Title	ケニア国コースト地区におけるビルハルツ住血吸虫症の疫学 : 流行地河川水中のセルカリア密度の日内変動及びセルカリオメトリーによるコントロール対策実施後の感染危険度の測定について
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Epidemiological Studies on *Schistosoma haematobium* Infection in Coastal Area of Kenya

— Diurnal fluctuation of cercarial density in natural water and measurement of the risk of infection after control by cercariometry —

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Abstract: Cercariometry was carried out at 2 major water contact sites in an endemic area of urinary schistosomiasis, before and after the introduction of control measures against the disease. The natural water was examined for the presence of cercariae by filtration technique at one hour interval during the daytime. Before the control measures performed, at one of the sites, 567 cercariae were detected in 90 liters of water examined and the pattern of cercarial density was found to be diurnal with the highest density at noon. Six months after the implementation of control measures with a combination of treatment with metrifonate and provision of piped water, 354 cercariae were recovered from 90 liters of water examined and the pattern was also diurnal. At the another site, on the other hand, only 2 cercariae were found in 180 liters of water sample before the control and no cercariae were detected after the introduction of control measures. Evaluation of the impact of control measures on the risk of contracting the infection was discussed.

Key words: Cercariometry, *Schistosoma haematobium*, Evaluation of control measures

INTRODUCTION

Since 1981, a research programme on epidemiology and control of urinary schistosomiasis has been carried out at Mwachinga village, Kwale, Kenya under the medical cooperation programme between Governments of Kenya and Japan. Urine examination, water contact study and snail survey done so far provided baseline data to understand the present situation of the disease and to evaluate the efficacy of control

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measures (Shimada *et al.*, in preparation). While cercariometry, detection and counting of schistosome cercariae in natural water, is of great value in epidemiology and evaluation of control measures of schistosomiasis as well (Jordan and Webbe, 1982). In a previous paper (Sato *et al.*, 1985), we reported the usefulness of the filtration technique of Prentice (1984) for counting cercariae in natural water in our study area.

In the present communication, we describe the diurnal fluctuation in cercarial density in natural water at two study sites and the results of the preliminaty study on the evaluation of control measures by using cercariometry.

MATERIALS AND METHODS

Sampling points:

At Mwachinga, our study area, we identified 30 human water contact sites along the two main rivers, namely Kadingo which flows from west to the east, and Marere which flows from southwest to the north. In the present study, only two water contact sites, site 6 on Marere river and site 19 on Kadingo river, were chosen according to the results of water contact study. The water of the two sites is used for daily life of the inhabitants of the village. The human water contact activities which take place at these sites include bathing, swimming, washing, drawing water and watering livestock. (Shimada *et al.*, in preparation)

Cercariometry:

Filtration method was used in order to measure cercarial density in natural water. The apparatus used in this study was a slight modification of Prentice (1984) and previously described in detail by Sato *et al.* (1985). Cercariometrty was performed in November, 1983 (dry season), before the introduction of the control measures and Auguest, 1984 (end of rainy seasen), after the implementation of the control measures. Ten to twenty liters of water were examined every one hour interval for eight hours during the daytime in each examination.

Control measures implemented in the study area:

The control of the disease was started in February, 1984 with a combination of treatment with metrifonate and supply of piped water (Sato *et al.*, in preparation).

RESULTS

The results of cercariometry are shown in Table 1. Before the introduction of control measures (November, 1983), at site 6 where water was running, few cercariae were detected only in the samples of water collected at 1100 and 1200 hours. On the other hand, at site 19 where water was stagnant, many cercariae were recovered at any time during the day except 0900 hours, with the highest density at 1200 hours. Six months after the control was started (August, 1984), no cercariae were found at site 6,

Table 1. Results of cercariometry at Mwachinga

Sampling time	Density of cercariae (No. of cercariae/liter) November, 1983 Site 6	Site 19	August, 1984 Site 6	Site 19
0900	0	0	0	0
1000	0	0.7	0	0.8
1100	0.05	8.0	0	4.9
1200	0.05	17.0	0	6.2
1300	0	9.3	0	8.2
1400	0	4.3	0	7.4
1500	0	10.0	0	5.3
1600	0	3.9	0	2.2
1700	0	3.5	0	0.4
Total No. of forktailed cercariae recovered	2	567	0	354
Total volume of sample water examined (liters)	180	90	180	90

however, considerable number of cercariae were recovered at site 19 with the highest density at 1300 hours.

DISCUSSION

Since only *S. haematobium* adult worms were recovered from the sentinel hamsters which were immersed at the infested water at site 19 in our study area,. therefore, we will consider the cercariae detected in the present study to be of *S. haematobium* species, however, further study for verification will be necessary.

There are some reports which dealt with the diurnal fluctuation of cercarial density in natural water and/or in laboratory condition. Rowan (1958) reported that the density of *S. mansoni* cercariae in Puerto Rican water showed a diurnal pattern with the highest density at noon in streams, or at 1600 hours in ponds. EL-Gindy and Radhaway (1965) and Nojima and Sato (1978) revealed that the emergence of *S. haematobium* cercariae from infected snails was diurnal in the laboratory condition. More recently, Kloos et al. (1982) reported that the highest density of *S. haematobium* cercariae in natural water was observed between 0700 and 0900 hours in River Nile and the related canals and ditches in Egypt, although the number of cercariae obtained seemed to be very few to determine the peak hour of the highest density. In the present study, we clarified that the density of *S. haematobium* cercariae showed a diurnal pattern with the highest density around noon in the field condition. Our results suggest that there is much risk of infection around noon, and the inhabitants would reduce their exposure to cercariae if they come to the water contact sites in early morning or late evening.

In our study area, the control of the disease was started with a combination of treatment with metrifonate and provision of piped water on February, 1984. The treatment with metrifonate could reduce the prevalence slightly, but it reduced remarkably the intensity of infection from 53.0 eggs/hour to 9.0 eggs/hour (Sato *et al.*, in preparation). And the anual infection rate of snails also decreased after the control, from 13.1% in 1983 to 3.5% in 1984 (Noda *et al.*, in preparation). The present paper, however, showed the fact that many cercariae were recovered 6 months after the control at site 19. These facts suggest that there is still much risk of infection at site 19 and more accurate judgement on the reduction of risk of infection can be done by the cercariometry than by the urine examination and the snail survey.

At site 6 we could recover only 2 cercariae in 180 liters of water sample before the control and no cercariae after the control. The reduction of cercarial density may not represent the effectivness of the control measures on the risk of infection, because the number of cercariae recovered was too low to determine the effect of the control. This result also raised the question that how much the risk of infection was involved at site 6. Prentice and Ouma (1984) reported that water which showed to contain cercariae by cercariometry was potentially infective. In a previous paper (Sato *et al.*, 1985), we reported that sentinel animals did not contracted the infection when they were immersed in the infested water in which cercarial density was as low as 0.025 per liter of water. More intensive study on cercariometry combined with animal immersion is needed to determine the least reliable quantity of water to be analysed before cercariometry is used as a mean to evaluate control measures of schistosomiasis.

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ケニア国コースト地区におけるビルハルツ住血吸虫症の疫学

―流行地河川水中のセルカリア密度の日内変動及びセルカリオメトリーによるコントロール対策実施後の感染危険度の測定について―

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ビルハルツ住血吸虫症の流行地であるケニア国クワレ地区ムワチンガ村において，住民によく利用されている水系から，特に利用頻度の高い2ケ所（Site 6, Site 19）を選び，水中セルカリア密度の日内変動をセルカリオメトリーにより測定した．測定は，メトリフォネートによる集団治療と水道水供給とを組み合わせたコントロール対策実施の前後2回にわたって行なった．（1983年11月及び1984年8月）Site 19 では，コントロール対策実施前には，90リットルの水から合計567隻のセルカリアが検出され，水中のセルカリア密度は正午をピークとする日内変動を示した．コントロール対策実施後6ケ月経た時点でも，90リットルの水から354隻のセルカリアが回収され，水中セルカリア密度は13時をピークとする日内変動を示した．このことから，Site 19 では正午から午後1時にかけて感染の危険度が最も高く，早朝や夕方は低いことが考えられる．また，コントロール実施後でも、まだ感染の危険が相当残っていることが明らかとなった。

一方，Site 6 ではコントロール対策実施前に180リットルの水から2隻のセルカリアが検出されただけで，コントロール実施後には，セルカリアは回収されなかった。このようにもともとセルカリア密度の低い水系では，本実験で用いたセルカリオメトリーでコントロール対策が住血吸虫症の伝搬に及ぼす効果について評価することは困難と思われる．住血吸虫症コントロール対策が感染の危険度の減少に及ぼす効果を判定する際に，セルカリオメトリーを用いた場合の問題点について考察した．

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