

The symbiotic role of *Wolbachia* in Onchocercidae and its impact on filariasis

T. Bouchery, E. Lefoulon, G. Karadjian, A. Nieguitsila and C. Martin

UMR 7245, MCAM MNHN CNRS, Muséum National d'Histoire Naturelle, Paris, France

Abstract

Symbiotic associations between eukaryotes and microorganisms are frequently observed in nature, and range along the continuum between parasitism and mutualism. The genus *Wolbachia* contains well-known intracellular bacteria of arthropods that induce several reproductive phenotypes that benefit the transmission of the bacteria. Interestingly, *Wolbachia* bacteria have been found in the Onchocercidae, a family of filarial nematodes, including species that cause human filarial diseases, e.g. lymphatic filariasis and onchocerciasis. The endosymbiont is thought to be mutualistic in the Onchocercidae, and to provide essential metabolites to the filariae. Currently, *Wolbachia* bacteria are targets of antibiotic therapy with tetracyclines, which have profound effects on the development, viability and fertility of filarial parasites. This overview article presents the Onchocercidae and *Wolbachia*, and then discusses the origin and the nature of the symbiosis. It highlights the contribution of *Wolbachia* to the survival of the filariae and to the development of pathology. Finally, the infection control implications for filariases are debated. Potential directions for future research are also discussed.

Keywords: Antibiotherapy, filariasis, onchocercidae, symbiosis, *Wolbachia*

Article published online: 11 October 2012

Clin Microbiol Infect 2013; **19**: 131–140

Corresponding author: C. Martin, UMR 7245, MCAM MNHN CNRS, Muséum National d'Histoire Naturelle, 61 rue Buffon, CP52, 75231 Paris Cedex 05, France
E-mail: cmartin@mnhn.fr

Introduction

Among the Nematoda, the order Spirurida encompasses the family Onchocercidae, commonly known as filariae. They infect a broad range of terrestrial vertebrates, and many of them are responsible for medical and veterinary issues in mammals (Table 1) [1–27]. They are all transmitted by haematophagous arthropod vectors that are either pool-feeders (telmophagous) (e.g. black flies for onchocerciasis transmission, or tabanid flies for loasis) or vessel-feeders (solenophagous) (e.g. mosquitoes for lymphatic filariasis transmission, or ticks for canid filariasis) (Table 1). Filarial nematode species can host *Wolbachia* bacterial endosymbionts. Research on the symbiosis of *Wolbachia* and Onchocercidae has highlighted the contributions of bacteria to the reproduction of filariae, the inflammatory disease pathogenesis, and the immunomodulation of the vertebrate host, and has led to the consideration of antibiotic therapy as a novel method of treatment.

Biology of Filariae and their Endosymbiont *Wolbachia*

The microfilariae (stage I or L1) are taken up by the vector during a blood meal. In this intermediate host, they moult and develop until they become stage 3 (infective) larvae (L3). Throughout this development, the larvae migrate from the ingested blood to other tissues, depending on the vector species [28]. During another blood meal of the vector, the infective larvae are passed to the dermis of the vertebrate's skin. Once there, the L3 larvae moult into stage 4 larvae within 2 days for the genera *Onchocerca* and *Dirofilaria*, and within approximately 10 days for the other genera [28]. Most of the species migrate through the host's body from the skin to their definitive niche, mainly the lymphatic system, the coelomic cavities, the cardiopulmonary system, and connective tissues (Table 1). The fourth and final moult results in adult male or female worms.

TABLE 1. Prominent filarial species of human and veterinary interest

Species	Vectors Genus (family)	Vertebrate hosts	Main tissue localization of adult worms	Localization of microfilariae	Main pathologies	Wolbachia supergroup	References
<i>Onchocercinae</i>							
<i>Acanthocheiloneema draucunculoides</i> (Cobbold, 1870)	Hippobosca (Hippoboscidae)	Canids	Coelomic cavity and subcutaneous tissue	Blood	Usually asymptomatic	NA	[1,2]
<i>Acanthocheiloneema reconditum</i> (Grassi, 1889)	Heterodoxus (Boopidae) Ctenocephalides (Pulicidae) Pulex (Pulicidae)	Canids	Subcutaneous tissue	Blood	Usually asymptomatic	Absent	[1,3]
<i>Acanthocheiloneema viteae</i> * (Kreplekogorskaya, 1933) <i>Brugia malayi</i> (Brug, 1927)	Heterodoxus (Boopidae) Ornithodoros (Argasidae) Mansonia (Culicidae) Anopheles (Culicidae) Aedes (Culicidae)	Rodents Humans ^a	Subcutaneous tissue LS, LN, testes	Blood Blood	Usually asymptomatic Adenopathy Lymphoedema	Absent D	[1,4,5] [1,6,7]
<i>Brugia pahangi</i> (Buckley & Edeson, 1956)	Aedes (Culicidae) Anopheles (Culicidae)	Dogs, felids, ^{b, c}	LS, LN, testes	Blood	Lymphoedema	D	[1,6,7]
<i>Brugia timori</i> (Partono et al., 1977)	Aedes (Culicidae) Anopheles (Culicidae)	Humans	LS, LN, testes	Blood	Lymphoedema	D	[1,7,8]
<i>Ceratotiphilaria grassii</i> (Noè, 1907) <i>Litomosoides sigmodontis</i> * (Chandler, 1931) <i>Mansonella (Mansonella) ozzardi</i> (Manson, 1897)	Rhipicephalus (Ixodidae) Ornithonyssus (Macronyssidae) Culicoides (Ceratopogonidae) Simulium (Simuliidae)	Dogs Rodents Humans	Subcutaneous tissue Coelomic cavity Coelomic cavity	Skin Blood Blood	Usually asymptomatic Usually asymptomatic Usually asymptomatic	NA D F	[1,9,10] [1,11] [1,12]
<i>Mansonella (Esslingeria) perstans</i> (Manson, 1891) <i>Mansonella (Esslingeria) streptocera</i> (Macfie & Corson, 1922) <i>Ondocerca cervicalis</i> (Railliet & Henry, 1910)	Culicoides (Ceratopogonidae) Culicoides (Ceratopogonidae) Culicoides (Ceratopogonidae)	Humans and monkeys Humans and monkeys	Coelomic cavity Intradermal	Blood Skin	Usually asymptomatic Dermatitis	F NA	[1,13] [1,14]
<i>Ondocerca gutturosa</i> (Neumann, 1910)	Culicoides (Ceratopogonidae) Simulium (Simuliidae)	Equids	Nuchal ligament	Skin	Dermatitis Ocular trauma	NA	[1,15]
<i>Ondocerca lupi</i> (Rodonaja, 1967)	Culicoides (Ceratopogonidae)	Bovids	Nuchal ligament	Skin	Dermatitis	NA	[1,16]
<i>Ondocerca ochengi</i> (Bwangamoi, 1969) <i>Ondocerca volvulus</i> (Leuckart, 1893)	Unknown Simulium (Simuliidae) Simulium (Simuliidae)	Canids Bovids Humans	Intradermal Subcutaneous tissue	Skin Skin	Ocular trauma Nodules Dermatitis	C C	[1,17] [1,11,18,19] [1,20]
<i>Wuchereria bancrofti</i> (Cobbold, 1877)	Culex (Culicidae) Anopheles (Culicidae) Aedes (Culicidae)	Humans	LS, LN, testes	Blood	Ocular trauma Lymphoedema	D	[1,7,21]
<i>Dirofilaria immitis</i> (Leidy, 1856)	Aedes (Culicidae)	Canids, felids, ^d	Right ventricle Pulmonary artery	Blood	Heart worm disease	C	[1,22,23]
<i>Dirofilaria repens</i> (Railliet et Henry, 1911)	Aedes (Culicidae)	Canids, felids, ^e	Vena cava Subcutaneous tissue	Blood	Subcutaneous tissue nodules	C	[1,24]
<i>Loa loa</i> (Cobbold, 1864)	Culex (Culicidae) Chrysops (Tabanidae)	Humans	Connective tissue Subcutaneous tissue Connective tissue	Blood	Calabar swelling Ocular trauma	Absent	[1,25]
<i>Setariinae</i>							
<i>Setaria equina</i> (Abildgaard, 1789)	Aedes (Culicidae)	Horses	Coelomic cavity	Blood	Usually asymptomatic	Absent	[1,26,27]

LN, lymph nodes; LS, lymphatic system; NA, data not available. Extra hosts are indicated by ^a—monkeys, cats, dogs, viverrids, pangolins; ^b—cebid, erinaceids, loriscids, sciurids, manids, viverrids; ^c—transmissible to humans; ^d—ferrets, raccoons, sea lions; ^e—raccoons, sea lions.*Rodent filariae commonly used as experimental models of filariasis.

Download English Version:

<https://daneshyari.com/en/article/6130993>

Download Persian Version:

<https://daneshyari.com/article/6130993>

[Daneshyari.com](https://daneshyari.com)