Family: Fasciolidae

Genus: Fasciola

Species: Fasciola gigantica

The adult fluke is larger than *F. hepatica.* It can reach 7.5 cm

Definitive hosts: Sheep, cattle, goat, horse, deer, man and other mammals.

Predilection site: Young flukes in liver parenchyma, adult flukes in bile duct

Intermediate host: Snails of the genus *Radix (Lymnea)*

Radix auricularia in Turkey.

***Aquatic snails only lives in water

Distribution: Prevalence of this parasite is more limited than *Fasciola hepatica*

Except to intermediate host, Life cycle is similar to those of Fasciola hepatica

Pathogenesis, clinical signs, diagnosis and treatment are similar to those of Fasciola hepatica

Family: Fasciolidae

Genus: Fascioloides

Species: *Fascioloides magna*
(known as: Large American Liver Fluke)

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.veterinaryparasitology.com%2Ffascioloides.html&psig=AOvVaw33Nxq73zoqQLk0ynl1YNCR&ust=1602794130060000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIi72c_3tOwCFQAAAAAdAAAAABAJ

Definitive hosts: Especially deer (White tailed deer, roe-deer), rarely sheep, cattle, goat, horse etc.

Predilection site: Biliary ducts and/or Liver tissue

The life cycle is similar to those of *Fasciola hepatica.*

Pathogenesis: *Fascioloides magna* tend to be encapsulated in the liver by host reaction and are less pathogenic in deer and cattle. However, this situation does not occur in sheep and goats; parasites migrating into the liver tissue cause traumatic hepatitis. A few parasites can cause death in sheep.

Family: Fasciolidae

Genus: Fasciolopsis

https://web.stanford.edu/group/parasites/ParaSites2002/fasciolopsiasis/fasciolopsiasis.html

Species: ***Fasciolopsis buski***

Definitive hosts: Pigs and Humans

Predilection site: Small intestine

Distribution: *Fasciolopsis buski* is found mainly in Asia.

Pathogenesis: Most cases of this parasite are asymptomatic. The symptoms include ulceration, haemorrhage, diarrhea abscess of the intestinal wall and sometimes even death.

Family: Dicrocoeliidae

Genus: Dicrocoelium

Dicrocoelium dendriticum

Definitive hosts: Ruminants (sheep, cattle, deer, camel..) Occasionally pigs, horse, and man.

Lenghts: 8-12 mm in size. It is small, according to *Fasciola.*

Unlike Fasciola;

Distinctly lanceolate shape and semi-transparent.

All internal organs are lobed.

Testes are in front of the ovary.

There are no spines on the tegument.

Predilection Site: Bile ducts and gall bladder.

Distribution: Worldwide.

Intermediate hosts:

1st: Land (terrestrial) snails of many genera as *Helix, Helicella, Zebrina, Cionella.*

2nd: **Ants of the genus *Formica*.**

https://www.sciencephoto.com/media/366195/view/lm-of-a-dicrocoelium-dendriticum-fluke

Helicella sp.

https://conchsoc.org/spAccount/helicella-itala

Zebrina sp.

https://inaturalist.nz/photos/57808572

Formica sp.

https://en.wikipedia.org/wiki/Formica_fusca#/media/File:Grauschwarze_Sklavenameise_Formica_fusca_01_(MK).jpg

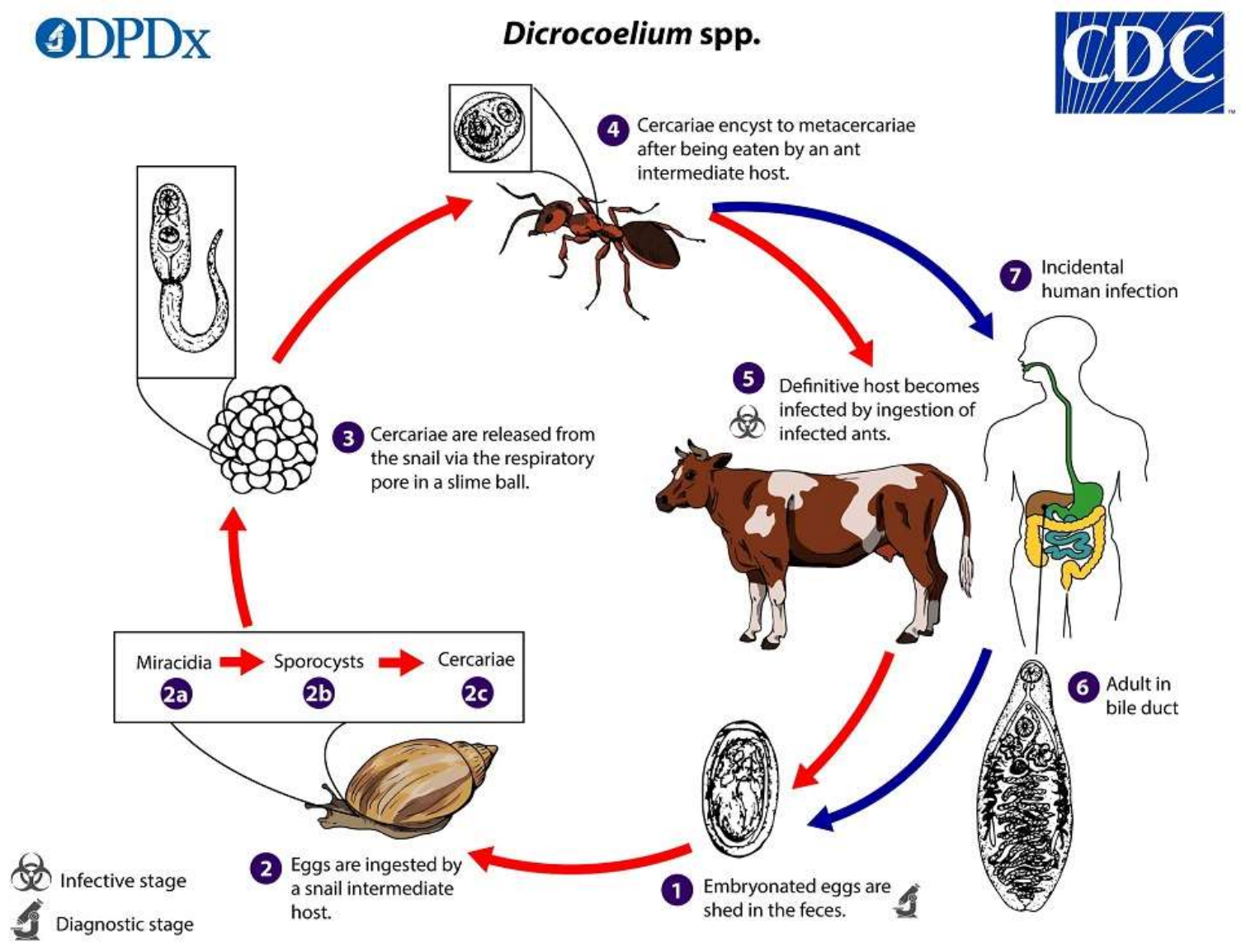
Biology

- Eggs containing developed miracidium produced in the bile ducts by adult trematodes in the final host are transferred to the intestine through the ductus choledochus and passed outside in the feces.
- The eggs are then ingested by the first intermediate host (snail).
- When the miracidia hatch , they migrate through the gut wall and settle into the connective tissue, where they become mother sporocysts.
- The sporocysts migrate to the digestive gland where they give rise to several daughter sporocysts. Inside of each daughter sporocyst, cercariae are produced . There is no REDIA stage.
- Cercariae migrate to the respiration chamber where they are shed in slime ball from the snail respiration pore.
- Development in the snail may take 3-5 months

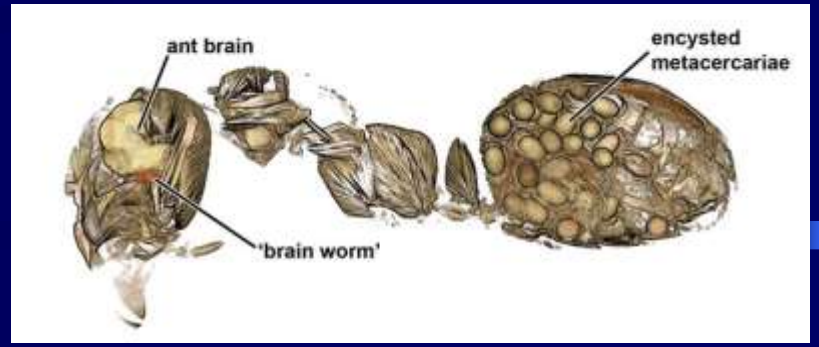
https://www.researchgate.net/figure/Cernuella-virgata-with-newly-excreted-slime-balls_fig8_1122398S

- After a slime ball is ingested by the **second intermediate host (ant)**, the cercariae become free in the intestine and migrate to the hemocoel and subesophageal ganglion where they become **metacercaria**.
- The implantation of metacercariae in the ant's subesophageal ganglion causes the ant to exhibit abnormal behavior. In this case, when temperatures drop, the ant climbs to the tips of grasses. Temperatures below 15°C cause the ant's jaw muscles to lock, preventing it from releasing itself. This increases the likelihood of the ant and its metacercariae being ingested by the definitive host, especially in the early morning and late evening when temperatures drop.
- **In the final host**, when the infected ant is eaten by a suitable definitive host, the metacercariae excyst in the small intestine. The immature flukes migrate to the bile duct through ductus choleodochus where they mature into adults . There is **no parenchymal migration.**
- The prepatent period is 10-12 weeks.
- The life span of parasites is at least 8 years.
- *****Humans can serve as definitive hosts after ingesting infected ants (crashing) food material = Zoonotic dis.

Biology



https://www.cdc.gov/dpdx/dicrocoeliasis/modules/Dicrocoelium_LifeCycle_lg.jpg



https://www.nhm.ac.uk/discover/news/2018/june/the-brain-worm-that-turns-ants-into-zombies.html

Pathogenesis:

•Although several thousand *D.dendriticum* are commonly found in the bile ducts, the livers are relatively normal; this is presumably due to the absence of a migratory phase.

•However, in heavy infections (in sheep over 5000 flukes) causes biliary fibrosis, distention of bile ducts, chronic cholangitis and extensive cirrhosis can occur. Sometimes the bladder become markedly enlarged.

irregular depressed whitish lines in liver

https://www.researchgate.net/figure/Liver-of-sheep-affected-with-Dicrocoelium-dendriticum-showing-irregular-depressed-whitish_fig5_269110541

Clinical signs:

Anaemia, oedema and emaciation, decreased milk and wool production have been reported in heavy infections.

Epidemiology:

There are two important features which differentiate the epidemiology of *Dicrocoeliu*m from that of *Fasciola sp.*

(i)The intermediate hosts are independent of water and are evenly distributed on the terrain. Infection is not depend on seasons.

(ii)The egg is so durable and it can survive for months on dry pasture, presenting a reservoir additional to that in the intermediate and definitive hosts.

Diagnosis:

This is entirely based on fecal examination for eggs (The eggs search with Sedimentation technique) and necropsy findings.

Diagnosis is based on microscopic identification of eggs in the stool, duodenal, and/or bile fluid.

**The egg is small, 45x 30µm, dark brown and operculate, usually asymetric shape.

It contains a miracidium when passed in the faeces.

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.com%2Fpin%2F408138784978839087%2F&psig=AOvVaw1mMekr83GCgV2wTIr0TUjN&ust=1602828514267000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCPCKktb3tewCFQAAAAAdAAAAABAD

Treatment:

High doses of anthelmintics are required for effective removal of *Dicrocoelium*. The benzimidazole, albendazole is very effective at three times dosage of normal rate. Praziquantel must be used at twice the rate of normal dosage. Other drugs such as thiabendazole and fenbendazole are also effective, but at very high dose rates. Recently netobimin has been shown to be highly effective.

Drugs used in the treatment of dicrocoeliosis			
Active ingredient	Route of administration	Dose (mg7kg)	
		Sheep and goat	Cattle
Thiabendazole	oral	200–300	100
Hetolin	oral	20–25	
Netobimin	oral	20	20
Febantel	oral	50	
Praziquantel	oral	20-50 (two times)	20-50
Hexachloroparaxylene	oral	150	125
Albendazole	oral	15-20 (2-3 weeks interval 2 times)	15-20
Fenbendazole	oral	100–150 (five times)	50
Mebendazole	oral	50–80	
Cambendazole	oral	25–100	
Luxabendazole	oral	7.5-10	
Thiophanate	oral	50	50
Diamphenethide	oral	80–200 (three times)	

Family: Paramphistomatidae

Genus: Paramphistomum

Paramphistomum

https://www.google.com/imgres?imgurl=https%3A%2F%2Fparasitipedia.net%2Fimages%2Fstories%2Fendo_para%2FTrematodes%2FParamWhole.jpg&imgrefurl=https%3A%2F%2Fparasitipedia.net%2Findex.php%3Foption%3Dcom_content%26view%3Darticle%26id%3D2568%26Itemid%3D2850&tbnid=lLwcy4PL5WXv2M&vet=12ahUKEwiR8dnd-7TsAhUN_BoKHQA5CXYQMygPegUIARCuAQ..i&docid=kPFqyaFK--WhlM&w=122&h=182&q=paramphistomum%20cervi%20&ved=2ahUKEwiR8dnd-7TsAhUN_BoKHQA5CXYQMygPegUIARCuAQ

Common name: Rumen flukes

Species:

Paramphistomum cervi

Paramphistomum microbothrium

Paramphistomum ichikawai

Definitive hosts: Ruminants

Predilection site: Adult flukes locate in rumen and reticulum, Immature flukes in the duodenum

Intermediate host: Water snails of the genus *Planorbis, Bulinus*

Distribution: Worldwide

Morphology:

Length: 6-12 mm.

Pink, conical rather than flat.

Ventral sucker is well developed, well visible and located subterminaly.

https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.vetstream.com%2FVetstream%2Fmedia%2Fimages%2FBovis%2FAdult-flukes-of-Paramphistomum.png&imgrefurl=https%3A%2F%2Fwww.vetstream.com%2Ftreat%2Fbovis%2Fdiseases%2Fparamphistomosis&tbnid=BCDuTG_hVorSBM&vet=12ahUKEwjL5OTp-bTsAhVDlxoKHaoLBo8QMygYegUIARC-AQ..i&docid=NVzwexnc9H8phM&w=800&h=505&q=paramphistomum%20life%20cycle&ved=2ahUKEwjL5OTp-bTsAhVDlxoKHaoLBo8QMygYegUIARC-AQ

https://d3i71xaburhd42.cloudfront.net/f7686a18019fda5f742e8b801d51a6036c218465/13-Figure1-1.png

Life cycle: Development of the snail takes about 4 weeks. In the final host, the metacercariae taken with the grass are released in the duodenum.

(4a sporocysts, 4b rediae, 4c cercariae)

In the final hosts: Metacercaria release in duodenum. They placed the intestinal wall by actively destroying the mucosa. Young parasites migrate from the duodenum and abomasum and settle in the rumen. It causes significant damage to the intestinal wall. Duration of migration in the duodenum is 6-8 weeks.

The prepatent period: 7-10 weeks

Clinical signs

In heavy duodenal infections, the most clinical signs is diarrhoea accompanied by anorexia and intense thirst.

Sometimes rectal haemorrhage occurs in cattle.

Haemorrhage and ulcers are visible through the peritoneal surface.

https://www.researchgate.net/figure/Small-intestine-of-a-lamb-necropsied-on-D52-Haemorrhage-and-ulcers-are-visible-through_fig3_280095351

- Pathogenesis
- Acute or intestinal paramphistomosis
- Pathological symptoms are produced by immature flukes.
- When as many as 30,000 young flukes start to gather in the intestine, they induce acute enteritis and anaemia in livestock mammals
- There is a watery and fetid diarrhoea which is often associated with high mortality (even up to 80-90%) in ruminants.
- Substantial production and economic losses occur in acute infection.

- Chronic or rumen paramphistomosis
- Adult flukes are relatively harmless. It is not seen any clinical signs in this stage.

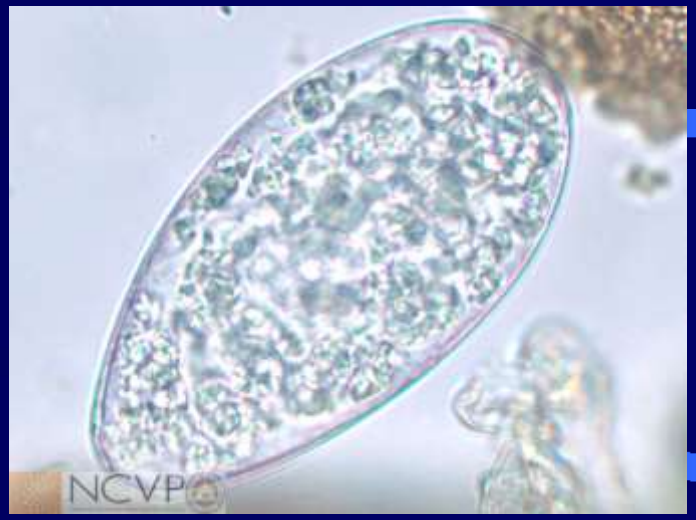
Diagnosis:

In the acute period, pink-white colored young parasites in the size of rice grains are sought in diarrhea stools.

In the chronic period, eggs are searched in the stool by sedimentation technique.

Eggs are 90-160 µm in diameter, gray-white in color and have an operculum.

https://www.ncvetp.org/trematodes



Immature paramphistomes (100X) in the faecal samples

https://www.researchgate.net/figure/Immature-paramphistomes-100X-in-the-faecal-samples_fig2_327879401

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/paramphistomum

Treatment:

Active ingredient	Aplication	Dose (mg/kg)	
		Sheep, goats	Cattle
Niclosamide	oral	50–125	90
Niclopholan	oral	10–15	6-9
Closantel	oral i.m	10 5	15
Rafoxanide	oral	7.5–23	15-20
Resorantel	oral	65–75	
Oxyclozanide	oral	15–25	10
Bithionol	oral	75	35
Brotianide	oral	5.6–15	
Albendazole	oral	4.75–7.5	
Clioxanide	oral		20
Hexachlorophene	oral	10–15	15-20
Hexachloroethane	oral	200-300	200-300
Hexachloroparaxylene	oral	150	125

Class: Trematoda
Family: Schistosomatidae
Genus: Schistosoma
Orientobilharzia

Schistosomosis)- Blood fluke disease

- Schistosomas are found in the circulatory system. The veins of the definitive hosts.
- The sexes are separate (not hermaphrodite). Sexual dimorphism is occur.
- Adult parasites have cylindrical bodies.
- There is no metacercaria period in their development.
- Furcocercaria form is infective stage.
- Cercaria (Furcocercaria) are fork-tailed and enter the last host by penetrating the skin or mucous membrane when taken orally.

Species	Definitive hosts	Predilection vein
Schistosoma mansoni	Man	Caudal mesenteric veins
S. haematobium	Man	Bladder veins, veins of urogenital system
S. japonicum	Man, domestic and wild animals	Portal and mesenteric veins
S. bovis	Ruminants (cattle, sheep, goats)	Portal and mesenteric veins Veins of the urogenital system
S. matthei	Domestic and wild ruminants	Portal and mesenteric veins
S. nasale	Ruminants, Horse	Veins of nasal mucosa
S. mekongi	Man, Dog	Mesenteric veins
Orientobilharzia turkestanicum	Ruminants	Portal and mesenteric veins

***Orientobilharzia turkestanicum* occurs in sheep in Turkey.

Morphology:

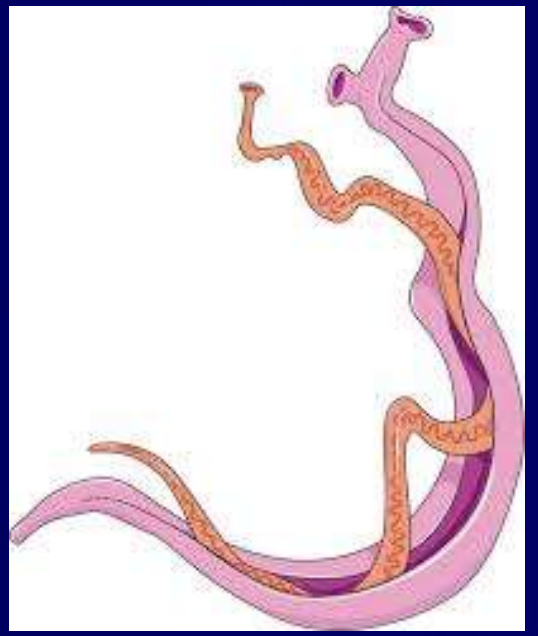
The body is cylindrical type.

Lengths: 2 cm

Unlike other trematodes, *Schistosoma* spp. are dioecous*.

Males are larger and flat than females.

The female is located in the male's gynaecophoric canal.



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https://www.google.com/url?sa=i&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FSchistosoma_mansoni&psig=AOvVaw1vqJaRerzwPLL6b78cuEQ3&ust=1603138030102000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIDf9t34vuwCFQAAAAAdAAAAABAg

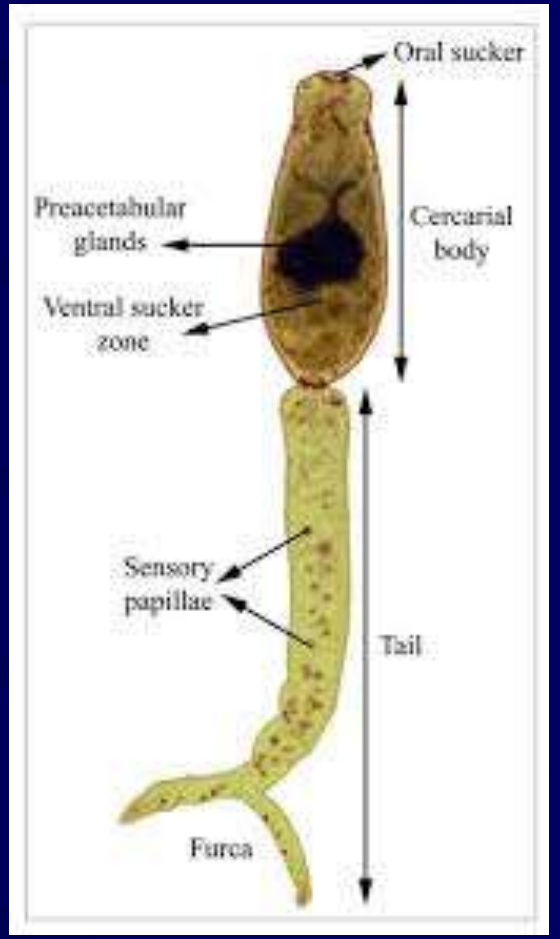
Morphology:

Cercaria have a fork tail calls «furcocercaria».

There are no metacercaria periods.

Their eggs have a spine and no operculum.

https://www.google.com/imgres?imgurl=https%3A%2F%2Fblogs.biomedcentral.com%2Fbugbitten%2Fwp-content%2Fuploads%2Fsites%2F11%2F2019%2F04%2FSchistosoma_mansoni_egg_4841_lores-620x342.jpg&imgrefurl=https%3A%2F%2Fblogs.biomedcentral.com%2Fbugbitten%2F2019%2F04%2F12%2Fnew-focus-on-intestinal-schistosomiasis-emergence-of-biomphalaria-snails-and-transmission-of-schistosoma-mansoni-in-lake-malawi%2F&tbnid=o4QzHVNtX-OdFM&vet=12ahUKEwjlj-DX-L7sAhUJ-4UKHSkWC70QMygLegUIARC4AQ..i&docid=YsjfDRDouY8VoM&w=620&h=342&q=schistosoma&ved=2ahUKEwjlj-DX-L7sAhUJ-4UKHSkWC70QMygLegUIARC4AQ



https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.waterpathogens.org%2Fsites%2Fdefault%2Ffiles%2FSchistosoma%2520Figure%25202.jpg&imgrefurl=https%3A%2F%2Fwww.waterpathogens.org%2Fbook%2Fschistosoma&tbnid=uy2z3q2fp68DwM&vet=12ahUKEwjlj-DX-L7sAhUJ-4UKHSkWC70QMygAegUIARCiAQ..i&docid=ssPLg1YsS1ZlOM&w=1650&h=2850&q=schistosoma&ved=2ahUKEwjlj-DX-L7sAhUJ-4UKHSkWC70QMygAegUIARCiAQ

Life cycle:

Life cycle: indirect

Intermediate host: Snails *(Planorbis, Bulinus)*

- Schistosoma eggs are passed out with faeces or urine, depending on species.
- The eggs hatch and release miracidia which can swim and penetrate specific intermediate hosts (snail: Planorbis, Bulinus sp....)
- The stages in the snail include two generations of sporocysts and the production of cercaria There is no **REDIA** period ***
- Upon release from the snail, the infective cercariae swim, penetrate the skin of the host and shed their forked tails, becoming **schistosomula**.
- The schistosomula migrate via venous circulation to lungs, then to the heart, and then develop in the liver, exiting the liver via the portal vein system when mature,
- Male and female adult flukes copulate and reside in the mesenteric venules, the location of which varies by species.

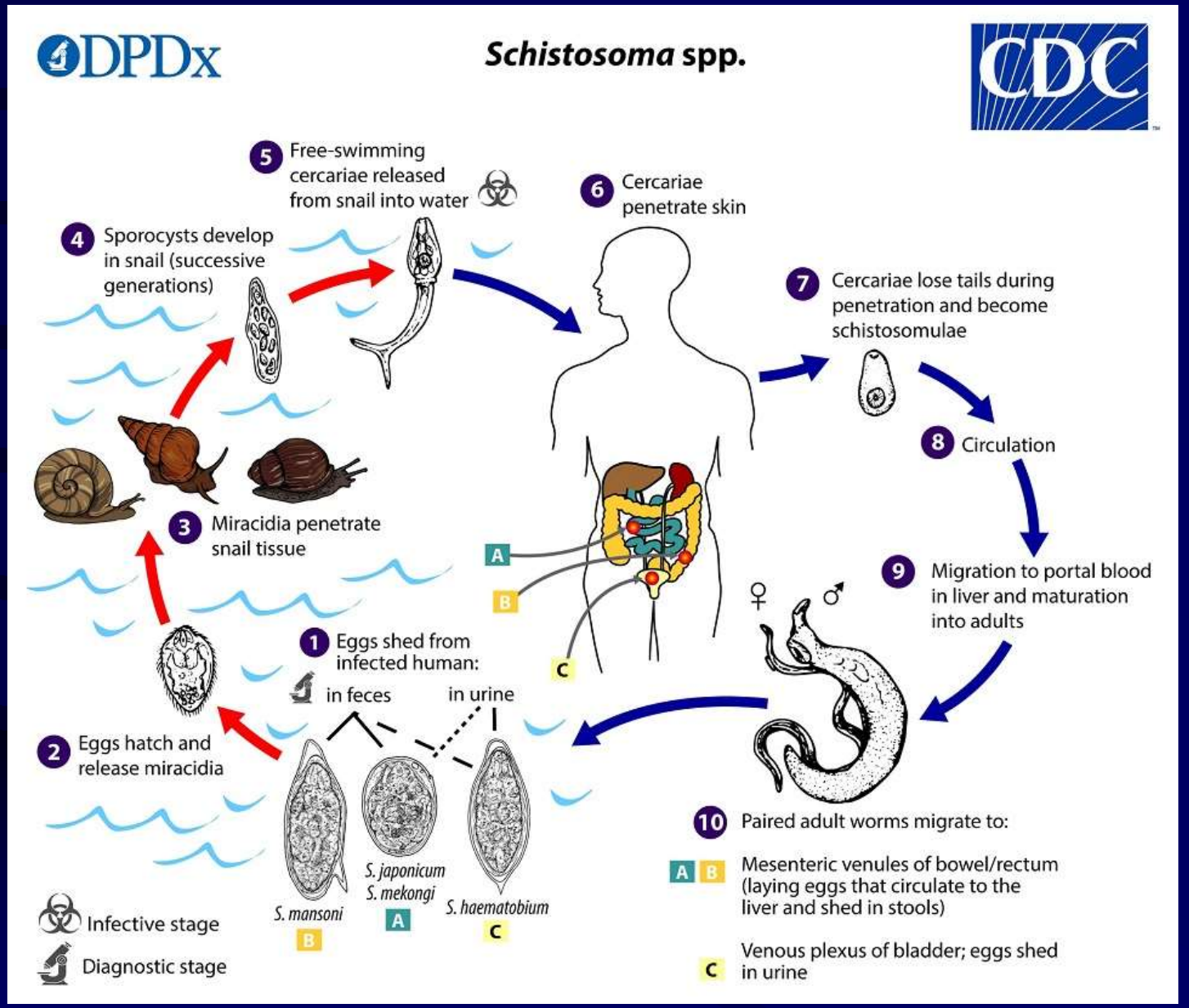
Pathogenesis:

Migration period: It is the period in which the schistosomula migrate through the blood to the heart, lung, liver and portal system. Pneumonia may occur in the lungs.

Maturation period: This is the period in which schistosomules mature in the liver. Usually no symptoms are seen. Vascular occlusion may occur.

Ovulation period: The most pathogenic period. The eggs tear the veins. Causes bleeding. Anemia occurs. Some eggs are kept in tissues (intestinal mucosa, liver) without leaving the host. It causes inflammation and fibrosis.

Life cycle



https://www.cdc.gov/parasites/schistosomiasis/biology.html

- **Diagnosis:**
- **Feces or urine samples can be examined microscopically (with sedimentation technique) for parasite eggs (stool for *S. mansoni* or *S. japonicum* eggs and urine for *S. haematobium* eggs).**

- **The eggs tend to be passed intermittently and in small amounts and may not be detected, so it may be necessary to perform a blood (serologic) test.**

- **Eggs are 100 μm in diameter, without operculum and with spines.**

https://www.google.com/imgres?imgurl=https%3A%2F%2Fblogs.biomedcentral.com%2Fbugbitten%2Fwp-content%2Fuploads%2Fsites%2F11%2F2019%2F04%2FSchistosoma_mansoni_egg_4841_lores-620x342.jpg&imgrefurl=https%3A%2F%2Fblogs.biomedcentral.com%2Fbugbitten%2F2019%2F04%2F12%2Fnew-focus-on-intestinal-schistosomiasis-emergence-of-biomphalaria-snails-and-transmission-of-schistosoma-mansoni-in-lake-malawi%2F&tbnid=o4QzHVNtX-OdFM&vet=12ahUKEwjlj-DX-L7sAhUJ-4UKHSkWC70QMygLegUIARC4AQ..i&docid=YsjfDRDouY8VoM&w=620&h=342&q=schistosoma&ved=2ahUKEwjlj-DX-L7sAhUJ-4UKHSkWC70QMygLegUIARC4AQ

Treatment

Drugs used in the treatment of schistosomatidosis		
Active ingredient	Route of administration	Dose (mg/kg)
Praziquantel	oral	15 –20
Triclorophon	oral	50 – 70 (4 - 6 times with 3 - 4 days interval)
Niridazole	oral	100 (3 days)
Neguvon	oral	100 – 120 (in goats)
Stibophen	oral	7.5 (6 days)
Hycanthone	i.m.	3

Cercarial dermatitis «swimmer's itch»

***Birds schistosomes; (*Trichobilharzia* spp, *Ornithobilharzia* spp., *Austrobilharzia* spp., and Mammals schistosomes; (*Heterobilharzia americana*, *Bivitellobiharzia* sp., *Orientobilharzia turkestanicum*) can cause cercarial dermatitis in humans. However, this dermatitis is clinically distinct from schistosomiasis.**

The cercariae do not mature into adults in the human body. They stay in the subcuteneous tissue a certain time and die in there. Causes severe itching

Distribution

It have been reported worldwide with cases reported from every inhabited continent.

Cases are commonly reported from the lakes region.

https://www.cdc.gov/dpdx/cercarialdermatitis/index.html#:~:text=Cercarial%20dermatitis%20(swimmer's%20itch)%20is,initial%20penetration%20of%20the%20cercariae.

https://www.google.com/url?sa=i&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FSwimmer%2527s_itch&psig=AOvVaw2kcKDAw7VXTu_4FM7H31dO&ust=1603372049598000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCJjj_7jgxewCFQAAAAAdAAAAABAD