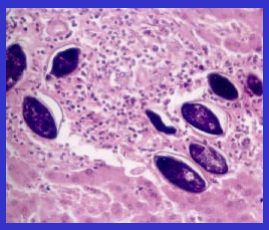
Biomedical Parasitology

Trematodes - tissues



Prof. Peter O'DONOGHUE

1

TISSUE TREMATODES

Fasciola spp.

Clonorchis sinensis

Opisthorchis spp.

Dicrocoelium dendriticum

Paragonimus spp.

2

Tissue trematodes

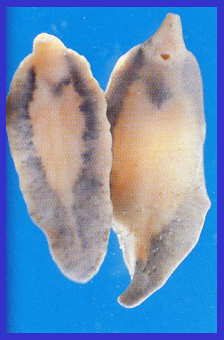
Parasite	Definitive host	Vector	Metacercaria	Locality
Liver flukes				
Fasciola	human/ruminant	snails	plants	worldwide
Clonorchis	human/dog/cat	snails	fish	China
Opisthorchis	human/dog/cat	snails	fish	Eurasia
Dicrocoelium	human/ruminants	snails	ants	Old World
Lung flukes				
Paragonimus	human/tiger/mink	snails	crabs	Indochina

3

Fasciola (liver fluke)

Order: Echinostomatida
Family: Fasciolidae

- large leaf-shaped flukes (unmistakable)
- adults in bile ducts
- metacercariae on plants
- primarily a zoonotic disease



4

Fasciola hepatica (liver fluke)

adults 2-3 cm
in bile ducts

snail vector

operculate eggs 140x80µm
passed in faeces

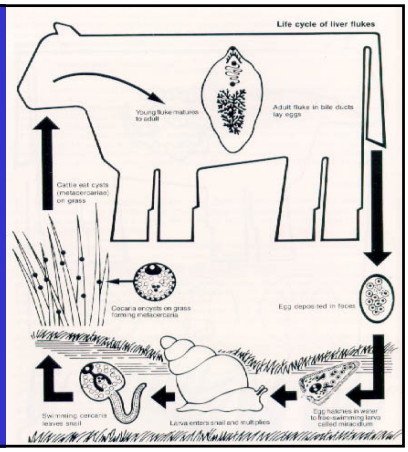
common in sheep/cattle on wet/irrigated pasture
may also infect humans, goats, pigs, macropods, rats, rabbits, etc

5

Heteroxenous transmission

prepatent period
8-13 weeks

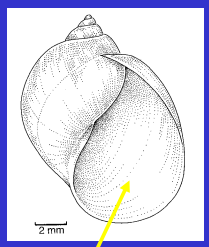
- eggs voided
- f-l miracidium
- form sporocysts rediae in snails
- f-l cercariae
- form metacercaria on vegetation
- eaten by herbivore
- adult in liver



6

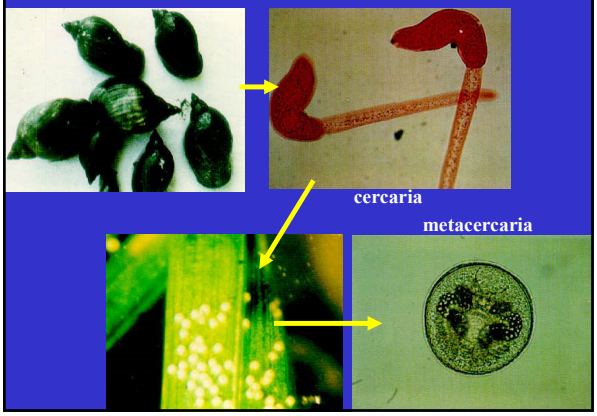
Snail intermediate hosts

- snails of Family Lymnaeidae
- snails "dextral" (right-handed)
  [aperture on right]
- lack operculum (trapdoor)
- high population density under right conditions (up to 3,000/m²)
- capable of aestivation over dry summers by burrowing into soil



7

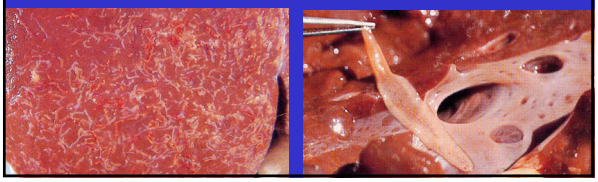
Amplification in snail and pasture contamination



8

Pathogenesis - acute

- ingested worms penetrate intestine, wander in body cavity, penetrate liver, then enter main bile ducts (~ 7 weeks)
- acute disease (liver rot) caused by mass migration of juveniles
- traumatic tissue damage, coagulative necrosis, haemorrhage, urticaria, eosinophilia, leukocytosis, pallor, anaemia
- predisposes for anaerobic *Clostridium perfringens/novyi* which produce toxins leading to rapidly fatal 'black disease' in sheep



9

Pathogenesis - chronic

- chronic infections cause fibrotic hardened liver, biliary epithelial hyperplasia, duct pipestem fibrosis, cholangitis
- mechanical damage, metabolic by-products, obstruction
- acute epigastric pain, pruritis, jaundice,weight loss
- metacercariae may wander (subcutaneous lumps common)

10

Clonorchis/Opisthorchis (liver flukes)

Order: Opisthorchiidae
Family: Opisthorchidae

- narrow elongate adults
- in distal bile ducts
- form metacercariae in freshwater fish

11

Clonorchis/Opisthorchis (liver flukes)

snail vector

adults 6-20mm
in bile ducts

operculate eggs 30x15 µm
passed in faeces

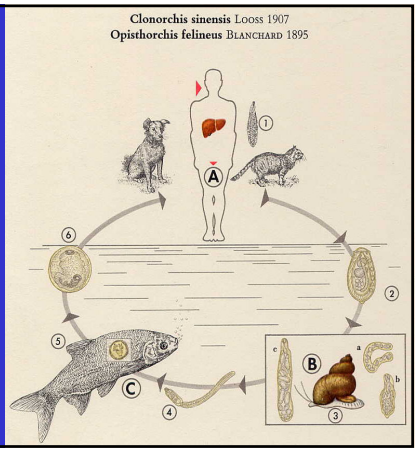
C. sinensis/O. viverrini/O. felineus in Far East

12

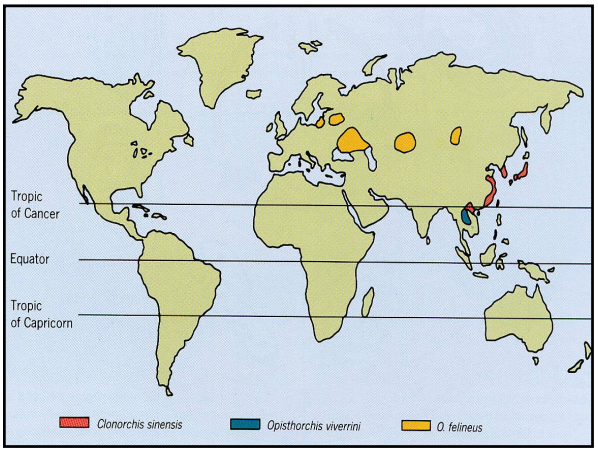
Food-borne transmission

prepatent period
2-5 weeks

- eggs voided
- ingested by snails
- miracidia form sporocysts, rediae
- f-l cercariae
- metacercaria in freshwater fish
- eaten by humans



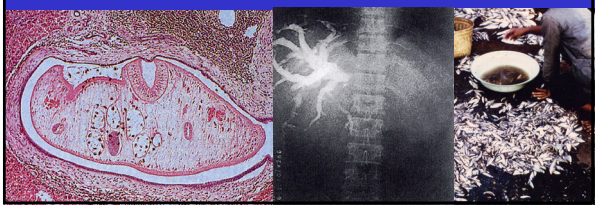
13



14

Pathogenesis

- lesions due to mechanical irritation/toxic products
- light infections, mild inflammation
- heavy infections, thickening of bile ducts, fibrosis, hyperplasia of mucinous glands
- resulting in biliary obstruction, jaundice, aggravated by bile stones, liver absecesses
- recurrent pyogenic cholangitis



15

Paragonimus (lung fluke)

Order: Plagiorchiida
Family: Troglotrematidae

- thick fleshy flukes
- adults live as pairs in cysts in lungs
- form metacercariae in freshwater crabs/crayfish

16

Paragonimus westermani (lung fluke)

adults 12 mm
in lungs

snail vector

operculate eggs 100x55 µm
passed in faeces

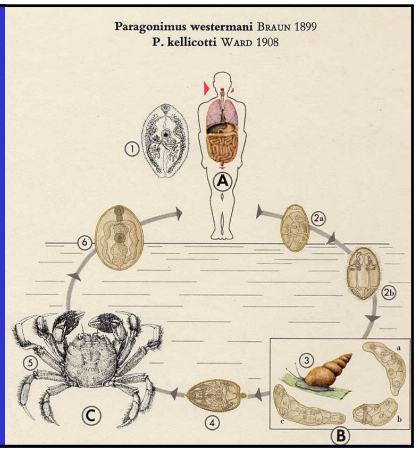
in crustacean-eating carnivores in Asia, Africa, Americas
prevalent in humans in Korea (crayfish juice cure for measles)

17

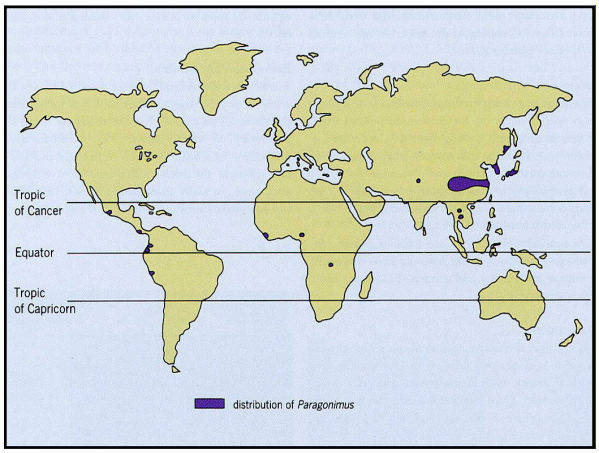
Food-borne transmission

prepatent period
8-12 weeks

- eggs coughed up and voided
- f-l miracidia
- sporocyst/redia in snails
- f-l cercaria
- metacercaria in crabs/crayfish
- eaten by humans
- migrate through viscera to lungs



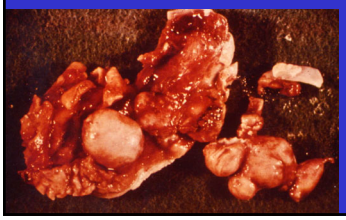
18

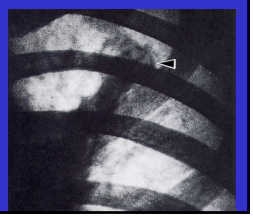


19

Pathogenesis

- migration through tissues to lungs produces localized haemorrhage and leucocytic infiltrates
- in lungs, pronounced tissue reaction, infiltration of eosinophils and neutrophils, fibrotic capsule
- cysts contain purulent fluid with 'iron-filing' flecks (=eggs)
- perforate bronchioles to release eggs, viscous bloody sputum, dyspnea with chronic bronchitis





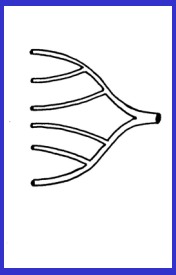
20

Pathogenesis

- some eggs in lungs swept away by circulation to other tissues (liver, muscles, brain) causing granulomas, calcification
- cerebral complications of paragonimiasis
- symptoms include fever, headache, nausea, vomiting, visual disturbances, motor weakness, localized or generalized paralysis, possibly death

21

VASCULAR TREMATODES



Schistosoma mansoni

Schistosoma japonicum

Schistosoma haematobium

22

Vascular trematodes

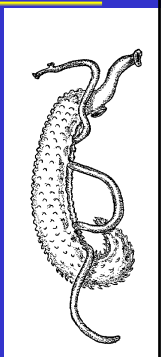
Parasite	Definitive host	Snail vector	Locality
Schistosomes			
S. mansoni	human/rodents	*Biomphalaria*	Africa, America
S. japonicum	human/ruminants	*Oncomelania*	SE Asia
S. haematobium	human/primates	*Bulinus*	Africa

23

Schistosoma spp. (blood flukes)

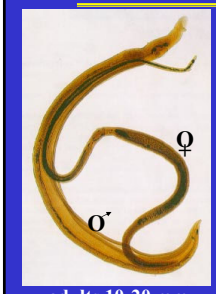
Order: Strigeatida
Family: Schistosomatidae

- blood flukes – adults in blood vessels
- unique trematodes as sexes separate (female lying in male gynecophoral canal) [schisto-soma = split body]
- no metacercaria, cercaria penetrate skin
- important human and animal parasites in Africa, Asia & South America
- haematuria (bloody urine) well known throughout history (Egyptian mummies 3000-1000BC, Napoleon's army 1800AD)



24

Schistosoma spp. (blood fluke)



snail vector

adults 10-20 mm
in blood vessels

non-operculated eggs
passed in faeces/urine

cause bilharzia (fibrosis, portal hypertension)

25

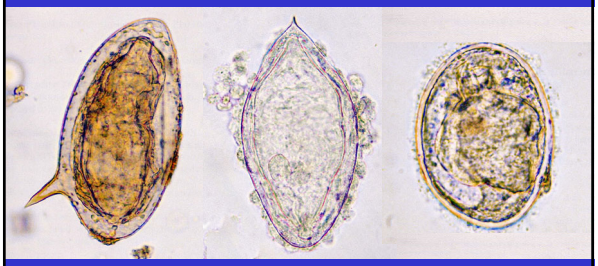
Schistosoma spp. adults

S. mansoni	*S. japonicum*	*S. haematobium*
inferior/superior mesenteric veins	inferior/superior mesenteric veins	vesical/prostate/uterine plexuses

eggs migrate into intestines and passed in faeces	eggs migrate into intestines and passed in faces	eggs migrate into bladder/urethra passed in urine

26

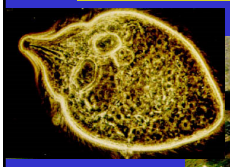
Schistosoma spp. eggs



S. mansoni	*S. haematobium*	*S. japonicum*
120-180 x 45-75 µm	110-170 x 40-70 µm	55-85 x 40-60 µm

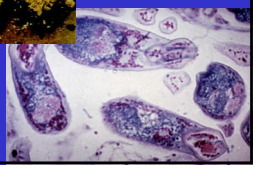
27

Amplification in snail hosts



miracidium

freshwater snails



sporocysts/redia

28

Snail hosts

S. mansoni	*S. haematobium*	*S. japonicum*

Biomphalaria

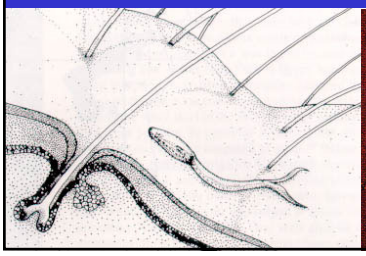
Bulinus

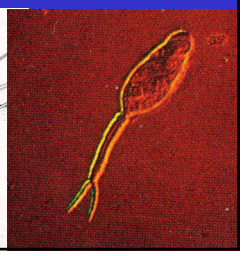
Oncomelania

29

Host finding

- fork-tailed cercaria 400-600 µm
- rapid swimmer
- penetration machine





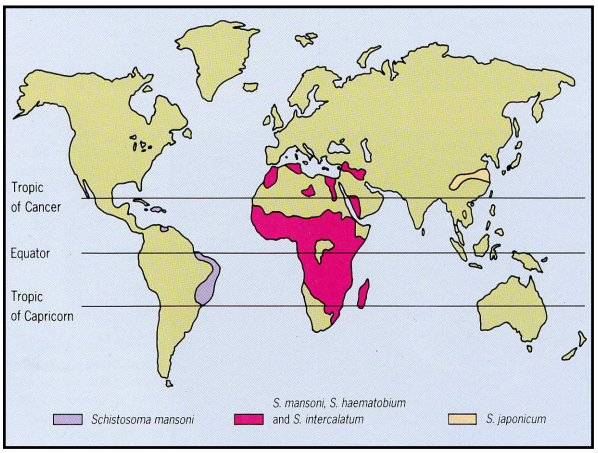
30

Water-borne transmission

prepatent period
5-10 weeks

- eggs voided
- f-l miracidia
- sporocysts in snail
- f-l cercariae
- penetrate skin
- schistosomulum carried to liver
- adults in vasculature

31



32

Pathogenesis

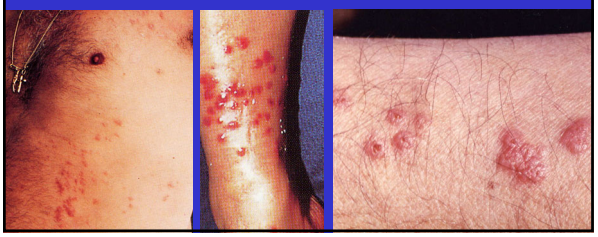
Three disease phases

- migratory phase, characterized by cercarial dermatitis ('swimmers itch' more marked with bird schistosomes)
- acute phase (Katayama fever), characterized by serum sickness coincident with first egg release
- chronic phase, characterized by host granulomatous responses to eggs deposited in tissues

33

Pathogenesis – migratory phase

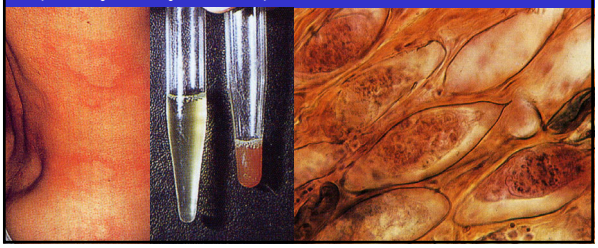
- often asymptomatic
- transient dermatitis due to cercarial penetration in sensitized patients
- occasionally pulmonary lesions, pneumonitis



34

Pathogenesis – acute phase

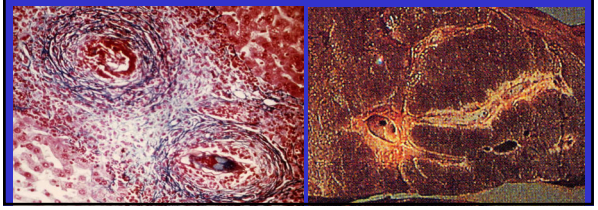
- acute allergic responses when eggs first produced
- eggs pass through tissues aided by enzymes from enclosed miracidia
- cause haematuria, pyrexia, lymphadenopathy, eosinophilia, liver tenderness, diarrhoea ('Katayama syndrome')



35

Pathogenesis – chronic phase

- eggs trapped in tissues surrounded by inflammatory cells (forming characteristic pseudotubercles)
- these coalesce to form larger granulomatous reactions (polyps) and eggs eventually calcify
- Symmer's periportal fibrosis, intestinal polyposis, glumerulonephritis, cardiopulmonary problems



36

Pathogenesis - chronic

- portal hypertension leads to hepatomegaly, splenomegaly, and possibly ascites
- also gross enlargement of oesophageal and gastric veins (varices) which sometimes burst

37

TREATMENT - trematodocides

Schistosoma (blood fluke)	praziquantel, oxamniquine
Fasciola (large liver fluke)	bithionol, triclabendazole
Clonorchis/Opisthorchis (small liver flukes)	praziquantel, albendazole
Paragonimus (lung fluke)	praziquantel, bithionol

38

Control

- stop water contamination (faeces/urine)
- treat water (disinfectants, standing)
- avoid grazing wetlands/irrigated pastures
- avoid raw aquatic vegetables, shellfish
- restrict immersion in water (rice paddies?)
- reduce snail populations
  - drain swamps
  - chemical treatment
- treat infected individuals
- vaccination?

39

Summary

Parasite	Site	Definitive host	Intermediate hosts	
Echinostoma	intestines	humans	snails	clams
Fasciolopsis	intestines	humans/pigs	snails	water plants
Fasciola	bile ducts	humans/ruminants	snails	water plants
Clonorchis	bile ducts	humans/piscivores	snails	fish
Opisthorchis	bile ducts	humans/piscivores	snails	fish
Paragonimus	lung	humans/carnivores	snails	crabs
Schistosoma	veins	humans	snails	-

40