Epidemiological Studies on *Schistosoma haematobium* Infection in Coastal Area, Kenya

—Cercarial Density at Water Contact Points and Identification of Species of Cercariae—

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Abstract: The cercarial density in natural water was measured at two major water contact points in Mwachinga, Kwale, an endemic area of *Schistosoma haematobium* infection, by using the filtration technique of Prentice (1984). In addition, the sentinel animals, male golden hamsters, were immersed in water for the identification of species of schistosomes. Only one cercaria was recovered from 40 litters of water sample at one site. Neither adult worm nor egg was recovered from 4 sentinel animals which were immersed there. At the other site, 231 cercariae were detected in 8 liters of water sample. A total of 31 adult worms, 20 males and 11 females, were recovered from 4 sentinel hamsters. The eggs from the livers of hamsters were identified to be *S. haematobium* based on their morphological features. The practicability of cerearіometry in detecting relative risk of infection in different water contact points was discussed.

Key words: *Schistosoma haematobium*, Cercariometry, Sentinel rodents

INTRODUCTION

Since 1981, the intensive epidemiological studies on *Schistosoma haematobium* infection have been carried out at Mwachinga village, Kwale, in Kenya under the medical

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cooperation programme between the Governments of Kenya and Japan. Although urine examination, water contact study and snail survey done so far provided baseine data to understand the present situation of the disease (Shimada *et al.*, in preparation), it has been highly desirable to determine directly the risk of infection. At present, cercariometry and exposure of sentinel rodents to the water are the practical techniques to achieve the purpose.

Cercariometry is the method of detecting and counting schistosome cercariae in natural water. Various methods have been developed, including filtration (Rowan, 1957, 1958; Sandt, 1973), phototropism (Klock, 1961) and overlay technique (Sandt, 1972). However, these methods have some disadvantages such as the necessity of power source or unreliability in turbid waters. Recently, Prentice (1984) introduced an improved filtration technique which is applicable for the field use and can be repeated as often as required. His technique encouraged us to investigate the density of cercariae at water contact points in our study area. To elucidate the species and infectivity of cercariae, animal exposure was also used in the present study.

MATERIALS AND METHODS

Filtration

The filtration apparatus used in this study was a slight modification of Prentice (1984). Steel mesh of 1 mm pore size was used as a pre-filter and nylon plankton net with a pore size of 30μm was used as a recovery filter. Water was bailed at noon at the selected water contact points and poured through the pre-filter into a bucket to remove larger debris and other obstacles. Formalin was added to water samples to give a final concentration of 0.2% in order to kill and fix cercariae, if any. Then, the samples were poured into the receiver of the apparatus and filtrated. The recovery filter was removed carefully and kept in a sealed vinyl bag containing 3 ml of 0.01% solution of Light Green in 2% acetic acid. The filter was examined for ceracariae under a stereoscopic microscope at 16 X magnification.

Animal exposure

Golden hamsters which had been maintained at National Public Health Laboratory Services, Ministry of Health, Kenya were used in this study. Eight male hamsters, 8 weeks old, were kept individualy in a floating wide-mesh wire cage and immersed in natural waters for one hour immediately after water was bailed for cercariometry. The animals were sacrificed and examined for adult worms by perfusion 3 months after the exposure to water. The livers and intestines of the animals were squashed between glass plates and examined for schistosome eggs under the microscope.

Sampling sites At Mwachinga, the study area of our project, human water contact points are mainly from two rivers, namely Kadingo which flows from west to the east, and Marere which flows from southwest to the north. Water contact studies have been

carried out at 16 sites of water contact points in the village (Shimada *et al.*, in preparation). The present study was performed in November, 1983 at two sites, site 19 on Kadingo river, which is located at the center of the village and site 6 on Marere river, which lies in the southern part of the village.

RESULTS

At site 6, 10 liters of water sample passed easily through a single filter. However, at site 19 only 4 liters of sample could be filtrated with a single filter owing to its turbidity. The results are shown in Table 1. All of the recovered cercariae were bifurcated—

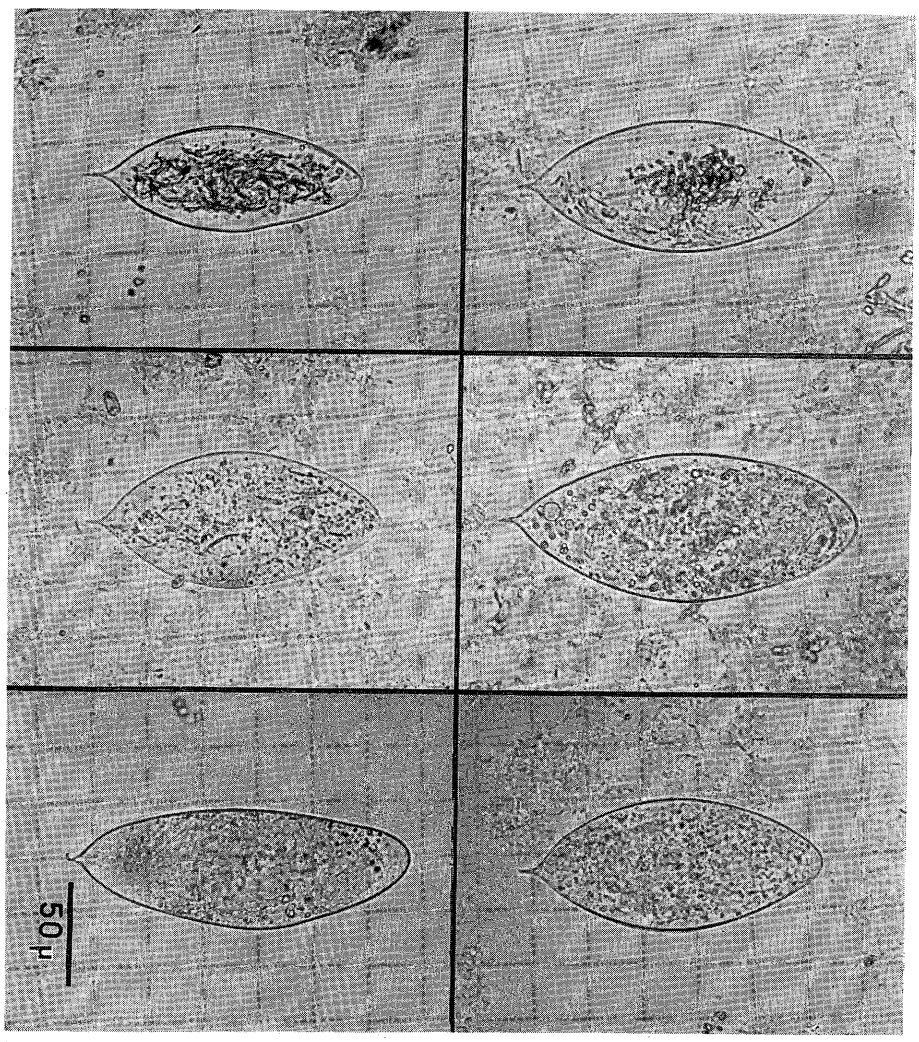

Fig. 1. Eggs observed in the livers of hamsters immersed at site 19.

tail cercariae.

Results of animal exposure are given in Table 2. All hamsters immersed at site 19 were found to be infected with schistosome. From those hamsters, 20 male and 11 female worms were recovered. Numerous eggs with a terminal spine were detected in the livers of these hamsters (Fig. 1). The averge size of the eggs was 146±13.2 μm in length and 61±9.2 μm in width (n=26). Our value is cose to those of *S. haematobium* eggs reported by Pitchford (1965). No eggs were found in the livers and intestines of the animals immersed at site 6.

Table 1. Results of cercariometry done at Mwachinga, Kwale

Sampling site	Volume of sample examined(liter)	No. of cercariae detected	Densityof cercariae (No. of cercariae/liter)
Site 19(Kadingo)	8	213	26.6
Site 6 (Marere)	40	1	0.025

Table 2. Results of animal exposure done at Mwachinga, Kwale

Water contact point	Hamster No.	No. of adult worms recovered Male	Female	Total
Site 19 (Kadingo)	1	3	2	5
	2	10	6	16
	3	4	1	5
	4	3	2	5
	Total	20	11	31
Site 6 (Marere)	1	0	0	0
	2	0	0	0
	3	0	0	0
	4	0	0	0
	Total	0	0	0

DISCUSSION

In most of epidemiological studies, "number of infected snail" and/or "percentage cercarial infection rate" have been used as an index of the risk of infection. These snail survey data, however, may be misleading, because the population and distribution of cercariae emerged from the infected snails in the natural water vary with several factors, such as water current, time of day, etc.. The increased attention, therefore, has been focused on a direct measure of cercarial density at water contact point.

There are some reports which dealt with the cercarial density in natural water in endemic areas of schistosomiasis. The number of cercariae per liter of water in previous reports are 0.01−144.20 in St. Lucia (Sandt, 1973), 0.05−21 in St. Lucia (Upatham,

1976), 0.05−35.67 in Puerto Rico (Rowan, 1958), 0.13−1.48 in Egypt (Kloss et al., 1982) and 0.016−4244 in Machacos, Kenya (Prentice and Ouma,1984) showing the wide variation of density in each endemic area. The corresponding value in our study was 0.025 at site 6 and 26.6 at site 19. The cercarial densities in natural waters are likely to vary widely from site to site even in our study area. The difference of snail density and/or the difference of the water flow are the preferable explanations of the considerable difference in the density of cercariae and in the worm recovery from hamsters between the two sites in our study area.

A cercariometry was combined with an animal exposure to determine the species and infectivity of cercariae. All of the eggs recovered from hamsters were identified to be *S. haematobium* based on their morphological feature and all of the worms were supposed to be *S. haematobium* (Pitchford, 1965). There is less possibility of inhabitation of any other mammalian schistosome such as *S. bovis* in our study area.

Prentice and Ouma (1984) reported that water which was shown to contain cercariae by cercariometry was potentially infective. In our study, at site 6, where cercarial density was 0.025 per liter, sentinel animals did not get infection with schistosome, while both sexes of adult worms were recovered from all of animals exposed at site 19. Although the number of experiment is limitted, these results indicate that cercariometry is a reliabe technology to determine the risk of infection. In our study area, the potential risk of infection was much higher at site 19 than at site 6. It is highly recommended to apply a cercariometry to determine the real risk of infested water, though cercariometry is too laborious to carry out frequently at many water contact points.

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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
一流行地の河川水におけるセルカリア密度測定とその種の同定について一

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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，水中のセルカリア密度を，Prentice（1984）の方法を用いて測定した。さらにセルカリアの種を同定するために，4匹ずつの未感染ハムスターを調査地の水に暴露し，約3カ月後剖検して住血吸虫の感染の有無について調べた．Site 6 では，40l の水からわずかに1隻の セルカリア が回収されただけで，4匹のハムスターには，いずれも住血吸虫の感染は見られなかった．これに対して，Site 19 では 8l の水から231隻のセルカリアが検出され，また4匹のハムスターからも，合計31個体の住血吸虫成虫（雄20，雌11）が回収された．これらのハムスターの肝臓には多数の住血吸虫卵が見い出され，形態学的特徴からビルハルツ住血吸虫のものと同定された．住血吸虫症流行地のいろいろな水系の水の危険度を測定する際のセルカリオメトリーの有用性について考察した．

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