

# An Outbreak of Cysticercosis in Feedlot Cattle

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## Abstract

An outbreak of cysticercosis (infestation with the larvae of *Taenia saginata*) occurred in feedlot cattle in Ontario in 1986. Two hundred and thirty-three of 271 steers were confirmed histologically to be positive for cysticerci. Nineteen (8.2%) animals had viable cysticerci, 87 (37.3%) had degenerated cysticerci, 77 (33.0%) had mineralized cysticerci, and 50 (21.5%) steers had lymphoid granulomas consistent with cysticercosis. Three viable cysticerci were partly evaginated and one degenerate cysticercus was fully evaginated.

## Résumé

### Une épidémie de cysticercose dans un parc d'engraissement bovin

Une épidémie de cysticercose (infestation par la larve de *Taenia saginata*) s'est déclarée dans un parc d'engraissement bovin en Ontario en 1986. Le diagnostic de cysticercose a été confirmé à l'histopathologie chez 233 des 271 bovins de l'élevage. Des cysticerques viables ont été retrouvés dans 19 cas (8,2%), des cysticerques dégénérés dans 87 cas (37,3%), des cysticerques minéralisés dans 77 cas (33,0%), tandis que 50 cas (21,5%) présentaient des granulomes lymphoïdes compatibles avec la cysticercose. Trois cysticerques viables étaient partiellement évaginés et un cysticerque dégénéré était complètement évaginé.

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## Introduction

Beef larval tapeworm infestation — cysticercosis — is a zoonosis (1). The adult tapeworm, *Taenia saginata*, is an intestinal parasite of man, infection occurring following ingestion of raw or undercooked beef containing viable cysticerci. An infected person may disseminate about half a million ova of *T. saginata* per day (1). Cattle become infected by ingesting ova passed by infected humans. Intrauterine infection of the bovine fetus has also been reported (2). Widespread bovine infections resulting from the contamination of soil and silage with ova of *T. saginata* by workers in feedlots have been reported in Texas (3), Arizona (4), and Ontario (5).

Ova of *T. saginata* can remain viable for 5–413 days in the field and for 13–335 days in the laboratory (6). The larval stage of *T. saginata* (formerly referred to as *Cysticercus bovis*) in the muscles of cattle may develop fully within two to three months postinfection

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(7), and remain viable for 3–30 months (8–10). Degeneration and mineralization of cysticerci may occur within one to eight months (7–10).

Viable cysticerci are transparent, and contain a pearl-like scolex; nonviable cysts are an opaque grey with yellow caseous centers (8). Degeneration of the cyst can occur at any stage of development (10), and usually starts by evagination and the development of an inflammatory response (11).

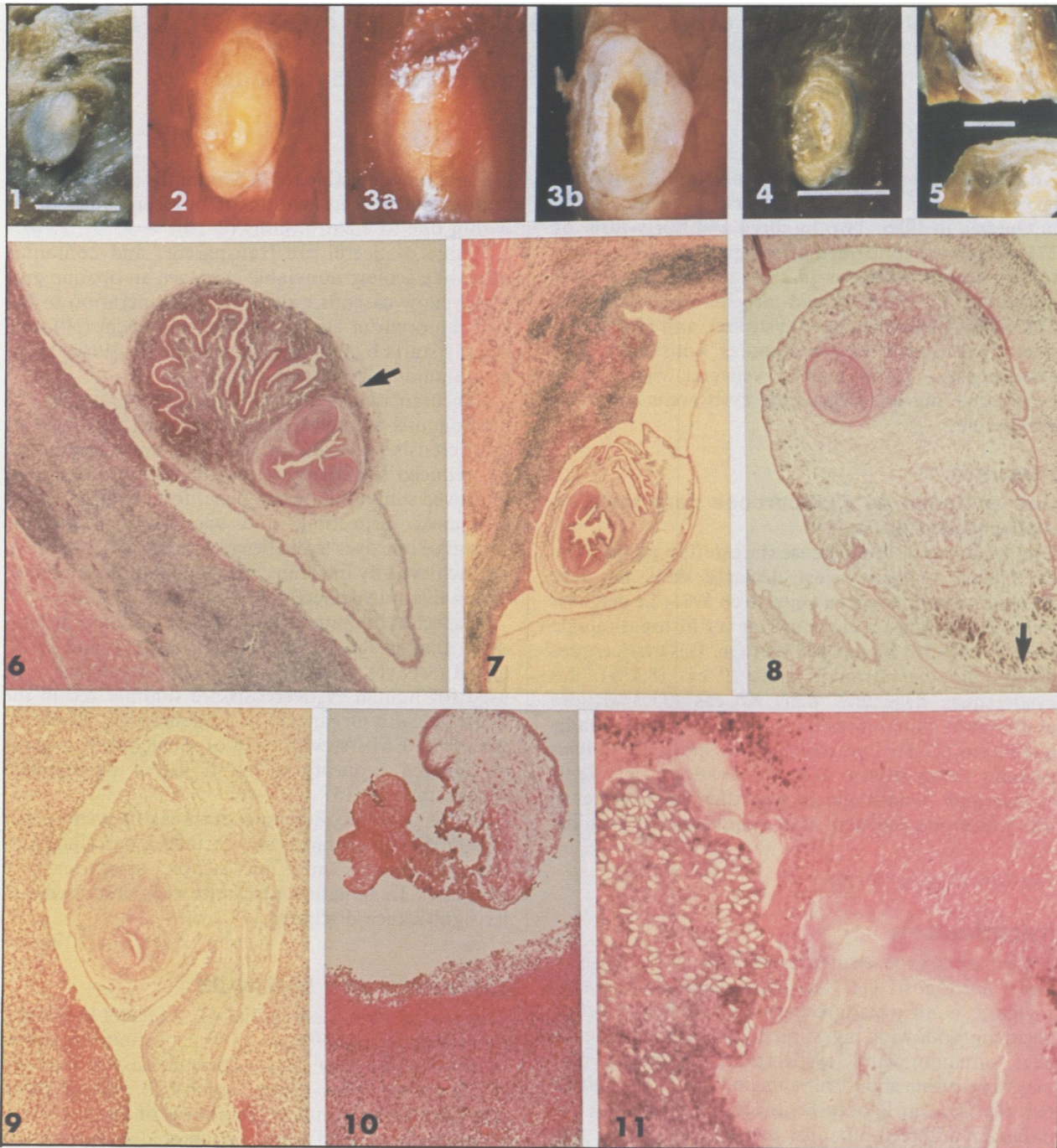
Subcutaneous administration of 100 mg/kg of praziquantel is an effective treatment for endemic cysticercosis (12). The incidence of cysticercosis can be reduced by elimination of human infection, improved sanitation, zoohygiene, food hygiene, effective meat inspection, and vaccination (1). High resistance of calves to challenge with ova of *T. saginata* was achieved by intramuscular inoculation of homologous live oncospheres of *T. saginata* (13,14).

Suspected human carriers should undergo at least three anal swabs, fecal examinations (5), and serological tests (1). Serological and immunological tests used for human cysticercosis are summarized in the World Health Organization guidelines (6). In cattle, the use of ELISA, with fluid of metacystode cysts as an antigen, appears to be a useful antemortem diagnostic test (15).

In this paper we discuss an outbreak of cysticercosis in a feedlot in Ontario, and include a description of the macroscopic and microscopic appearance of cysticerci. Evagination of cysticerci is described and its significance discussed.

## Materials and Methods

Cysticercosis was found initially in a feedlot in Ontario on November 28, 1986, on routine postmortem examination of slaughter cattle. Quarantine was imposed in December 1986. From January to July of 1987, 630 cattle approximately 20 months of age (14 loads, 45 animals per load) were slaughtered and examined in detail at a federally inspected meat packing plant. Heads, viscera, and carcasses were identified with serially numbered tags and were cross-referenced with eartag numbers for trace-back purposes. Criss-cross incisions were made at 1 cm intervals in the myocardium, the diaphragm, the esophagus and neck muscles. Deep incisions in search of cysts were made in the gluteal and shoulder muscles of carcasses in which cysticerci were found during routine inspection. Samples of heart, skeletal muscle, and liver were collected from 271 of the slaughtered steers, and submitted to federal diagnostic laboratories in Nepean, Ontario, and Sackville, New Brunswick. The samples were submitted either fixed in 10% neutral-buffered formalin for histological examination, or fresh for parasitology. The formalinized tissues were processed routinely and stained with hematoxylin and eosin



**Figure 1.** Viable cysticercus in the musculature of the lip. Bar = 5 mm. **Figure 2.** Caseated, myocardial cysticercus, 8 × 12 mm. **Figure 3.** a. Epicardial lesion, 7 × 10 mm. b. Thickened, mineralized cyst wall of cysticercus, 10 × 15 mm. **Figure 4.** Partly mineralized myocardial cysticercus. Bar = 5 mm. **Figure 5.** Severe, diffuse mineralization of a myocardial cysticercus. Bar = 5 mm. **Figure 6.** Invaginated cysticercus surrounded by a wide zone of inflammation, calcareous corpuscles (arrow). H & E. **Figure 7.** Partly evaginated cysticercus surrounded by inflammatory infiltrate. H & E. **Figure 8.** Partly evaginated cysticercus without inflammation; calcareous corpuscles (arrow). H & E. **Figure 9.** Evaginated cysticercus surrounded by a wide zone of inflammatory cells. H & E. **Figure 10.** Fully evaginated (including the scolex with two suckers), slightly degenerated cysticercus, surrounded by mixed necrotic inflammatory infiltrate. H & E. **Figure 11.** Degenerated cysticercus with calcareous corpuscles (left) and mineralization at upper left corner. H & E.

(H & E). At least ten serial sections were cut from each block. Some samples were photographed fresh (Figures 2,3) and others after fixation (Figures 1,4,5).

Diagnosis of cysticercosis in this report was based on finding one or more of the following: 1) a *viable*

invaginated or partly evaginated parasite without rostellar hooks; 2) the *degenerated* body or parts of a parasite with or without calcareous corpuscles and hooks; 3) the *mineralized* body of a parasite with or without inflammatory infiltrate, or the finding of

**TABLE 1**  
**Histological Confirmation of Cysticercus Lesions Found in Cattle in Each Truck Load of 45 Cattle Slaughtered**

Status of Parasite	Truck Load Number														Total	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
V	1	2	0	0	8	2	2	2	0	0	0	0	1	1	19	8.2
D	16	10	12	9	1	3	5	2	6	1	3	8	5	6	87	37.3
M	6	4	2	10	16	6	4	8	3	4	4	2	3	5	77	33.0
LG	8	3	11	4	3	2	4	0	5	2	5	0	3	0	50	21.5
Total	31	19	25	23	28	13	15	12	14	7	12	10	12	12	233	100.0
%/load	68.9	42.2	55.5	51.1	62.2	28.9	33.3	26.7	31.1	15.5	26.7	22.2	26.7	26.7		

V = viable; D = degenerate; M = mineralized; LG = lymphoid granuloma

calcareous corpuscles alone in the necrotic or mineralized mass without hooks; and 4) a *lymphoid granuloma* with calcareous corpuscles and no hooks.

## Results

Of the 630 steers slaughtered, 271 were suspected to be infected with cysticerci (Figures 1-5). Macroscopic and microscopic findings, along with status of animals on consecutive truck loads, are summarized in Table 1. Within the heart, cysts were located in a subepicardial location or within the myocardium. Cysts in the liver were usually found in subcapsular sites, whereas those in the tongue were in the apex. Masseter muscle had cysts close to the maxilla. Some animals had more than one cysticercus.

Histologically, 233 of the 271 animals were positive for cysticerci (Table 1). Viable cysticerci ranged from 5 to 11 mm in length and usually contained an eccentric, white, pearly scolex within the lumen of the transparent cyst (Figure 1). Most frequently, diagnoses were based on detection of cysts in the heart (94.4% of the 233 cases). In the remaining cases, diagnoses were based on cysts in liver (2.6%), tongue (2.1%), and masseter (0.9%). Most of the cysts were degenerate (Figures 2,3), or mineralized (Figures 4,5, Table 1).

The highest prevalence of cysticerci (68.9%) was found in the first truck load and the lowest (15.5%) in load 10 (Table 1). In 19 steers (8.2%) the cysts were viable; 15 were invaginated, each having a scolex, two suckers, and a neck with spiral canal (Figure 6). Three steers had cysticerci that were partly evaginated (Figures 7-9) and one steer had a fully evaginated larva (Figure 10). Those that were partly evaginated (with their scolices invaginated) had a wide zone of inflammation at one side (Figures 6,7) or the parasite was surrounded by a diffuse mixed inflammatory infiltrate with necrosis at one pole (Figure 9). Most of the affected steers (37.3%) had degenerate cysticerci (Figure 11), 33.0% had mineralized lesions, and 21.5% had old lesions, variably-sized lymphoid granulomas, thought to result from prior cysticercus infection. These granulomas usually contained central or eccentric areas of necrosis surrounded by lymphoid cells, macrophages, eosinophils, and giant cells. Calcareous corpuscles were found in one of the lymphoid granulomas in a serial section.

## Discussion

The prevalence of infestation in this outbreak (37.0%) is comparable to that of previous outbreaks reported from Texas (2.2-12.7%; 3), Arizona (10-12%; 4) and Ontario (50%; 5). Cysts were most commonly found in the heart in our survey. So-called predilection sites such as heart, masseter muscle, esophagus, diaphragm, or tongue continue to be controversial. Apparently, there were no true predilection sites found in a study in Great Britain and for that reason an ELISA test has been recommended for routine diagnosis (16).

Some of the histological findings here differ from those of previous reports. According to Slais (11), *in vivo* evagination of larvae of *T. saginata* elicits an inflammatory response. One invaginated parasite had adjacent inflammatory infiltrate (Figure 6). Our finding of some completely evaginated larvae of *T. saginata* (Figure 10) differs from the observation of Slais that evagination is never complete in cattle (11).

Some of the nonmineralized, small, green or grey lesions in the heart, liver, tongue, or skeletal muscle suspected at postmortem to be cysticerci were old granulomas of larvae of *T. saginata*. However, others were foci of hepatitis, sarcocystosis, or fatty infiltration. Occasionally, the grey-white nodules characteristic of myocardial neurofibroma can be mistaken grossly for cysticercosis (17).

This is the second outbreak of cysticercosis reported in Ontario. The epidemiological study was inconclusive, but vegetable refuse contaminated by a human carrier and fed to these cattle was the suspected source of infection. Examination of the vegetable refuse and sanitation plant sludge used for fertilization of the vegetable field were negative for the eggs of *T. saginata* by flotation. All feedlot workers underwent four consecutive fecal examinations with negative results. The potential human health hazard of this outbreak was eliminated through the practice of effective meat inspection and freezing (18). It would be advisable to report each case of bovine cysticercosis to the medical officer of health in order to test for carriers of *T. saginata* and treat if required.

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