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Comparative Efficacy of various Interval Mass Treatment on *Ascaris lumbricoides* Infection in Korea

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INTRODUCTION

What we expect in mass chemotherapy against *Ascaris lumbricoides* infection is not only the temporary decrease of infection rate but also the gradual lowering of reinfection in a community. However, many authors have experienced the rapid return of reinfection rate up to the pre-treatment level after single chemotherapy even though they had tried with the most effective anthelmintic(Mackay *et al.*, 1979; Jancloes *et al.*, 1979). That phenomenon is now well interpreted as a result of rapid reinfection which is one of the epidemiological charateristics in *Ascaris lumbricoides* infection. Therefore, by repeating the mass chemotherapy, the reduction in total sum of fertilized egg production is expected as well as in the gradual decrease of reinfection.

In this respect, the interval between chemotherapies is of primary concern to those who are engaged in the control of ascariasis. Unfortunately, however, there have been many different reports in applying mass chemotherapy to the endemic population especially in regards to its frequency employed in a year.

In Korea, the control activity of *Ascaris* infection have been performed by 6-month interval mass chemotherapy on schoolchildren group. And much appreciable result was obtained, since the ova positive rate, 55.4% in 1969 dramatically dropped to 19.4% in 1978 (the Korean Association for Parasite Eradication, 1980). Morishita(1972) was of opinion that the interval should be variable according to infection rate of endemic area concerned. Komiya(1962) proposed 4-month interval mass chemotherapy where the infection rate was 50 ~60% in Japan. Cabrera *et al.*(1975) reported good results by 3-month interval where the infection rate was higher, 84.4% in the Philippines. Arfaa and Gharidian(1977) were disappointed by the single chemotherapy per anuum in central Iran(87~95% infection rate), and proposed 2-3 month interval mass chemotherapy.

Considering various opinions on the proper mass chemotherapy interval, it is necessary to have informations on the comparative effect of various interval mass chemotherapy on later infection of *Ascaris* in Korean environment.

This study was designed and undertaken to figure out the effect of various schemes of mass chemotherapy on the egg and worm positive rates and worm burden per population. It was expected that the result of this study would afford the sound background for the policy making on the mass chemotherapy interval.

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MATERIALS AND METHODS

1. Subjected population

Nine villages of Hwasung Gun, Kyunggi Do, Korea were selected for this study. Each village consisted of about 100~140 population of whole age and either sex. All of the inhabitants residing in each village were included in the list of mass treatment. New immigrants, if any, during the course of study were immediately registered and included in the next treatment.

2. Treatment of the inhabitant

Inhabitants in Group A were began to be treated in June 1977, and repeated until December 1978 bimonthly for 10 times. To the 6 villages in Group B, treatments were begun in April-September 1977 respectively in each month, and repeated biannually until April-September 1979 for 5 times. Inhabitants in Group C were treated firstly in April 1977, second time in April 1978(12-month interval), third time in January 1979(9-month interval). Then, the group C were treated every 4 months until May 1980 for 4 times.

All of the inhabitants in each village were tried to be subjected in every treatment. Inevitably, there have been some drop-outs, such as pregnant women, reluctant individuals and absentees. The drug used was pyrantel pamoate in dose of 10mg/kg throughout the study.

3. Evaluation of the efficacy of mass treatment

The efficacy of various schemes of interval mass treatment was evaluated by observing the transition pattern of endemicity revealed by both egg/worm positive rate and worm burdens per case.

As described by Seo *et* Chai(1980), examination for eggs and worms was performed after collection of whole-day stool specimens for 2 consecutive days from each case immediately after each treatment. Egg examination was done on one sample in each case by cellophane thick smear technique to the firstly passed specimen after treatment. In worm examination, the expelled worm(s) from each case was counted each time.

All of the villagers were included in each follow-up. The drop-outs in the former treatment were also included because they were few in number. The bias in efficacy evaluation was neglected.

RESULTS

The pre-treatment infection status with *A. lumbricoides* was 32.5~42.3% in egg positive rate and 33.8~46.2% in worm positive rate according to groups, as shown in Table 1-4. The difference between groups was not significant from the epidemiological point of view. The mean values of worm burden were much more variable according to groups, 1.6~4.2 per infected case and 0.61~1.42 per population.

Table 1 shows the result of repeated mass chemotherapy in Group A. Both the egg and worm positive rates at pre-treatment level, 37.8 and 38.7% were Lower after the first treatment. Egg positive cases in successive follow-up examinations were not over 6% until the 10th treatment. But the worm positive rate was up to 12.7% in December 1977 and 10.9% in June 1978, which was seasonal fluctuation in Korea (Seo *et al.*, 1979). Mean worm burden per infected case and per population were 1.6 and 0.16 respectively at pretreatment, by far decreased after treatment. Most of the reinfected cases had one worm throughout the follow-up period in this group.

In 4-month interval group, the egg and worm positive rates were 32.5 and 33.8% respectively at pre-treatment (Table 2). The egg positive rates were then Lower to the one third level at the second and third interval treatments;

Table 1. Infection status of *Ascaris lumbricoides* revealed by egg and worm examinations in 2-month interval treatment group*

Sequent. No. of treatment	Date	No. of population	No. treated	Egg examination		Worm examination			Mean No. of worm	
				No. examined	No. positive (%)	No. examined	No. positive (%)	Total No. collected	per infected	per population
1	Jun. 1977	134	113	90	34(37.8)	31	12(38.7)	19	1.6	0.61
2	Aug. 1977	136	107	87	2(2.3)	70	2(2.9)	2	1.0	0.03
3	Oct. 1977	135	101	85	1(1.2)	53	3(5.7)	3	1.0	0.06
4	Dec. 1977	138	101	91	1(1.1)	71	9(12.7)	10	1.1	0.14
5	Feb. 1978	133	102	72	0(0.0)	52	5(9.6)	6	1.2	0.11
6	Apr. 1978	123	92	68	2(2.9)	50	3(6.0)	3	1.0	0.06
7	Jun. 1978	120	88	49	3(6.1)	46	5(10.9)	5	1.0	0.11
8	Aug. 1978	120	92	—	—	—	—	—	—	—
9	Oct. 1978	120	92	—	—	—	—	—	—	—
10	Dec. 1978	120	95	61	3(4.9)	39	1 (2.6)	1	1.0	0.03
	Total	1,279	983	603	46	412	40	49		

* Identical group as Group C reported by Seo *et* Chai(1980)

** Drop-outs in the former treatment were included in efficacy evaluation of the scheme, because they were few in number in each follow-up.

Table 2. Infection status of *Ascaris lumbricoides* revealed by egg and worm examinations in 4-month interval treatment group

Sequent. No. of treatment	Date	No. of population	No. treated	Egg examination		Worm examination			Mean No. of worms	
				No. examined	No. positive (%)	No. examined	No. positive (%)	Total No. collected	per infected	per population
1	Jan. 1979*	242	208	120	39(32.5)	74	25(33.8)	105	4.2**	1.42
2	May 1979	240	202	106	9(8.5)	76	8(10.5)	49	5.1**	0.64
3	Sep. 1979	246	199	108	12(12.2)	60	8(13.3)	57	7.1**	0.95
4	Jan. 1980	238	194	94	2(2.1)	50	3(6.0)	3	1.0	0.06
5	May 1980	236	199	105	9(8.6)	75	7(9.3)	40	5.7**	0.53
	Total	1,202	1,002	533	71	335	51	254		

* Same as the third treatment in Table 4.

** High values were due to one highly risked family, whose worm burdens were unusually high, 7-34 per case.

i.e., 8.5 and 12.2% respectively. Further lowering was observed at the fourth treatment. The changing pattern of worm positive rates was similar with that of egg rates. There was a high risked family to *Ascaris* infection in this group. All of the family members were infected 7~34 worms in each follow-up. Therefore, the worm burden data fluctuated in each time.

In 6-month interval group, the pre-treatment egg and worm positive rates were 42.3 and 46.2% in average as presented in Table 3. Egg positive rate was decreased to 16.9 and 17.5% respectively at the first and second follow-up examinations. The rate was decreased further to 11.3% at the third follow-up and to 8.2% at the fourth. Worm positive rates decr-

Table 3. Infection status of *Ascaris lumbricoides* revealed by egg and worm examination in 6-month interval treatment group

Sequent. No. of treatment	Date	No. of population	No. treated	Egg examination		Worm examination			Mean No. of worm	
				No. examined	No. positive (%)	No. examined	No. positive (%)	Total No. collected	per infected	per population
1	Apr.-Sep. 1977	746	612	562	238(42.3)	370	171(46.2)	461	2.7	1.25
2	Oct.-Mar. 1978	740	599	531	90(16.9)	393	101(25.7)	157	1.6	0.40
3	Apr.-Sep. 1978	738	571	469	82(17.5)	291	57(19.6)	90	1.6	0.31
4	Oct.-Mar. 1979	735	598	522	59(11.3)	303	46(15.7)	70	1.5	0.23
5	Apr.-Sep. 1979	710	560	439	36(8.2)	302	36(11.9)	44	1.2	0.15
Total		3,669	2,940	2,523	505	1,659	411	822		

Table 4. Infection status of *Ascaris lumbricoides* revealed by egg and worm examination in 12-month interval treatment group

Sequent. No. of treatment	Date	No. of population	No. treated	Egg examination		Worm examination			Mean No. of worm	
				No. examined	No. positive (%)	No. examined	No. positive (%)	Total No. collected	per infected	per population
1	Apr. 1977	248	212	122	43(35.2)	79	29(36.7)	60	2.1	0.76
2	Apr. 1978	238	201	140	51(36.4)	91	35(38.5)	83	2.4	0.91
3	Jan. 1979	242	208	120	39(32.5)	74	25(33.8)	105	4.2	1.42
Total		728	621	382	133	244	89	248		

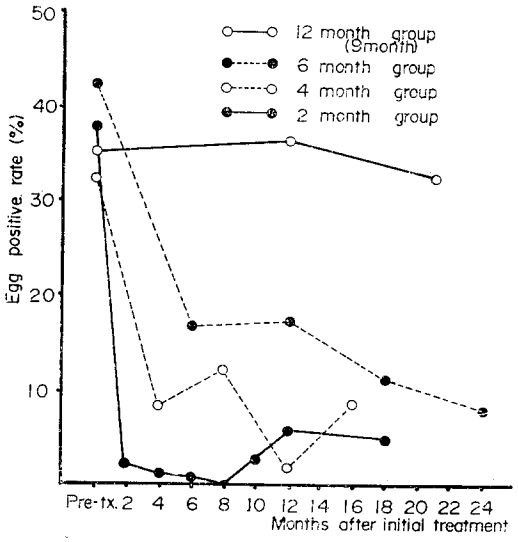

Fig. 1. Comparative efficacy of various interval mass chemotherapy revealed by egg positive rate.

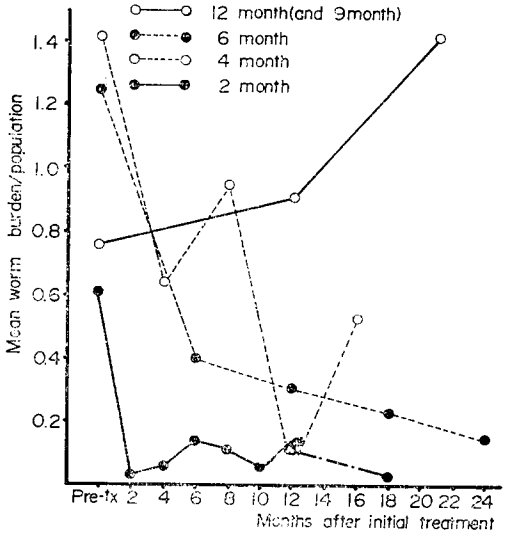

Fig. 2. Mean worm burden per population during the course of various interval mass treatment.

eased similarly with that of eggs. Mean value of worm burden per case was 2.7 at pre-treatment and decreased gradually to 1.2 at the last follow-up and the mean value of worm burden per population decreased similarly, from 1.25 to 0.15.

Table 4 shows the efficacy of mass chemotherapy by 12-month and 9-month intervals. All of the indices, egg and worm positive rates, and mean values of worm burden/infected and worm burden/population were changed little. The worms collected in January 1979 were even more than those of the first treatment.

The changing patterns of the egg positive rate are plotted in Fig. 1 by schemes of mass treatment. And Fig. 2 shows the same patterns of the index, worm burden/population in every scheme. These two figures present schematic idea on the effect of various interval mass therapy on two indices of *Ascaris* infection status. The shorter the interval between chemotherapies, the better the results in prevalence. From these figures it is inferred that the *Ascaris* reinfection increased proportionately with the lapse of time up to 1 year though there should be monthly differences in increasing rates.

DISCUSSION

Pyrantel pamoate was highly effective in treatment of *A. lumbricoides* infection in dose of 10mg/kg. Excellent results were reported both in egg negative conversion(=cure) and egg reduction rate(Desowitz *et al.*, 1970; Seo *et al.*, 1972). Immediately after each treatment, most of inhabitants have been almost free from infection. Therefore the prevalence rates obtained in consecutive follow-ups represent the accumulated incidences of reinfection of relevant interval between pyrantel treatments.

Although the people were treated, there have been persistent reinfection until the end of follow-up in all surveyed villages. The average monthly reinfection rate was calculated as 1.3~3.3% by egg positive rate and 2.4~3.6% by worm positive rate respectively in each group.

In 12-month interval group, the prevalence rate one year after the first mass chemotherapy was almost same as that of pre-treatment. In addition, the mean burden of worm did not decrease to any extent. This result was similar with that reported by Arfaa and Ghadirian (1977) in central Iran, though there was a significant difference of endemicity between their country and Korea. Egg positive rate and mean worm burden per infected case were 87~95% and 16.0~34.8 in Iran, comparing with 33~42% and 1.6~4.2 respectively in Korea. However, returning pattern of the prevalence rate to pre-treatment level showed exactly same. These results suggest that the prevalence rate of *Ascaris* in a community attain its equilibrium within a year in both countries.

In case of biannual, triannual and six-times-in-a-year schemes, the prevalence rates were almost proportionately decreased according to the length of interval between treatments.

In addition, during 2 years after the initial treatment, the rates showed the tendency of further lowering. The mean value of worm burden, especially per population also decreased by these schemes.

It takes time to control *Ascaris* infection when attempted only with chemotherapy. As Seo *et* Chai (1980) showed in their long-term 2-month interval mass chemotherapy on *Ascaris*, it took at least 30 months or 2 over-winterings to control reinfection in a small community in Korea. The longer the interval than 2 months is, it is expected that it takes longer period of time to control because more amount of fertilized egg production should be allowed.

As a measure of controlling *Ascaris* reinfection, 12-month interval seems by no means meaningful. Its only merit is temporary reduction of worm burden in a population. Unless the sanitary condition is improved in the relevant community this kind of control measure should be repeated endlessly without any lowering effect on overall prevalence rate. Present results

confirm the necessity of at least biannual mass chemotherapy as a control measure. The favourable results of more repetition do not necessarily mean that the agency responsible for control of ascariasis should select that kind of luxurious scheme in developing countries. The decision depends on their own social demand of control.

SUMMARY

To observe the effect of various interval mass treatment on *Ascaris* ova and worm positive rates and worm burden per population, 2-month, 4-month, 6-month and 12-month interval schemes were designed and applied. All of inhabitants in nine villages of Hwasung Gun, Kyunggi Do, Korea were treated from April 1977 to May 1980.

Each village consisted of 100~140 people, however, there had been 20~40 drop-outs in every treatment. Pyrantel pamoate was used in dose of 10mg/kg. Evaluation of schemes was made by examinations both for eggs and for expelled worms. The drop-outs in former treatment was included because they were few in number. The results obtained were summarized as follows:

1. The pre-treatment infection status of *A. lumbricoides* was not significantly different between Groups; 32.5—42.2% and 33.8—46.2% in egg and worm positive rates respectively. The mean worm burdens were in range, 1.6~4.2 per infected and 0.61~1.42 per population.

2. Twelve-month interval treatment was by no means meaningful to be adopted as a strategy of *Ascaris* control because egg and worm positive rates and mean worm burden were returned to pretreatment level.

3. The shorter the treatment interval was, the lower the egg/worm positive rates and worm burden were. By repeating biannual, triannual and six-times-in-a-year treatments, the indices of prevalence showed the tendency of further lowering during later 2 years of follow-up.

If the mass chemotherapy is adopted as a method of controlling ascariasis in a community, it should be repeated more than two times in a year to expect the gradual lowering of reinfection.

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=國文抄錄=

투약간격에 따른 회충 집단관리 효과의 비교

서울대학교 의과대학 기생충학교실 및 풍토병연구소
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회충의 집단관리를 화학요법으로 실시할 때 우리는 회충감염이 단지 일시적으로 저하하기만을 기대하는 것은 아니다. 그러나 회충감염에서는 빠른 재감염이 疫學的 특징이기 때문에 감염율이 일시적으로 저하한 다음에는 반드시 치료전 수준으로 되돌아 오게 마련이다. 따라서 장기적으로는 집단 투약을 반복함으로써 수정란의 배출을 억제하고 재감염 자체의 감소를 기대한다. 그러므로 회충관리를 위한 집단투약에서는 치료제의 유효성은 물론이지만 치료간격이 매우 중요한 요인이 될 것으로 생각되어 왔다. 그런데 이 문제에 대하여 명확한 대답을 할 수 있는 자료는 매우 부족한 상태이다. 이 연구는 우리나라 농촌부락민에게 2개월, 4개월, 6개월, 및 12개월 간격으로 집단투약을 실시하였을 때 충란 양성율과 감염충체수가 어떻게 변화하는가를 관찰할 목적으로 실시하였다.

1977년 4월부터 1980년 5월까지 3년동안 京畿道 華城郡 鄕南面의 9개 마을(주민수 100～140명)을 대상으로 하여 1개 마을에 대해서는 2개월 간격으로 10회, 6개 마을에 대해서는 6개월 간격으로 각각 5회, 나머지 2개 마을에 대해서는 12개월 및 9개월 간격으로 2회 치료하였다. 마지막의 2개 마을 주민에게는 그 후 다시 4개월 간격으로 5회의 치료를 실시하였다. 사용약제는 pyrantel pamoate이었고 사용량은 10mg/kg, 대상자는 모든 주민이었고 남녀 노소의 구별없이 투약하였다. 매번 투약때마다 20～40명의 탈락자가 각 마을에서 있었다. 검사는 매번 투약직후에 2일간의 전대변을 수집한 다음 충란 및 충체배출 여부를 검사하였고, 감염자에 있어서는 감염충체수를 관찰하여 각 투약군사이의 차이를 비교 검토하였다.

이 연구의 결과를 요약하면 다음과 같다.

1. 투약전 충란 및 충체양성율은 각 群別로 차이가 없었으며 각각 32.5～42.3% 및 33.8～46.2%의 범위에 있었다. 감염자의 평균 감염충체수는 1.6～4.2마리, 全 檢査者에 대해서는 평균 0.61～1.42마리의 범위에 있었다.

2. 12개월이나 9개월 간격으로 치료했을 때에는 치료전후의 충란양성율 및 감염충체수에 있어 차이가 없었다.

3. 충란양성율을 기초로 하여 관찰할 때 6개월 간격 치료는 치료전의 약 1/2 수준으로 4개월 간격 치료는 약 1/3수준으로 2개월 간격 치료는 약 1/4수준으로 저하시켰다. 충란양성율 및 평균 감염충체수는 집단치료가 반복됨에 따라 더욱 저하하는 경향을 보이고 있었다.

위의 결과를 종합하여 볼 때 회충 집단관리의 한 방법으로서 집단투약을 실시한다면 년 1회의 방법으로는 회충재감염의 저하를 기대하기는 어렵고 1년에 최소한 2회 이상 반복하여야 함을 지적하고 있다.

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