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PRELIMINARY STUDIES ON THE BITING ACTIVITY AND TRANSMISSION OF *ONCHOCERCA VOLVULUS* BY *SIMULIUM NEAVEI* (DIPTERA: SIMULIIDAE) IN KASHOYA-KITOMI FOCUS, WESTERN UGANDA

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PRELIMINARY STUDIES ON THE BITING ACTIVITY AND TRANSMISSION OF *ONCHOCERCA VOLVULUS* BY *SIMULIUM NEAVEI* (DIPTERA: SIMULIIDAE) IN KASHOYA-KITOMI FOCUS, WESTERN UGANDA

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ABSTRACT

Objective: To determine the biting activity and onchocerciasis transmission in Kashoya-Kitomi focus, Western Uganda.

Design: Cross-sectional survey in randomly selected sites.

Setting: Three districts in Western Uganda.

Method: Crab trapping and examination for immature stages of *Simulium neavei* and full day human bait catches and dissections were conducted at three sites.

Results: A total of 338 crabs were caught and out of this 372 (95.9%) were positive with immature stages of *S. neavei* with mean *S. neavei* /crab of 6.9. High biting density of *S. neavei* was observed in the two sites in Kabarole and Mbarara districts whereas an extremely low density was observed at a site in Bushenyi. Diurnal biting pattern revealed two peaks in the morning (09:00-10:00 hours.) and in the late afternoon (14:00-15:00 hours.) with a mid-day lull. The infection/infective rates were 53.3/11.0%, 30.7% to 7.8% and 20.0/0% for sites in Mbarara, Kabarole and Bushenyi districts, respectively. Monthly biting rates/ Transmission potentials for Mbarara, Kabarole and Bushenyi districts were 6231/5437, 9244/2916 and 247/0.

Conclusion: There was high transmission of onchocerciasis observed in Kashoya-Kitomi focus despite the ongoing ivermectin treatment. The need for improved chemotherapeutic coverage and instituting other control measures may be necessary.

INTRODUCTION

The Kashoya-Kitomi focus is one of the foci in Western Uganda, that straddles Kabarole, Mbarara, and Bushenyi districts. Onchocerciasis is known to be endemic in the three districts but the level of transmission is not very much clearly known. In Kabarole district, high endemicity had been recorded in Kicece. These similar situations are also observed along the Nkurungu river and its tributary the Nyamuswiga, which drain through the plains directly to Lake George. The area is separated by a watershed from the Kakasi forest and this appears to be an isolated focus. On the Kitomi river, a main northern tributary of the Buhindagi, that separates the Kashoya-Kitomi and Kakasi forest reserves and forms the southern boundary of Kabarole district, high transmission was reported(1).

In Bushenyi district, onchocerciasis prevalence had been reported to range from 17% to 58% with communities most affected being those close to the Kashoya-Kitomi forest reserves. Similarly, in Mbarara district a higher prevalence of 40% to 70% has been recorded especially in Rukiri County, which overlaps the forest reserves according to figures from Christofel Blinden Mission (Wamugasho per.comm). Although ivermectin is a safe means of morbidity control of onchocerciasis, it probably does not reduce transmission

sufficiently to result in eradication of the parasite. In consequence, it will need to be given indefinitely(2). Along river Kitomi in Kabarole districts, transmission has been reported to be high(3). Given this scenario, there is need to assess the vector situation in Kashoya-Kitomi focus to allow consideration for some vector elimination/control measures that may be feasible to enhance the effect of ivermectin treatments. The present study reports the biting activity and transmission of onchocerciasis in this focus.

MATERIALS AND METHODS

Study area: The Kashoya-Kitomi focus is one of the largest onchocerciasis foci in western Uganda covering an area of 399 km². The focus is located within a large forest reserve and straddling the districts of Kabarole to the north Bushenyi to southwest and Mbarara to southeast (Figure 1). The terrain are steeply undulating and deeply dissected by the river systems of the Kyambura and Buhindagi, which drain westwards across the Rift valley into Kazinga channel and Lake George. Community based treatments with ivermectin was initiated in 1992 by Christofel Blinden Mission (CBM) in the districts of Bushenyi and Mbarara. In Kabarole district, treatment started slightly earlier in 1991 through the support of German Technical cooperation (GTZ). However, at the moment the African Programme for Onchocerciasis Control is one of the main partners supporting mass treatment with ivermectin in the three districts.

Crab trapping and examination: Crab trapping was conducted for one hour at sites where adult human bait captures were carried along river Kitomi, Rivers Kichwankeito and River Nyungu using locally made basket traps baited with meat(4). The crabs were examined for the immature stages of *S. neavei*. Crab infestation and mean *S. neavei* per crab for all stages were calculated.

Adult catches and dissections: An 11-hour human baited catches were conducted at three selected sites in Kyarwera (0° 08 706'S: 30° 21 051'E), Rwabatenga (0° 09 30' S: 30° 20 38'E) and Mburumaizi (0°15 020'S: 30° 21 050'E) in Kabarole, Mbarara and Bushenyi districts, respectively. This catch was to determine the hourly biting activity and the total number of flies that will bite a stationery person between the hours of 07:00-18:00. Two hired vector collectors made collections at alternate hours. Fresh flies were aged as nulliparous and parous by examination of the ovaries(5) and dissected individually in normal saline. Infection, infective rates and transmission indices were calculated as described by Davies and Crosskey(6).

RESULTS

The results of crab collection and examination at three sites on river Kitomi, river Kichwankeito and river Nyungu in Kabarole, Mbarara and Bushenyi districts, respectively are shown in Table 1. Out of the 388 crabs caught 372(95.9%) were infested with *S. neavei* immature stages with mean *S. neavei*/crab of 6.9. The highest infestation and mean *S. neavei*/crab was observed at a site on river Kitomi in Kabarole district. Adult catches revealed high vector biting density at Kyarwera and Rwabatenga sites in Kabarole and Mbarara districts, respectively whereas an extremely low density was observed at a site in Bushenyi district. Diurnal biting pattern revealed two peaks in the morning (09:00-10:00 hours) and in the late afternoon (14:00-15:00 hours) with a mid-day lull for all the sites.

Table 1

Crab catches and examination at three sites in Kashoya-Kitomi focus, Western Uganda

District	River	No. of Crabs			No. of		Mean (%) <i>S. neavei</i> /crab	Infestation %	
		Caught	+ve	-ve	Larvae	Pupae			Cases
Bushenyi	Nyungu	149	140	9	264	15	29	6.3	93.9
Kabarole	Kitomi	112	112	0	558	50	267	7.8	100
Mbarara	Kichwankeito	127	111	16	80	8	17	3.8	87.4
Total		338	372	25	902	73	313	6.9	95.9

+ve= Positive, -ne=Negative

Table 2

*Adult catches and dissections of *S. neavei* at three sites in Kashoya-Kitomi focus, Western Uganda*

District	Site	No. of flies		No. of Parous flies infected with				MBR	MTP(H)	L3/1000
		Caught	Parous	L1/L2/L3	L1/L2	L3 (AII)	L3H			
Mbarara	Rwabatenga	1005	385	206	177	59	42	6231	5437	872
Kabarole	Kyarwera	1491	485	149	123	38	31	9244	2916	315
Bushenyi	Mburumaizi	56	10	2	2	0	0	347	0	0
Total		2552	880	357	302	97	73	5274	2784	395

L1=First stage, L2= Second stage larva, L3= Third stage infective larva

L3 (AII)= L3 found in any part of the fly, L3H= Infected larvae from head of flies

MTP (H)= Monthly transmission potential calculated using infective larvae from head of flies

L3/1000= Ratio of L3 larvae/every 1000 parous flies

MBR= Monthly biting rate

Figure 1

Study sites in Kashoya-Kitomi focus in Western Uganda

Figure 2

Simulium neavei diurnal biting pattern in Kashoya-Kitomi focus in Western Uganda

The pattern observed in Mbarara did not synchronize with the other two sites (Figure 2). This basic pattern, however, was observed to be subject to some climatic variation. In cold weather the morning peak was suppressed and much smaller than the afternoon, and the mid-day lull was not clearly defined. It was noted that parity rates in the three sites were 38.3%, 32.5% and 17.9% for Mbarara, Kabarole and Bushenyi districts, respectively. The infection/infective rates in the flies were 53.3/11.0%, 30.7/7.8% and 20/0% for sites in Mbarara, Kabarole and Bushenyi districts, respectively. Calculated monthly biting rates/Transmission potentials for the same sites in Mbarara, Kabarole and Bushenyi districts were 6231/5437, 9244/2916 and 247/0, respectively (Table 2).

DISCUSSION

The most direct method of sampling anthropophilic haematophagous flies is by human-bait catches(7). This will give you the biting activity, vector density and the various transmission indices although due to lack of standardization in the method of catching blackflies it may be difficult to accurately compare catches. In the present study in Kashoya-Kitomi focus in western

Uganda, the diurnal biting activity observed seems to conform to that of *S. woodi*, *S. neavei* group in Usambara, Tanzania(8). However, these patterns may also be influenced by climatic factors, for instance, the activity pattern in Mbarara district was slightly different because catches were conducted during rainy season. Usually during cold weather the morning and afternoon peaks are affected with no clear mid-day lull. But in situations of intermediate temperatures, the peaks would be distinct and mid-day lulls more pronounced.

The unique low biting phenomena observed in Bushenyi district could be attributed to species differences inhabiting this locality. Environmental and climatic changes in recent years may have altered vector ecology in this locality possibly resulting in geographical variant of a polymorphic species. This can be observed from the fact that despite very heavy infestation of river crabs with *S. neavei* immature stages, very low biting rate was registered. Whether the immature stages of *S. neavei* currently found on the crabs constitute one species, and are human-biting and potential or actual vectors has to be determined. This may require wider sampling, ecological description and species characterization by a combination of methods, including cytogenetics and DNA analysis(9,10).

The preliminary data has also confirmed that there is high transmission of onchocerciasis in this focus especially in Kabarole and Mbarara districts inspite of the ongoing ivermectin treatment. This is further supported by the rather high monthly transmission potentials. The high infection rates and parasitic loads of larvae observed in flies is most likely an indication that persons with high microfilariae loads in their skin still exist in the community. Although there is evidence that large-scale distribution of ivermectin reduces transmission(11,12) it is unlikely that total interruption of transmission may occur, and treatment may need to be continued to sustain the control of the disease as a public health problem. Furthermore, limitations of ivermectin lie in the numbers of infected persons excluded from treatment for medical reasons(13) together with those who fail to comply (sometimes up to 40%)(14) and, in the absence of vector control/elimination, may maintain transmission in the community. In this focus, ivermectin has been distributed for the last nine years and the impact seems not to have appropriately covered most of the affected communities. This may cast some doubt whether treatment alone can achieve the goal of eliminating onchocerciasis during an envisage of 12 or 15 years. With the evidence of high transmission, the current treatment strategy has to be improved in the three districts in this focus to ensure high chemotherapeutic coverage. Another alternative is to initiate vector elimination in feasible areas like the Nyamuswiga Nkurungu system, which is believed to be isolated from the main Kashoya-Kitomi focus. This approach when instituted would supplement and rapidly reduce the high transmission in the focus.

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