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FAILURE OF 74 DAYS OLD *CYSTICERCUS BOVIS* TO DEVELOP IN ANTHROPOID APES, MONKEYS AND HAMSTERS (*)

by

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Summary — Various primates, *viz.*, chimpanzees, baboons, Java-monkeys, long-tailed African monkeys besides 12 golden-hamsters were infected with 74 days old *Cysticercus bovis* orally. In most of the instances, these hosts were administered immunosuppressive agents. None of these hosts could be infected with *T. saginata* and the authors conclude that the cysts were not mature enough to be infective.

KEYWORDS : Helminthiasis, human; *Taenia saginata*, alternative definitive host; *Cysticercus bovis*, age of their attaining infectivity.

Introduction

Taenia saginata, the common cause of taeniasis among human beings, is a strict host-specific species of cestode. The physiological adaptation of this cestode appears to be highly evolved since it is not found in hosts other than man inspite of the fact that every ecological opportunity exists for cross-infection. Because of lack of a suitable model host for *T. saginata*, a comprehensive study on various aspects of host-parasite relationship can not be taken up under experimental conditions.

Scanty informations are available in the literature on the definitive host-range of *T. saginata.* Clarenburg (1932) fed *Cysticercus inermis* (= *C. bovis*) to monkeys and Viljoen (1937) exposed a baboon with *C. bovis.* They could not succeed in infecting these hosts. Verster (1965) as she cites in her paper appearing in 1971, also failed to infect three monkeys, *Cercopithecus aethiops*, and a baboon, *Papio ursinus*, with *T. saginata.* Subsequently, Verster (1971, 1974) succeeded in infecting golden-hamsters with *T. solium* and *T. saginata* although susceptibility to the latter species was lower. These observations of Verster are apparently the only authentic experimental records of occurrence of *T. saginata* in a host other than man.

Experimental studies on *T. saginata* are further beset with limitations since in the available literature there is no mention of evidence to

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precisely indicate the age of *C. bovis* in bovines when they first attain infectivity for the definitive host.

Susceptibility experiments were, therefore, undertaken in our laboratory to reassess the observations of the foregoing workers by using 74 days old *C. bovis*, harvested from an experimentally infected calf, as the infective material, and primates and hamsters as the hosts.

Materials and Methods

In vitro evagination test on a sample of freshly harvested *C. bovis* was done before their feeding to various hosts. The free cysts were left in physiological saline containing five per cent ox-bile for two hours at 37 °C and examined. In two such successive tests it was found that 75 per cent of the cysticerci had evaginated.

The general experimental plan for infection of primates and hamsters with *C. bovis* is given in Table 1. Nine adult primates, *viz.*, three chimpanzees *(Pan schweinfurthii)*, two baboons *(Papio papio)*, two Java-monkeys (*Macaca irus*) and two long-tailed African monkeys (*Cercopithecus aethiops*) besides 12 golden-hamsters, about eight weeks old, were included in the susceptibility experiment.

TABLE 1

Schedule of infection of various primates and hamsters with 74 days old *C. bovis*

Hosts	Number of animals	Treatments, if any	Number of *C. bovis* administered orally
Chimpanzees (*Pan schweinfurthii*)	3	—	10 each
Baboons (*Papio papio*)	2	One of them given 40 mg methyl prednisolone acetate, I. M., once weekly	10 each
Java-monkeys (*Macaca irus*)	2	One of them given 1 mg dexamethason, I. M., every alternate day	10 each
African monkeys (*Cercopithecus aethiops*)	2	One of them given 1 mg dexamethason, I. M., every alternate day	10 each
Golden-hamsters	12	Six of them given 0.5 ml ALS each, I. P., twice weekly and the other six were given 0.25 mg dexamethason, S. C., every alternate day	5 each

Each primate received ten *C. bovis*. These were anesthetised and the cysts were pushed into their stomach through a stomach tube. One of each of the two Java-monkeys and the two long-tailed African monkeys received one mg dexamethason every alternate day, given intramuscularly while one of the two baboons received 40 mg methyl prednisolone acetate intramuscularly, once every week. Administration of these drugs was commenced immediately following the introduction of *C. bovis* and continued throughout the entire period of observation.

The golden-hamsters were divided in two groups, each of six animals. The hamsters of the first group were given 0.5 ml anti-hamster-lymphocytic-thymocytic serum (ALS) each, intraperitoneally and twice weekly. ALS was prepared in our laboratory following the method of Gray *et al.* (1966) and the cytotoxic effect of the prepared ALS was tested following method No. 3 given by James (1973). The other six hamsters were given 0.25 mg dexamethason, subcutaneously and every alternate day. The hamsters of both the groups were given these injections two days before they were force-fed orally five *C. bovis* each.

Results and Discussion

One of the baboons receiving methyl prednisolone acetate and one of the long-tailed African monkeys which did not receive dexamethason succumbed to natural death 63 and 71 days post-exposure, respectively. Autopsy examination on them revealed absence of *T. saginata*. Faecal samples of the remaining primates were examined periodically for presence of proglottides of *T. saginata*, if any, and microscopically by zinc chloride floatation method for four times during a period lapsing between 10 to 14 weeks post-exposure with *C. bovis*. On no occasion proglottides or eggs of *T. saginata* were found in their faeces. Three hamsters of each of the two groups were sacrificed for examination seven days post-exposure, and the remaining 20 days post-exposure. On both occasions, no evidence of *T. saginata* infection was present.

Excepting the golden-hamsters, all other hosts which were exposed to 74 days old *C. bovis* in the present study are unknown hosts of *T. saginata*. Since these have failed to develop in golden-hamsters, the only known experimental definitive host of *T. saginata*, it provides evidence that the cysts were not infective. Evagination test, apparently the only *in vitro* method for detection of viability of *C. bovis*, showed that the majority of these could evaginate. How far evagination of cysts could correlate with their infectivity is a matter of speculation.

Few of the workers are of the opinion that about 18 weeks are needed for *C. bovis* to complete development in bovines (Hertwig, 1891; Viljoen, 1937; Gregoire *et al.*, 1956 and Soulsby, 1968) although some claim these to be infective somewhat earlier. McIntosch and Miller (1960), however, concluded that 10 to 12 weeks old *C. bovis* could be considered infective for the definitive host on morphological grounds.

On the basis of our observations, it is recommended that *C. bovis* older than 74 days should be incorporated in any subsequent study to determine their age of attaining infectivity and more varieties of experimental hosts should be included to investigate the definitive host-range of *T. saginata.*

Addendum

After this article had gone to the press, the present authors succeeded in infecting a hamster with 89 days old *C. bovis.* The three weeks

old hamster in question was administered ALS, 0.5 ml, intraperitoneally and twice weekly. ALS administration to this hamster was started two days before oral infection with *C. bovis*. Six days after the infection the hamster was autopsied and a single living *T. saginata*, about one mm long, was isolated from its intestine. In view of this success, two chimpanzees are again infected with 89 days old *C. bovis*, ten cysts each, and the results if found positive will be published in due course.

Résumé — **Insuccès de transmission de** *Cysticercus bovis* **âgés de 74 jours chez des primates anthropoïdes, singes et hamsters.**

Plusieurs primates, notamment des chimpanzés, babouins, singes de Java et singes africains à longue queue, ainsi que 12 hamsters dorés ont été infectés par voie orale avec des cystes de *Cysticercus bovis* âgés de 74 jours. Dans la plupart des cas ces hôtes ont reçu des produits immunosuppressifs. Aucun de ces hôtes n'a pu être infecté avec *T. saginata* et les auteurs concluent que les cystes n'étaient pas assez mûrs pour être infectieux.

Samenvatting — **Mislukte poging tot ontwikkeling van 74 dagen oude** *Cysticercus bovis* **in anthropoïde primaten, apen en hamsters.**

Verscheidene primaten, nl. chimpansees, bavianen, Java-apen en langstaartige Afrikaanse apen, naast 12 goudhamsters werden oraal geïnfecteerd met 74 dagen oude *Cysticercus bovis* kysten. In het merendeel der gevallen werden aan deze gastheren immunosuppressieve stoffen toegediend. Geen enkele kon worden geïnfecteerd met *T. saginata*. De auteurs menen dat de kysten niet voldoende rijp waren om infectief te zijn.

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REFERENCES

Clarenburg, A. (1932) : Onderzoekingen over de levensvatbaarheid van *Cysticercus inermis*. Tijdschr. Diergeneesk., **59**, 1-18.

Gray, J. G., Monaco, A. P., Wood, M. L. & Russel, P. S. (1966) : Studies on heterologous anti-lymphocytic serum in mice. I. *In vitro* and *in vivo* properties. J. Immun., **96**, 217-228.

Gregoire, C., Granville, A., Pouplard, L., Deberdt, A., Sprengers, R. & Villanyi, J. (1956) : La cysticercose bovine. A — Epidémiologie et diagnostic de la ladrerie. Ann. Méd. vét., **100**, 24-36.

Hertwig (1891) : Beitrag zur Frage der Entwicklung der Rinderfinne. Zeitschr. Fl. Milchhyg., **1**, 107-115.

James, K. (1973) : Preparation of anti-lymphocytic antibodies. *in* : Handbook of experimental immunology, chap. 31, ed. D. M. Weir, Blackwell Scientific Publications, Oxford.

McIntosh, A. and Miller, D. (1960) : Bovine cysticercosis, with special reference to the early developmental stages of *Taenia saginata*. Amer. J. vet. Res., **21**, 169-177.

Soulsby, E. J. L. (1968) : Helminths, arthropods and protozoa of domesticated animals. Baillière, Tindall and Cassell, London, 824 pp.

Verster, A. (1965) : *Taenia solium* Linn., 1758 in the chacma baboon, *Papio ursinus* (Kerr, 1792). J. S. Afr. vet. med. Ass., **36**, 580.

Verster, A. (1971) : Preliminary report on the golden hamster as a definitive host of *Taenia solium* Linnaeus, 1758, and *Taenia saginata* Goeze, 1782. Onderstepoort J. vet. Res., **38**, 63-64.

Verster, A. (1974) : The golden hamster as a definitive host of *Taenia solium* and *Taenia saginata*. Onderstepoort J. vet. Res., **41**, 23-28.

Viljoen, N. F. (1937) : Cysticercosis in swine and bovines, with special reference to South African conditions. Onderstepoort J. vet. Sci. Anim. Ind., **9**, 337-570.