Original article

The cercarial emergence rhythm of *schistosoma mansoni* in Ethiopia

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Abstract: The cercarial emergence rhythm of *Schistosoma mansoni* from *Biomphalaria pfeifferi* of Ethiopia origin was studied in irrigation canals in Metehara Sugar Estate in December (1992), January and February (1993). Snails were allowed to shed cercariae individually in vials containing 2 ml of aged water and exposed to natural light between 800 hr and 1500 hr. In addition, batches of five swiss albino mice (Mus musculus) were exposed to canal water for an hour each between 800 hr and 1500 hr. The results indicate that peak cercarial emergence was between 900 hr and 1000 hr, while peak cercarial infectivity in mice was between and 1100 hr and 1200 hr. However, both cercarial emergence and infectivity in mice continued up to 1500 hr. These findings indicate that canal water can be used with less risk of schistosomiasis at least after 1500 hr, provided proper health education is given to the community.[*Ethiop. J. Health Dev.* 199-;0(0):0000]

Introduction

Studies concerned with the cercarial shedding of human schistosomes have shown the circadial nature of the shedding pattern and have demonstrated maximum emission during the illuminated period of the lifecycle. However, in the case of *Schistosoma mansoni*, comparison between a number of studies has highlighted several variations in the time of peak shedding during the photophase: between 1000 hr and 1200 hr (1); 1100 and 1300 hr (2,3); 1300 hr and 1400 hr (4); 1200 hr and 1600 hr (5).

In Ethiopia, although schistosomiasis is one of the most important parasitic diseases affecting millions of people (6), neither the cercarial emission pattern nor the number of cercariae shed per snail per day is known. However, such information is of paramount importance in epidemiological studies because schistosomiasis transmission depends on the number of cercariae at transmission sites. Hence, to look into the possibility of using canal water without the risk of schistosomiasis, periodic cercarial emergence from *Biomphalaria pfeifferi* hence their infectivity in mice were studied in canals in Matehara Sugar Estate.

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Methods

Study Site

The study was conducted in Metehara Sugar Estate which is located at about 200 km east of Addis Ababa on Assab road. The Matehara Sugar Estate was established in 1966 for the development of irrigation-based sugar cane. Metehara Sugar Estate is one of the most schistosomiasis-affected water development schemes in Ethiopia.

Cercarial Emergence

In order to determine periodic cercarial emergence, 5 positive *Biomphalaria pfeifferi*, ranging in size from 7.5mm to 10mm were allowed to shed cercariae individually in vials containing 2mm snail water by exposing them to natural light for 8 hours between 800hr and 1500hr. Cercariae emmited by each snail every hour were transferred from the vials to petridishes and diluted in a known volume of snail water and the suspension was mixed well and 1ml of the suspension was transferred to a counting chamber and counted under a dissecting microscope using fine-tipped pasteur pipette. The total cercarial output per snail per hour was determined by multiplying the number of cercariae in 1 ml of aged water by the total volume (12ml). The average of the cercarial output of the five snails was taken as cercarial output per snail per hour. The experiment was carried out for three consecutive days to accommodate in variation in daily cercarial production each time in December (1992), January and February (1993).

Mouse Immersion

In addition to direct counting of cercariae by the above method, a batch of 5 swiss albine mice (Mus musculus) was exposed to canal water at the selected site for an hour each between 800hr and 1500hr to determine periodic infectivity of cercariae (transmission pattern). The mice were sacrificed and worms perfused between 6 and 8 weeks post exposure using the method of DuVall and DeWitt (12).

Statistical Analysis

Analysis of variance (ANOVA) was used to test if there was any significant variation in the periodic cercarial emergence, and rank correlation analysis was used to test the relationship between periodic cercarial infectivity in mice and the number of worm load in the infected mice.

Results

Results of cercarial infestation measurements indicate that cercarial emergence commences earlier than 800hr, and reaches peak between 900hr and 1000hr, which is followed by gradual decline up to 1500hr. The maximum cercariae produced by a single snail per day was 1963 and the minimum was 740 cercarae per snail per day showing a significant variation in the cercarial emergence per snail per hour as well as between days ($P<0.005$). The results also show that the time of peak cercarial emergence did not coincide with that of cercarial infectivity in mice. Peak cercarial emergence was between 900hr and 1000hr while peak cercarial infectivity in mice was between 1100hr and 1200 hr (fig. 1), indicating at least an hour gap between peak cercarial emission per snail per day and peak cercarial infectivity in mice. However, there was no significant variation in the periodic infectivity of mice. Cercariae remain infective between 900hr and 1500hr. Worm load ranged from 1 to 11 worms per mouse, and the average worm load was 5 worms per mouse, although some worms could be lost during perfusion. There was a positive correlation between the number of positive mice and total worm load ($r=0.86$), but negative correlation between periodic cercarial infectivity and worm load per infected mouse ($r=-0.54$).

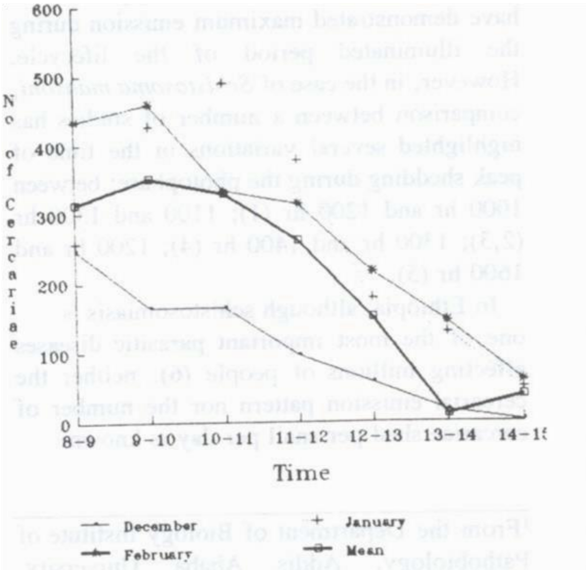

Figure 1: **Mean periodic cercarial emergence per snail/hour**

Discussion

A key question in research on schistosomiasis and control of the disease is to identify active transmission sites (14). Moreover, the number of cercariae entering human skin and the cercarial shedding patterns of snails is of great epidemiologic significance as these will determine the number of worms developing in the definitive host and subsequent disease (15). Such information is of paramount importance in designing preventive measures, particularly through health education.

In Ethiopia, no information is available on the number of cercariae emitted per snail per day as well as the cercarial shedding patterns. All studies carried out to determine cercarial shadding patterns of human schistosomes have shown the circadial nature of the shedding pattern (13). However, comparisons between different studies indicate considerable variations in the time of peak shedding during the illumination period. According to different investigators, peak emission was found between 1000hr and 1200hr (1); 1100hr and 1300hr (2,3); 1300hr and 1400hr (4); 1200hr and 1600hr (5). In the present study which is the first of its type in Ethiopia, peak cercarial emergence per snail per hour was found to be between 900hr and 1000hr, while peak cercarial infectivity was between 1100hr and 1200hr. Although strict comparisons between the present study and that of earlier investigators is difficult to make because of differences in parasite - host combinations, the peak emission observed in the present study is the earliest type so far reported (1-5).

In the present study, the difference in time of peak cercarial emergence and infectivity in mice could be due to the presence of other transmission sites up the canal from where cercariae are swept downwards to increase the chances of mice to get infection together with the cercariae emitted from the site where mouse immersion was made. Cercariae could be infective after being swept very long distances (13).

The differences in the pattern of cercarial emergence have been described by Theron (15, 16), who attributes this rhythm to definitive host activity. In urban foci, where man maintains the parasite, cercarial rhythm is that of the early type. In sylvatic foci where rats are the main hosts, cercariae are shed in the late afternoon. Where man and rats are both present, the schistosomes have intermediate rhythm (15). Hence, from the present study one can easily assume that animal reservoirs play very little role in schistosomiasis transmission in Metehara. The fact that cercarial production continued and transmission took place upto 1500hr does not support the view that irrigation workers can be protected from schistosome infection by shifting the working hours, reported by Tameim et al (16) from Sudan. However, from the present study one can safely assume that canal water could be used with less risk of schistosomiasis infection after 1500hrs, at least, for domestic purposes, provided proper health education is given to the residents of the farm population. It is recommended that such a study be repeated in different ecological settings to give sound conclusions about periodic cercarial production and infectivity in Ethiopia.

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