

Morphology and Life Cycle of *Wuchereria bancrofti*

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Commentary

Received: 01-Jun-2022, Manuscript No. JZS-22-88161; **Editor assigned:** 03-Jun-2022, Pre QC No. JZS-22-88161 (PQ); **Reviewed:** 17-Jun-2022, QC No. JZS-22-88161; **Revised:** 24-Jun-2022, Manuscript No. JZS-22-88161(R); **Published:** 30-Jun-2022, DOI: 10.4172/2321-6190.10.S5.001

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ABOUT THE STUDY

Wuchereria bancrofti is a filarial (arthropod-borne) nematode (roundworm) that is the major cause of lymphatic filariasis. It is one of the three parasitic worms, together with *Brugia malayi* and *B. timori*, that infect the lymphatic system to cause lymphatic filariasis. These filarial worms are spread by a variety of mosquito vector species. *W. bancrofti* is the most prevalent of the three and affects over 120 million people, primarily in Central Africa and the Nile delta, South and Central America, the tropical regions of Asia including southern China, and the Pacific islands. If left untreated, the infection can develop into lymphatic filariasis. In rare conditions, it also causes tropical pulmonary eosinophilia. No vaccine is commercially available, but high rates of cure have been achieved with various antifilarial regimens, and lymphatic filariasis is the target of the World Health Organization Global Program to Eliminate Lymphatic Filariasis with the aim to eradicate the disease as a public-health problem by 2020. However, this goal was not met by 2020.

Morphology

As a dioecious worm, *W. bancrofti* exhibits sexual dimorphism. The adult worm is long, cylindrical, slender, and smooth with rounded ends. It is white in colour and almost transparent. The body is quite delicate, making removing it from tissues difficult. It has a short cephalic or head region connected to the main body by a short neck, which appears as a constriction. Dark spots are dispersed nuclei throughout the body cavity, with no nuclei at the tail tip. Males and females can be differentiated by size and structure of their tail tips. The male worm is smaller, 40 mm (1.6 in) long and 100 µm (0.0039 in) wide, and features a ventrally curved tail. The tip of the tail has 15 pairs of minute caudal papillae, the sensory organs. The anal region is an elaborate structure consisting of 12 pairs of papillae, of which eight are in front and four are behind the anus. In contrast, the female is 60 mm (2.4) to 100 millimetres (3.9) long and 300 micrometres (0.012) wide, nearly three times larger in diameter than the male. Its tail gradually tapers and rounded at the tip. No additional sensory structures are seen. Its vulva lies towards the anterior region, about 0.25 mm from the head. Adult males and females are most often coiled together and are

difficult to separate. Females are ovoviviparous and can produce thousands of juveniles known as microfilariae. The microfilaria is a miniature adult, and retains the egg membrane as a sheath, and is often considered an advanced embryo. It measures 280 μm long and 25 μm wide. It appears quite structureless in vivo, but histological staining makes its primitive gut, nerve ring, and muscles apparent.

Life cycle

W. bancrofti carries out its lifecycle in two hosts. Humans serve as the definitive host and mosquitos as the intermediate host. The adult parasites reside in the lymphatics of the human host. They are found mostly in the afferent lymphatic channels of the lymph glands in the lower part of the body. The first-stage larvae, known as microfilariae, are present in the circulation. The microfilariae have a membrane "sheath". This sheath, along with the area in which the worms reside, makes identification of the species of microfilariae in humans easier to determine. The microfilariae are found mainly in the peripheral blood and can be found at peak amounts from 10 pm to 4 am. They migrate between the deep and the peripheral, circulation exhibiting unique diurnal periodicity. During the day, they are present in the deep veins, and during the night, they migrate to the peripheral circulation. The cause of this periodicity remains unknown, but the advantages of the microfilariae being in the peripheral blood during these hours may ensure the vector, the nighttime mosquito, will have a higher chance of transmitting them elsewhere. Physiological changes also are associated with sleeping, such as lowered body temperature, oxygen tension, and adrenal activity, and an increased carbon dioxide tension, among other physical alterations, any of which could be the signals for the rhythmic behavior of microfilarial parasites. If the hosts sleep by day and are awake at night, their periodicity is reversed. In the South Pacific, where *W. bancrofti* shows diurnal periodicity, it is known as periodic.

The microfilariae are transferred into a vector, which are most commonly mosquito species of the genera *Culex*, *Anopheles*, *Mansonia*, and *Aedes*. Inside the mosquito, the microfilariae mature into motile larvae called juveniles; these migrate to the labium after a period around 10 days. When the infected mosquito has its next blood meal, *W. bancrofti* larvae are deposited from the mouthparts onto the skin of the prospective host and migrate through microcuts in the dermis or the tract created by the proboscis into the bloodstream of the new human host. The larvae move through the lymphatic system to regional lymph nodes, predominantly in the legs and genital area. The larvae develop into adult worms over the course of a year, and reach sexual maturity in the afferent lymphatic vessels. After mating, the adult female worm can produce thousands of microfilariae that migrate into the bloodstream. A mosquito vector can bite the infected human host, ingest the microfilariae, and thus repeat the lifecycle. The organism notably does not multiply within its intermediate host, the mosquito.