Gastrodiscoides
(platyhelminth: trematode)

Overview

Platyhelminths have triploblastic acoelomate soft bodies which are markedly flattened in profile (hence their common name as flatworms). They undergo protostomial embryonic development but do not moult during growth. On the basis of molecular evidence, they are classified within the Lophotrochozoa despite the absence of lophophore mouthparts and trochophore larvae. Three classes are composed entirely of parasitic flatworms (Cestoda, Trematoda and Monogenea), which have prominent attachment organs (suckers or bothria), syncytial teguments, shell glands and vitellaria involved in ectolecithal egg development, and life-cycles involving a variety of larval stages. Trematodes (flukes) have soft leaf-like bodies with oral and ventral suckers, a blind gut (mouth but no anus) and both male and female reproductive organs (hermaphroditic). Digeneans have indirect life-cycles involving alternation of sexual stages in vertebrates and asexual stages in molluscs. Miracidia released from eggs infect snails (obligate intermediate hosts) where they undergo massive asexual proliferation through sac-like sporocyst and redia stages eventually releasing larval cercariae into the water. Vertebrate (definitive) hosts become infected by penetration of the skin by cercariae or by eating encysted stages (metacercariae) on herbage or in second intermediate hosts. Adult paramphistomids are thick fleshy worms and the ventral sucker is near the posterior end. Paramphistomes are conical (rather than flat) in shape and most occur as parasites in the forestomach of ruminants (rumen/stomach flukes), although some infect the intestines of pigs and horses. Infections by a range of species belonging to several genera have been associated with enteritis and diarrhoea in domestic animals.

Classification:
Domain: Eukaryota (membrane-bound nucleus)
Supergroup: Amorphea (unikonts with single flagellum, or nonflagellated amoebae)
Kingdom: Metazoa (multicellular eukaryotes, heterotrophs, notably animals)
Group: Protostomia (triploblastic, spiral cleavage)
Subgroup: Lophotrochozoa (lophophore feeding structure or trochophore larva or neither)
Phylum: Platyhelminthes (flatworms, acoelomate, most hermaphroditic, prominent attachment organs)
Clade: Neodermata (syncytial tegument = neodermis)
Class: Trematoda (flukes, most with dorsoventrally-flattened bodies, sac-like gut)
Subclass: Digenea (heteroxenous, larval miracidium, sac-like sporocyst/redia stages in mollusc, cercariae/metacercariae)
Order: Plagiorchiida ('echinostomatids', plagiorchiids', mainly fish hosts, some tetrapods, infection by ingestion of cercariae or metacercariae)
Suborder: Pronocephalata (gastropod IH, sporocyst and redia formed; simple-tailed cercariae, encysts in open, metacercariae eaten by DH)
Superfamily: Paramphistomoidea (rumen flukes, miracidium penetrates gastropod IH)
Family: Paramphistomidae (thick fleshy worms, conical shape, ventral sucker near posterior end, rediae with appendages, cercariae with two eyespots)
Genus: *Gastrodiscoides* (parasitic in intestines of pigs/humans)
Species: various species cause diarrhoea

Parasite biodiversity and host range: Most Metazoa are multicellular triploblastic animals with differentiated tissues, many being bilaterally symmetrical with a body cavity. Most invertebrate animals are protostomes as their embryonic development involves spiral determinate cleavage. Those that do not moult during their life-cycles are grouped together in the enigmatic clade Lophotrochozoa, including the platyhelminths, rotifers, lophophorates, annelids and molluscs. Platyhelminths (flatworms) have soft acoelomate flat bodies with three-dimensional arrays of muscles that generate a typical writhing motion (cf. longitudinal muscles in nematodes producing a thrashing motion). Flatworms do not have a single unifying characteristic (synapomorphy) but comprise diverse free-living (most Turbellaria) and parasitic (Neodermata) assemblages. Neodermata have non-ciliated syncytial (multinucleate) teguments and 3 classes are recognized, all with prominent attachment organs, namely, Cestoda with anterior bothridia/bothria (true/false suckers), Trematoda with oral and ventral suckers (previously called acetabula), and Monogenea with posterior haptors (opisthaptors). All have shell glands surrounding the ootype, and most exhibit ectolecithal egg development (yolk not present in egg but secreted by accessory glands called vitellaria or yolk glands). Most have indirect life-cycles involving the development of adult worms in vertebrates and larval stages in intermediate hosts (usually invertebrates).

The trematodes (flukes) and monogeneans have blind sac-like guts (lacking an anus) while the cestodes (tapeworms) lack digestive tracts. Trematodes have leaf-like bodies well adapted to living in confined spaces in tubular organs of vertebrate hosts. Two trematode subclasses are recognized: the Aspidogastrea with relatively few species (obligate external parasites of molluscs, fish and turtles, adults possessing a large ventral disc divided with numerous alveoli (suckerlets) or rows of suckers and the tegument having short protrusions (microtubercles)); and the speciose Digenea (obligate endoparasites of vertebrates, adults bearing undivided ventral suckers (when present) and life-cycles involving alternation of sexual stages in vertebrates and asexual stages in molluscs). The success of digeneans as widespread parasites has been attributed to their ability to proliferate at 2 separate parts of their life-cycles. Adults worms in vertebrate definitive hosts produce numerous eggs which are excreted and release free-swimming miracidia which seek molluscan intermediate hosts. Massive asexual proliferation occurs in molluscs involving unique sporocysts and rediae. Both stages are sac-like structures with almost no anatomical features (no suckers, no reproductive organs). The difference is that sporocysts lack a gut (they absorb their food), whereas rediae have a mouth, a muscular pharynx and a sac-like gut (they browse on molluscan tissues). Sequential development of these stages varies considerably, with mother sporocysts producing daughter sporocysts or rediae over multiple generations, culminating in the production of cercariae. The infected molluscs are typically rendered sterile ('castrated') with parasites replacing their gonads and producing dozens to thousands of infective cercariae every day. The cercariae are larval forms, almost always with tails, and they actively emerge from molluscs and swim around in water. There is enormous variation in cercarial behaviour, but the 3 most important routes of infection for definitive hosts are by penetration of the skin by cercariae (e.g. blood flukes), by ingestion of encysted stages (metacercariae) on vegetation (e.g. sheep liver flukes), or ingestion of encysted metacercariae in the tissues of a second intermediate host (e.g. human liver flukes). Some 6,700 digenean species belonging to 22 superfamilies have been described in fish and tetrapods. The subclass Digenea is divided into 2 orders: Diplostomida characterized by furcocercous cercariae that penetrate definitive hosts; and Plagiorchiida with variable life-cycles but often involving cercariae being ingested by definitive hosts.

Superfamily (+ no. families)	**No. spp.**	**DH[a]**	**Egg[b]**	**IH1[c]**	**Asexual[d]**	**Cercaria[e]**	**IH2[f]**	**Mode[g]**
Subclass: Aspidogastrea (large ventral disc with numerous alveoli (suckerlets) or rows of suckers, tegument with short protrusions (microtubercles), obligate ectoparasites on molluscs, turtles, fish)								
Aspidogastroidea (4)	65	M,F,C,T	A	G,B	-	-	-	8
Subclass: Digenea (oral and ventral sucker; syncytial tegument; obligate endoparasites of vertebrates)								
Order: Diplostomida (blood flukes, 'strigeids') ~1,480 species								
Brachylaimoidea (2)	250	T	E	G	S	S,F	M	6,7
Diplostomoidea (5)	800	T	P	G	S	F	C,M,A	6
Schistosomatoidea (5)	430	F,C,T	P	G,B,A	R,S	F	-	1,6
Order: Plagiorchiida ('echinostomatids', 'plagiorchiids') ~5,200 species								
Allocreadioidea (6)	1,118	F,T	P	G,B	R,S	S,Y	C,M,R,A	6
Apocreadioidea (1)	94	F	P	G	R	S	M,A	6
Azygioidea (1)	43	F,C	E	G	R	F	C	3,4
Bivesiculoidea (1)	28	F	P	G	R	F	C	3,4
Bucephaloidea (2)	410	F	P	B	S	F	C	4
Echinostomatoidea (10)	112	F,T	P	G	R	S	C,M,R	5,6,7
Gorgoderoidea (10)	106	F,C,T	P	G,B	R,S	S,Y	C,M,R	5,6,7
Gymnophalloidea (4)	200	F,T	P	B	S	F	C,M,R,A,E,N	3,4,6
Haplosplanchnoidea (1)	51	F	P	G	S	S	-	5
Hemiuroidea (15)	1,160	F,C,T	E	G,B,S	R,S	F	C,M,R,N	4
Heronimoidea (1)	1	T	P	G	S	S	-	7
Lepocreadioidea (8)	473	F	P	G	R	S	C,M,R,A,E,N	6
Microphalloidea (12)	414	F,T	P	G,B	S	S,Y	C,M,R,A,E	6.7
Monorchioidea (3)	270	F	E	G,B	R,S	S	C,R,A,E	6
Opisthorchioidea (3)	436	F,T	E	G	R	S	C	6
Paramphistomoidea (5)	74	F,T	P	G	R	S	-	5
Plagiorchioidea (16)	47	F,T	P	G	R,S	S,Y	C,M,R,A	6
Pronocephaloidea (6)	131	F,T	E	G	R	S	-	5
Transversotrematoidea (1)	27	F	P	G	R	F	-	2

LEGEND
[a] DH = definitive host: F = teleost fish; C = chondrichthyan fish; T = tetrapod; M = mollusc
[b] Fate of egg: A = larva hatches and attaches to IH1, E = eaten by IH1, P = hatches releasing miracidium which penetrates IH1
[c] IH1 = first intermediate host: G = gastropod, B = bivalve, A = annelid, S = scaphopod
[d] Asexual reproduction involves formation of secondary: R = redia, S = sporocyst
[e] F = fork-tailed cercaria, S = simple tailed cercaria, Y = cercaria with stylet
[f] IH2 = second intermediate host: C = chordate, M = mollusc, R = arthropod, A = annelid, E = echinoderm, N = cnidaria, ctenophore
[g] Mode of infection for DH: 1 = cercaria penetrates DH; 2 = cercaria attaches to DH; 3 = cercaria eaten by DH; 4 = cercaria eaten by IH2; 5 = cercaria emerges, encysts in open and eaten by DH; 6 = cercaria emerges, penetrates IH2, encysts and eaten by DH; 7 = cercaria remains in IH1, encysts and eaten by DH; 8 = no cercarial stage, infected IH1 eaten by DH.

Thirteen plagiorchidan suborders have been recognized containing 19 superfamilies. The suborder Pronocephalata is characterized by species forming simple-tailed cercariae which encyst in the open and the resultant metacercariae are eaten by herbivorous/omnivorous definitive hosts. One cognate superfamily is the Paramphistomoidea which contains thick fleshy worms from the stomach and intestines of ruminants and some omnivores. Adult worms possess a pharynx rather than an oral sucker at the anterior end, and a ventral sucker at the posterior end (amphistome arrangement, as distinct from monostome, holostome, distome, echinostome or schistosome). Hundreds of species have been described in over 140 genera in 10 families (Balanorchiidae, Brumptiidae, Cladorchiidae, Diplodiscidae, Gastrodiscidae, Gastrothylacidae, Mesometridae, Microscaphidiidae, Paramphistomidae and Zygocotylidae). Familial designations have been extensively reviewed on the basis of morphotypic and biotypic characters with significant reclassifications of individual genera and species. Hopefully, contemporary molecular characterization studies will help resolve their phylogenetic affinities. Amphistome stomach flukes have been detected in a broad range of definitive hosts encompassing all vertebrate classes (mammals, birds, reptiles, amphibians and fish) widely distributed throughout the world.

Paramphistome families and subfamilies	Genera	Definitive Hosts
Paramphistomidae		
Paramphistominae	*Calicophoron, Cotylophoron, Explanatum, Gigantocotyle, Paramphistomum* (syn. *Liorchis, Srivastavaia*), *Ugandocotyle*	artiodactyls
Orthocoeliinae	*Bilatorchis, Buxifrons, Gemellicotyle, Gigantoatrium, Glyptamphistoma, Leiperocotyle, Macropharynx, Nilocotyle, Orthocoelium* (syn. *Ceylonocotyle*), *Palamphistomum, Paramphistomoides, Platyamphistoma, Pseudoparamphistoma, Sellsitrema*	artiodactyls
Gastrothylacidae		
	Carmyerius, *Duttiella, Fischoederius*, *Gastrothylax, Velasquezotrema*	artiodactyls
Zygocotylidae		
Olveriinae	*Olveria, Sureshiella*	artiodactyls
Pseudodiscinae	*Macropotrema, Pseudodiscus*	perissodactyls, proboscids, macropodids
Stephanopharynginae	*Stephanopharynx*	artiodactyls
Watsoniinae	*Gastrodiscoides*, *Homalogaster*, *Skrjabinocladorchis, Watsonius*	primates, artiodactyls, rodents
Zygocotylinae	*Choerocotyloides, Wardius, Zygocotyle*	birds, artiodactyls, rodents
Gastrodiscidae		
	Gastrodiscus	proboscids, perissodactyls
Brumptiidae		
	Brumptia, Choerocotyle, Hawkesius	proboscids, rhinocerotids
Balanorchiidae		
	Balanorchis	artiodactyls
Cladorchiidae		
Caballerodiscinae	*Cabellerodiscus, Elseyatrema*	reptiles
Caballeroiinae	*Bancroftrema, Cabelleroia, Platycladorchis*	fish
Chiorchiinae	*Chiorchis, Chiostichorchis, Paraibatrema*	testudines, rodents, sirenia
Cladorchiinae	*Australodiscus, Catadiscus, Cladorchis, Dermatemytrema, Diplodiscus, Progonimodiscus, Pseudodiplodiscus, Taxorchis*	mainly amphibians
Dadaytrematinae	*Alphamphistoma, Anavilhanatrema, Annelamphistoma, Australotrema, Betamphistoma, Cleptodiscus, Dadayius, Dadaytrema, Dadaytremoides, Deltamphistoma, Gammamphistoma, Inpamphistoma, Macrorchitrema, Neocladorchis, Ophioxenus, Pacudistoma, Panamphistomum, Pronamphistoma*	fish, amphibians
Helostomatinae	*Amurotrema, Helostomatis, Protocladorchis*	fish
Megalodiscinae	*Megalodiscus, Opisthodiscus, Pseudopisthodiscus*	mainly amphibians
Microrchiinae	*Brevicaecum, Colocladorchis, Kalitrema, Micramphistoma, Microrchis, Nicollodiscus, Pseudocladorchis*	fish
Nemathophilinae	*Halltrema, Nematophila, Parachiorchis, Pseudoalassostoma*	reptiles
Orientodiscinae	*Australotrema, Basidiodiscus, Orientodiscus, Pretestis, Pseudoorientodiscus, Sandonia*	fish
Osteochilotrematinae	*Osteochilotrema*	fish
Pfenderiinae	*Pfenderius*	proboscids
Pisciamphistominae	*Pisciamphistomum*	fish
Schizamphistominae	*Alassostoma, Alassostomoides, Lobatodiscus, Pseudoalassostomoides, Pseudoceloiptodiscus, Quasichiorchis, Schizamphistomum, Schizamphistomoides, Stunkardia*	mainly reptiles, amphibians

Solenorchiinae	*Solenorchis*	dugongs
Stichorchiinae	*Stichorchis*	rodents, artiodactyls
Transvassosiniinae	*Travassosinia, Zetamphistoma*	fish
Mesometridae		
	Centroderma, Elstia, Mesometra, Neowardula, Parawardula, Wardula	fish
Microscaphidiidae (syn. Angiodictyidae)		
	Angiodictyum, Curumai, Denticauda, Deuterobaris, Dictyangium, Doodytrema, Hexangitrema, Hexangium, Microscaphidium, Neoctangium, Neodeuterobaris, Neohexangitrema, Octangioides, Octangium, Paradeuterobaris, Podocnemitrema, Polyangium, Polygorgyra, Pseudohexangium, Pseudoparabaris	testudines

Most of the known paramphistomes of ruminants belong to the families Paramphistomidae and Gastrothylacidae. The family Paramphistomidae comprises the rumen flukes whose adults lack a ventral pouch, and some 20 genera have been classified in 2 major subfamilies: the Paramphistominae (Laurer's canal crosses excretory duct); and the Orthocoeliinae (Laurer's canal and excretory duct do not cross). Some classifications include other subfamilies within the Paramphistomidae but subsequent reviews have reassigned them elsewhere. Notably, the subfamily Gastrodiscinae was split with the genus *Gastrodiscus* placed in the family Gastrodiscidae and the genera *Gastrodiscoides* and *Homalogaster* allocated to the subfamily Watsoniinae in the family Zygocotylidae. The genus *Gastrodiscoides* is monotypic and only contains one species *G. hominis* which infects the intestines mostly of pigs and humans throughout Asia.

Gastrodiscoides **species**	**Definitive hosts [adults in intestines]**	**First intermediate hosts [sporocysts/rediae in tissues]**	**Infective stages [metacercariae]**	**Distribution**
G. hominis (syn. *Amphistoma, Gastrodiscus*) (colonic fluke)	Rodentia: cricetid (water vole, muskrat), murid (bandicoot rats, ricefield rat, brown rat, black rat), echimyid (coypu); Artiodactyla: suid (pig, bushpig, warthog), tragulid (napu mouse-deer); Primates: cercopithecid (crab-eating macaque, Philippine long-tailed macaque, rhesus macaque, Sumatran surili), hominid (orangutan, human)	freshwater Gastropoda: planorbid (*Helicorbis coenosus, Anisus acronicus*), lymnaeid (*Lymnaea stagnalis*)	on herbage (esp. water caltrop)	India, Asia, Russia, Africa

Parasite morphology: *Gastrodiscoides hominis* forms 7 different stages in its developmental cycle: eggs, miracidia, sporocysts, rediae, cercariae, metacercariae and adult flukes. Unembryonated eggs are ovoid-rhomboidal measuring 120-165 x 60-75 µm and are surrounded by a transparent green-brown eggshell with a small polar operculum and an abopercular thickening (rarely with a spine-like projection). Eggs embryonate in water to form a miracidium which is released when eggs hatch. Free miracidia have elongated streamlined bodies measuring 115-140 x 35-50 µm with long cilia (arranged in staggered longitudinal rows anteriorly), prominent papilla, a primitive gut and cellular masses representing developing organs. Sporocysts have sac-like bodies measuring up to 1.5 mm in length and they do not contain any organs other than balls of germinal cells which develop into rediae. Two generations of rediae are formed, with first generation (mother) rediae forming second-generation (daughter) rediae. Rediae have sausage-shaped bodies that vary in size ranging from 150-750 x 45-150 µm (daughter rediae are larger). They are parasitic stages possessing a mouth, pharynx and saccular gut, but lacking locomotory organs. Cercariae have light brown ovoid bodies ranging in dimensions from 190-920 x 400–860 µm and have long unforked tails measuring 470-920 µm in length with central excretion tubes. They have 2 hemispherical eyespots, an oral region with 2 well-developed oral pouches, an oesophagus with a muscular bulb, 2 blind caeca, an excretory system (with a cross-connection between the 2 main trunks), developing reproductive organs and a ventral sucker. Metacercariae are brown and hemispherical ranging from 200–230 µm in diameter and they consist essentially of cercariae bodies that have shed their tails and become encapsulated within several cyst walls. Adult *G. hominis* have pyriform fleshy bodies measuring from 5-10 x 4-6 mm (generally smaller in pigs than humans) with distinctive anterior conical and posterior discoidal regions. They are covered by smooth (aspinose) tegument which is pink-red in colour. They have an anterior conical projection bearing the pharynx and a well-developed posterior concave ventral sucker separated from surrounding tissue by a deep narrow groove. Worms have a conspicuous alimentary tract comprising a pair of lateral pouches arising from the pharynx, a torturous pharyngeal tube and bifurcate caeca which are blind-ended. Adult worms are hermaphroditic and possess both male and female reproductive organs lying mostly between the caeca, except for the vitellaria. Worms have 2 large lobulated testes with vas efferentia, a single ovoid ovary with oviduct, extensive vitelline glands, Laurer's canal, and a curved uterus terminating in a prominent genital cone. Fertile worms are oviparous and produce unembryonated eggs.

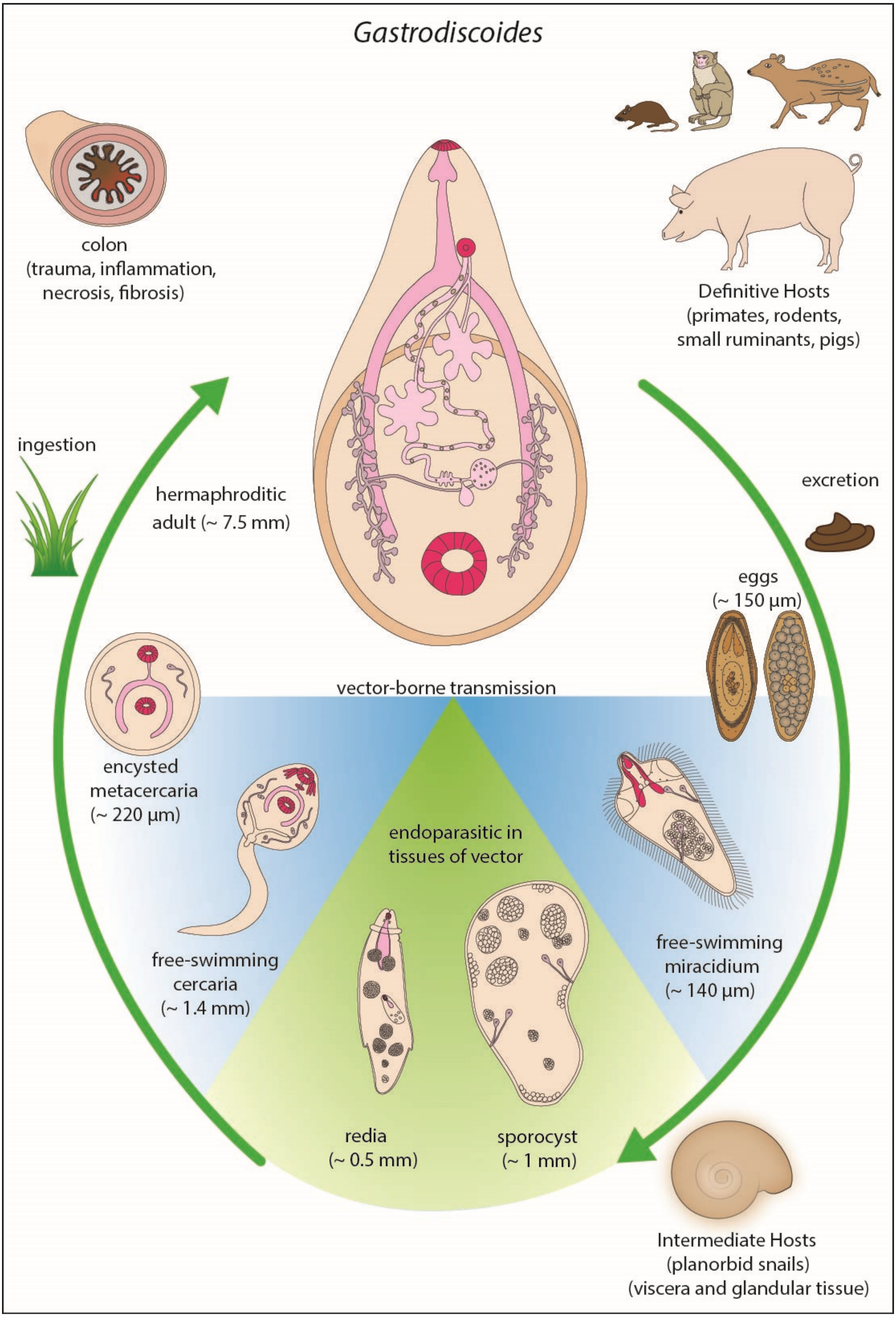
Site of infection: Infections by adult flukes occur in the large intestines (caecum and/or colon) of their definitive hosts (hence the common name of colonic fluke). However, juvenile worms first emerge from metacercariae in the small intestines (usually duodenum) from where they migrate posteriad to their final predilection sites to develop as adults. Larval stages (sporocysts and rediae) develop in various tissues of their snail intermediate hosts, particularly the digestive gland.

Pathogenesis: Adult flukes attach to the intestinal mucosa producing focal lesions characterized by hyperaemia, epithelial loss, necrosis, ulceration, neutrophilic infiltrates, and submucosal sclerosis due to connective tissue fibrosis and lymphoplasmacytic cellular infiltrates. Heavy infections in humans may cause oedematous catarrhal typhlitis (inflammation of the caecum) and/or chronic necrotizing typhlocolitis (inflammation of both the caecum and colon) with increased mucus production, mucoid diarrhoea, dehydration, abdominal pain, colic, fever and sometimes cachexia (weakness/wasting) and death. In severe cases, the presence of large number of eggs and worms may cause tissue reactions in the heart or mesenteric lymphatics, and untreated patients (esp. children) may die. On occasion, infections have been so extreme that the caecum and ascending colon are completely filled with parasites causing malabsorption, hypoalbuminaemia and intestinal obstruction. Infections in animals are less severe and generally involve chronic inflammation of the caecum and/or colon with mucosal desquamation, submucosal infiltrates and diarrhoea.

Developmental cycle and mode of transmission: *G. hominis* has an indirect digenetic (2-host) life-cycle with transmission occurring between vertebrates (definitive hosts) and molluscs (intermediate hosts) via free-swimming aquatic stages and encysted stages on vegetation. Unembryonated eggs are passed into the external environment with host faeces. They embryonate in water over 9-28 days depending on temperature (longer in cold water), forming a miracidium which hatches 1-5 days later. The free-swimming miracidia actively seek snail intermediate hosts using chemotactic cues to find snail mucus, but some may slowly settle on sediments until a snail host comes into contact. The miracidia penetrate snail tissues shedding their ciliated plates and forming sac-like sporocysts, usually in the snail digestive gland. Asexual development occurs primarily in the freshwater planorbid snail *Helicorbis coenosus,* although development has also been noted in another planorbid *Anisus acronicus* and the lymnaeid *Lymnaea stagnalis*. Sporocysts produce 2 generations of rediae: the first generation (mother) rediae being released from sporocysts into host tissues where they produce second generation (daughter) rediae. Cercariae are ultimately produced in daughter rediae and released into lymph spaces to complete their development before emerging from the snails. The prepatent period for infections in snails (time from infection to emergence of first cercariae) ranges from 28-152 days. Snails may shed from 7-238 cercariae and they usually emerge during morning hours. Cercariae swim about in water for up to 24 hours and then shed their tails and encyst as metacercariae on the external surfaces of aquatic plants (esp. water caltrop). A recent study detected metacercariae on market vegetables (cabbages), but how they became contaminated was not determined. It has also been suggested that metacercariae may form on other substrates such as the external surfaces of aquatic animals ["crustaceans (crayfish), squid, molluscs, or amphibians (frogs, tadpoles)"], or even in their tissues after they have consumed snails infected with cercariae. However, these suppositions are speculative and appear to be based on comparisons with other amphistomes (esp. *Gastrodiscus*) that have been perpetuated in textbooks and review papers without citing substantiating evidence (confirmatory primary scientific publications apparently lacking). Definitive hosts become infected by ingesting metacercariae on contaminated vegetation. The metacercaria excyst in the small intestines and the juvenile worms migrate posteriad to the caecum and/or ascending colon where they attach and mature to adults. Fertilized worms produce hundreds of eggs which are released and excreted with host faeces. The prepatent and patent periods in definitive hosts is unknown and it is unsure how long adult worms live.

Differential diagnosis: Infections are readily diagnosed by the microscopic detection of characteristic fluke eggs in faecal samples, usually following concentration by sedimentation. Adult worms may be collected ante-mortem following colonoscopic biopsy, soap-water enemas or anthelmintic treatment, or at post-mortem by gut dissection. Worms may be identified by their morphological characteristics with specific anatomical features (esp. with respect to genitalia) verified by microscopy. Haematological assessment often detects high levels of eosinophils in association with patent infections. Molecular characterization techniques have recently been used to confirm diagnoses and examine parasite strain variation by the polymerase chain reaction (PCR) amplification and sequencing of nuclear genes (18S and 28S ribosomal RNA, internal transcribed spacer regions 1 and 2).

Treatment and control: Several anthelmintic drugs have been used to treat clinical infections in humans and pigs, including the isoquinoline (praziquantel), halogenated hydrocarbons (carbon tetrachloride, tetrachloroethylene) and benzimidazole (mebendazole). Soapy water enemas have also been used to cleanse the bowels of worms, presumably by their detergent and washing action detaching worms from the mucosa. The prevention of infections is based on interrupting parasite transmission between hosts; by reducing faecal contamination of the environment (through better sanitation, preventing promiscuous defaecation, not using 'night-soil' to fertilize crops, sewage collection and treatment, water treatment); reducing snail intermediate host populations (using physical barriers or chemical molluscicides); and preventing metacercarial uptake by vertebrates (cooking or blanching vegetation in boiling water, not using aquatic green fodder in piggeries, water treatment). Public health educational campaigns should be used to alert communities to the dangers of infections, particularly in high-risk endemic regions, and suggest appropriate courses of preventive action.


Gastrodiscoides
colon
(trauma, inflammation,
necrosis, fibrosis)
Definitive Hosts
(primates, rodents,
small ruminants, pigs)
ingestion
hermaphroditic
adult (~ 7.5 mm)
excretion
eggs
(~ 150 µm)
vector-borne transmission
encysted
metacercaria
(~ 220 µm)
endoparasitic in
tissues of vector
free-swimming
cercaria
(~ 1.4 mm)
free-swimming
miracidium
(~ 140 µm)
redia
(~ 0.5 mm)
sporocyst
(~ 1 mm)
Intermediate Hosts
(planorbid snails)
(viscera and glandular tissue)

 *Gastrodiscoides* adult worm	 *Gastrodiscoides* egg