

Periodicity of *W. bancrofti* microfilaraemia in Orissa, India

G. P. Chhotray, M. R. Ranjit and Anil Kumar

INTRODUCTION

Periodicity is a biological adaptation inherent in the microfilariae (mF). The microfilariae of most filarial species exhibit to some extent a circadian periodicity (Subramanyam, 1982). Orissa situated on the eastern coast of India is an endemic home for bancroftian lymphatic filariasis. The mF rate in this area was reported to be 15.8 per cent (Kar, 1986). In spite of high mF rate, there is no published report about the periodicity of microfilariae in this area. The present study is first of its kind to report on the mF periodicity in Orissa. The importance of mF periodicity has been envisaged from the public health point to correctly detect the mF carriers in a community and to establish the periodic form of the parasite. This would also help to understand the transmission dynamics of filarial disease.

MATERIALS AND METHODS

Twenty two human subjects, 7 from village Gangapada in Jatni block area and 15 from village Panchukera of Pipili block volunteered for the study. Both the villages are located 40 km apart in the Puri district of Orissa. In an earlier survey conducted by us just prior to the study in these villages the mF rate was found to be 8.0% and 17.4% for *W. bancrofti*, respectively. All the 22 subjects who volunteered for this study were detected to be positive for mF in their blood during the parasitological survey.

Blood samples (100 µl) were collected from these subjects from 10 A.M. to 10 A.M. of the next day. To determine the periodicity microfilariae (mF) levels were assessed by counting chamber method (Denham et al., 1971) at a regular interval of 3 hours over a 24 hours period.

The mathematical modelling developed by Aikat and Das (1977) using harmonic relationship between time (h) and mean mF

counts was used. The model is:

$$Y(h) = m + a \cos(h-k) \quad (1)$$

where 'k' is the peak hour, 'Y' is geometric mean and 'm' is 24 hours mean of mF counts when 'h' approaches zero.

This equation (1) is further expanded as

$$Y(h) = m + b \cos 15h + c \sin 15h \quad (2)$$

$$\text{where } b = a \cos 15k, c = a \sin 15k, \\ a^2 = b^2 + c^2 \text{ and } \tan 15k = c/b$$

The time 'h' was multiplied by 15 as 24 hours period was compared to 360 degrees in the model. Using least squares estimation procedures (Kenny and Keeping, 1951), the parameters m, b and c are estimated as follows:

$$m = 1/n \sum (Y), b = 2/n \sum (Y \cos 15h)$$

$$c = 2/n \sum (Y \sin 15h),$$

where 'n' being number of observation.

The slope 'a' in equation (1) has been tested for significance ($H_0: a = 0$) by using F-statistics as follows:

$$F = \frac{n/2 \cdot a^2}{1/(n-3) \{ \sum (Y^2) - (\sum Y)^2/n - n/2 \cdot a^2 \}}$$

at 2 and n-3 degrees of freedom

The periodicity index, PI, has been calculated as $PI = 100 \cdot a/m$ to ascertain the nature of periodicity. Some studies have shown (Aikat and Das, 1977) that if $a > m$, then PI should indicate the periodic form and if $a < m$, it should represent subperiodic or diurnal form of the parasite. Since, wide variation in mF count (0-140) were observed, the mF counts being 9-140 at peak time, the mF counts were treated as mF + 1 to compute the geometric mean and adjusted for 1 to represent the correct geometric mean.

RESULTS

The results are presented in table 1. It could be observed from table 1 that at 10 A.M., the beginning of the day, no microfilaria (mF) could be detected in any of the 22 subjects. But some of the subjects started showing mF

in the peripheral blood smear taken at 13 hours. At about mid night (22 to 01 hours), all the subjects did show mF in the blood, although mF counts were higher beyond 12 mid night and then declined. The estimated peak time (k) for microfilariae appearance has been ten minutes past 12 mid night in both the villages. The mF counts at peak time have been estimated as 12 and 20 in the two villages. The value of slope 'a' is found to be statistically significant ($p < .05$). The estimated periodicity index, PI in the two villages was high, about 148, suggesting the periodic form of the filarial parasite in these areas. The harmonic wave equation proposed above is in good agreement between observed and estimated mF counts ($p < 0.05$).

Table 1: Periodicity of mF appearance in two villages of undivided Puri district of Orissa

Time (h)	Village	Vilage	Both
	Gangapada	Panchukera	
	Mean Observed mF count		
10 hrs	0	0	0
13hrs	0.22	0.06	0.17
16 hrs	0.35	0.37	0.36
19 hrs	3.34	6.48	5.05
22 hrs	11.14	19.61	16.4
01 hr	16.93	24.45	21.7
04 hrs	5.17	12.70	9.6
07 hrs	1.65	1.37	1.45
Subjects (N)	7	15	22
Peak time k (hours)	0.17	0.18	0.18
*Mfc at peak time	12	20	17
Slope (a)	p < .01	p < .01	p < .01
Periodicity	147.8	147.8	147.8
Regression fit	Good	Good	Good

*Mfc - Mean microfilarial count

DISCUSSION

The study highlights important observation on the periodicity of microfilaria, *W. bancrofti*, appearance in the human blood. The *W. bancrofti* is largely responsible for filariasis in Orissa. The important observation is that the optimum time for blood collection should be around 12 mid night in this area. Similar findings were reported from Portblair, Andaman and some other parts of the world (Das et al.,

1987; Manson - Bahr and Bell, 1987; Mak and Dennis, 1985). The periodic index (PI), suggest periodic form of *W. bancrofti* in this area. However the subperiodic forms of *W. bancrofti* have been reported from Thailand where, PI = 50 and peak hour of appearance was at about 20 - 22 hours and in South Pacific, PI = 25 and peak was at 16 hours. The subperiodic form of *W. bancrofti* was not observed in these areas. However, it would be helpful to study this form of the parasite. This study would be of use for community filariasis control programme in detecting mF carriers.

ACKNOWLEDGMENTS

The authors are grateful to Dr. K. Satyanarayan, Director, RMRC, Bhubaneswar for his encouragement. The help rendered by Mr. B.N. Sethi, Mr. H.K. Khuntia and Mr B.K. Kanhar of this centre and the patients who co-operated voluntarily with us is thankfully acknowledged.

KEY WORDS Periodicity, *W. bancrofti*, Microfilariae.

ABSTRACT The periodicity of microfilariae of the filarial parasite, *W. bancrofti* was studied in 22 human volunteers in 2 filarial endemic villages of undivided Puri district of Orissa by using harmonic wave equation. The estimated peak hour of microfilariaemia was around 10 minutes past 12 midnight. The microfilaria counts (Mfc) at the peak time were found to be 12 and 20 in the two villages studied respectively. The nature of the parasite *W. bancrofti*, was found to be nocturnal periodicity in these areas where the mF rate was found to be 8.0% and 17.4%, respectively.

REFERENCES

- Aikat, T.K. and Das, M.: A modified statistical method for analysis of periodicity of microfilariae. *Indian J. Med. Res.*, 65: 58-64 (1977).
- Das, M.: Filariasis in Andaman and Nicobar Islands. Part II - Periodicity of microfilariae of *W. bancrofti*, *J. Comm. Dis.*, 7: 251 (1975).
- Denham, D.A., Dennis, D.T. et al.: Comparison of counting chamber a thick smear methods of counting microfilariae. *Trans. R. Soc. Trop. Med. & Hyg.*, 65: 521-526 (1971).
- Kar, S. K.: Epidemiological study on lymphatic filariasis in endemic zones of Orissa. *J. Comm. Dis.*, 18: 312 (1986).
- Kenny, J.F. and Keeping, E. S.: *The Mathematics of Statistics, Part II*, D. Van Nostrand Company, New York (1951).
- Manson - Bahr, Bell D.R.: *Manson's Tropical Diseases*,

19th Edition, ELBS (1987).
Mark, N. J. W. and Denis, D. T. : *Epidemiology and Community Control Disease in Warm Climate Countries*,

Churchill livingstone, Edinberg, pp: 430-450(1985).
Subramanyam, D. : Filariasis is spreading. *Science Today*, April: 17-23(1982).

Authors' Address: G. P. Chhotray, M.R. Ranjit and Anil Kumar, Regional Medical Research Centre, (Indian Council of Medical Research), Chandrasekharpur, Bhubaneswar 751 016, Orissa, India. Fax: 0674 - 440974 E-Mail: immunol@dte.vsnl.net.in