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RETURN OF MALARIA

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Malaria has returned as a major scourge causing enormous loss to the economy of the people of India. Malaria was nearly controlled by DDT spraying in the early 1960s. Unfortunately malaria remained endemic and 9% of India's population was refractory to spraying. There were persistent transmission foci in the urban areas. While malaria was resurging, it was ignored and given low priority. This provided an opportunity for malaria to return with venegence and occupy new paradigms. By the 1970s malaria was noticed occupying areas at one time freed by the National Malaria Eradication Programme (NMEP). In 1976 epidemic situations returned with 6.5 million cases. In 1977 the eradication strategy was replaced by control under the modified plan of operation, prioritizing control objectives. In high risk areas spraying was re-started resulting in initial decline and incidence stabilizing at about 2 million cases. Forty per cent of these constitute *P. falciparum*, a dangerous parasite responsible for almost all deaths due to malaria. Seen in the background of changing malaria profile, return of malaria has its own characteristic features involving vector, parasite, host, and the environment; establishing new malaria paradigms. This is facilitated by control failures due to blunted control tools aided and abetted by poor understanding of the malaria transmission dynamics. Malaria control requires new approaches and targets, selective and sustainable vector control, strengthening of health delivery at the periphery, and rapid absorption of new technologies into the NMEP.

INSIDE

A flea can perform a long jump of 330.20 mm and high jump of 196.85 mm with the leg measuring 1.27 mm. Comparatively, a man with leg measuring 0.914 metres in length would be expected to clear 21.366 metres in a long jump and 13.616 in high jump. The leg of the flea contains a substance called resilin which enables it to perform the spectacular feat.

PYRETHROID IMPREGNATED BEDNETS AND CURTAINS FOR CONTROL OF MALARIA AND OTHER VECTOR-BORNE DISEASES

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The past two decades have seen the resurgence of malaria in many parts of the world, and for the foreseeable future eradication is no longer a practical objective. Indoor residual spraying with DDT, once the main plank of the global malaria eradication programme, is now very inefficient due to development of resistance by vectors, operational problems and increased public resistance to spraying operations. One of the most promising of several innovative alternative strategies developed in recent years is the use of pyrethroid-impregnated bednets and curtains.

Pyrethroids are a relatively new group of synthetic compounds based on the biologically active principles of the natural product, pyrethrum. They have the advantage of extremely low mammalian toxicity combined with high efficacy and persistence against insects. Unfortunately they are also extremely expensive. Deltamethrin for example, was several times more expensive than malathion, which itself cost 20 times more than DDT spraying. The use of impregnated nets is more acceptable and cost effective than indoor residual spraying.

Using bednets for personal protection is, of course, not a new idea. However, a bednet protects only the person sleeping under it, and simply diverts the mosquitoes to unprotected persons sleeping nearby. When holes develop in the net it ceases to be effective. In community trials with untreated nets reduction in malaria incidence could not be demonstrated. On the other hand, in similar trials using pyrethroid impregnated nets, drastic reductions in vector density as well as sporozoite rates were obtained. Malaria morbidity and parasitological indices were usually reduced. However, in some parts of Africa where transmission is holoendemic and sporozoite inoculation rates exceed saturation point for much of the year, morbidity could not be reduced, but there was a decline in intensity of parasitaemia and severity of the disease. Impregnated bednets have been used on a large scale in China, with an estimated 2.25 million nets - already owned by the householders - being treated each year since 1987 in Sichuan Province. Malaria transmitted by *Anopheles sinensis* and *An. anthrophagus* have been reduced to very low levels. In the Gambia a combination of net treatment and chemoprophylaxis reduced overall child mortality by 63%. The Gambian government has now incorporated bednet treatment into the Primary Health Care System. In Thailand pregnant women sleeping under treated bednets were significantly less anaemic than unprotected controls, although parasite rates did not differ.

Treated bednets cannot reduce transmission sufficiently to influence morbidity if the vector species bite outdoors in the early part of the night, as for example in Papua New Guinea, or if the human population sleep mainly outdoors. In India *An. culicifacies* sibling species C bites mainly in the first quarter of the night, and malaria may not be amenable to control by this method in areas where this species is dominant. But treated bednets have been very successful in controlling malaria transmitted by *An. minimus* in the Northeastern region, and against *fluviatilis* transmitted malaria in Koraput District, Orissa.

The promising results obtained against malaria vectors have led to the hope that similar protection can be obtained against vectors of filaria also. This method is well suited for community use, and indeed success depends on acceptability and cooperation, particularly by women, who have to ensure that the nets are used properly, and to decide at what intervals nets should be washed and when they need to be re-impregnated. Implementation will be easiest where bednets are already commonly used, as they are in the northeastern states. Introduction of nets may not pose a problem where the climate is cool, but proper compliance might not be obtained in hot and humid conditions. Better ventilation can be obtained by using wide-mesh netting, and it has been shown that mosquitoes acquire a lethal dose of insecticide passing through mesh with a diameter less than their wing span. The huts in tribal areas are often so small that nets cannot conveniently be tied in them, and have been known to catch fire as the inmates try to sleep as close to the fireplace as possible in cold weather. In these circumstances impregnated eaves' and doorway curtains may be a better approach to protecting sleepers. Impregnated curtains have been shown to be both effective and acceptable in Africa, although in comparative trials they were less efficacious than bednets.

Impregnated curtains can be made from cheap indigenous materials. In Madurai loose-weave hessian (jute) curtains were used, and an average of 8.5m^2 of material was required for a one-roomed hut (mean sprayable surface area 48 m^2). Impregnated with Deltamethrin at a target dose of 50mg a.i./m^2 the curtains gave excellent protection against *Culex quinquefasciatus* as well as anophelines for a period of 3 months. The curtains cost Rs.33 and the pyrethroid Rs.10 per hut, and since curtains can be re-impregnated many times, long-term economy can be expected. Preliminary results from village-scale trials of deltamethrin impregnated polypropylene curtains against culicine vectors of Japanese encephalitis have also been encouraging.

The large scale use of impregnated materials could result in selection for resistance to pyrethroids in vector population. However, tests carried out in China, where there has been widespread use of treated nets for nearly 10 years, showed that malaria vectors were still susceptible. Nevertheless it is necessary to develop strategies to delay or prevent the possible development of resistance, and studies are in progress to identify compounds which can be alternated with pyrethroids. Another possible approach might be to manage resistance by using synergysts like piperonyl butoxide. With proper planning and foresight, impregnated materials can contribute significantly to the control of vector borne diseases because of their social acceptability and long term cost-effectiveness.

ANNOUNCEMENT

The proceedings volume of the International Symposium on Vectors and Vector Borne Diseases held at Bhubaneswar in November, 1994 containing around 40 selected research papers (246 pages) is now available. Interested persons/ institutions (not life members) are requested to send Rs.550/- (inclusive of postal charges) by M.O. or bank draft drawn in favour of the "Treasurer, National Academy of Vector Borne Diseases" to Sri R.K. Hazra (Treasurer of the Academy), Regional Medical Research Centre, Bhubaneswar-751 016, India. Limited copies are available.

AN EMERGING TICK-BORNE ZOONOSIS : LYME BORRELIOSIS

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Ticks rank second only to mosquitoes as vectors of life threatening or debilitating human and animal diseases. The cost of worldwide economic losses and the additional burden of protecting livestock against ticks and tick-borne diseases is now estimated to be billions of dollars annually. Among the tick-borne diseases, Lyme borreliosis caused by *Borrelia burgdorferi,* is gaining importance particularly in North America and Europe with recent inclusion of some of the Asian countries e.g. Israel, Japan and China. From India too, it has been reported from a child in Shimla. It is a zoonotic disease and apart from human beings has been reported in dogs, horses and cattle. Rodents are the important reservoir hosts of this infection but sheep, dog, birds, cattle and cat may also act as reservoir hosts.

Organism is an irregularly coiled spirochaete and is the longest (10-40 μ) and the narrowest (0.2-0.3 μ) of the borreliae and has the fewest flagella (7-12) as compared to 15-30 in other species. It is gram negative and stains with Giemsa stain. The primary vectors of Lyme borreliosis are tiny hard bodied ticks of *Ixodes ricinus* complex including *I. persulcatus* (which has also been reported from India). Other tick species include : *Dermacenter* spp., *Haemaphysalis* spp. and *Rhipicephalus sanguineus.* Some blood sucking insects have also been incriminated in the transmission of *B. burgdorferi* which include mosquitoes, fleas, horseflies, deer flies. Transmission is generally transstadial but transovarian transmission has also been reported. The spirochaetes may be injected into the blood stream by the infected tick or may be placed directly in the skin of the host. The spirochaetes remain closer to their site of inoculation for several days and then via blood migrate to the nervous system.

In human beings the disease usually develops in three states, and the symptoms often resemble other known diseases. Stage I resembles influenza, stage 2 is similar to meningitis, while the stage 3 resembles rheumatic arthritis. Stage I starts mostly with the appearance of erythema migrans from 2-3 days upto 5 weeks after the tick bite and lasts for a few weeks. The rash is usually accompanied by marked fatigue, fever, headache, backpain and regional lymph adenopathy. Stage 2 occurs within weeks to months after the bite and may affect the heart and nervous systems. There may be paralysis of the muscles on one or other sides of the face. Other symptoms include encephalitis or meningitis. The cardiac symptoms include palpitation, dizziness or shortness of breath associated with irregular electrical impulses to the heart. Stage 3 is characterised by the symptoms typical for arthritis. The arthritic pains which affect mainly the knees and other large joints may last a few days and upto a few weeks, appearing and disappearing. Some patients may show chronic neurological syndromes.

A large percentage of domestic animals exposed to the causative agent, *B. burgdorferi,* are a symptomatically infected. Lameness and joint swelling are the predominant clinical signs include myocarditis, encephalitis, renal disease, abortion, lethargy and behaviour changes.

Diagnosis of Lyme borreliosis is based upon clinical findings, histopathology, supported by serology. Using Giemsa, silver or immunohistologic stains, spirochaetes have been detected in skin lesions, synovium, brain cardiac and skeletal muscles. Attempts to grow this organism from joint fluid, CSF, Cardiac and other tissues have been successful, and BSK medium is used for the growth. Serological tests include IFAT, ELISA and Western blotting. Presently PCR is the most sensitive and specific method which can detect even small quantities of *B. burgdorferi* DNA.

A broad spectrum of antibiotics have been found effective against *B. burgdorferi.* Penicillin as well as tetracyclines are effective in the initial stages. In last stages penicillin has to be administered intravenously. Other effective drugs include cephalosphorins. For children erythromycin may be used. In case of dogs an anti *B. burgdorferi* vaccine is available.

Keeping in view the occurrence of causative tick species in India, chances of the occurrence of this infection are too much. The physicians and veterinarians particularly those practising in hilly areas should pay more attention on this zoonosis.

The author has done his Doctorate on this disease recently from Germany.

NATURAL HISTORY OF LYMPHATIC FILARIASIS

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The natural history of lymphatic filarial infection and disease is most intriguing. Understanding these is important for development of appropriate community based control programmes and also the therapeutic principles for management of individual cases. In the last decade there has been several studies which have direct or indirect bearing on the natural history of this disease.

The studies carried out at the Vector Control Research Centre have showed the following : (a) The fecundic life span of *W. bancrofti* and *B. malayi* has been estimated, (b) Fresh insights have been made into the parasite dynamics both in human and vectors. For example studies on frequency distribution of underestimated and that density depend factors (such as immunity) play important role in parasite dynamics, (c) Study on filarial distribution has shown that while parasite carriers tend to cluster in families, clinical cases do not, (d) Application of mathematical models to study dynamics of infection and disease has shown that microfilaria carriers have a high risk of developing chronic disease when they become amicrofilaraemic, (e) The prevalence of infection in children below 10 years of age has been found to be related to their past exposure to infective vector bites, (f) There appears to be a relation between exposure to infection and development of lymphoedema but not hydrocele, (g) The analyses of relationship of acute and chronic disease have shown that frequency of acute episodic adenolymphangitis increases with progress of lymphoedema both in bancroftian and brugian disease.

Studies carried out elsewhere have shown that intrauterine exposure to antigens in maternal blood may have important bearing on infection status of offsprings later in life. Similarly, immune tolerance has been important for microfilaria carrier status and break in such tolerance is suspected to be important cause of development of disease.

INSECT HORMONES AND THEIR ROLE IN VECTOR MANAGEMENT

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Neurohormones, ecdysteroids and juvenile hormones (JHs) are three major classes of hormones found in insects. The JHs not only regulate the growth and metamorphosis from nymph to adult / larvae to pupae to adult in natural condition in insects but also after exogenous supply to larva and pupa before a certain period causes partial or complete inhibition of metamorphosis, manifested by partial or complete retention of the old epidermal structures, on the next instar. Through greater selectivity of action the JHs amongst the three groups of hormones, appear to play an important role in vector management since they are safe to man, livestock and environment.

During the past decades about 4000 synthetic analogues of juvenile hormones (Juvenoids) have been produced because of the possibility of using them as biorational agents. They are categorised into 7 different groups viz., cecropia hormone type; juvabione type; acyclic terpenes, acyclic terpenoids with heteroatoms in the chain; aromatic terpenoid ethers, thioethers and amines; peptidic JHa and non terpenic JHa.

The exogenous application of juvenoids to the insects causes a range of morphological anomalies such as larval-pupal intermediates, adultoids, supernumerary or extra larvae and secondary pupea, etc. They also derrange the cellular architecture like atrophy of the abdominal longitudinal muscles, karyorrhexis of the cells of the malpighian tubules and vacuolation in the supra oesophageal ganglion, ot the internal organs causing fatality to the insects. In addition, the juvenoids are also known to adversely affect the embryonic development, reproduction, diapause and sexual behaviour of the adults.

Amongst all, only a few juvenoids (hydeoprene, methoprene and fenoxycarb, etc.) have been registered for control of vectors like mosquitoes, fleas and cockroaches.

Recently a study in India has demonstrated that the efficacy of juvenile hormones extracted from aphids is comparable with the juvenoids like neporex, DPE28, OMS 3019 and OMS 3007 against three mosquito vectors. The study also illustrated that methoprene, OMS 3007 and OMS 3019 can also be used as ovicides besides as larvicides.

"It seems logical that if one asks money from anyone with which to do research, one has to tell what one wants to do with it. However, the situation is not like this simple because research means going out into the unknown with the hope of finding something new to bring home. If you know in advance what you are going to do, or even to find there, then it is not research at all: then it is a kind of honourable occupation. But this is exactly what such proposals are: an account of what one is going to do and expects to find".

Albert S. Gyorgyi (1971)

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(Regn. No.19767/199 of 1994-95 under Societies Registration Act XXI of 1860)

(Regional Medical Research Centre, Bhubaneswar - 751 016, India)

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