

A Short Communication

Mosquitoes and their Medical Importance

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ABSTRACT

Mosquitoes are vectors of many biologic agents of infection that range from bacteria, viral and parasitic infection. They cause diseases with high rate of morbidity and mortality. Plasmodium species are transmitted by the female anopheles genus and is the etiologic agent of malaria which is the major cause of absenteeism from work, school, reduced productivity, reduction in labour supply, illness and death in the tropics. Burkitts lymphoma is a malignancy that is higher in malaria endemic region. The genus culex and mansonia are the vectors of nematodes in the filariodea family. They cause spectrum of diseases ranging from eosinophillia, allergic lymphadenitis, lymphoedema and persistent infection could cause "elephantiasis". The vector of zika virus is Aedes species. It is responsible for microcephaly in fetus of pregnant women infected in pregnancy. Yellow fever is a viral haemorrhagic fever caused by a flavivirus and transmitted also by the aedes species. Vector control with proper cleaning of the environment, individual use of insecticide treated net, use of prophylactic and prompt treatment of diseases caused by them are methods that have been suggested to reduce the mortality associated with the diseases caused by these mosquitoes.

Keywords: Eosinophilia, Flavivirus, Haemorrhagic, Microcephaly, Plasmodium

LITERATURE

Vectors are either arthropods or any living thing that transmits infectious agents to a susceptible host. A vector can play either a biological or mechanical role in the transmission of an infectious agent. A biological role is played when the vector is important in the essential phase of the lifecycle of the infectious agent. The vector plays a mechanical role when it carries the infectious agents to a susceptible host on its body, limbs, body fluids and faeces.¹ Vectors include mosquitoes, fleas, ticks and mites. Mosquitoes belong to the phylum : arthropoda, Class : insecta, Order: *Diphthera*, Family: Culcidae with

Subfamily: Anophelinae and Culcinae.² Genus in this families are: *Aedes*, *Anopheles*, *culex*, *Culiseta*, *Ficalbia*, *Latzia*, *Mansonia*, *Mimomyia*, *Onirion* and *Udaya*. There are about 3000 species of mosquito, of which about 100 are vectors of human diseases.³ They have a long, slender body and long, needle-shaped, piercing mouthparts. Females of most species are ectoparasites whose tube-like mouth called proboscis pierce the host skin to consume blood. The adult mosquito measure between 2 mm and 12.5 mm in length.³ They feed on blood of vertebrates, mammals, birds, reptiles and fishes. They can survive in a variety of environment because of their special adaptational skills. They can survive in clean, dirty, small and large bodies of water.⁴

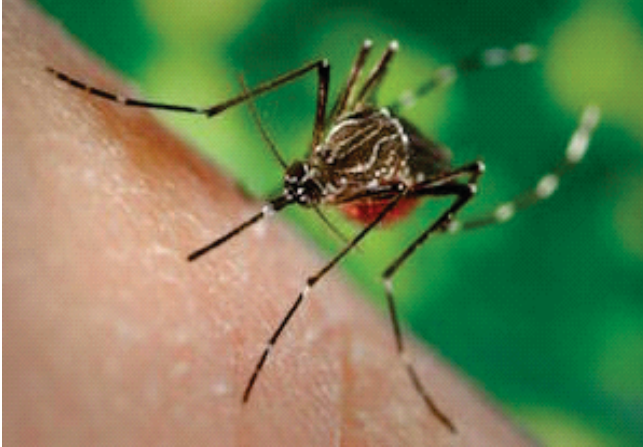


Figure 1: Picture of a mosquito⁵

They have four stages in their lifecycle. egg, larva, pupa and adult. The females usually mate only once but produce eggs at regular intervals throughout their life. A blood meal is needed to propagate the species hence the need for them to constantly bite human and animals. Female mosquitoes lay up to 50-500 eggs after a blood meal. The eggs are released through a genital opening.⁶ The egg is able to survive the aquatic environment with the hydrophilic inner surface and a hydrophobic outer surface. Factors such as water quality, incidence of light, existing eggs, available food, and local vegetation are decisive factors in selecting a favourable breeding site by female anopheles mosquito. The eggs develop after 2-7 days of been laid depending on the temperature.⁶ The Larva is legless and the body is divided into three distinct parts: (a) the head with mouth-parts, eyes and antennae; (b) the broader thorax and (c) the abdomen which is composed of seven almost identical segments and three modified posterior segments. The larval food consists of microorganisms, algae, protozoa, invertebrates and detritus.⁴ They can be classified based on their feeding behaviours into filter or suspension feeders, browsers or predators. Larvae moult four times at intervals, before reaching the pupal stage. At each moult, the head capsule is increased to the full size characteristic of the next instar, whereas the body grows continuously.

The pupa stage is aquatic, last for 2 days and is temperature dependent. Some larval organs are subsequently histolysed, whilst the body of the adult is formed through the development of imaginal disks (cells or groups of cells that remained quiescent in the larval body until the pupal stage). The adult stage develops at the completion of the final stage of metamorphosis, the males in the population usually emerge 1–2 days before the females in order to achieve sexual maturity at the same time as the emerging females. The life cycle again of mating, feeding and oviposition begins soon after the emergence into adult.⁴ The male deposits the spermatozoa in the bursa copulatrix of the female within less than half a minute.⁶ The female mosquito can only mate once whereas the male mosquito can mate several times. The female therefore stores sufficient sperm in their spermathecae to fertilize several egg batches without further copulation. The search for a host to obtain a blood-meal is the next important phase after insemination in order to propagate their kind. They are vectors and have been linked to the following illnesses

Malaria

Malaria is an old disease whose name is derived from the Italian (mal-aria) or “bad air”. It is also known as Roman fever, ague, marsh fever, periodic fever, paludism.⁷ Malaria control was revolutionalised when Dr. Ronald Ross in 1898 discovered that the female Anopheles mosquito was actually responsible for transmitting malaria parasite.^{8,9} Malaria is a disease mostly of tropical and subtropical areas, It is prevalent in sub-Saharan Africa and common in other tropical regions of China, India, Southeast Asia, South and Central America.¹⁰ Malaria accounts for 65 percent of all diseases reported in Nigerian health facilities and in 42% of pregnant women.¹¹ At least 1 million people die of malaria each year, mostly children under 5 years of age.¹² More than 80% of the deaths worldwide occur in sub-Saharan Africa.^{12,13} In Nigeria, statistics show that malaria accounts for 25% of under-five mortality, 30% of childhood mortality and 11% of maternal mortality.¹⁴ The

parts of the world that are continuously at high risk of malaria are predominantly the poorest.¹⁵ Malaria is the major cause of absenteeism from work and school in Africa and reduced productivity, reduction in labour supply, illness and death.¹⁶ *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale* and *Plasmodium malariae* are the four known species of Plasmodium genus that transmits malaria. *Anopheles gambiae*, *Anopheles funestus*, *Anopheles arabiensis* and *Anopheles melas*. *A.arabiensis* species are the anopheles species that are vectors of this parasite.¹⁷ Over 80% of malaria infections are caused by *P. falciparum* while up to 15% are caused by *P. malariae* and less than 5% are caused by *P.ovale* infections.^{17,18} Variation in climatic conditions has profound effect on the life of a mosquito and on the development of malaria parasites. Temperature and humidity are the most important factors. The best conditions for the development

of Plasmodia in the Anopheles and the transmission of infection are when the mean temperature is within a range of 20-30°C while the mean relative humidity is at least 60%. A high relative humidity lengthens the life of the mosquito and enables it to live long enough to transmit the infection to several persons.¹⁹ The lifecycle of malaria is shown in the diagram below

The symptoms of uncomplicated malaria include headache, fever, jointaches, reduced appetite and bitter taste. That of complicated malaria include : coma, DIC, kidney failure and Acute respiratory distress syndrome. The group of individuals that are most vulnerable to complicated malaria are children, pregnant women, immunosuppressed patients and immigrants from malaria non endemic areas. Drugs that were used in the past to treat malaria include: Chloroquine, Quinine, Sulphadoxine/

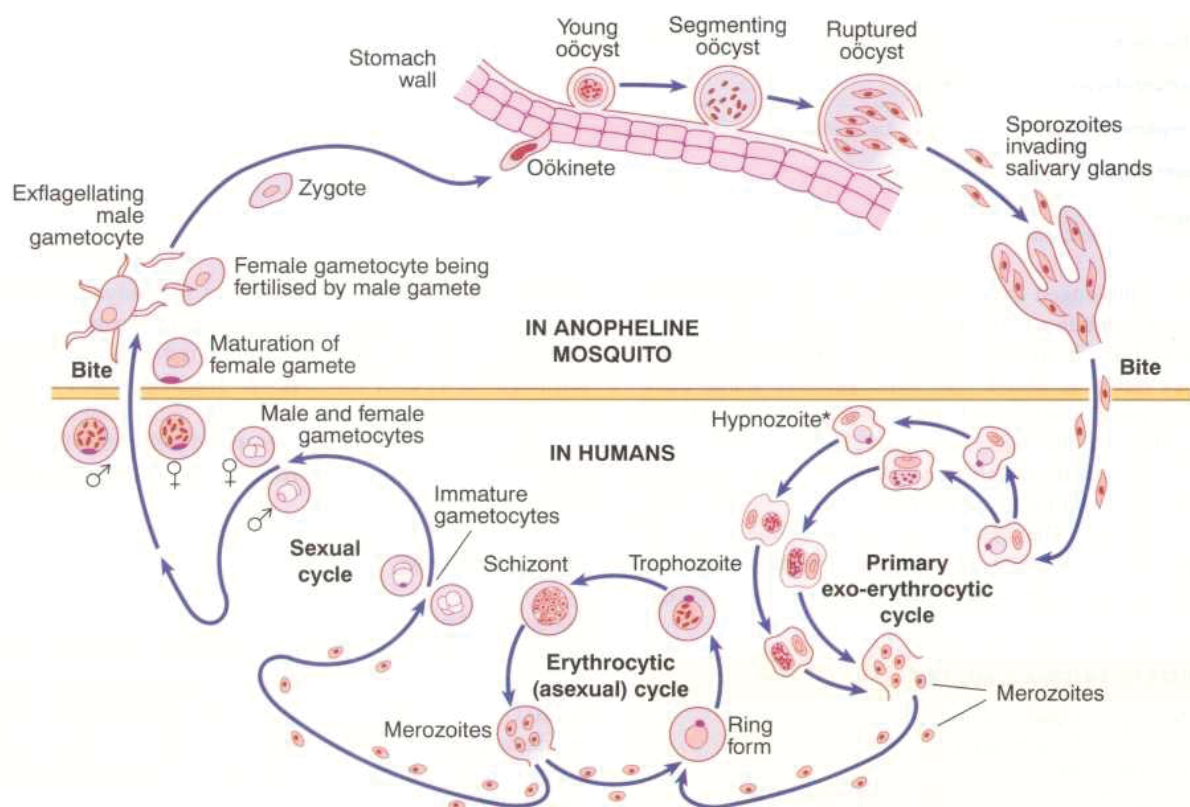


Figure 2: Malaria parasite life cycle.²⁰

Pyrimethamine and halofantrine .The WHO now advocates the use of Artemisinin Combination Therapy for the treatment of malaria.²¹

Burkitt's lymphoma : was first discovered in Uganda, East Africa by Dr Denis Burkitt about 5 decades ago. The incidence of BL has increased in the endemic areas in Africa in recent years, overlapping with the epidemic of HIV and malaria in the region.²² It results from translocation of cmyc oncogene from 8 to 14. Several forms of Burkitt Lymphoma exist depending on its geographic distribution, incidence magnitude and risk factors .Endemic BL (eBL) is the disease originally described by Burkitt and largely found in Africa, characteristically affecting the facial skeleton in children between ages two to nine. Sporadic Burkitt's lymphoma (sBL) is the form subsequently described outside the African region, morphologically similar to eBL and affecting the abdomen mainly. It has no age specificity. A third subtype has been proposed based on its association with HIV infection. It is well described in the developed world and known among HIV positive adults in Africa. The likelihood of the disease among HIV positive children has not been well characterized.²³ It presents with swelling of the facial skeleton with CNS involvement. A starry-sky pattern is usually present, imparted by numerous benign macrophages that have ingested apoptotic tumor cells . Despite that Burkitt has been linked to EBV (lymphotrophic gamma human herpesvirus widely spread among humans).²⁴ *P. falciparum* role in its development has been suggested by the shared geographic distribution of eBL and holoendemic malaria. Both diseases show highest incidence rates in the lymphoma belt or malaria belt, an area around the equatorial Africa (+/-10°C) where average temperature exceeds 15.5°C and have yearly rainfall higher than 50 ml. The suggested pathways by which both infections could induce eBL include the fact that malaria could disrupt immune response against EBV, leading to BL. A reduction of BL incidence was observed in areas where malaria was eradicated.²⁵

Filariasis

Filariasis is caused by several nematodes in the *filariodea* family which infects humans. Larva stages are inoculated by the flying mosquitoes. These larvae develop into adults and produce millions of microfilariae after mating and migrate in the blood or skin.²⁰ Disease caused by the adult worm or the microfilariae is due to the host immune response to the parasite and its characterized by massive eosinophilia.²⁶ *Wuchereria bancrofti* and *Brugia malayi* are transmitted by *Culex* species and *Mansonia* species of mosquito respectively. Presence of the adult worm in the lymphatic system causes allergic lymphadenitis.



Figure 3: Picture of Elephantiasis²⁷

Subsequent infection will lead to lymphatic obstruction which may progress to lymphoedema. Clinical features in the acute stage include fever, pain and tenderness on the path that involves the inflamed lymph vessels. Chronic and persistent infection leads to enlargement of the regional lymph nodes and subsequently leads to “elephantiasis” The development of elephantiasis takes at least 10 years of infection and it is common in highly endemic region. Treatment is with the use of Diethyl carbamazine (DEC) which kills the microfilariae and the

adult worms. Treatment of elephantiasis may require surgical intervention. Prevention and control involves the use of insecticides and individual avoidance of mosquito bite.

Zika

Zika is a zoonotic disease that is caused by an arthropod borne virus called Zika virus. It was first discovered in Zika Forest in near Entebbe in Uganda in 1947 during a mosquito and primate surveillance.^{28,29} It has been 'quiet' but for some few isolated outbreaks in the state of Yap and French Polynesia until March 2015 whole world went agog when an exanthematous illness was identified in Brazil and had spread to about 14 Brazilian States and Columbia by October 2015.³⁰ This same mosquito borne viral illness was declared a Public Health Emergency of International Concern by WHO on the 1st of February 2016.³¹ It is an RNA flavivirus transmitted majorly by a bite from *Aedes* species of mosquitoes. *A. aegypti* which is well distributed in the tropical and subtropical region and *A. albopictus* which exists more in the temperate region.³² The Zika virus is neurotropic in that it is attracted to neural cells.³³ This explains how it destroys the growing fetal neural tissues causing a teratogenic effect of microcephaly. Microcephaly is defined as a head circumference that measures more than two standard deviations below the mean for age and sex.³⁴ It is a major cause of mental retardation, seizure disorder and developmental delay. Zika virus also causes meningo-encephalitis in adults. It is said to be the only virus that has teratogenic effect and this shows that mosquitoes can cause diseases with serious deleterious effects like monstrous babies.

Yellow Fever

Yellow fever is caused by a flavivirus. It is a zoonosis of monkeys that inhabit tropical rainforest in West and Central Africa and South and Central America. transmitted among humans in urban areas by *Aedes aegypti* by

mosquitoes living on tree tops *Aedes africanus* and *haemagogus* in Africa and America respectively.²⁰ It causes 200,000 to 300,000 death per year mainly in the Sub Saharan Africa. It has an incubation period of 3-6 days. Clinical features include high fever and rigors, backache, headache, bone pains, nausea and vomiting, jaundice, haemorrhagic diathesis, haemorrhages into the mucosa, gastrointestinal bleeding and oliguria. management involves fluid and electrolyte balance with fluids, monitoring urine output and blood pressure, Use of plasma expanders and blood transfusion may be necessary. Patients should be isolated and contacts should be quarantined.¹ Yellow fever has been incorporated into the Expanded programme on immunization for infants and persons entering or leaving an endemic area are required to possess a valid certificate of vaccination. The certificate is valid for 10 years after which the person is requested to be revaccinated.

CONCLUSION

Mosquitoes are important vectors of many communicable diseases. The diseases caused by the organisms they carry are major causes of morbidity and mortality. A lot has to be done in the area of mosquito control, prophylactic and prompt treatment of infection and reducing the complications of the infection caused by them.

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