



A checklist of protozoan parasite belonging to the genus *Apolocystis* Cognetii de Martiis, 1923 (Apicomplexa: Eugregarinida: Monocystidae) recorded from oligochaete hosts

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Abstract

A checklist of forty-one species of genus *Apolocystis* documented throughout the world being presented here. Out of forty-one seven species of genus *Apolocystis* have so far been recorded from India. The species mainly infect seminal vesicles, coelom, coelomic fluid, intestine, blood vessel, peripharyngeal coelom, pharyngeal gland and nephredia of different oligochaete host.

Keywords: Apicomplexa, *Apolocystis*, Checklist, Eugregarinida, Monocystidae

Introduction

Phylum Apicomplexa are a large and diverse group of parasites under the subkingdom Protozoa. Most of them possess a unique form of organelle that comprises a type of plastid called an apicoplast and an apical complex structure. The order Eugregarinida Léger, 1900 belonging to the phylum Apicomplexa represents interesting group gregarines. Levine in 1988 included the gregarine groups to the phylum Apicomplexa. The gregarine parasites inhabit the intestine, coelom and reproductive organ of invertebrates. Gregarines are the earliest lineage of apicomplexan animals and separated from coccidians, haemosporidians and piroplasms.

Gregarines group represent mainly two forms aseptate and septate. Approximately, 250 genera and 1650 species of aseptate gregarines have so far been described (Levine, 1976, 1977 and 1988; Clopton, 2000; Hausmann *et al.*, 2003). The aseptate gregarine trophozoites contain one compartment, but the septate gregarines bear septum.

Aseptate form harbours mainly in oligochaete host. Septate form mainly infects Arthropods and Mollusc.

The genus *Apolocystis* was erected by Cognetii de Martiis in 1923, having solitary, spherical gamonts without principle axis and biconical oocyst. Later on, many scientists worked on the genus *Apolocystis* and documented forty one species, (Cognetii de Martiis, 1923; Troisi, 1933; Philips and Mackinnon, 1946; Tuzet and Loubatieres, 1946; Loubatieres, 1955; Berlin, 1924; Meier, 1956; Tuzet and Zuber-Vogeli, 1955; Tuzet and Vogeli, 1956; Meier, 1956; Rees, 1963; Berczky, 1967; Ramadan 1969; Segun, 1971 and 1978; Frolov, 1991; Loubatieres, 1995; Gullo Armeendariz, 2002; Ramadan *et al.*, 2014, 2015 and Ali *et al.*, 2018) out of which only seven species have so far been reported from india (Pradhan and Dasgupta, 1983; Bhatia and Setna, 1926; Bandyopadhyay *et al.*, 2004; Bhowmik *et al.*, 2012). In view of this it has become necessary to establish an updated checklist of different *Apolocystis* species. The checklist is presented below including type host, type locality and site of infection in Table 1.

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Table 1. A checklist of *Apolocystis* species, type hosts, distribution, site of infection. SV = Seminal Vesicles; C = Coelom; BV = Blood Vessel; CF = Coelomic Fluid; Ints = Intestine; PG = Pharyngeal Gland; PC = Peripharyngeal; Coelom; Neph = Nephredia

Name of the <i>Apolocystis</i> Species	Host(s)	Distribution	Site of Infection	Material deposited
1. <i>A. lumbricolidi</i> (Schmidt, 1854) Cognetii de Martiis, 1923 emend. Levine 1977	<i>Eisenia foetida</i> (Savigny, 1826); <i>Dendrobaena rubida</i> (Savigny, 1826); <i>D. subrubicunda</i> (Eisen, 1874); <i>D. tenuis</i> (Eisen, 1874)	England, France, Germany, Poland	SV	
2. <i>A. michaelsoni</i> (Hesse, 1909) Cognetii de Martiis, 1923	<i>Pheretima hawayana</i> (Rosa, 1891)	France	C	
3. <i>A. villosa</i> (Hesse 1909) Cognetii de Martiis, 1923	<i>Octolasion lacteum</i> (Orley, 1881)	France, Germany, Wales	SV	
4. <i>A. pareudrili</i> (Cognetii de Martiis, 1911) Cognetii de Martiis, 1923	<i>Pareudrilus pallidus</i> (Cognetii de Martiis, 1907)	Ruwenzori (Africa)	SV	
5. <i>A. catenata</i> (Mulsow, 1911) Cognetii de Martiis, 1923	<i>Lumbricus terrestris</i> (Linnaeus, 1758)	Germany	C	
6. <i>A. beaufortii</i> (Cognetii de Martiis, 1918) Cognetii de Martiis, 1923	<i>Pheretima</i> (Parapheretima) <i>beaufortii</i> (Cognetii de Martiis, 1911)	Dutch New Guinea	SV	
7. <i>A. minuta</i> Troisi, 1933	<i>Lumbricus terrestris</i> (Linnaeus, 1758); <i>L. castaneus</i> (Savigny, 1826); <i>L. rubellus</i> (Hoffmeister, 1843)	England, U.S.A	SV	
8. <i>A. gigantea</i> Troisi, 1933	<i>Eisenia foetida</i> , (Savigny, 1826) <i>Lumbricus rubellus</i> (Hoffmeister, 1843)	U.S.A	SV	
9. <i>A. chattoni</i> Tuzet and Loubatieres, 1946	<i>Allobophora gigas</i> (Rosa, 1886)	France	SV	
10. <i>A. elongata</i> Philips and Mackinnon, 1946	<i>Eisenia foetida</i> (Savigny, 1826)	Clifton, Bristol	SV	
11. <i>A. gigas</i> Tuzet and Loubatieres, 1946	<i>Octolasion complanatum</i> (Duges, 1828)	France	SV	
12. <i>A. granulata</i> Tuzet and Loubatieres, 1946	<i>Allolobophora chlorotica</i> (Savigny, 1826); <i>A. gigas</i> (Rosa, 1886)	France, Hungary	SV	
13. <i>A. pertusa</i> Loubatieres, 1955	<i>Allolobophora chlorotica</i> (Savigny, 1826); <i>A. gigas</i> (Rosa, 1886) ; <i>A. rosea</i> (Savigny, 1826);	France, Germany	SV	
14. <i>A. mattheii</i> (Bhatia and Setna, 1926) Loubatieres, 1955	<i>Megascolex tribolatus</i> (Stephenson, 1891)	India	SV	Not available
15. <i>A. vivax</i> (Berlin, 1924) Meier, 1956	<i>Eiseniella t. tetraedra</i> (Savigny, 1826)	Germany, Sweden	SV	
16. <i>A. dichogasteri</i> (Tuzet and Zuber-Vogeli, 1955) Tuzet and Vogeli, 1956	<i>Dichogaster baeri</i> (Sciaccchitano, 1952)	France, West Africa	SV	

17.	<i>A. herculea</i> (Bosanquet, 1894) Meier, 1956	<i>Lumbricus terrestris</i> (Linnaeus, 1758); <i>L. rubellus</i> (Hoffmeister, 1843); <i>L. castaneus</i> (Savigny, 1826) ; <i>Octolasion lacteum</i> (Orley, 1881); <i>O. cyaneum</i> (Savigny, 1826) ; <i>Allolobophora caliginosa</i> (Duges,1828); <i>A. chlorotica</i> (Savigny, 1826); <i>Dendrobaena rubida</i> (Savigny, 1826);	England, France, Germany, Sweden, Wales	SV & C	
18.	<i>A. pilosa</i> Meier, 1956	<i>Lumbricus terrestris</i> (Linnaeus, 1758); <i>L. rubellus</i> (Hoffmeister, 1843); <i>L. festivus</i> (Savigny, 1826); <i>L. castaneus</i> (Savigny, 1826)	England, Germany, Hungary	SV	
19.	<i>A. stammeri</i> Meier, 1956	<i>Fridericia striata</i> , <i>F. perrieri</i> (Vejdovsky, 1878); <i>Fratzeli</i> (Eisen, 1872)	Germany	C	
20.	<i>A. lavernensis</i> Rees, 1963	<i>Allolobophora longa</i> (Ude, 1885)	England, Wales	SV	
21.	<i>A. perfida</i> Rees, 1963	<i>Allolobophora chlorotica</i> (Savigny, 1826)	Wales	C	
22.	<i>A. rotaria</i> Rees, 1963	<i>Octolasion cyaneum</i> (Savigny, 1826)	Wales	C	
23.	<i>A. spinosa</i> Rees, 1963	<i>Allolobophora chlorotica</i> (Savigny, 1826)	England, Wales	SV	
24.	<i>A. almanili</i> Ramadan, 1969	Not available	Nile river banks	Not available	
25.	<i>A. centrospora</i> Ramadan, 1969	Not available	Abole-Rawash	Not available	
26.	<i>A. dudichi</i> Bereczky, 1967	<i>Dendrobaena platyura</i> var. <i>depressa</i> (Fitzinger, 1883)	Hungary	SV	
27.	<i>A. megagranulata</i> Segun 1971	<i>Dendrobaena rubida</i> , (Savigny, 1826) <i>F. subrubicunda</i> (Eisen, 1874)	England	SV	
28.	<i>A. iridodrili</i> Segun, 1978	<i>Iridodrilus preussi</i> (Michaelson); <i>I. roseus</i> (Beddard, 1897)	Nigeria	SV	
29.	<i>A. libyodrili</i> Segun, 1978	<i>Libyodrilus violaceus</i> (Beddard, 1891)	Nigeria	SV	
30.	<i>A. akaryosomiferus</i> Pradhan and Dasgupta 1983	<i>Pheretima robusta</i> (E. Perrier,1872)	Darjeeling (26.887° N 88.187°E), West Bengal, India	BV	Not available
31.	<i>A. goomtiensis</i> Pradhan and Dasgupta, 1983	<i>Pheretima diffringens</i> (Baird, 1869)	Darjeeling (27.03° N 88.16°E), West Bengal, india	CF	Not available
32.	<i>A. monokaryosomiferus</i> Pradhan and Dasgupta 1983	<i>Pheretima robusta</i> (E.Perrier,1872)	Darjeeling (26.887° N 88°187° E), West Bengal, India	BV	Not available

33. <i>A. vacuolata</i> Pradhan and Dasgupta, 1983	<i>Pheretima alexandri</i> (Beddard, 1900)	Darjeeling (27.03° N 88.16°E), West Bengal, India	Inst.	Not available
34. <i>A. saigonensis</i> Frolov, 1991	<i>Pheretima peguana</i> (Rosa, 1890)	Not available	SV	
35. <i>A. minima</i> (Boisson, 1957) Frolov, 1991	<i>Pheretima posthuma</i> (L.Vaillant, 1868)	Not available	SV	
36. <i>A. janovyi</i> Gullo Armeendariz, 2002	<i>Microscolex dubius</i> (Fletscher, 1887)	Los Talas, Buenos Aires, Argentina	C	
37. <i>A. chotonagpurensis</i> Bandyopadhyay <i>et al.</i> , 2004	<i>Amyntus robusta</i> (Perrier, 1872)	Chotonagpur (22°N; 84°E), Bihar, India	SV	The Syntype no. AC/2-2002 deposited in the Zoological Survey of India (ZSI), Calcutta, 700016 (Catalogue No. 2407)
38. <i>A. cognetti</i> Bhowmik <i>et al.</i> , 2012	<i>Amyntus hawayanus</i> (Rosa, 1891)	Darjeeling (Lat. 26°31'N 87°59'E), West Bengal, India	SV	Paratype API/9 deposited in the national collection of the ZSI, Calcutta-53 (Accession no. Pt/2435/ZSI)
39. <i>A. perienteron</i> Ramadan <i>et al.</i> , 2014	<i>Pheretima californica</i> (Chen, 1936)	Egypt	C	
40. <i>A. proventus</i> Ramadan <i>et al.</i> , 2015	<i>Pheretima californica</i> (Chen, 1936); <i>Pheretima elongate</i> (E.Perrier, 1872)	Egypt	PG & PC	
41. <i>A. nephredii</i> Medhat <i>et al.</i> , 2018	<i>Limnodrilus</i> sp. (Claparede, 1862)	Maghaga region, Egypt, Abo-Rawash	Neph.	

Summary

In this communication, forty-one species belonging to the genus *Apolocystis* Cognetti de Martiis, 1923 have been consolidated. All these aseptate gregarine fauna have been documented from different oligochaete hosts of various geographical distributions, including the site

of infections. This communication will enlighten on the taxonomic studies and evolution of the genus *Apolocystis*.

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