

## SHORT REPORT: CYSTICERCOSIS IN AN EGYPTIAN MUMMY OF THE LATE PTOLEMAIC PERIOD

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**Abstract.** We describe here an ancient case of cysticercosis that was discovered in an Egyptian mummy of a young woman of about 20 years of age who lived in the late Ptolemaic period (second to first centuries B.C.). On removal of the stomach and its rehydration, a cystic lesion in the stomach wall was observed by naked eye. Microscopical examination of sections of this lesion revealed a cystic structure, with a wall, with numerous projecting eversions, a characteristic feature of the larval stage (cysticercus) of the human tapeworm *Taenia solium* (or “pig tapeworm”). Immunohistochemical testing with serum from a *T. solium*-infected human confirmed the identity of the cyst. This finding is the oldest on record of the antiquity of this zoonotic parasite. This observation also confirms that, in Hellenistic Egypt, the farming of swine, along with man an intermediate host of this parasite, was present, and supports other archeological evidence.

Cysticercosis in humans is caused by the pig tapeworm *Taenia solium*. We describe here a case of cysticercosis in an Egyptian mummy dating back to the late Ptolemaic period (second to first centuries B.C.). The Egyptian mummy, a young woman of about 20 years of age, is at present exhibited in the City Hall of Narni (central Italy). An autopsy was performed aided by the fact that the embalming technique of this period, consisting of evisceration followed by re-deposition of the internal organs in the body cavities, allowed a convenient examination of the mummy's organs.

The autopsy revealed a bundle of linen bandages, enveloping a hollow muscular organ, measuring 9 × 6 × 3 cm, with wall 5 mm thick, identified as the stomach. After rehydration,<sup>1</sup> a cystic lesion was observed by naked eye. Light microscopy of sections derived from this lesion (Figure 1A) revealed a cyst of 6 × 4 mm in size, with a wall of about 80 μm thick, with numerous projecting eversions (Figure 1B). The morphology of the cyst strongly suggested a larval stage (cysticercus) of the human/pig tapeworm *Taenia solium* (Figure 2), according to the criteria described by Slais.<sup>2</sup> To confirm the presumptive diagnosis, the tissue was tested by immunohistochemical staining with antibody to *T. solium*.

For the immunohistochemical test, we used indirect immunofluorescence and serum from a patient diagnosed with cysticercosis. Sections of tissue derived from the stomach were fixed in 10% neutral buffered formalin and embedded in paraffin. Five-micrometer-thick tissue sections, mounted on electrostatically charged glass slides, were dewaxed in histolene and, after rehydration, heated by microwaving in citrate buffer, as described by Munakata and Hendricks.<sup>3</sup> After three washes in phosphate-buffered saline (PBS), sections were preblocked with bovine serum albumin (1% in PBS) and incubated with a highly reactive and specific anti-*T. solium* human serum, provided by Dr. Noh (Centers for Disease Control, Chamblee, GA) or with a *T. solium* negative human serum, for 24 hours at 4°C. After washing, sections were incubated with a FITC-labeled anti-human IgG (1:200 dilution), at room temperature for 1 hour, then washed, mounted, and

observed with a laser confocal microscope (Radiance Plus Biorad, Biorad Laboratories, Hercules, CA).

The wall of the cystic structure showed an intense yellow-green fluorescence; the surrounding structures were not labeled (Figure 3). The control sections were all negative. Based on these morphologic and immunological data, we conclude with confidence that this young Egyptian woman suffered from porcine cysticercosis. This observation has scientific importance because, until now, only the presence of taeniid ova has been documented in the ancient specimens.<sup>4</sup> For example, taeniid ova were found in intestinal tract of an Egyptian male buried in the first half of the twelfth century B.C. (known as the mummy of Nakht, “the weaver of the funerary temple of the Pharaoh Setnakht” (1184–1181 B.C.))<sup>5</sup> and similar ova were found also in the bowel of an adult Chinese male from the Western Han dynasty buried in 167 B.C.<sup>6</sup>

However, taeniid eggs cannot be identified as to species on the basis of morphology alone. Therefore, this is the first diagnosis of ancient human cysticercosis (i.e., of human tissue

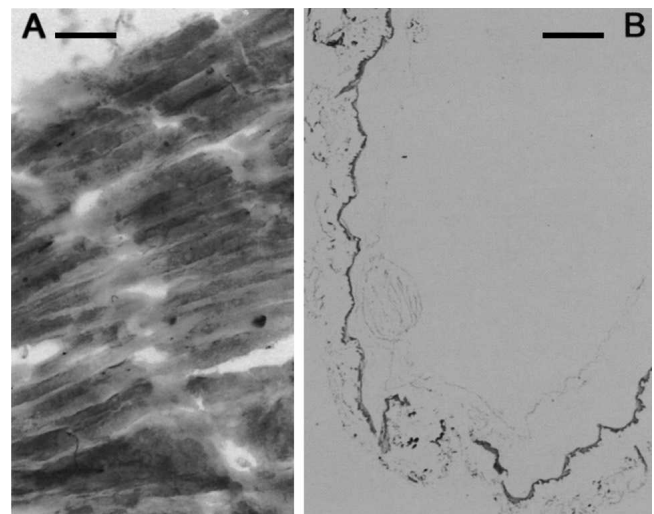


FIGURE 1. **A**, Muscle layer of the stomach wall (van Gieson, bar = 150 μm). **B**, Oval object, limited by a chitinous wall 80 μm thick, containing on the left a round structure, shown at higher magnification in Figure 2 (van Gieson, bar = 400 μm).

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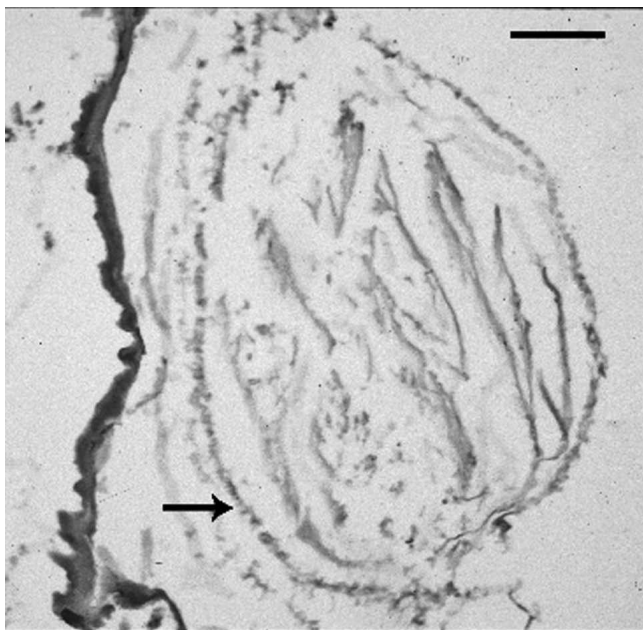


FIGURE 2. *Cysticercus cellulosae* with spiral channel (arrow) (van Gieson, bar = 100  $\mu$ m).

invasion by a larva of *T. solium*). The farming of swine was practiced in Hellenistic Egypt, probably for meat consumption, as several pictures originating from Egyptian civilization show.<sup>7</sup>

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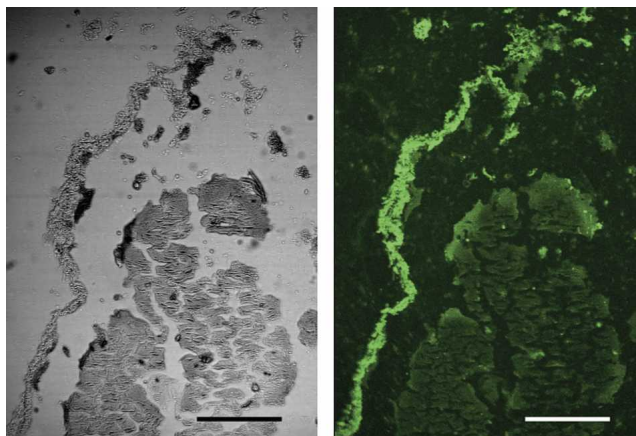


FIGURE 3. *Cysticercus cellulosae* and cyst wall observed by laser confocal microscopy after exposition of sections with *Taenia solium* highly reactive serum. Left: transmission light microscope view. Right: corresponding fluorescent image; the bladder wall is strongly stained. Bars = 100  $\mu$ m. This figure appears in color at [www.ajtmh.org](http://www.ajtmh.org).

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