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Use of Ivermectin in Neurocysticercosis: A Case Report

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Funds Collection G

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Patient: Female, 25
Final Diagnosis: Neurocysticercosis
Symptoms: Headache • seizure
Medication: —
Clinical Procedure: Lumber puncture
Specialty: Infectious Diseases

Objective: Rare disease





Background: Neurocysticercosis is a *Taenia solium* infection which utilizes the tapeworm as a vector and humans as a definitive host and causes development of cystic lesions in the central nervous system. The current established medical therapy is albendazole with praziquantel as a secondary agent, but results can be mixed depending on each patient and their form of neurocysticercosis.

Case Report: We present a case pertaining to a young female patient diagnosed with single parenchymal neurocysticercosis based on clinical and diagnostic findings. This case was unique in the sense that ivermectin, another antiparasitic agent, was used as monotherapy with significant improvement in the patient's clinical presentation and radiological findings.

Conclusions: Despite current guidelines recommending use of albendazole with or without praziquantel for neurocysticercosis, our case (as well as 4 other cases documented in the recent past) suggest a possible use of ivermectin as potential therapy for neurocysticercosis. We recommend continued research regarding other cases of ivermectin use in similar patients and even comparison studies with albendazole with or without praziquantel in terms of efficacy and side effects in order to better treat this international endemic.

MeSH Keywords: Albendazole • Ivermectin • Neurocysticercosis

Full-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/911269>

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Background

Neurocysticercosis is a specific infection which *Taenia solium*, a tapeworm species that uses pigs as a vector and humans as the sole definitive host and forms cystic lesions in the central nervous system [1]. The use of antiparasitic agents, such as albendazole and/or praziquantel, have yielded mixed results based on reduction of seizure recurrence and improvement in lesion reduction and resolution. Certain forms of this infection such as a single enhancing lesion and viable parenchymal cysticerci do respond well to therapy including albendazole, but recent studies show that other subtypes such as ventricular neurocysticercosis and subarachnoid neurocysticercosis do not share a similar significant response to current antiparasitic regimens [2–4].

As cysticercosis continues to be an endemic in developing countries and is increasing in incidence in developed nations, the need for further research and consideration for a more complete medical therapy grows [5]. Our review of current literature found that ivermectin had a limited effect in *in vitro* studies and in porcine cases but also found a positive response in human presentations of neurocysticercosis refractory to albendazole. We are presenting the first documented case of diagnosed neurocysticercosis in which ivermectin was used as the initial therapy.

Case Report

On July 2017, a 25-year-old female patient presented with new onset seizure, left upper extremity weakness, and headache for

1 day. She was born in El Salvador and came to USA in 2010. The patient denied any sick contacts, drug abuse, recent travel, pets, or eating undercooked meat recently.

On physical examination, her blood pressure was 122/78 mm Hg, her temperature was 37.1°C (98.8°F), her pulse was 70 beats per minute, and her respiratory rate was 16 breath per minute. Her neurological examination was unremarkable except for a score of 4 out of 5 on strength of the left upper extremity. The cardiovascular, respiratory, fundoscopic, and abdominal examinations were unremarkable. The complete blood count and complete metabolic panel were unremarkable. Cerebrospinal fluid (CSF) analysis showed white blood cell count (WBC) of 1 cell/ μ L, red blood cell (RBC) count of 1 cell/ μ L, glucose 58 mg/dL, and protein of 25 mg/dL. CSF WBC was not enough to perform CSF viral panel. The human immunodeficiency virus (HIV) test, toxoplasma serology, CSF Cryptococcus antigen, and CSF culture were all negative. However, cysticercosis serology was positive in the serum and CSF. Magnetic resonance imaging (MRI) of the brain showed round cystic lesion 1.5×1.0 cm in the right superior parietal lobule medially with imaging characteristics of neurocysticercosis including the presence of a scolex and surrounded by a moderate amount of vasogenic edema (Figure 1A).

Due to a shortage of albendazole nationwide in the USA (which resolved on September 20, 2017 per the American Society of Health-System Pharmacists), the patient agreed to be started on oral ivermectin 10 mg once daily for 1-month, tapering course of dexamethasone for 1 month, and oral levetiracetam. She was re-evaluated in our clinic 1 month later and denied experiencing any headache, weakness, or seizure. Physical examination was unremarkable. Follow-up brain MRI 2 months

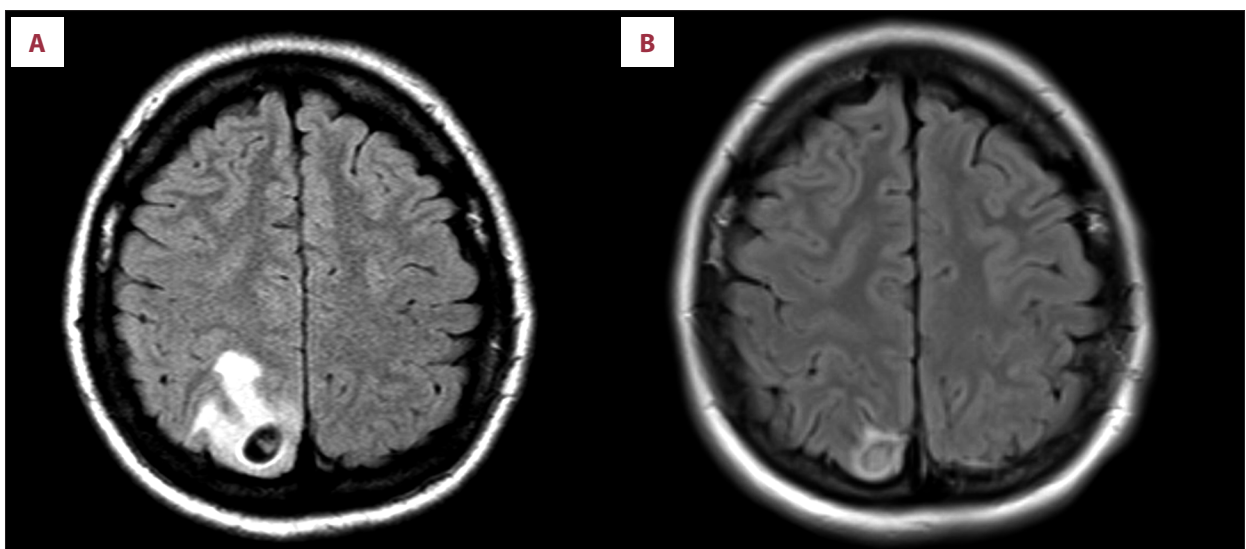


Figure 1. (A) Magnetic resonance imaging (MRI) of the brain with round cystic lesion 1.5×1.0 cm in the right superior parietal lobule medially with imaging characteristics of neurocysticercosis (presence of scolex) and moderate surrounding vasogenic edema. (B) Follow-up brain MRI, 2 months later, showed significant decrease in cystic lesion size to 0.8×0.6 cm.

later showed a significant decrease in cystic lesion size to 0.8×0.6 cm (Figure 1B). The patient continued to follow-up with the Neurology Clinic periodically as an outpatient. Her most recent assessment was 7 months after therapy, and she remained well and asymptomatic at that time.

Discussion

Neurocysticercosis remains a unique disease in modern medicine today for its significant prevalence, wide range of possible manifestations, and limited evidence on treatment and intervention. Regarded as one of the most common helminthic neurological infections worldwide, neurocysticercosis was recently predicted to be the primary cause of seizures in up to 30% of patients with epilepsy in endemic regions (Latin America, India, sub-Saharan Africa) [4].

Although current recommendations for antiparasitic agents consist of the use of albendazole with or without praziquantel, we presented a patient with single parenchymal neurocysticercosis which responded adequately (based on resolution of symptoms and decrease in cyst size) to a month course of oral ivermectin. Our choice to consider ivermectin was based on the discovery of a national shortage of albendazole; we similarly did not consider praziquantel as monotherapy as current guidelines recommended only albendazole for monotherapy or albendazole and praziquantel for dual therapy.

Ivermectin acts as an antiparasitic agent by binding with high selectivity and affinity for glutamate-gated chloride ion channels in the nerve and muscle cells of microfilaria, causing an increase in permeability of the cell membrane to chloride ions, hyperpolarization, and ultimately death of the targeted parasite. In veterinary fields, ivermectin is a standard of treatment for gastrointestinal roundworms and bovine lungworm in the livestock industry and is also used for ectoparasites in domesticated pets such as canine heartworm [7,8]. However, research pertaining to ivermectin use against *T. solium* is very limited at this time. In 2012, Cederberg et al. demonstrated that ivermectin had very limited effect against cysts *in vitro*, while in 2013, Mkupasi et al. reported a similarly low efficacy using porcine subjects with cysticercosis [9,10]. In addition, it is believed that ivermectin does not readily cross the blood-brain barrier in humans. Any crossing might become significant only in high doses of ivermectin which in turn may cause severe side effects including central nervous system (CNS) suppression. However, in 2008, Diazgranados-Sánchez et al.

presented a case report of 4 patients with neurocysticercosis refractory to albendazole and/or praziquantel that responded positively to ivermectin. Three out of the 4 patients had persistent symptoms despite 3 cycles of albendazole with course duration ranging from 10 to 30 days. In addition, 1 patient suffered from intraventricular neurocysticercosis, while another patient suffered a racemose form of the disease, both of which are significantly more challenging to treat medically. All of the 4 patients later demonstrated significant improvement in symptoms and even complete resolution of neural cystic lesions [11].

To date, there have been no other documented cases in the current medical literature that utilized ivermectin as possible therapy, to our knowledge. Our case was unique even in comparison with those 4 patient cases because we are the first to use ivermectin as the primary therapy. In the 2017 Infectious Diseases Society of America guidelines on neurocysticercosis, albendazole was the gold standard of antiparasitic therapy for cases with 1 to 2 parenchymal cysts with the addition of praziquantel for presentations with greater than 2 parenchymal cysts [12]. Our patient had not undergone any cycles of albendazole but instead improved clinically and radiologically with ivermectin therapy alone. We strongly propose that additional research in broader and more controlled settings be pursued, particularly a controlled trial to support the efficacy of ivermectin as well as a comparison of ivermectin with the established protocols of albendazole with or without praziquantel in terms of efficacy and side effects. While previous studies did not show a significant impact on neurocysticercosis *in vitro* or in porcine samples, our case argues that the response in human presentations might yield a very different result. As neurocysticercosis continues to be a medical burden internationally, the need for a more complete therapeutic regimen remains, and will benefit from exploration of ivermectin as a potential therapy for refractory cases or even as monotherapy.

Conclusions

This case report and the documentation of 4 additional case reports in the past support the hypothesis that ivermectin might be a viable pharmacotherapy for neurocysticercosis in addition to albendazole and praziquantel. However, given that this data is limited and studies in the past have shown limited efficacy in porcine and *in vitro* subjects, we strongly recommend continued research including additional case reports and even comparison studies for different therapies in the future.

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