

## Elimination of hook worm infection by using the method of continuous treatment.

Phisai Kraivichian\* Pirum Kamol-ratanakul\*\*  
Pisal Yingyourd\* Medhi Kulkumthorn\*  
Bodi Dhanamun\*\* Prasert Siththichareonchai\*

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*The prevalence of hookworm infection among 295 individuals from three villages in the Bothong district of Cholburi province was studied by stool examinations using both the Kato-Katz method and the polyethylene tube cultivation technique. Results revealed that the hookworm infection rate was 76.27 %. Six hundred milligrams of albendazole was given to all infected adults and adjusted dosage to children every two months for five consecutive times. Consequently, the hookworm infection rate decreased to 6.08 % after the last dose of such treatment. However, follow-up stool examinations of the same population 18 months later showed an increase in the number of hookworminfected cases to be 33.61%, about a 50% reduction compared with the pretreatment rate. Therefore, albendazole given in five consecutive dosages alone, without other preventive measures, could not eliminate hookworm infection in this endemic area.*

**Key words:** Elimination, Hook worm, Continuous treatment.

Reprint request : Kraivichian P, Department of Parasitology, Faculty of Medicine,  
Chulalongkorn University, Bangkok 10330 Thailand.

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\* Department of Parasitology, Faculty of Medicine, Chulalongkorn University.

\*\* Department of Preventive and Social Medicine, Faculty of Medicine, Chulalongkorn University.

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จากการตรวจอุจจาระโดยวิธี Kato Katz และทำการเพาะเลี้ยงโดยวิธี Polyethylene tube method จำนวนประชากร 295 คน จาก 3 หมู่บ้านของอำเภอปอทอง จังหวัดชลบุรี พบ Hook worm 76.27% โดยการให้ยาทุกๆ 2 เดือน ในประชากรที่ตรวจพบไข่พยาธิปากขอด้วยยา Albendazole 600 มิลลิกรัม (3 เม็ด) ในผู้ใหญ่และลดขนาดยาลงตามอายุเป็นจำนวน 5 ครั้ง ติดต่อกัน ผลปรากฏว่า infected rate ลดลงเรื่อยๆ ครั้งสุดท้ายตรวจพบเพียง 6.08% หลังจากนั้นอีกประมาณปีครึ่ง ได้ตรวจอุจจาระของประชากรในเขตดังกล่าว พบ infected rate เพิ่มขึ้นเป็น 33.61% ซึ่งลดกว่าเดิม กว่า 50% แสดงถึงวิธีกำจัดโรคพยาธิปากขอให้หมดไปด้วยการให้ยา 5 ครั้ง อาจจะไม่พอเพียง พร้อมทั้งต้องมีการแก้ไของค์ประกอบทางพฤติกรรมของประชากรที่เอื้ออำนวยในการเกิดโรคนี้อีกด้วย ถึงจะกำจัดโรคนี้ออกไปให้ได้

Parasitic diseases are common in Thailand. The prevalence of helminthic infestation in the Thai population is approximately 67.2%<sup>(1,2)</sup> (in 25 million cases). These diseases include hookworm infestation, ascariasis, trichuriasis, opisthorchiasis and taeniasis. Hookworm infection is found in all parts of Thailand, but especially in the Southern and Central parts. The prevalence is estimated to be 75% and 40% of such populations, respectively. Parasitic diseases cause illness and decreased work efficacy which will lead to economic loss in decreased agricultural and industrial production.

Thailand is an agricultural country. Because Thai people usually do not use shoes when they work in the fields, the infective stage of hookworm, namely skin penetration can easily occur. The promotion of wearing shoes during work is extremely difficult and is supported by an epidemiologic study which found that the prevalence of this disease was not decreased.<sup>(3)</sup> Various treatments to eliminate the adult worms have been used to control this disease.<sup>(4-6)</sup> In the past drugs for treatment of hookworm infection were not too effective because of the frequency of administration and side-effects. In lightly infected patients, a single dose of albendazole treatment is effective<sup>(7,8)</sup> and convenient. The spread of hookworm eggs could be prevented by this method alone or combined with other methods.

## Survey of Related Literature

Methods to control hookworm infection, recommended by the Minister of Public Health, are health education, latrine use and elimination of the source of diseases. A study of mebendazole treatment, giving a dosage of 300 mg two times per year, in primary school students from 1982-1991 found the prevalence rate decreased from 40.56%<sup>(9)</sup> to 27.4%. In the Southern part of Thailand where highly-prevalent, blanket mass treatment was performed, administering mebendazole 300 mg two times per year in children who were more than two years old. The results showed that the prevalence decreased from 75.94% in 1980 to 49.2 in 1991. The results from both these studies are still not satisfactory.

## Procedure

We studied three villages in Botong district of Chonburi province, with 316 patients selected and studied from March to June 1992. The Kato-Katz<sup>(10)</sup> technique and poly-ethylene tube<sup>(11)</sup> cultivation method were used to determine the prevalence and intensity of hookworm infection. An albendazole single dose of 600 mg (3 tablets) was prescribed to patients older than 15 years, 400 mg (2 tablets) to patients between 5-15 years, and 200 mg (1 tablet) to patients younger than 5 years. Treatment for hookworm infection was given five times every two months. After the fifth treatment stool examinations were performed 12 times at later periods of months and 18 months. (Table 1)

**Table 1.** Schedule of treatment and pre-or post-treatment examination.

Date	Treatment	Stool examination
April/90	-	1 Pre-treatment examination
	1 <sup>st</sup> treatment	
June/90	-	2 Post-treatment examination
	2 <sup>nd</sup> treatment	
August/90	-	3 Post-treatment examination
	3 <sup>rd</sup> treatment	
October/90	-	4 Post-treatment examination
	4 <sup>th</sup> treatment	
December/90	-	5 Post-treatment examination
	5 <sup>th</sup> treatment	
December/91	-	6 Post-treatment examination
June/92	-	7 Post-treatment examination

Patients whom no found hookworm eggs were found using the Kato-Katz method but in whom hookworm larvae by the polyethelene culture method had the severity determined by counting the larvae in the polyethelene tube per gram of stool as in the Kato-Katz method.

Patients who recovered from the hookworm infection no longer had eggs and larvae. The severity of the disease followed the Report of an Informal WHO/UNCEF Consultation.<sup>(12)</sup>

## Results

Stool collection boxes were distributed to 330 people from three villages and 234 students from Klaw-Yai School. 407 boxes were returned, 295 from villagers and 112 from students. Specimens were examined by the Kato-Katz modified thick smear and polyethylene tube method. (Table 2)

**Table 2.** Number and type of helminthic infection found by katz and cultivation.

Method/ (No.of exams)	Parasites	No.of cases (%)
Katz (407)	Trichuris trichiura	4 (0.98)
	Opisthorchis viverrini	8 (1.96)
	Echinostoma sp.	1 (0.25)
	Enterobius vermicularis	1 (0.25)
	Trichostrongylus sp.	1 (0.25)
	Hook worm	310 (76.16)*
Cultivation (220)	Necator americanus	168 (76.36)
	Ancylostoma sp.	13 (5.91)
	Strongyloides stercoralis	13 (5.91)

\* Multiple infection included.

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The subjects in this study were 0.2-66 years old (mean 21.91 years old) SD  $\pm$  16.98). Their weights ranged from 4.6-99.9 kgs (mean 35.5 kgs, SD  $\pm$  17.81 kgs). Before treatment, stools from 295 subjects were examined. The infective rate of hookworm was 76.27%. After treatment with albendazole every two months for five times, from 1<sup>st</sup> to 4<sup>th</sup> treatment, the infective rate decreased to 29.29, 6.45, 6.15 and 7.17%

respectively. However, 12 months after the last treatment, we found that the infective rate was 6.08% which was not much different from the 2<sup>nd</sup>-4<sup>th</sup> treatment. Moreover, 18 months after the last treatment the non-infective rate increased after the 1<sup>st</sup>-5<sup>th</sup> treatment, but decreased to 66.39% at 18 months after the 5<sup>th</sup> treatment. (Table 3)

**Table 3.** Effects of treatment on prevalence of hookworm infection in Bothong population.

Stool examination (date)	No.of examined	No.of infected	Infection rate %	non-infection rate %
Pre-treatment (April/90)	295	225	76.27	23.73
After 1 <sup>st</sup> treatment (June/90)	256	75	29.29	70.71
After 2 <sup>nd</sup> treatment (August/90)	217	14	6.45	93.55
After 3 <sup>rd</sup> treatment (October/90)	244	15	6.15	93.85
After 4 <sup>th</sup> treatment (December/90)	237	17	7.17	92.83
After 5 <sup>th</sup> treatment (December 91)	230	14	6.08	93.92
(June/92)	238	80	33.61	66.39

From the intensity of hookworm infection shown in Table 4, most of the subjects (90.2%) before treatment were found to have light infection 8%, moderate infection and 1.8% severe infection. After the treatment, the moderate infection rate decreased to 2.7%(2/75), but was

6.7%(1/15) after the 3<sup>rd</sup> treatment, but was 6.7% (1/15). At the end of the study, the number of patients who had moderate and severe infection was one patient each. An others were found to have only light infection.

**Table 4.** Effects of albendazole treatment on Intensity of Hookworm Infection (WHO) Criteria, Parasitic Disease Programme, May (1981) in Bothong population.

Stool examination	No. of infected	Eggs Per Gram (EPG)		
		<2000 (Light infection) Case (%)	2000-7000 (Moderate infection) Case (%)	>7000 (Heavy infection) Case (%)
Pre-treatment	225	203 (90.2)	18 (8)	4 (1.8)
After 1 <sup>st</sup> treatment (2 months)	75	73 (97.3)	2 (2.7)	0 (0)
After 2 <sup>nd</sup> treatment (2 months)	14	14 (100)	0 (0)	0 (0)
After 3 <sup>rd</sup> treatment (2 months)	15	14 (33.3)	1 (6.7)	0 (0)
After 4 <sup>th</sup> treatment (2 months)	17	17 (100)	0 (0)	0 (0)
After 5 <sup>th</sup> treatment (12 months)	14	14 (100)	0 (0)	0 (0)
After 5 <sup>th</sup> treatment (18 months)	80	78 (97.5)	1 (1.25)	1 (1.25)

From the results of the treatment shown in Table 5, the egg reduction rate ranged from 58.54 to 98.17%. The cure rate was between 50-90.3% (mean 73.2%). The study subjects showed that who were free from infection and cured, deve-

loped a new infection after the 1<sup>st</sup>-5<sup>th</sup> treatment in the numbers of 4, 8, 11, 11, 10 and 69, respectively. The incidence was 5.7, 4.4, 5.4, 4.8, 4.5 and 31.9, respectively.

**Table 5.** Effects of treatment on egg reduction rate, cure rate and incidence of infection in Bothong population.

Date	Range (EPG)	Egg reduction Rate %	Cure rate (%) (No.neg./ No.treated)	Incidence (%) (New positive/ Neg.)
April/90	23-12,880	-	-	-
June/90	23-4,255	86.51	69.1 (123/178)	5.7 (4/70)
August/90	23-1,610	96.05	90.3 (56/62)	4.4 (8/181)
October/90	23-4,715	98.17	83.3 (10/12)	5.4 (11/203)
December/90	23.414	93.81	50.0 (6/12)	4.8 (11/229)
December/91	23-138	58.54	63.6 (7/11)	4.5 (10/220)
June/92	23-10,189	0	-	31.9 (216)

The results of the treatment with albendazole single dose 200 mg in patients younger than 5 years old, 400 mg in patients aged between 5-15 years old and 600 mg in patients older than 15 years were not significantly different ( $p>0.05$ ). (Table 6)

**Table 6.** Effects of 200, 400 and 600 mg of albendazole on the cure rate after the first treatment.

Group dosage	Group age(year)	No.of positive	No.of negative	Cure rate % day 60
1 x 200	< 5	16	11	68.75
1 x 400	5-15	52	37	71.15
1 x 600	> 5	110	75	68.18

The side effects were a mild-recovering form of nausea and dizziness for short periods was found in two patients taking 600 mg of albendazole.

## Discussion

The prevalence of hookworm infection in this study, before treatment was 76.27%, with 90.2% of this population lightly infected. After the 1<sup>st</sup> treatment the cure rate was 69.1% (average 73.2%); this result is quite similar to the studies of Viranya *et al* 1982<sup>(4)</sup>, Ramalingam *et al*<sup>(5)</sup> and Nontasut *et al* 1989<sup>(15)</sup>, which had a cure rate between 50-75%. However, the cure rate was higher (89.5-96.7%) in the studies of Richard-Lenoble *et al.*(1982)<sup>(16)</sup>, Rossignol *et al* (1983)<sup>(17)</sup> and Sitthicharoenchai *et al* (1984)<sup>(18)</sup>. From our study comparing the dosage used in children and adults (200, 400 and 600 mg), the cure rate was not found to be different. Again the results are similar to the studies of, Viranya *et al* 1982<sup>(13)</sup>, Ramalingam *et al* 1983<sup>(14)</sup> and Halzer *et al* 1987, which used dosages of 600 and 800 mg.

The reason why the cure rate from our study was lower than other studies may be that we used different methods to evaluate the cure rate of the disease. In this study we used the Katz and cultivation techniques. Moreover, the duration we used to evaluate the results was 60 days after treatment which is longer than the duration used in other studies (which used 14,21,28 days after treatment). The longer duration would either decrease the cure rate or increase the prevalence rate because some patients were reinfected or had new infections. Table 5 shows the incidence was 4.4-5.7% after treatment. When we followed up 18 months after treatment, the incidence increased to 31.9%, which is different from the study of Somporn P. *et al*<sup>(20)</sup>, who found that the incidence was 71.3% after treatment for seven months. This difference could be due to the high intensity of hookworm infection in the population in the Southern part of Thailand.

In this study we used Kat-Katz and polyethylene-tube cultivation techniques for stool examinations because these two methods are economic and convenient. The Katz method is

used for the count of soil transmitted helminth eggs and is also easier and faster than the Stoll dilution egg count technique.<sup>(21)</sup> We used the Saso *et al* method to culture hookworm because it easily be used in the field work and because it was also economic. Because the culture method used more stools than the Harada-Mori method, the chance to found hookworm larvae was higher. We used the culture technique in addition to the Katz to confirm hook worm infection because this culture technique is more sensitive than the Katz one Nontasut *et al* 1987<sup>(15)</sup> reported that the culture technique had 88% sensitivity and 77.5% specificity. Kouniya and Kabayashi 1966<sup>(22)</sup> also that the culture technique was more sensitive than the Katz technique.

To eradicate the hookworm infection by treatment every two months for 5 times (Table 1), we found that the prevalence decreased from 76.27 to 6.08%. at 12 months after the treatment However, at 18 months after the treatment, the prevalence increased to 33.61% which was similar to the results of the first treatment (29.29%). In Table3. the intensity of infection was divided into three groups. In Table 4. at 12 months after treatment, the number of patients in all three groups decreased with only 14 patients found to have light infection. At 18 months after treatment only one patient was found in the moderate and severe groups. The other 78 patients had light infection. The study of Yogogawa *et al*<sup>(23)</sup> showed that after three treatments in the first year the prevalence increased to 80.4% which was similar to the prevalence before treatment. There are two reasons to explain this difference. First, the Southern part of Thailand has higher prevalence and intensity of hookworm infection.<sup>(24-26)</sup> Second, the efficacy of the treat-

ment to eradicate hookworm infection is not very high, So that it can reduce the intensity but not the prevalence.<sup>(15)</sup>

In this study we gave treatment five times for eight months only. For complete eradication and control of hookworm infection, we may have to give treatment every year, study the intensity, prevalence, and incidence continually and promote health education for people. In this study we found that the prevalence in the sample population was high but the intensity was low (light infection was more than 90%). The cure rate after the first treatment was 69.1% which was lower than others study which may have resulted from the poor control of the patients in taking medication. After two to five treatments, we could control the infection rate to be 6.08-7.17% and within one year the incidence was 4.4-5.7%. After 11/2 years, the prevalence increased to 33.61% and the incidence increased to 31.9%. Treatment five times per year can control the hookworm infection. If we repeated this treatment for two years the hookworm infection might be eradicated. The factors that influence the eradication of the hookworm infection are: the migration of people which induces new hookworm, the promotion of latrine use (in this study only 20% of the population used latrines) and improved health education for people.

## Conclusion

By using albendazole every two months to eradicate the hookworm infection, the prevalence decreased from 76.27% to 6.08% after the fifth treatment. Although the prevalence increased to 33.61% at one and a half years after treatment, this was still found to be 50% lower than the prevalence before treatment. From this



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study we can conclude that the treatment was beneficial in the control of hookworm and may be effective in eradicating the disease when combined with other behavioral factors such as latrine use and health education.

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