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Asian Pacific Journal of Tropical Medicine

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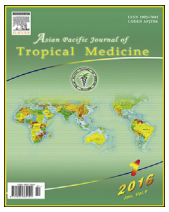

Original research http://dx.doi.org/10.1016/j.apjtm.2015.12.005

Evaluation of activity of triclabendazole against *Taenia solium* metacestode in naturally infected pigs

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ARTICLE INFO

Article history:
Received 15 Oct 2015
Received in revised form 20 Nov 2015
Accepted 3 Dec 2015
Available online 19 Dec 2015

Keywords:
Taenia solium
Cysticercosis
Triclabendazole
Oxfendazole
Treatment

ABSTRACT

Objective: To assess the efficacy of triclabendazole (TCBZ) in porcine cysticercosis.
Methods: Eighteen naturally infected cysticercosis pigs were divided into 3 groups of 6 individuals each. The first group was treated orally with TCBZ at a single dose of 30 mg/kg of body weight, the second group was treated orally with oxfendazole at a single dose of 30 mg/kg of body weight and the third group received a placebo (control group). All animals were kept under the same management conditions. The pigs were euthanized 17 wk post-treatment and the number of surviving cysts in muscles was assessed and compared between groups.
Results: All pigs treated with oxfendazole had only degenerated cysts in their carcasses. In contrast, TCBZ had very little effect against the parasitic cysts. Cysts from pigs in the TCBZ group looked apparently normal after treatment. However, histological evaluation showed a mild to moderate degree of inflammation.
Conclusions: TCBZ is not an efficacious drug against *Taenia solium* cysticercosis in swine using a single dose.

1. Introduction

The disease complex, taeniasis/cysticercosis caused by the pork tapeworm *Taenia solium* (*T. solium*), is a very important zoonotic disease in developing countries [1,2]. The adult *T. solium* tapeworm localizes in the small intestine of humans, the definitive host. The eggs of *T. solium* are eliminated into gravid proglottids with the faeces, and then they are ingested by pigs, the intermediate host. The *T. solium* metacestode then develops in different organs of the pig, principally muscles [3,4]. However, humans can act as accidental hosts when they ingest eggs in contaminated food [3,5].

During the last decade, a variety of strategies have been performed for the control of *T. solium* cysticercosis including animal inspection, massive chemotherapy for *T. solium* in humans and pigs from endemics areas, health education, and pig vaccination [2,6–9]. For this purpose, many studies have been performed to evaluate the efficacy of different drugs against porcine cysticercosis [10]. Of these drugs, albendazole and oxfendazole (OFZ), members of the benzimidazole drugs, are efficacious for the treatment of the porcine cysticercosis [11]. Albendazole has been used in humans since 1979, and currently it is considered the drug of preference in humans for its availability, low cost and efficacy [5,11]. Albendazole does not seem to be a good option for field interventions due to the requirement for multiple doses [10]. OFZ, used in a single oral dose of 30 mg/kg, is the drug of choice for the treatment of porcine cysticercosis [12]. The widely used triclabendazole (TCBZ), another member of the benzimidazole family, is efficacious against adults and larval stages of a variety of helminthic parasites [13,14]. The aim of this study was to compare the efficacy of a single oral dose of TCBZ or OFZ against *T. solium* cysticercosis in naturally infected pigs.

2. Materials and methods

2.1. Study design and settings

The study was conducted at the animal facilities of the Laboratory of Veterinary Epidemiology and Economics, School of Veterinary Medicine, National University of San Marcos in

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Peer review under responsibility of Hainan Medical College.

Lima, Peru. Pigs were acquired in a cysticercosis-endemic area and transported to the animal facilities in Lima. Pigs were randomized in three similar groups (TCBZ, OFZ, and placebo) using a random numbers table. All pigs were coded and labelled with ear tags.

2.2. Animals

Eighteen adult pigs were acquired in Huancayo, a cysticercosis-endemic area in the Peruvian highlands [15]. All animals were positive to cysticercosis by tongue examination, and confirmed by antibody detection on serum enzyme-linked immunoelectro transfer blot [16,17]. Only animals with more than one cyst in the tongue and more than four antigen bands in enzyme-linked immunoelectro transfer blot were included in the study. All pigs were vaccinated against hog cholera immediately after purchase.

2.3. Treatment protocol

The pigs were randomly placed in three different groups of six pigs each. Pigs in group 1 received a single oral dose of 30 mg/kg body weight of TCBZ (Trisan 12%, Montana S.A., Peru). Pigs in group 2 were treated orally with OFZ (Synanthic® 9.06%, Fort Dodge, Mexico), using a single dose of 30 mg/kg body weight. Control pigs (group 3) received sugar water as a placebo. Each treatment group was housed in a single pen.

2.4. Necropsy

All animals were euthanized 17 wk after treatment, and necropsied at the School of Veterinary Medicine facilities in Lima, Peru. Pigs were anesthetized and sacrificed by intramuscular injection of a combination of ketamine (20 mg/kg) and xylazine (2 mg/kg) followed by intravenous injection of pentobarbital sodium overdose (60 mg/kg). Necropsy was performed immediately after euthanasia, and muscles from arms and legs were dissected, and all cysts were counted and classified. Cysts were classified as viable if a defined cystic structure with clear liquid content was still present, and degenerated if this had been replaced by semi-solid contents or an inflammatory scar (calcified nodule).

2.5. Histological analysis

Five randomized cysts from the muscles of each pig were fixed in 10% formalin, embedded in paraffin, then sectioned at 5 μm and stained with haematoxylin and eosine (H&E), as well as Von Kossa stain to assess the presence of calcium.

2.6. Data analysis

Parasitic load was expressed in median with their respective ranges. A non-parametric one-way analysis of variance (Kruskal–Wallis) test was used to estimate the difference in the number of cysts between treatment groups. Data was analysed using STATA 10 statistical software (v10.0; StataCorp LP, College Station, TX). Differences were considered statistically significant at P-value <0.05.

2.7. Ethical approval

The study was approved by the Animal Ethics Committee of the School of Veterinary Medicine, National University of San Marcos, Lima, Peru.

3. Results

During treatment and follow up, pigs from the treated groups involved in this experiment were apparently normal without apparent adverse events. All pigs used in this study were positive to cysticercosis at tongue examination as well as positive to 4 or more antibody bands enzyme-linked immunoelectro transfer blot. After necropsy, the overall parasite load including viable or degenerated cysts for each group was 1658 (131–2575) (median, interquartile range) cysts for control group, 1414 (511–4052) cysts for TCBZ treated group, and 259 (38–1953) cysts for OFZ treated group (Table 1). All remaining cysts in the OFZ pigs were evidently degenerated. Furthermore, the numbers of cysts were statistically significantly smaller in OFZ group compared with the TCBZ and control groups ($P < 0.01$).

TCBZ had very little effect against the parasitic cysts. Cysts from animals in the TCBZ group looked apparently normal after

Table 1
Median, range and feature of larval stage of *T. solium* after treatment of pigs.

Indexes	Group		
	TCBZ	OFZ	Control
Animals	6	6	6
Male	2	2	2
Weight (kg)[a]	77 (67–86)	95 (66–117)	81 (49–119)
Number of viable cysts	1414 (511–4052)[b]	0[b]	1658 (131–2575)[b]
Number of degenerated cysts	0	259 (38–1953)	0

[a]Mean and range; [b]Significant difference between control and treatment (Kruskal–Wallis test, $P < 0.01$).

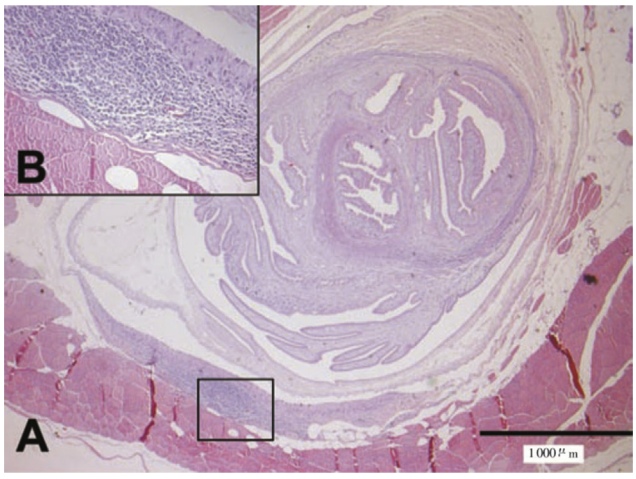

Figure 1. Histological section of cysts from a pig treated with TCBZ (H&E stain).
It showed a significant inflammatory reaction. Multifocal lymphocytic myositis (A). Presence of lymphocytes, eosinophils, macrophages, plasmocytes, and fibroblasts (B).