

Lymphatic Filariasis

Epidemiology

Egypt

Impact of the Egyptian control programme for elimination of filariasis on the indices of *Wuchereria bancrofti* transmission by mosquitoes

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Filaria endemic villages

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Abstract

Bancroftian filariasis is focally endemic in the Nile delta of Egypt where the vector mosquito, *Culex pipiens*, is extremely abundant, and most endemic villages are characterized by low rates and intensities of infection. The ultimate goal of the Lymphatic filariasis elimination programme is to reduce blood microfilaraemia to levels at which transmission by the vector mosquito cannot be sustained, thereby interrupting the cycle of the disease. Therefore, a study was carried out to evaluate the impact of the filariasis elimination programme on the indices of *Wuchereria bancrofti* transmission by mosquitoes.

A total of 34 microfilaraemic subjects were selected based on the results of a blood survey carried out 6 months before mass drug administration (MDA) of diethylcarbamazine/albendazole (DEC/ALB) in filaria-endemic villages. Venous and capillary blood samples were taken 11 months after the intake of the first annual dose of DEC/ALB, and 3, 6 and 9 months after having received the second annual dose of the drug regimen. Blood samples were stained and microscopically examined for the presence and number of microfilaria (MF).

Field-collected *Culex pipiens* larvae were reared to maturity and unfed females were exposed to selected volunteers, after which 20–30 blood-engorged females were dissected and examined for the presence and number of MF. To estimate the infectivity rate of mosquitoes, remaining females were maintained on a carbohydrate diet then dissected for the presence and number of infective *W. bancrofti* larvae (L3).

Results 93.3% and 96.7% of subjects had cleared their microfilaraemia, as determined by both membrane filtration and thick blood smear, respectively, 11 months after the second round of MDA. Median intensity of MF infection, decreased from 10 MF/ml and 3 MF/50 μ l to 4 MF/ml and zero MF/50 μ l, following two cycles of MDA.

Eleven months after the first round of MDA, overall rates of MF ingestion and development to infectivity in *Culex pipiens* were 2.4% (19/781) and 0.5% (14/2722), respectively. Nine months following the second round of MDA these numbers fell to 0.0% (n = 1310) and 0.01% (3/3337), respectively (P < 0.005).

Conclusion The transmission cycle of the filarial parasite by mosquitoes is seriously impaired by the administration of annual single doses of a combined regimen of DEC/ALB.

Background

Egypt is one of the first countries to implement a nationwide programme to eliminate lymphatic filariasis as a public health problem. The programme is based on 4–5 years of mass drug administration (MDA) of single doses of albendazole (ALB) (600 mg) in combination with diethylcarbamazine (DEC) (6 mg/kg). However, so far there is no information regarding the effects of such therapy on individuals with low-level microfilaraemia, and on the uptake and maturation of filarial parasites in vector mosquitoes.

Field studies implemented in other regions of the world indicate that low level microfilaraemia could initiate a resumption of transmission after very efficient control programmes where *Aedes* species are vectors [1]. Eradication of microfilaraemia has been achieved in areas of *Anopheles* transmission [1]. However, the situation in endemic areas where *Culex* species are vectors is less clear, and ought to be investigated.

Accordingly, a study was carried out to evaluate the effects of annual single doses of a combined regimen of diethylcarbamazine/albendazole (DEC/ALB), when administered to individuals with

Conclusions and implications of the study

■ This study clearly demonstrated that the administration of two rounds of DEC/ALB resulted in the clearance of microfilaraemia from more than 96% of the studied microfilaraemic subjects, and that mosquitoes failed to ingest microfilariae and develop the infective stage from these treated subjects.

■ The transmission cycle of the filarial parasite by mosquitoes is seriously impaired by the administration of annual single doses of a combined regimen of DEC/ALB.

■ It is recommended to sustain a high coverage rate of mass drug administration of combined DEC/ALB in order to eliminate lymphatic filariasis as a public health problem.

low-level microfilaraemia in lymphatic filariasis-endemic villages in Egypt, on the parameters of parasite transmission by *Culex pipiens*.

Materials and methods

A total of 34 microfilaraemic subjects were studied. These were selected based on records from a blood survey carried out 6 months before the Ministry of Health and Population initiated MDA of DEC/ALB in filaria-endemic villages. This group of subjects with low-level microfilaraemia represents a significant percentage (60%) of all microfilaraemic residents in endemic localities in Egypt. The criteria for their inclusion in the study were: low microfilaraemia level (1–74 MF/ml) before treatment, participation in the national lymphatic filariasis elimination programme (having received the first dose of treatment), and voluntary agreement to provide night blood and exposure to mosquito bites. Both venous and capillary blood was taken from selected individuals 11 months after they had received the first annual dose of DEC/ALB, and 3, 6 and 9 months after having received the second annual dose of the drug regimen. Volunteers were exposed to mosquitoes at the same time intervals.

Blood collection and processing Venous blood samples (2 ml) were collected in vacutainers between 22:00 and 24:00 from selected subjects within one week before volunteering for mosquito feeding. Samples were refrigerated overnight, after which blood samples were processed by filtration of 1 ml on nitrocellulose membranes, 5 µm pore size (Nuclepore, Pleasanton, CA, USA), then stained with Giemsa and microscopically examined for the presence and number of microfilaria (MF). Immediately before exposure to mosquitoes, a 50 µl finger-prick blood sample was thick-smear on a glass slide, methanol fixed and air-dried. Giemsa stained smears were examined for the presence and number of MF.

Mosquito feeding experiments Field-collected *Culex pipiens* larvae were reared to maturity in an indoor insectary at 27 °C and 70%–80% relative humidity. Emerging mosquitoes were maintained on a sugar diet until shortly before feeding. Starving females, 3–5 days old (approximately 200/cage), were transported to the field and exposed for 30 min to selected volunteers, between 22:00 and 24:00.

To estimate the rate of MF uptake by mosquitoes, 20–30 blood-engorged females were cold-killed immediately after blood feeding and their midgut dissected. Midgut content was smeared in a drop of saline solution and microscopically examined for the presence and number of MF. To estimate the infectivity rate of mosquitoes, the remaining females (about 100) were maintained on a carbohydrate diet for 12 days (the extrinsic incubation period of the parasite). Females surviving the extrinsic incubation period

were cold-killed and their body parts separately dissected (head, thorax and abdomen) for the presence and number of infective *W. bancrofti* larvae (L3).

Main study findings

Human microfilaraemia Of 34 cases selected for low-level microfilariae (1–74 MF/ml), 30 different subjects were available for examination at each time point. Of these, 93.3% and 96.7% had cleared their microfilaraemia, as determined by both membrane filtration and thick blood smear, respectively, 11 months after the second round of MDA. Median intensity of MF infection had decreased from 10 MF/ml and 3 MF/50 µl to 4 MF/ml and zero MF/50 µl, following two cycles of MDA.

Mosquito infection A total of 19 469 adult female mosquitoes were used in the study for assessment of rates of MF ingestion ($n = 4970$) and for measuring mosquito infectivity rates ($n = 14\ 499$) at determined intervals. Eleven months after the first round of MDA, overall rates of MF ingestion and development to infectivity were 2.4% (19/781) and 0.5% (14/2722), respectively. Nine months after the second round of MDA these numbers fell to 0.0% ($n = 1310$) and 0.01% (3/3337), respectively ($P < 0.005$).

Conclusions and recommendations

The transmission cycle of the filarial parasite by mosquitoes is seriously impaired by the administration of annual single doses of a combined regimen of DEC/ALB. It is recommended to sustain high MDA coverage rates to eliminate filariasis as a public health problem in Egypt.

References

[1] Southgate BA. The significance of low density microfilaraemia in the transmission of lymphatic filarial parasites. *Journal of Tropical Medicine and Hygiene*, 1992, 95(2):79–86.