Experimental human infection with Asian *Taenia saginata* metacestodes obtained from naturally infected Korean domestic pigs*

Keeseon S. Eom and Han-Jong Rim**

Department of Parasitology, College of Medicine, Chungbuk National University, Cheongju 360-763, Department of Parasitology**, College of Medicine, Korea University, Seoul 136-705, Korea

Abstract: The infectivity of metacestodes of Asian *Taenia saginata*, now tentatively called *Taenia saginata taiwanensis*, in human host was confirmed. The metacestodes used in experimental infection were collected from the livers of naturally infected domestic pigs at an abattoir in Cheongju City, Korea. The first gravid proglottid was spontaneously discharged 76 days after infection. Two worms were recovered two years later by chemotherapy. The scolex was unarmed. The number of main uterine branches, varying from 16 to 21, was similar to that of classical *Taenia saginata*. The liver of pigs was confirmed to be an infection source of Asian *T. saginata* in Korea.

Key words: Asian *Taenia saginata*, experimental human infection, naturally infected metacestodes in domestic pigs, Korea

INTRODUCTION

Asian *Taenia saginata*, morphologically similar to *T. saginata*, is a cestode that provides an important clue for understanding an epidemiological enigma of human taeniasis in many Asian countries, including Korea.

Park and Chyu(1963) in Korea; Huang *et al.* (1966) in Taiwan; Harinasuta and Charoenlarp (1971) in Thailand; Kosin(1972) in Indonesia; and Arambulo *et al.*(1976) in the Philippines have raised questions about the source of human *Taenia saginata* infection in Asian countries mainly because of the irrelevance between eating habit of the local people and resulting species of *Taenia* infections. These puzzling relations

began to be solved by Fan *et al.* (1986) who recognized the liver of pigs as a source of the so-called *T. saginata* in these countries.

Eom and Rim(1992), in a recent survey, reported that the livers of 1.01% of 25,358 domestic pigs in Korea were infected with Asian *Taenia saginata* metacestodes. Of those infected, live metacestodes were found in 0.01% of the pigs and the authors suggested that domestic pigs may well be an infection source of Asian *T. saginata*.

We have undertaken this study to confirm the suggestion by experimental infection in a volunteer.

MATERIALS AND METHODS

Asian *T. saginata* metacestodes were collected from naturally infected domestic pigs at an abattoir in Cheongju City (Eom and Rim, 1992).

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A Korean male volunteer who was not previously infected with any species of *Taenia*, was inoculated per os with five metacestodes. He was treated two years later with 2 g of niclosamide. Scolex and discharged gravid proglottids were observed by light microscopy after fixing and acetocarmine staining.

RESULTS

The first gravid proglottid was discharged spontaneously 76 days after infection.

One of the two recovered worms which were collected by niclosamide treatment, was fixed in 10% formalin. This entire worm with a scolex measured 330 cm in total length and had approximately 700 proglottids (Fig. 1). The scolex measured 0.81 mm in width. Four simple suckers measured 0.24~0.29 mm in maximum diameter. The number of main uterine branches was 18.3 ($n=18$) in a range of 16 to 21 (Fig. 2). Eggs with a hexacanth embryo in the embryophore measured $35.7\ \mu\text{m}$ ($33.8\sim40.0$) by $34.4\ \mu\text{m}$ ($33.5\sim37.5$) ($n=50$) (Fig. 3).

DISCUSSION

Asian *Taenia saginata*, now tentatively called *T. saginata taiwanensis*, is a cyclo-zoonotic parasite which needs intermediate animal hosts. Fan *et al.* (1986) had found wild boars and Lanyu pigs as possible intermediate hosts for this tapeworm. The liver of those animals was noticed especially as an infection source of Asian *T. saginata*. In Korea, however, wild boars are unusual and the Lanyu pigs are non-existent. In such situations, Eom and Rim (1992) reported natural infections of Asian *T. saginata* metacestodes in the livers of Korean domestic pigs. The present study, using the metacestodes obtained from naturally infected domestic pigs, confirms that domestic pigs are intermediate hosts for this parasite and the liver of pigs can be a source of human infection.

The taxonomic status of Asian *T. saginata* found in many Asian countries, however, remains

Fig. 1. Asian *Taenia saginata* recovered from a man infected with metacestodes obtained from a naturally infected pig.

Fig. 2. Gravid proglottid, unpresed and fixed.

Fig. 3. Eggs with hexacanth embryo and thick shell.

unclear especially since the morphology of the adult parasite is so similar to classical *T. saginata* (Fan *et al.*, 1986; Fan, 1988; Cross, 1987; Cross and Murrell, 1991).

Of the methods for diagnosing tapeworms, uterine branch counting in gravid proglottids has been considered the most simple and useful. The recorded number of uterine branches in *T. saginata* varies: Faust (1929) and Noble and Noble (1961) reported more than 15; du Noyer and Baer (1928) reported 18–25; Brumpt (1949) reported 15–30 and Abuladze (1964) reported 18–32. Uterine branches in our study of Asian *T. saginata*, 16–21 were within the range of 9–32 of Fan *et al.* (1988). This number is undifferentiable from that of classical *T. saginata* as 15–32. The shape and size of the eggs were also very similar to those of *T. saginata*. Although they cannot be a key for taxonomy, worm lengths of Asian *T. saginata* according to Liu *et al.* (1965) in Taiwan are 75 to 540 cm. Our specimen fell within this range. The morphology of adult worm will be described elsewhere.

The Korean habit of eating the raw viscera of pigs, varying from 19.2% to 52.3% (Park and Chyu, 1993; Kang *et al.*, 1965; Kim, 1982), has traditionally been considered insignificant because that muscle alone was believed to be the source of human taeniasis; but now the fact that most people eat livers explains the disproportionately high ratio of unarmed tapeworms to armed tapeworms (approximately 5 : 1).

This study leads us to believe that the Asian *T. saginata* metacestodes in Korean domestic pigs can be one of the infection source of human taenia tapeworm which has been, hitherto, identified as *Taenia saginata*.

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REFERENCES

- Abuladze, K.I. (1964) Principles of Cestodology, Vol. 4, Taeniata, pp. 163, Izd. Nauka, Moscow.
- Arambulo, P.V., Cabrera, B.D. and Tongson, M.S. (1976) Studies on the zoonotic cycle of *Taenia saginata* taeniasis and cysticercosis in the Philippines. *Int. J. Zool.*, 3:77–104.
- Brumpt, E. (1949) *Precis de parasitologie*. 6th Ed., Masson et Cie, Paris.
- Cross, J.M. (1987) Current status of some parasitic zoonosis in Asia and suggested studies on the application of new technologies. *Proceedings of the First Sino-American Symposium on Biotechnology and Parasitic Diseases*, 1:1–5.
- Eom, K.S. (1991) Ecological approach to Asian *Taenia* with reference to viscerotropic cysticercosis in intermediate hosts. pp.137. Dissertation for Ph.D. degree in Seoul National University.
- Eom, K.S. and Rim, H.J. (1988) Pigs as a possible intermediate host of *Taenia saginata*. *Korean J. Parasit.*, 26(4):304 (Korean abstract).
- Eom, K.S. and Rim, H.J. (1992) Natural infections of Asian *Taenia saginata* metacestodes in the livers of Korean domestic pigs. *Korean J. Parasitol.*, 30(1):15–20.
- Fan, P.C., Chan, C.H., Chung, W.C., Chen, C.C., Wong, M.M., Chao, D., Huang, S.H., Hsu, M.C., Wu, C.C. and Chen, Y.A. (1986) Studies on taeniasis in Taiwan W. Current status of epidemiological, experimental, and morphological aspects of Taiwan *Taenia*. *Proceedings of Sino-Japanese Symposium on Parasitic Zoonoses*, 100–107.
- Fan, P.C., Chung, W.C., Lin, C.Y., Soh, C.T., Lee, K.T., Kosman, M.L., Kosin, E., Depari, A.A. and Napitupulu, T. (1988) Studies on taeniasis in Taiwan W. Is *Taenia saginata* from Taiwan, Korea and Indonesia a new species? *Chinese J. Parasit.*, 1(1):56–70.
- Faust, E.C. (1929) Human helminthology. A manual for clinicians, sanitarians. pp.616, Philadelphia.
- Harinasuta, T. and Charoenlarp, P. (1971) Parasitic infections of the gastrointestinal tract in Thailand, a review. [in *Proceedings of the Seventh SEAMEO Tropical Medicine Seminar on Infective Diseases of the Gastrointestinal System in Southeast Asia and the Far East* (Ed. by Cross, J.H.), pp.19–37, SEAMEO Central Coordinating Board for Tropical

- Medicine and Public Health Project*, Thailand.
- Huang, S.W., Khaw, O.K. and Liu, C.Y. (1966) Studies on *Taenia* species prevalent among the aborigines in Wulai District. *Bull. Inst. Zool. Academia Sinica*, 5:87-91.
- Kang, S.Y., Loh, I.K., Park, Y.H. Kim, B.C. and Lim, T.B. (1965) Survey on the eating habits of foods infested with parasites among inhabitants in Cheju province, Korea. *Korean J. Int. Med.*, 8(4):13-25.
- Kim, S.H. (1982) Survey on the taeniasis infection and eating habits of raw pork in Jeju-Do. *Cheju Univ. J.*, 14:65-70.
- Kosin, E., Depary, A. and Djohansjah, A. (1972) Taeniasis auf der Insel Samosir. *J. Med. Fak. Univ. North Sumatra*, 2:5-11.
- Liu, H.Y., Chao, D. and Fan, P.C. (1981) Prevalence and chemotherapy of taeniasis among the aborigines in Nan-ao District, I-lan County, North-eastern Taiwan. *Proc. National Science Council. Part A: Applied Sciences*, 5(3):185-195.
- Noble, E.R. and Noble, G.A. (1961) Parasitology. The biology of animal parasites. pp.767, Philadelphia.
- du Noyer, M.R. and Baer, J.G. (1928) Memoires originaux. *Bulletin des Sciences Pharmacologiques*, 30(4):209-233.
- Park, C.B. and Chyu, I. (1963) A socio-epidemiological study of swine pen human latrine system practiced on Cheju Island. *J. Catholic Med. Coll.*, 7:161-186.

＝국문초록＝

돼지 肝에 自然感染된 *Asian Taenia saginata* 囊尾蟲의 人體感染 實驗

忠北大學校 醫科大學 寄生蟲學教室 및 高麗大學校 醫科大學 寄生蟲學教室*

嚴 基 善・林 漢 鍾*

Asian Taenia saginata 囊尾蟲에 의한 人體 감염이 성립된다는 것을 실험적으로 확인하였다. 감염에 사용한 5 개의 낭미충은 우리나라 돼지 간에 자연 감염되었던 것으로 청주 소재 도축장에서 얻은 것이었다. 감염 후 제 76 일에 활발한 운동성을 가진 수태편질이 자연 배출되었다. 2년 후 치료하여 두마리의 성충을 회수하였다. 두견에는 小鉤가 없었고 수태편질의 자궁축지수는 16~21 개 이었으며 다른 부분은 형태학상으로 무구조충과 유사하였다.

돼지 肝을 날로 먹으면 우리나라에서 *Asian Taenia saginata*에 감염될 수 있다는 것을 실험적으로 증명하였다.

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