



Cysticercosis and suicide – an example from a forensic collection

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Abstract

In this case from 1937, the deceased was a 52-year-old female who was suffering from systemic cysticercosis, with prominent neurological and psychiatric symptoms. Given the protracted clinical course and autopsy findings it appears likely that the disease led the woman to commit suicide by ingesting lye, a corrosive substance, and the most common way to commit suicide in Belgrade at the time. The autopsy revealed many rounded transparent cysts, attached to the dura and pia-arachnoid, as well as encapsulated in the intercostal muscles, diaphragm and muscles of the arms, legs and the trunk. Solitary cysticercosis of muscles without involvement of the central nervous system is rare: most soft tissue and muscular cysticercal infections are associated with the central nervous system. Parasites usually lodge in the cerebral cortex or the subcortical white matter, due to the high vascular supply of these areas. Psychiatric symptoms in neurocysticercosis have been frequently reported, along with cognitive decline and intellectual deterioration, depressive disorders, behavioral disturbance and psychosis. Although sporadically, the disease is present even today, and neurocysticercosis is the leading cause of epilepsy in the developing world. To maintain its lifecycle, *Taenia solium* requires non-industrialized pig rearing conditions, consumption of undercooked pork, and low sanitation standards. Socioeconomic and sanitary improvement and educating people about food processing, the disease and antihelminthic therapy, are important factors contributing to a significant reduction in the prevalence of this potentially eradicable disease worldwide.

Keywords Autopsy · Museum specimen · Suicide · Neurocysticercosis · *Taenia solium*

During his life, Dr. Eduard Michel (1864–1915), the first forensic pathologist in Serbia, assembled a small collection of interesting forensic specimens. In the early 1920s, his successor, Professor Milovan Milovanović (1884–1948), expanded the collection and formally founded the Forensic Museum of the Institute of Forensic Medicine – School of Medicine, University of Belgrade. On rare occasions, in particularly interesting cases, more than one specimen from the same autopsy was taken for the museum collection. That was the case with the two specimens from the Forensic Museum presented here: the brain and the calf muscles, both infected with pork tapeworm, *Taenia solium*, which resulted in cysticercosis.

Case outline

Museum references The preserved labels attached to the two jars, with the text written in Cyrillic, refer to the forensic case No. 350 with the autopsy performed on 30 July 1937 by Professor Milovanović. The first jar contains the brain of the deceased, cut into two halves during autopsy (Fig. 1a and b). The other one contains the calf muscles (Fig. 2a and b). Several solitary subarachnoid cysts are visible on the cerebral surface (Fig. 3). Most of the cysts in the calf muscles are also solitary, yet some of them are clustered, resembling a “bunch of grapes” (Figs. 2 and 4). All the cysts are up to 1 cm in diameter (Fig. 2).

Case history, autopsy findings and cause of death The deceased was a 52-year-old female who died in the General State Hospital in Belgrade on 29 July 1937, twenty hours after admission. The following data in the autopsy report were hand-written in ink by Professor Milovanović, in old-fashioned Cyrillic letters: “Over the last five years

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Fig. 1 The first museum specimen of forensic case No. 350, from 1937. The jar containing the brain of the deceased, cut into two halves during autopsy. **a** Brain surfaces. **b** Internal brain structures



of her life, the victim became physically, neurologically and psychiatrically ill. She was unbearable in marriage and was abandoned by her husband and child... She has been medically treated many times and... epilepsy, syphilis and echinococcus of the brain were diagnosed. Her

illness caused her to clash with her family and lose her job. She was alone in her apartment when she poisoned herself with lye. When she was transferred to the hospital, the woman told the doctors that she poisoned herself because of her mental disease...".

Fig. 2 The second museum specimen of forensic case No. 350, from 1937. Closer aspect of the calf muscles after removing the museum specimen from the jar. Most cysts are solitary, yet some of them are clustered, resembling a “bunch of grapes”. The diameter of cysts is up to 1 cm. **a** Subcutaneous surface of the muscle. **b** The cut side of muscles



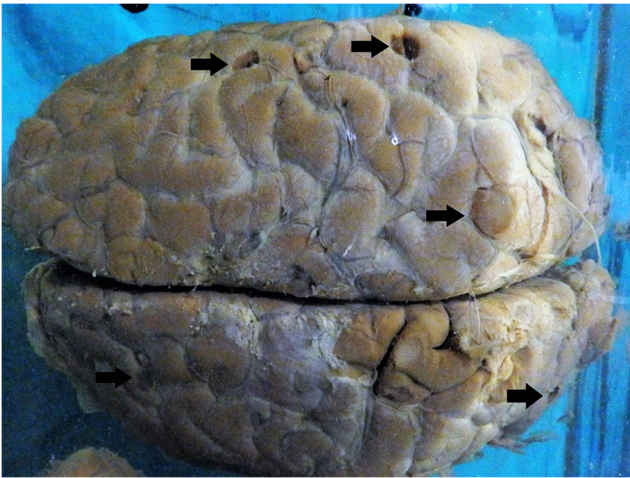


Fig. 3 Closer aspect of the brain surface with a few of solitary subarachnoid cysts (arrows)

During external examination, Professor Milovanović noticed “subcutaneous, fixed pea-form nodules... under the skin of the shoulder, lower legs and forearms”. Autopsy revealed a few rounded transparent cysts, attached to the dura and pia-arachnoid (Fig. 3). Similar cysts were revealed in the intercostal muscles and diaphragm, as well as in the skeletal muscles of the arms, legs (Figs. 2 and 4) and the trunk. Internal examination showed caustic changes to the oral mucosa and mucosa of the esophagus, stomach and small intestine. The cause of death was attributed to corrosive intoxication by lye, and death was suicidal in manner.

Discussion

Taenia solium, or pork tapeworm, develops in the human intestine following the ingestion of larvae in incompletely cooked pork. Ova in proglottids, released from the tapeworm and ingested via fecal–oral transfer, penetrate the stomach wall and are then disseminated by blood vessels to various organs including the brain [1] (Figs. 1 and 3). Humans are permanent hosts of this parasite [1]. The total number of cysts can range from a solitary lesion to several hundred [2]. The clinical features of cysticercosis depend on the location, cyst burden and associated inflammation. The brain, eye and muscle cysts cause most morbidity, the brain being the most common location (60–90%) [1, 2]. Solitary cysticercosis of muscles without involvement of the central nervous system is rare: most soft tissue and muscular cysticercal infections are associated with the central nervous system or involve multiple cysts [2], as in the case described here.

Large cysts often adopt a multilobulated, clustered appearance due to the confluence of vesicles, resembling a “bunch of grapes” [3] (Figs. 2 and 4). The cyst lies within the trilaminar membrane generated by the parasite. The ovoid cyst with its

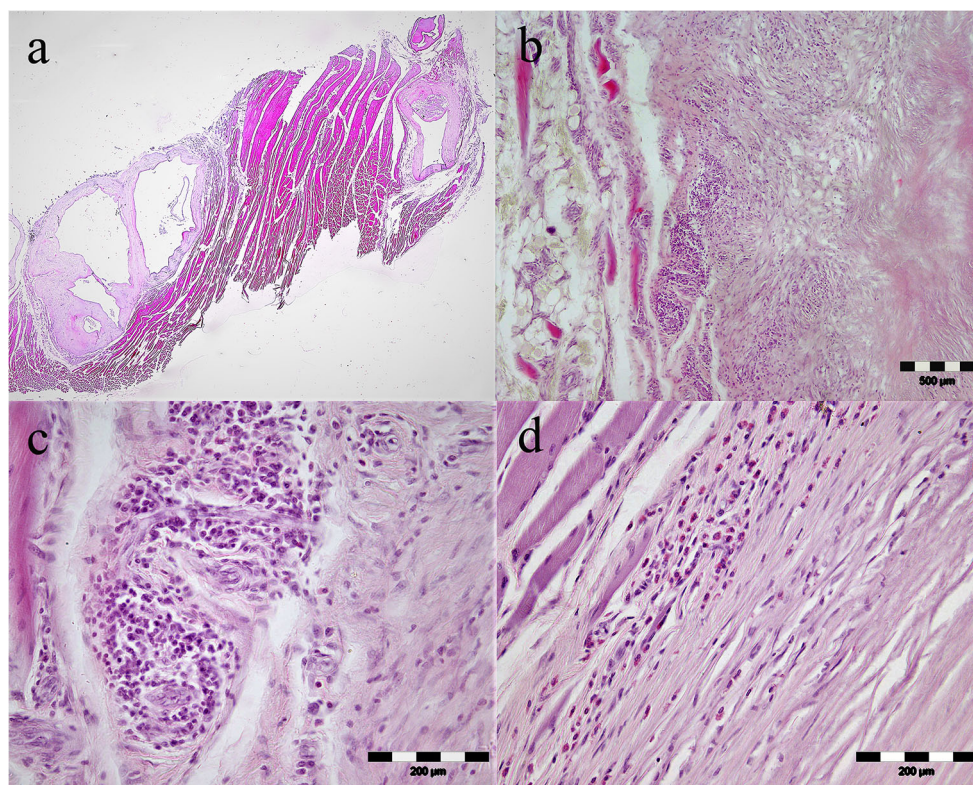


Fig. 4 The photograph of the calf muscles taken by Professor Milovanović in the autopsy room in 1937, prepared for the museum as a specimen

encysted opaque white larva is usually round and in average has a diameter of less than 1.5 cm (Fig. 2). It contains an invaginated scolex with hooklets, bathed in clear cyst fluid (Fig. 5a). Living larvae evade immune recognition [2] and evoke little host inflammatory reaction [1] (Fig. 5b-d).

Neurocysticercosis is the most common parasitic disease of the central nervous system [4] and can be classified anatomically as parenchymal, meningeal, intraventricular and spinal [1]. This disease is highly pleomorphic in manifestation owing to the individual differences in the number and location of the lesions. Parasites usually lodge in the cerebral cortex or the subcortical white matter, due to the high vascular supply of these areas [5], and may induce epilepsy [4, 5]. Even today, neurocysticercosis is the leading cause of epilepsy in the developing world [6, 7]. It can also be the cause of sudden and unexpected death [4, 8]. In such cases, a cyst becomes lodged in the third or fourth ventricle. Acute hydrocephalus and inflammatory changes along the walls of the fourth ventricle suggest a possible cardiorespiratory arrest secondary to an effect on the dorsal motor nucleus of the vagus (adjacent to the walls of the distended third ventricle) [1]. The muscular form of cysticercosis is commonly asymptomatic. If clinical manifestations are present, they occur in the following

Fig. 5 The histological section of the calf muscles cysticercosis taken from museum specimen (forensic case No. 350, the autopsy performed on 30 July 1937). **a** Low-power photomicrograph of the calf muscles cysticercosis with multilobulated clustered appearance due to the confluence of vesicles and with degenerated larva within one cyst. **b** and **c** Low (20x) and high-power (40x) aspect of a zone of mixed inflammatory infiltrate and foreign body giant cell reaction to a degenerated parasitic membrane. **d** Foci of abundant eosinophilic infiltration



three forms: the myalgic type, the mass-like, pseudotumor or abscess-like type and the pseudohypertrophic type [9]. In the presented case, there was no data about the muscular symptoms.

Psychiatric symptoms in neurocysticercosis have been frequently reported, along with cognitive decline and intellectual deterioration, depressive disorders, behavioral disturbance and psychosis. Progression of the disease and intracranial hypertension correlates with higher levels of psychiatric comorbidity [10, 11].

The data in the autopsy report suggest that the psychiatric symptoms were dominant in the last five years of the victim's life, leading not only to health impairment, but also to social impairment, substantially reducing the quality of her life. We can only assume that the symptoms were quite intense, since both her marriage and professional life fell apart during that period. The psychiatric symptoms the unfortunate woman displayed exacerbated, yet their cause remained unknown to the physicians who treated her. Finally, given the protracted clinical course and autopsy findings it appears likely that the disease led the woman to commit suicide by ingesting lye, the most common way to commit suicide in Belgrade at the time [12, 13].

Conclusion

Taenia solium has been effectively controlled in most of Europe; however, autochthonous transmission, although rare, has been reported in the Iberian Peninsula and some

areas of Eastern Europe [14, 15]. There were a few autochthonous cysticercosis cases in Serbia [16]. To maintain its lifecycle, *Taenia solium* requires non-industrialized pig rearing conditions, consumption of undercooked pork, and low sanitation standards [16]. Lifestyle changes, socioeconomic and sanitary improvement, educating people about food processing, as well as about the disease and antihelminthic therapy, are important factors contributing to a significant reduction in the prevalence of this potentially eradicable disease worldwide [2]. Although the disease is only sporadically present today, pathologists should consider it, not only as the possible (contributing) cause of death, but also because of its broader medicolegal implications.

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Compliance with ethical standards

Conflict of interest The authors hereby declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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