - once/year, for 10-15 years
  - paralyzes and kills microfilariae
  - relieves skin itching
  - slows progression of blindness

- Doxycycline
  - typically in combination with Ivermectin
  - kills adults worms

- No vaccines or preventative medication
  - personal protection from biting insects
  - repellants (DEET), long clothing, treat clothes with permethrin (insecticide that acts like natural extract from chrysanthemum flowers)
References


