Short Report: Hemorrhagic Cerebrovascular Events and Neurocysticercosis: A Case Report and Review of the Literature

George M. Viola, A. Clinton White Jr., and Jose A. Serpa*

Department of Medicine, Section of Infectious Diseases, Baylor College of Medicine, Houston, Texas;
The University of Texas, MD Anderson Cancer Center, Houston, Texas; Division of Infectious Diseases,
University of Texas Medical Branch at Galveston, Texas

Abstract. Cerebrovascular complications have been reported to occur in patients with neurocysticercosis (NCC). We report a patient who presented with relapsed subarachnoid hemorrhage possibly linked to NCC. In addition, we performed a literature review of all of the reported cases of aneurysmal and non-aneurysmal hemorrhagic cerebrovascular events associated with NCC. We identified 11 such cases. The majority of the individuals were young males (mean: 38 years; 70% males). Four cases (36%) had aneurysms. Four (36%) others had negative cerebral angiograms and therefore classified as non-aneurysmal, while the remaining three (28%) did not report sufficient information to classify them. All cases with aneurysmal hemorrhage underwent successful surgical repair of the aneurysms. Seven patients received albendazole (including three who had had surgery). Three patients died; all three presented in the pre-albendazole era. In summary, neurocysticercosis should be considered in the differential diagnosis of hemorrhagic cerebrovascular events in young patients without classical vascular risk factors who have lived or visited NCC-endemic areas.

INTRODUCTION

Neurocysticercosis (NCC) caused by the larval stage of *Taenia solium* is the most common helminth infection of the human central nervous system worldwide.¹ Neurocysticercosis has become an important emerging infection in the United States. This has largely been driven by the influx of immigrants from highly endemic regions into the United States and widespread access to neuroimaging.²

Neurocysticercosis is a disease with protean manifestations, which depends upon the number of parasites, their location, and the degree of host inflammatory response. Most common clinical manifestations include late onset epilepsy or symptoms of intracranial hypertension.³ Cerebrovascular complications have been reported to occur in 4–12% of patients with NCC.⁴ In the majority of these cases, the diagnoses were ischemic cerebrovascular events associated with vasculitis and/or thrombosis from surrounding cysts in both small- and large-diameter vessels. Subarachnoid hemorrhages have been noted in subarachnoid neurocysticercosis and have been associated with cerebral aneurysms in some, but not all, cases.^{4–8}

Despite recent advances, treatment of NCC remains suboptimal at this time. Treatment with antihelmintics, corticosteroids, antiepileptic drugs, and surgical interventions constitute some alternatives in the management of the disease.⁹ Here we report a patient who presented with a relapsed non-aneurysmal subarachnoid hemorrhage possibly associated with subarachnoid cysticercosis. In addition, we systematically reviewed the literature to summarize all of the reported cases of hemorrhagic cerebrovascular events associated with NCC.

MATERIAL AND METHODS

We searched the English literature in December 2009 with PubMed using the search terms [Stroke AND neurocysticercosis].

[Subarachnoid hemorrhage AND neurocysticercosis], and [cerebral hemorrhage AND neurocysticercosis]. We also searched references from previous literature. Abstracts were reviewed, and papers that presented original cases of hemorrhagic cerebrovascular events associated with neurocysticercosis were reviewed in detail.

RESULTS

Case report. A 39-year-old Hispanic female was admitted with a 1-day history of severe bilateral frontal headache not associated with visual disturbances, nausea, vomiting, or neurological deficits. She was afebrile and her physical exam, including a detailed neurologic examination, was within normal limits. She had moved to Houston, Texas ~15 years earlier from a small rural desert town on the Pacific coast of Mexico, where she used to be a farmer. Two years earlier, she had been diagnosed with a subarachnoid hemorrhage located around the left Sylvian fissure. Multiple magnetic resonance imaging (MRI) studies and cerebral angiograms done at that time did not show any evidence of aneurysms or vascular malformations. Up until her current hospitalization, she had remained asymptomatic. However, on admission an MRI of her brain revealed a new left subarachnoid hemorrhage involving the left suprasellar cistern, interpeduncular cistern, left ambient cistern, and again the left Sylvian fissure. Additionally, the images showed dilatation of the lateral and third ventricles, and the aqueduct of Sylvius, with obstruction caused by cysts associated with leptomeningeal enhancement of the supracerebellar cistern (Figure 1). A lumbar puncture revealed an opening pressure of 15 mm H₂O, 18 red blood cells/mL, 20 white blood cells/mL (78% lymphocytes and 5% eosinophils), glucose of 88 mg/dL, and protein of 28 mg/dL. Bacterial, fungal, and mycobacterial cultures of the cerebral spinal fluid were all negative. She was also found to have peripheral eosinophilia (absolute eosinophil count of 900 cells/mL). A repeat cerebral angiogram was again negative for aneurysms. Enzyme-linked immunotransfer blot for cysticercosis in serum was positive. As a result, the patient had a ventriculoperitoneal shunt placed because of the obstructive hydrocephalus. Subsequently, she was given dexamethasone

*Address correspondence to Jose A. Serpa, Baylor College of Medicine, Department of Medicine, Section of Infectious Diseases, One Baylor Plaza, BCM 286, Room N1319, Houston, TX 77030. E-mail: jaserpaa@bcm.edu

FIGURE 1. T1-weighted axial magnetic resonance image of the brain revealing an acute subarachnoid hemorrhage around the Sylvian fissure (arrow) and racemose cyst within the supracerebellar cistern (square), causing a non-communicating hydrocephalus with dilatation of the third and lateral ventricles, and the aqueduct of Sylvius.

and albendazole for a total of 4 weeks. She fully recovered without any neurological deficits.

Review of the literature. We identified 10 other cases with aneurysmal or non-aneurysmal hemorrhagic cerebrovascular events associated with neurocysticercosis in the literature (Table 1). The mean age was 38 years (median: 33). Most cases were males (70%, 7 of 10 cases; data was not available for one case). Four cases (36%) were found to have an aneurysmal hemorrhagic event. Four (36%) had negative cerebral angiograms and therefore had a non-aneurysmal hemorrhagic event. Three (28%) did not report sufficient information to categorize them as aneurysmal or non-aneurysmal. Location of lesions was varied but perhaps the most common presentation involved subarachnoid hemorrhage in the Sylvian fissure (28%, 3 of 11 cases). All three patients who had examination of cerebrospinal fluid (CSF) showed evidence of anti-cysticercal antibodies in the CSF. All cases with aneurysmal hemorrhagic events underwent successful surgical repair of the aneurysms. Seven patients received albendazole (including three who had had surgery) usually along with corticosteroids. Three patients died; all presented in the pre-albendazole era.

DISCUSSION

Although cerebral cysticercosis (particularly subarachnoid cysticercosis) has been linked to the occurrence of cerebrovascular events, most studies have focused on ischemic events. In our review we found 11 cases with aneurysmal or non-aneurysmal hemorrhagic cerebrovascular events associated with cysticercosis.

The majority of cases occurred in young individuals presumptively without classic vascular risk factors. The fact that

neurocysticercosis involving the subarachnoid space was the most common finding observed underscores the progressive nature and poor evolution, if not properly managed, of this type of neurocysticercosis.

The pathogenesis of subarachnoid hemorrhage in neurocysticercosis is not clear. The presence of clumps of subarachnoid cysts within the cisterns of the cerebrospinal fluid may cause an inflammatory exudate, which could result in thickening of the leptomeninges. Blood vessels trapped within this dense exudate might undergo invasion of the vessel wall by inflammatory cells, leading to endarteritis and endothelial hyperplasia (cysticercotic angiitis).^{5,7} In a previous study, 15 (53%) of 28 patients with subarachnoid cysticercosis who underwent cerebral angiography had evidence of cerebral arteritis in middle size arteries (middle cerebral artery and posterior cerebral artery).¹³ Almost certainly this severe inflammatory process could lead not only to ischemic cerebrovascular events but also hemorrhagic events. The mechanism of blood vessel rupture might result directly from the marked inflammatory process of a small penetrating artery,⁷ from erosion of a degenerating cyst in the wall of a small vessel or through the formation of an inflammatory aneurysm.^{5,6,8,10} Inflammatory aneurysms are usually located at distal intracranial arteries, not at bifurcations like congenital aneurysms, and are more commonly fusiform in shape.⁸ Direct clipping of inflammatory aneurysms is also more difficult than with congenital aneurysms.^{5,6} The wall of inflammatory aneurysms and parent vessels are extremely friable, and the possibility of intraoperative rupture is higher. In addition, inflammatory aneurysms are fusiform so clipping of the aneurysm neck while preserving the parent artery is technically challenging. As a result, they are generally secured by wrapping,⁵ clipping of the proximal artery,¹⁰ or trapping.⁸

Among those patients who had examination of the CSF, all of them showed positive anti-cysticercal antibodies. This could be caused by a large parasite (antigenic) burden leading to an intense inflammatory response in the CSF. Recently, it has been demonstrated that detection of cysticercal antigens by monoclonal antibody-based enzyme-linked immunosorbent assay (ELISA) in the CSF suggests active subarachnoid cysticercosis.¹⁴ Hence, we hypothesize that application of this technique in cases of hemorrhagic cerebrovascular events associated with neurocysticercosis may be warranted.

After albendazole became available in the mid-1990s, all cases of hemorrhagic stroke associated with cysticercosis were treated with a course of this antihelminthic, usually along with corticosteroids and surgical therapy, if an aneurysm was present. All of these patients experienced improvement of their symptoms. Whether albendazole, as part of the administered therapeutic regimen, contributed to the improvement of the condition remains speculative at this time. In addition, there seems to be consensus on the need of surgical intervention in cases of aneurysmal hemorrhagic events associated with neurocysticercosis; however, its role, if any, in cases of non-aneurysmal hemorrhagic events needs to be investigated.

In summary, neurocysticercosis should be considered in the differential diagnosis of aneurysmal and non-aneurysmal hemorrhagic cerebrovascular events in young patients without classical vascular risk factors who have lived in or traveled to areas where NCC is endemic. Further studies of the pathophysiology, diagnosis, therapy, and prognosis of

TABLE 1
Aneurysmal and non-aneurysmal CNS hemorrhage caused by neurocysticercosis (NCC)*

Report	Age/sex	Clinical presentation	CSF	Imaging studies	Aneurysm location/ morphology	Surgery	Medication	Outcome
1. Zee and others, ¹⁰ 1980	23/M	Headache, nausea, vomiting, AMS, and CN impairment	NA	Large right temporal hematoma	Right distal MCA /mycotic	Clipping of the proximal artery	NA	NA
2. Iwanowski and others, ¹¹ 1987	56/F	NA	NA	Focal hemorrhage in basal ganglia. Solitary cyst in temporal horn	NA	NA	NA	Died
3. Iwanowski and others, ¹¹ 1987	54/M	Hemiparesis	NA	Subarachnoid hemorrhage with solitary cyst on quadrigeminal plate	NA	NA	NA	Died
4. Alarcon and others, ⁴ 1992	NA	Motor deficits	NA	Hemorrhage into a frontal lobe cyst†	NA	None	NA	Died
5. Soto-Hernandez and others, ⁵ 1996	32/M	Headaches, nausea, vomiting, AMS, and meningeal signs	6,486 cells (77% PMN and 5% E), glucose 10 mg/dL, protein 1,560 mg/dL, ELISA for NCC (+)	Subarachnoid hemorrhage, hydrocephalus, subarachnoid cysts at the suprasellar, and pontine cisterns and anterior aspect of right temporal lobe	Right branch of AICA/fusiform	Wrapping	Albendazole for 10 days and steroids	Improved
6. Sawhney and others, ¹² 1998	10/M	Headache, nausea, vomiting, and partial seizures	NA	Left parietal hematoma and multiple cysts	Normal angiogram	NA	Albendazole, steroids, (duration unknown)	No improvement
7. Huang and others, ⁶ 2000	32/M	Headache, nausea, and dysphasia	NA	Subarachnoid hemorrhage and multiple cysts in the left Sylvian fissure	Left M2 MCA Branch/pseudofusiform angiogram	Clipping	Albendazole, (duration unknown)	Improved
8. Tellez-Zenteno and others, ⁷ 2003	32/F	Headache, dysarthria, left hemiparesis, and psychomotor agitation	3 cells, glucose 55 mg/dL, protein 33 mg/dL, ELISA for NCC (+)	Right lenticulo-capsular hemorrhage around a large cystic lesion and cysts in right parietal lobe	Normal angiogram	None	Albendazole for 15 days and steroids	Improved
9. Tellez-Zenteno and others, ⁷ 2003	34/M	Headache, nausea, vomiting, diplopia, gait disorder, psychomotor agitation, CN impairment	107 cells (97% L), glucose 19 mg/dL, protein 695 mg/dL, ELISA for NCC (+)	Hemorrhagic lesion and a cyst in the ambiens cistern	Normal angiogram	None	Albendazole for 8 days and steroids	Improved
10. Kim and others, ⁸ 2005	69/M	AMS	NA	Subarachnoid hemorrhage in the right Sylvian fissure, large right temporal lobe hematoma, and a cyst within the fissure	Right MCA, distal branch of ATA/fusiform	Trapping	Albendazole for 2 months	Improved
11. Current case, 2010	39/F	Headaches	20 cells (78% L, 5% E), glucose 88 mg/dL, protein 28 mg/dL	Subarachnoid hemorrhage around the left Sylvian fissure and multiple cysts within the basilar cistern	Normal angiogram	None	Albendazole for 4 weeks and steroids	Improved

* AICA = anterior/inferior cerebellar artery; AMS = altered mental status; ATA = anterior temporal artery; CN = cranial nerve; CNS = central nervous system; CSF = cerebrospinal fluid; E = eosinophils; ELISA = enzyme-linked immunosorbent assay; L = lymphocytes; MCA = middle cerebral artery; NA = information not available; PMN = polymorphonuclear cells.
† Autopsy findings.

hemorrhagic cerebrovascular complications associated with neurocysticercosis are clearly needed.

Received July 29, 2010. Accepted for publication November 24, 2010.

Authors' addresses: George M. Viola, The University of Texas MD Anderson Cancer Center, Department of Medicine, Division of Infectious Diseases, Infection Control and Employee Health, Houston, TX, E-mail: GMViola@mdanderson.org. A. Clinton White Jr., Director, Infectious Disease Division, Department of Internal Medicine, University of Texas Medical Branch, Galveston, TX, E-mail: acwhite@utmb.edu. Jose A. Serpa, Department of Medicine, Section of Infectious Diseases, Baylor College of Medicine, Houston, TX, E-mail: jaserpaa@bcm.edu.

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