Phylum -Apicomplexa

Members of this phylum bears apical complex,
Apical complex-A group of cytoskeletal structures and associated membrane-bounded organelles found at the anterior end. The apical complex is involved in attachment to and penetration of the host cell, and in parasite proliferation. These include conoid, rhoptries, micronemes, subpellicular microtubles, wall forming body etc. present at some stage.
These contain single vesicular nucleus, cilia & flagella absent (expect microgametes) syngamy & cyst often present, all are parasitic.
Class - Sporozoea- which have well-developed apical complex, sexual & asexual reproduction, oocyst present.

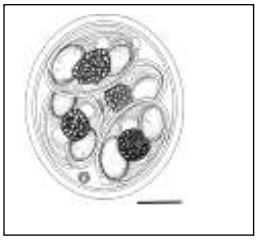
Sub class - Coccidia - Typically intracellular parasite of vertebrates.

Order-Eucoccidida - parasites of epithelial cells & blood cells. Schizogamy & gametogamy occur inside and sporogamy outside or inside the host.

Sub order- Eimeriina -they have macro & micro gametocytes develop independently, Zygote is non-motile, sporozoites in sporocysts, endodyogeny absent or present.

Family-Eimeriidae - These protozoa are known as the enteric coccidia; monoxenous (one-host) parasites in the digestive tracts of herbivores or carnivores causing diarrhoeal disease (known as coccidiosis). Parasites form environmentally-resistant oocysts with/without sporocyst with sporozoites, schizogamy inside the host and sporogamy outside the host. There are about 25 genera are recognized but only few are important. Genera of importance- ***Eimeria, Isospora, Tyzzeria*** **and** ***Wenyonella***

These genera are recognized on the basis of oocyst configuration (the number of sporocysts per oocyst, and the number of sporozoites per sporocyst).
*Eimeria*spp contain 4 sporocyst each containing 2 sporozoites (1)
*Isospora*spp contain 2 sporocyst each containing 4 sporozoites (2)
*Tyzzeria*spp contain nosporocyst each containing 8sporozoites (3)
*Wenyonella*spp contain 4 sporocyst each containing 4sporozoites (4)
Another genus Cryptosporidium containing 4 sporozoites only. (5)



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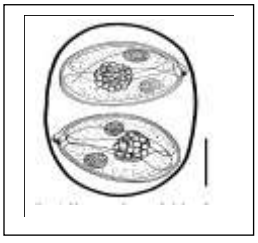

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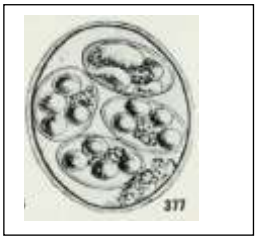

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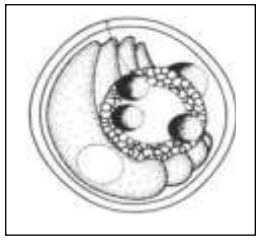

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Parasite morphology: Coccidian parasites form three developmental stages: schizonts, gamonts and oocysts.

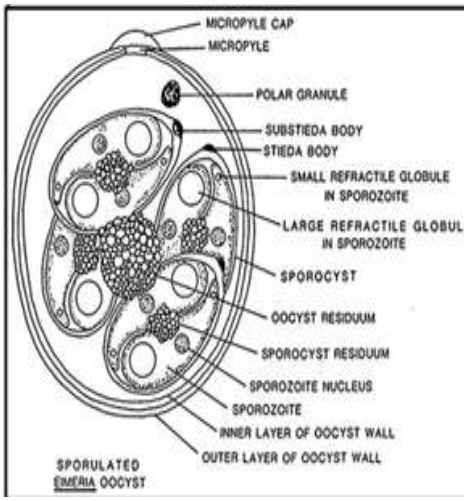
Schizonts range in size depending on parasite species, location in the host and stage of maturity. They begin as small basophilic rounded cells (mother meronts) located intracellularly within host cells. These form numerous daughter merozoites by endogenous division of the nucleus followed by cytokinesis. Mature schizonts appear as membrane-bound clusters of small basophilic bodies (similar to bunches of grapes). These range in diameter from 10-100µm but some species form enormous megaloschizonts (up to 1mm in diameter).

Gamonts exhibit sexual differentiation, with microgamonts (♂) apparent as multinucleate basophilic stages ultimately shedding small biflagellated microgametes; and macrogamonts (♀) evident as uninucleate eosinophilic cells with a single ovoid nucleus.

Developing oocysts contain numerous eosinophilic wall-forming bodies which give rise to the tough outer oocyst walls. Unsporulated oocysts contain a developing sporoblast which eventually undergoes sporulation forming sporocysts which contain the infective sporozoites. The unsporulated oocysts undergo meiosis upon contact with oxygen and moisture. This process is known as sporulation and the oocysts take approximately 2 to 7 days to become infectious

Oocysts are generally ovoid to ellipsoid in shape, range from 10-40µm in length by 10-30µm in width, and may contain specialized structures, such as polar caps, micropyles, residual and crystalline bodies.

The morphology of a typical oocyst, that of *Eimeria*spp, is shown in Figure. The oocyst wall is composed of 1 or 2 layers and may be lined by a membrane. It may have a micropyle, which may be covered by a micropylar cap. Within the oocyst in this genus are 4 sporocysts, each containing 2 sporozoites. There may be a refractile polar granule in the oocyst. There may be an oocyst residuum or a sporocyst residuum in the oocyst and sporocyst, respectively; these are composed of material left over after the formation of the sporocysts and sporozoites. The sporocyst may have a knob, the Stieda body, at one end. The sporozoites are usually sausage- or comma-shaped, and may contain 1 or 2 clear globules.

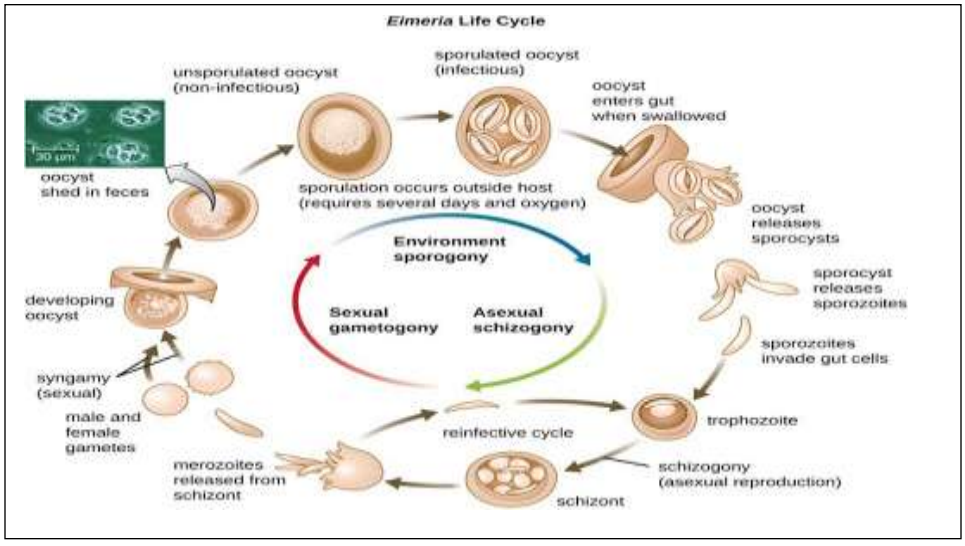


Host range: Infections have been recorded throughout the world in most vertebrate species, including eutherian and metatherian mammals, birds, reptiles and fish. Most coccidian species are considered to be highly host-specific and only parasitize single host species (oioxenous), although some species in birds and reptiles may parasitize closely-related hosts (stenoxenous) and a few species in fish may parasitize unrelated hosts (euryxenous). Many hosts also harbour multiple species of coccidia which may vary considerably in morphology, developmental cycle, site of infection and pathogenicity.

Mode of transmission: Oocysts excreted with host faeces contaminate the external environment, but they must undergo internal sporulation (sporozoite formation) before they become infective. New hosts are infected when they ingest sporulated oocysts contaminating food or water supplies (faecal-oral transmission).

Seat of predilection: Most species undergo endogenous development in the intestinal mucosa (small and/or large intestines) whereas some species develop in the liver, gall bladder or kidneys. They generally exhibit rigid tissue tropism, infecting host cells in particular locations. The parasites undergo several cycles of schizogony culminating in the lysis of host cells to release merozoites. Ultimately, gamonts are formed which mature to produce micro- and macro-gametes that undergo fertilization forming a non-motile zygote (oocyst) which is excreted with host faeces.

Life cycle: The life cycle of Eimeriidae starts with the ingestion of mature oocysts. Bile salts and chymotrypsin stimulate the release of the sporozoites from the oocyst. Once freed, the sporozoites invade intestinal cells beginning the asexual development stage called schizogony. After a variable number of asexual cycles, gametes are formed and the sexual stage of development begins (gamogony). The sexual phase terminates with the production and release of oocysts into the intestinal lumen. Once in the environment, oocysts must sporulate to become infective. Sporulation process usually takes from 2 to 3 days depending on environmental conditions.



Pathogenesis and clinical signs: Most species are not significant pathogens and cause little or no disease. Certain species, however, are highly pathogenic and cause catarrhalic or haemorrhagic enteritis by severe erosion of the mucosal membranes through cell lysis resulting in profuse watery-to-bloody diarrhoea. Clinical disease is not usually manifest until cumulative tissue damage associated with second or third generation schizogony. Moderately-affected animals may show progressive signs such as poor weight gain or weight loss, weakness and emaciation, while severely-affected individuals may die soon after the appearance of disease.

Pathogenicity depends on many factors; such as parasite species, viability, infectivity, virulence, tropism, host age, nutritional status, immunological competence, as well as prevailing environmental conditions (temperature, moisture) and management practices. Young animals are most susceptible to clinical disease, although survivors develop strong specific protective immunity against subsequent infection and disease.

Differential diagnosis: Clinical signs usually coincide with parasite patency (patent period = period during which oocysts are produced). Infections are usually diagnosed by the coprological examination of host faeces for coccidial oocysts (concentrated using various sedimentation-flotation techniques). Unstained oocysts are best observed by light microscopy. Fresh faecal samples may only contain unsporulated oocysts so differential specific diagnosis may sometime require short-term storage to facilitate sporulation by the use of 2% potassium dichromate Researchers have recently used a range of molecular techniques to characterize genetic variation between and within parasite species, but few techniques are suitable for routine diagnostic use.

Treatment and control: Disease progression is usually so rapid that any therapeutic (curative) treatment may simply be too late. For this reason, continuous in-food or in-water medication is often used for prophylactic (preventative) treatment in many intensive animal industries. A wide range of drugs are available, including those with coccidio-static (reversible suppressive) activity or coccidio-cidal (irreversible lethal) activity. The main drug groups include sulfonamides (sulfanilamide, trimethoprim, ethopabate), pyridinoles (clopidol, decoquinate), nitrobenzamides (zoalene), organic arsenicals (roxarsone), nitrofurans (furazolidone, amprolium), quinazolinones (halofuginone), polyether ionophorous antibiotics (monensin, laslocid, salinomycin, narasin), asymmetric (diclazuril) and symmetric (toltrazuril) triazines. Due to drug resistance amongst many coccidian species, especially that against synthetic drugs. Many industries recommend periodic rotation between different drug groups and the use of combination (cocktail) drugs to minimize the occurrence of resistance. Most coccidial infections stimulate the development of strong protective immune responses, albeit transient unless premunitive (short-lived unless parasites persist). There has been considerable success with control through immunoprophylaxis using attenuated or precocious strains of parasites, particularly in the poultry industry. Researchers are now attempting to develop recombinant subcellular vaccines. Outbreaks can generally be controlled by management practices based around improving hygiene, reducing crowding, removing contaminated litter and isolating infected individuals. Chemical disinfection is usually impractical as the oocysts are resistant to many conventional disinfectants.