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Reduction in the incidence of biliary and other surgical complications of ascariasis according to the decrease of its national egg prevalence in Korea

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Abstract: While various examples of rationale or benefits of ascariasis control could justify a necessity of control activity in a community, few practical index other than the egg prevalence or intensity of infection has been used to evaluate the efficacy obtained by the control activity. A literature-based retrospective study was undertaken to provide some numerical data on the decreasing morbidity of surgical ascariasis as a consequence of ascariasis control in Korea. A thorough review of literatures (1959~1990) on biliary and other surgical complications of ascariasis reported from general hospitals revealed that their incidence has been decreasing very proportionally to the national figures of its egg prevalence and worm burden. For example, according to the remarkable decreases of the prevalence of ascariasis, there is an evident decreasing tendency of the proportion(%) of biliary ascariasis cases among all biliary surgical patients and the proportion of biliary ascariasis cases among all biliary stone patients in general hospitals. It is highly suggested that the Korean people have been much benefited by the control activity of ascariasis executed at a national scale since 1960s, especially in terms of incidence of biliary and other surgical complications of ascariasis.

Key words: *Ascaris lumbricoides*, surgical complications, biliary ascariasis, control, morbidity

INTRODUCTION

Ascaris lumbricoides, the roundworm, is even at present, recognized as the most prevalent human intestinal helminth in the world. The global number of people infected with *Ascaris* is estimated at 1,008 million which comprises about 22% of the whole population (Crompton, 1988). In Korea, however, the national status of *Ascaris* infection has been remarkably changed (Seo *et al.*, 1983; Seo and Chai, 1988). The egg positive rate, which was over 80% until the end of 1950s (Hunter *et al.*, 1949; Brooke *et al.*, 1956) and about 60% at the end of 1960s (Seo *et al.*, 1969), decreased steadily and remarkably to become 1% or lower in recent years. This dramatic decrease of ascariasis is considered greatly due to the national control activities, including mass chemotherapy, environmental sanitation, and health education, for the past 25 years (Seo and Chai, 1988).

Under this situation, it seems necessary to review what happened to us with the control of ascariasis. In other words, what kind of benefit we have obtained during the period of

ascariasis control? Despite this necessity, there have been no appropriate data to properly evaluate such benefits or effects. Examples for the benefits of ascariasis control in a community should include improvement of nutritional status and individual hygiene, prevention from other associable diseases, and reduction of morbidity and mortality due to migrating *Ascaris* larvae or adults. Among those examples, reduction of morbidity of surgical ascariasis, the data of which are easily accessible from the literature pool of general surgery, is strongly suggested to be a useful index of success in the control of ascariasis in Korea.

In order to verify this suggestion, we reviewed literatures on the incidence of biliary and other surgical complications of ascariasis reported during the past 30 years from general hospitals in Korea and analyzed the relationship between the incidence of surgical ascariasis and national egg positive rate of students or that of all population, reported by KAH (The Korea Association of Health) or MOHSA (Ministry of Health and Social Affairs) & KAH, respectively.

MATERIALS AND METHODS

In order to review the decreasing pattern of egg prevalence of *A. lumbricoides*, the data from biannual (during 1969~1988) or annual (after 1989) student-directed mass stool examinations (KAH, 1989) and those from quinquennial ones directed to randomly-sampled nationwide inhabitants (Ministry of Health and Social Affairs & KAH, 1971, 1976, 1981 & 1986), were subjected to analysis. The annual number of students examined was 6,551,926 in 1969, which was progressively increased up to 16,229,764 in 1981, and then decreased to 9,594,316 in 1989. The quinquennial examinations on the whole age population were performed on 24,887 subjects in 1971, 27,178 in 1976, 35,018 in 1981, and 43,590 in 1986. To understand the status before 1969, several local reports on the egg prevalence of Koreans were briefly referred.

So as to provide some supplementary data on the decrease of endemicity of ascariasis, the intensity of infection for the recent 16 years (1973~1989) was analysed, using the U-rate (No. of unfertilized egg passers/Total No. of egg positive cases) as a parameter for the decrease of individual worm burden, as suggested by Seo *et al.* (1983).

Total 102 general surgery papers published from various localities of South Korea (1958~1990) were reviewed in detail, especially for those dealing with surgical diseases of the bile duct (73 papers), pancreas (5 papers), appendix (8 papers) or intestine (16 papers) in general hospitals (15 papers are listed in 'References'). The number and proportion(%) of patients undergone surgery in each hospital, due to migrated or tangled mass of *Ascaris*, among the total surgical patients for each relevant organ, were taken into major considerations.

As most of the papers were dealing with different scopes of data and covering unequal length of years, direct comparison of raw data was considered not much meaningful. Therefore, it was necessitated to estimate annual proportions (%) of biliary ascariasis cases/all biliary surgical patients(A) or of biliary ascariasis cases/all biliary stone patients(B). These values, A and B, were obtained by calculating the annual No. of biliary ascariasis cases/annual No. of total biliary patients from each paper, and by summing up of the data from different papers to obtain average values of A and B.

By similar methods, the proportions (%) of appendiceal ascariasis cases/appendicitis patients, intestinal obstruction cases due to *Ascaris*/intestinal obstruction patients, and pancreatic duct ascariasis cases/pancreatitis patients were calculated.

RESULTS

The prevalence of *A. lumbricoides* in Korea has been steadily and remarkably decreasing to the level lower than 1.0% of egg positive rate in 1988~1989. The rate before 1969 was very high, from 60% to 80% (Hunter *et al.*, 1949;

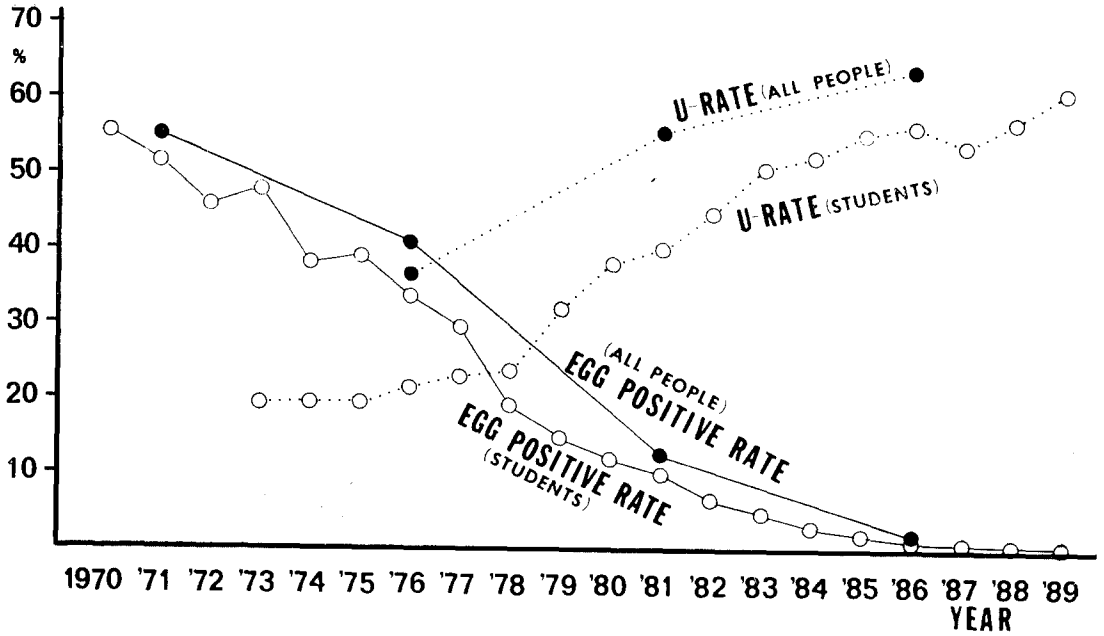

Fig. 1. Comparative view of the decreasing pattern of the egg positive rate of *A. lumbricoides* (students and all people) and the increasing tendency of U-rate (students and all people) in Korea.

Seo *et al.*, 1969). After 1969, however, when the national control programme of ascariasis was started along its regular line targeting the student population chiefly by means of mass chemotherapy, the egg prevalence of *A. lumbricoides* in the student group continued to decrease in a very steady pattern, from 55.4% in 1969 to 0.3% in 1989 (Fig. 1). The egg prevalence was concurrently decreased in the whole age population, from 54.9% in 1971 to 2.1% in 1986 (Fig. 1).

Together with the decrease of the prevalence, the infection intensity or worm burden of *A. lumbricoides* among Koreans was also found significantly decreasing, as shown by the changing pattern of the parameter, U-rate (Fig. 1). It is interesting to note that the U-rate is inversely proportional to the changes of the total egg positive rate (Fig. 1), as it was reported to represent a declination of the number of worms per infected case (Seo *et al.*, 1983).

Various kinds of surgical ascariasis due to migrating worm(s) or tangled mass of *Ascaris* have been reported during the past 35 years of 1955~1989, and were 1,299 in the total number of cases (Table 1). Among them, biliary ascariasis was the most frequent example of such complication due to *Ascaris* infection (92.2%). Others included appendicitis (3.4%), intestinal obstruction (3.0%), pancreatic obstruction (1.3%), and peritoneal abscess formation (0.1%) in the descending order of frequency.

Table 1. Surgical conditions of ascariasis reported during 1955~1989 in Korea

Conditions	No. cases reported	% to total cases
Biliary ascariasis	1,198	92.2
Appendicitis	44	3.4
Intestinal obstruction	39	3.0
Pancreatic duct obstruction	17	1.3
Peritoneal abscess formation	1	0.1
Total	1,299	100.0

Important and useful reports on biliary ascariasis available in the Korean literature (1959~1990) were 73 in total number of reports. Among them, 36 were concerned with the frequency of biliary ascariasis among biliary

Table 2. Reports on the incidence of biliary ascariasis among all biliary surgery patients in general hospitals, Korea (1959~1990)

Reporter(year)	Name of General Hospital(Place)	Period of observation	No. biliary ascariasis cases(%)/Total No. biliary surgery patients
Shin(1959)*	Seoul Paik H.(Seoul)	1955~1959	26/128 (20.3)
Chai *et al.*(1962)	Yonsei Univ. H.(Seoul)	1957~1961	11/84 (13.1)
Kim & Seo(1963)	Seoul Paik H.(Seoul)	1955~1963	44/257 (17.1)
Chang(1964)	Catholic Univ. H.(Seoul)	1962~1963	7/85 (8.2)
Jun *et al.*(1965)	Soo Do Med. Coll. H.(Seoul)	1959~1964	5/64 (7.8)
Kim *et al.*(1966)	Kwangju Jejung H.(Kwangju)	1962~1965	18/120 (15.0)
Min *et al.*(1966)	Seoul Nat. Univ. H.(Seoul)	1963~1965	13/100 (13.0)
Choi *et al.*(1967)	Soo Do Med. Coll. H.(Seoul)	1963~1966	9/80 (11.3)
Hong *et al.*(1969)	Kyungpook Nat. Univ. H.(Taegu)	1962~1968	29/231**(12.6)
Kang *et al.*(1970)*	Chunhae H.(Pusan)	1963~1969	37/179 (20.7)
Lee *et al.*(1972)*	Taegu Fatima H.(Taegu)	1966~1971	28/173 (16.2)
Min *et al.*(1974)*	Seoul Nat. Univ. H.(Seoul)	1965~1972	55/538**(10.2)
Rha *et al.*(1974)	Chung-Ang Univ. H.(Seoul)	1968~1974	15/236** (6.4)
Choi & Yang(1974)	Pusan Gospel H.(Pusan)	1970~1972	37/699 (5.3)
Kim(1975)	Chonnam Nat. Univ. H.(Kwangju)	1970~1975	13/167** (7.8)
Kim(1976)	St. Benedict H.(Pusan)	1971~1976	12/287 (4.2)
Hwang(1979)*	Kwangju Christian H.(Kwangju)	1971~1978	53/289 (18.3)
Choi *et al.*(1979)	Kyung Hee Univ. H.(Seoul)	1972~1978	6/242 (2.5)
Lee & Park(1980)	Seoul Nat. Univ. H.(Seoul)	1976~1979	13/227** (5.7)
Yu(1981)	Hanil H.(Seoul)	1972~1980	5/209 (2.4)
Choi & Ro(1981)	Ewha Woman's Univ. H.(Seoul)	1974~1980	7/172 (4.1)
Park & Won(1982)	Hanyang Univ. H.(Seoul)	1972~1981	6/489 (1.2)
Jang(1983)	Seoul Adventist H.(Seoul)	1974~1980	11/141** (7.8)
Lee *et al.*(1983)	Pusan Nat. Univ. H.(Pusan)	1975~1981	5/284** (1.8)
Oh & Sung(1984)	Hanil H.(Seoul)	1976~1983	6/276 (2.2)
Kim & Kim(1984)	Chonnam Nat. Univ. H.(Seoul)	1977~1982	6/530 (1.1)
Huh(1984)	Pusan Nat. Univ. H.(Seoul)	1977~1983	3/256** (1.2)
Cho & Park(1984)	Eul-Ji H.(Seoul)	1978~1982	4/180 (2.2)
Lee & Son(1984)	Chungnam Nat. Univ. H.(Daejeon)	1978~1982	7/228** (3.0)
Kim & Kim(1984)	Presbyterian Med. Cen.(Chonju)	1978~1982	4/178** (2.2)
Kim *et al.*(1984)	Hangang Sacred Heart H.(Seoul)	1978~1983	5/401 (1.2)
Jang & Choi(1986)	St. Benedict H.(Pusan)	1976~1985	13/510 (2.5)
Jeong & Chae(1986)	Wonkwang Univ. H.(Iri)	1979~1985	5/138 (3.6)
Kang *et al.*(1987)	Seoul Red Cross H.(Seoul)	1980~1986	1/102 (1.0)
Choi & Chung(1987)	Ewha Woman's Univ. H.(Seoul)	1981~1985	0/204 (0.0)
Kang & Son(1990)*	Chungnam Nat. Univ. H.(Daejeon)	1985~1988	1/332 (0.3)

*Listed in 'References'
**No. of benign biliary disease patients

surgical patients in general hospitals. Twelve papers were concerned with the frequency of biliary ascariasis among biliary stone patients. Other 25 papers were each reporting 1~100 cases of biliary ascariasis with descriptions on their clinical and/or surgical findings.

Each of the 36 papers on biliary surgery patients was dealing with variable numbers of

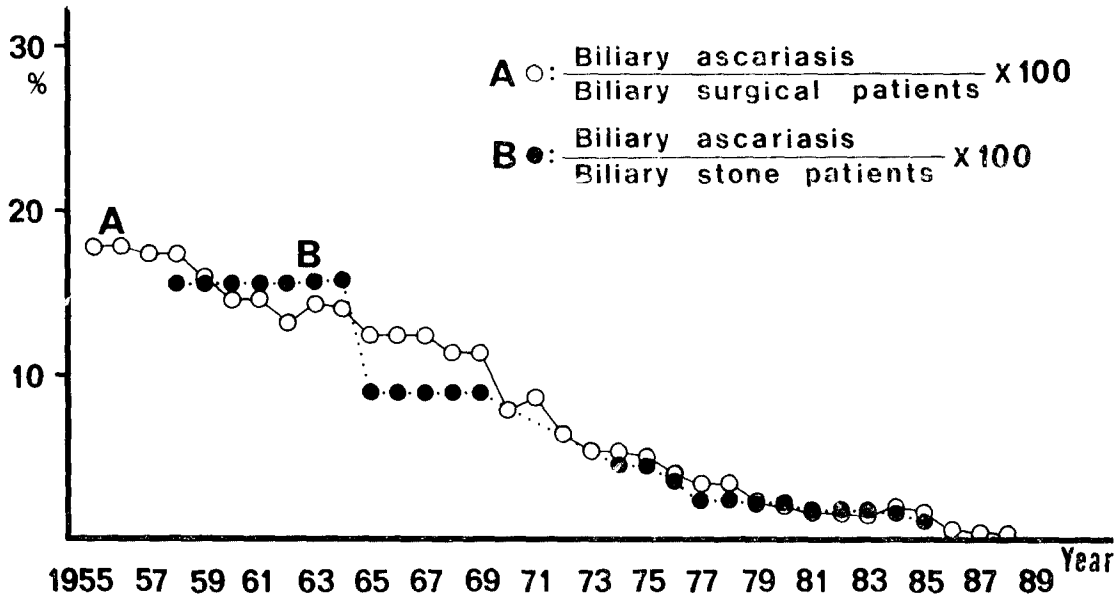

Fig. 2. Decreasing patterns of the proportion (%) of biliary ascariasis cases/biliary surgical patients (○) and of biliary ascariasis cases/biliary stone patients (●).

Table 3. Reports on the incidence of biliary ascariasis among all biliary stone patients in general hospitals, Korea(1963~1988)

Reporter(year)	Name of General Hospital(Place)	Period of observation	No. biliary ascariasis cases (%)/Total No. biliary stone patients
Hur *et al.*(1963)*	Yonsei Univ. H.(Seoul)	1958~1963	18/115 (15.7)
Kim & Sho(1988)	Yonsei Univ. H.(Seoul)	1966~1976	58/650 (8.9)
Choi *et al.*(1982)	Yonsei Univ. H.(Seoul)	1970~1979	18/1099 (1.6)
Han *et al.*(1988)*	Catholic Univ. H.(Seoul)	1971~1975	7/134 (5.2)
Park *et al.*(1979)	Chonnam Nat. Univ. H.(Kwangju)	1973~1978	13/225 (5.8)
Bae & Kim(1980)	Seoul Nat. Univ. H.(Seoul)	1975~1979	6/63 (9.5)
Cho *et al.*(1981)	Yonsei Univ. H.(Seoul)	1978~1980	6/40 (15.0)
Hong *et al.*(1982)	Cho-Sun Univ. H.(Kwangju)	1975~1979	4/125 (3.2)
Chun & Son(1983)	Seoul Red Cross H.(Seoul)	1975~1981	4/201 (2.0)
Han *et al.*(1988)*	Catholic Univ. H.(Seoul)	1976~1980	6/226 (2.7)
Seo & Jegal(1982)	Chonnam Nat. Univ. H.(Kwangju)	1976~1981	1/35 (2.9)
Kim & Jegal(1983)	Chonnam Nat. Univ. H.(Kwangju)	1977~1982	7/152 (4.6)
Kim & Sho(1988)*	Yonsei Univ. H.(Seoul)	1977~1985	24/1453 (1.7)
Han *et al.*(1988)*	Catholic Univ. H.(Seoul)	1981~1985	9/604 (1.5)

*Listed in 'References'

biliary ascariasis cases with variable proportion (%) of such cases to total biliary surgeries (Table 2). However, a strong decreasing tendency was recognized in the proportion(%) of biliary ascariasis cases by the passage of years (Table 2). The calculated annual rates (%) of biliary ascariasis cases among all biliary surgical patients(A) during 1959~1990 again evidently showed a gradual but steady decrease as the year passed by (Fig. 2). A very similar result was observed in the proportion of biliary ascariasis cases among all biliary stone patients(B)

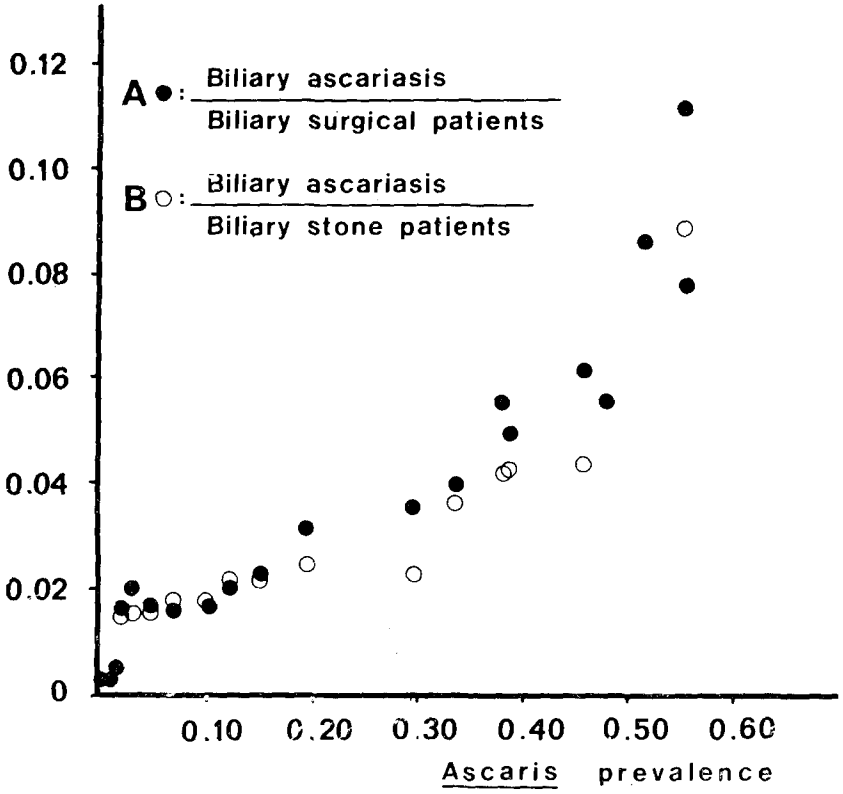

Fig. 3. Positive correlations of *Ascaris* egg prevalence and proportion of biliary ascariasis cases/biliary surgical patients (•), and *Ascaris* egg prevalence and proportion of biliary ascariasis cases/biliary stone patients (○).

Table 4. Annual number of reported biliary ascariasis cases during 1955~1989 in Korea

Year	No. cases
1955~1969	564*
1970	49
1971	56
1972	55
1973	52
1974	56
1975	59
1976	57
1977	52
1978	44
1979	37
1980	32
1981	29
1982	23
1983	14
1984	10
1985	8
1986~1989	1
Total	1,198

*No. per year: 37.6

for 1958~1985 (Table 3 & Fig. 2).

The parameter A (or B) each year and the national egg prevalence of *Ascaris* among the student population each year statistically revealed a significant correlation according to the equation, $Y_A=0.25X^2+0.013$ (correlation coefficient, $r=0.96$) for the parameter A, and $Y_B=0.19X^2+0.016$ ($r=0.94$) for the parameter B (Fig. 3), where 'X' is national egg prevalence, and 'Y_A' is frequency of biliary ascariasis among all biliary surgeries ('Y_B' is the rate among all biliary stone patients).

When the yearly recorded number of biliary ascariasis cases was calculated and chronologically plotted, also a decreasing pattern of this complication was evidently seen (Table 4). It was quite noticeable that annually over 50 cases of biliary ascariasis had been reported before 1977 whereas only 1 case was recorded during the recent 4 years of 1986~1989 based on the

Table 5. Reported appendiceal ascariasis cases in general hospitals, Korea

Reporter (Year)	Name of General Hospital (Place)	No. appendiceal ascariasis cases(%) /Total No. appendix surgery patients
Lee(1927)	Chosen Imperial H.(Seoul)	4/55 (7.3)
Shin(1959)*	Seoul Paik H.(Seoul)	27/2291 (1.2)
Min(1965)	Soo Do Med. Coll.(Seoul)	6/300 (2.0)
Cho(1970)	Chonnam Nat. Univ. H.(Kwangju)	1/174 (0.6)
Choi(1970)	Chonnam Nat. Univ. H.(Kwangju)	2/200 (1.0)
Jung(1979)	Hanyang Univ. H.(Seoul)	0/100 (0.0)
Kim *et al.*(1987)	Dong Gang H.(Ulsan)	0/219 (0.0)
Lee & Chang(1987)	KyungpookNat. Univ. H.(Taegu)	0/100 (0.0)

*Listed in 'References'

Table 6. Reported intestinal obstruction cases due to *Ascaris* in general hospitals, Korea

Reporter (year)	Name of General Hospital (Place)	No. cases due to *Ascaris* (%)/Total No. intestinal obstruction patients
Shin(1959)*	Seoul Paik H.(Seoul)	11/299 (3.7)
Chung *et al.*(1964)	Soo Do Med. Coll.(Seoul)	2/163 (1.2)
Crane *et al.*(1965)*	Presbyterian Med. Cen.(Chonju)	1/ — (—)
Lee *et al.*(1966)	Yonsei Univ. H.(Seoul)	2/243 (0.82)
Park & Kwak(1967)	3rd Army H.(Taegu)	1/ — (—)
Kang *et al.*(1968)*	Seoul Nat. Univ. H.(Seoul)	10/256 (3.9)
Cho(1971)	Chonnam Nat. Univ. H.(Kwangju)	1/ — (—)
Kim(1972)	Chonnam Nat. Univ. H.(Kwangju)	1/ — (—)
Kim *et al.*(1973)	Ewha Woman's Univ. H.(Seoul)	4/126 (3.2)
Kim & Min(1974)	Yonsei Univ. H.(Seoul)	3/768 (0.4)
Youn & Cho(1975)	Chonnam Nat. Univ. H.(Kwangju)	2/170 (1.2)
Lee *et al.*(1978)*	Hanyang Univ. H.(Seoul)	1/ — (—)
Lee & Son(1984)	Seoul Red Cross H.(Seoul)	0/246 (0.0)
Choi *et al.*(1985)	National Police H.(Seoul)	0/167 (0.0)
Lee *et al.*(1988)	Presbyterian Med. Cen.(Chonju)	0/253 (0.0)
Jeong *et al.*(1989)	Won Kwang Univ. H.(Kwangju)	0/177 (0.0)

*Listed in 'References'

available literature.

The proportions(%) of other complications due to *Ascaris* among total surgery cases of the appendix (Table 5), intestine (Table 6) and pancreatic duct (data not shown) also represented very similar patterns of decrease as in the case of biliary complications. The proportions of these types of surgical ascariasis were also positively correlated with the *Ascaris* egg prevalence.

DISCUSSION

It is generally acknowledged that although the mortality rate for ascariasis appears low, the absolute number of deaths due to ascariasis is fairly high because of high prevalence in developing countries (WHO, 1987; Pawlowski and Davis, 1989). Even if the mortality rate was as low as 2~6 per 100,000 infected, this might constitute thousands of deaths when multiplied by the millions of people who are infected (Walsh and Warren, 1979; WHO, 1981 & 1987). This fact solely can justify why we have to control ascariasis. Besides mortality, there should also be many other reasons why ascariasis be controlled.

According to the Report of WHO Expert Committee on Control of Ascariasis (WHO, 1967), manifestations due to *Ascaris* infection could be in three ways: allergic action by adults or larvae, action of adults on the intestinal tract, and wandering of adults to various organs. Action of adults on the intestinal tract includes nutritional disorders, enterocolitis of diarrheal type, and surgical conditions such as intestinal obstruction or occlusion and penetration into the appendix. Wandering of adults may result in biliary tract obstruction, pancreatic duct obstruction, peritonitis, or appearing from the mouth, nose or Eustachian tube. However, objective measurements of the morbidity due to *Ascaris* is very difficult and there was relatively little factual information concerning it (WHO, 1967, 1981 & 1987).

In the mean time, Maki (1972) reported a very useful review on surgical complications due to *Ascaris* in Japan. He stated that biliary tract ascariasis was most commonly encountered, and thus seemed to be of greatest clinical significance. He further mentioned that approximately 10% of all instances of gall stones were attributed to parasitic infections such as *A. lumbricoides* or *Clonorchis sinensis*, the liver fluke. It was speculated by Maki (1972) that the incidence of biliary ascariasis might have some direct correlations with the prevalence of ascariasis, however, he had no appropriate data to verify his speculation.

The present study also revealed that biliary tract ascariasis was the most common and major complication among the surgical diseases due to *Ascaris* in Korea. Out of total 1,299 reported surgical ascariasis cases during the period of 1955～1989, as many as 1,198 (or 92.2%) were biliary cases with or without calculi. Therefore, biliary ascariasis could represent nearly the whole picture of surgical complications due to *Ascaris* in Korea. This is quite comparable with the data (1903～1958) presented from Japan (Maki, 1972), where 861 (or 61.6%) biliary cases out of total 1,398 surgical ascariasis cases were reported. For this discrepancy, we are under speculation that the rate 92.2% of Korea is a slightly exaggerated one probably because of many unreported, neglected cases of non-biliary surgical ascariasis in comparison to biliary cases. So far as surgical biliary diseases including those due to *Ascaris* are concerned, clinical case reports have been made very actively during the past 30 years in Korea, since biliary ascariasis seems to have been one of the primary attentions of general surgeons in Korea (Shin, 1959; Crane *et al.*, 1965; Min *et al.*, 1974).

The present study confirmed that the incidence of biliary and other surgical complications of ascariasis had been decreasing very proportionally to the national figures of *Ascaris* prevalence in Korea. It is suggested that the incidence, *i.e.*, parameter A or B, could be applied as an index for the decrease of ascariasis in a community or a barometer of success in the control of ascariasis. According to the correlation equation between the local egg prevalence(X) and proportion(%) of biliary ascariasis cases among all biliary surgical patients(Y_A) or that among biliary stone patients(Y_B), if ascariasis is highly prevalent up to X=90% (0.9), for example, Y_A would be 22% (0.22) and Y_B 17% (0.17), and if it is controlled to X=10% (0.1), Y_A would be only 1.6% (0.016) and Y_B 1.8% (0.018).

It is regreted, however, that there is world-widely little information on the incidence of surgical ascariasis among *Ascaris* infected population. Even in the present study, the data were based only on hospital admitted surgical patients, hence, population-based or *Ascaris* infection cases-based incidence of surgical ascariasis was hard to be drawn. On this point, a useful report from Burma (Thein Hlaing, 1987) has indicated that at least 0.8 per 1,000 *Ascaris*-infected were hospitalized every year because of intestinal obstruction and/or other complication. The paper further mentioned that the mortality rate due to *Ascaris* in those cases was 9.3 per 1,000 hospitalized cases. Concerning intestinal obstruction due to *Ascaris*, it was once estimated in

South-eastern USA that about 2 per 1,000 children, aged 1~5 years, who were infected with *Ascaris*, were suffering from this complication (WHO, 1981). In Cape Town, South Africa, surgical ascariasis constituted about 10~15% of all acute abdominal emergencies, with the peak incidence in children of 4~8 years of age (Louw, 1974).

In the present study we regret that we could not analyse overall age-specific incidence of surgical ascariasis because of limited informations contained in the subjected case reports. However, several papers each dealing with more than 28 cases revealed no special predilection of surgical ascariasis to children ages (Kang *et al.*, 1970; Lee *et al.*, 1972; Kye and Kim, 1976; Lee and Kim, 1977; Hwang, 1979). Instead of children, middle aged men and women between 30~60 years of age were the most frequently affected, based on most of the above reports. We still have to rule out a possibility whether it was due to a paucity of reports on surgical diseases of children (10 years or younger) during the past 30 years in Korea.

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=국문초록=

전국 회충란 양성률 감소에 따른 담도 및 기타 외과적 회충증의 감소 양상

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한 지역사회에서 회충 감염을 반드시 관리해야 하는 궁극적 이유 또는 그 당위성에 대하여 답하기 어려운 경우가 있다. 그것은 회충 관리 결과 충란 양성률이나 감염량의 감소 이외에 실제로 무엇이 호전되었는지를 알기가 그리 쉽지 않기 때문이다. 이 연구는 우리 나라에서 전국적으로 시행해 온 회충 집단관리 사업이 성공적 결실을 맺게 됨에 따라 국내 각 종합병원급 이상의 담도(또는 담석증), 충수, 췌장 등에 대한 수술 환자 중 회충 미립증(迷入症)의 빈도가 크게 감소된 점을 중시하고 이들 외과적 회충증의 감소를 우리 나라 회충 관리의 실질적 효과 중 하나로 제시하고자 하였다.

우리 나라 국민의 회충 감염률 감소 양상은 전국 학생 검변 자료(1969~1989) 및 전국민 장내 기생충 감염현황 자료(1971, '76, '81, '86)에서 파악하였다. 외과적 회충증의 빈도는 주로 문헌 고찰에 의하되 1959~1990년 사이에 외과학회지 등에 발표된 담도 질환, 충수염, 췌장염, 장폐쇄 등에 관한 논문을 총 망라하여 참고로 하였다.

분석 결과 종합병원급 이상의 총 담도 수술례(또는 총 담석증례) 중 회충 미립이 차지하는 비율을 Y_A(또는 Y_B)라 할 때 Y_A(또는 Y_B)의 감소 양상은 전국 학생 회충란 양성률(X)의 감소와 매우 밀접한 순 상관관계를 나타내고 있다는 것을 알 수 있었다. 즉, 수치로 표시하면 $Y_A=0.25X^2+0.013$($r=0.96$), $Y_B=0.19X^2+0.016$($r=0.94$)의 관계를 보였다. 다른 외과적 회충증의 경우에도 담도 회충증과 비슷한 양상을 보였다.

결국 우리 나라의 회충 관리사업은 회충 감염률 및 감염량의 감소 뿐만 아니라 회충 감염시 심각한 합병증의 하나인 담도 회충증 또는 기타 외과적 회충증의 빈도를 격감시키는 데에도 크게 기여한 것으로 판단되었다.

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