Multiple neurocysticercosis and aneurismal subarachnoid hemorrhage: case presentation and systematic literature review

Edinson Dante Meregildo Rodriguez[1,2]

[1]Universidad Señor de Sipán, Chiclayo, Lambayeque, Peru;
[2]Department of Internal Medicine, Hospital Regional Lambayeque, Chiclayo, Peru

SUMMARY

Neurocysticercosis (NCC) is a global health problem. In more developed countries, NCC is mainly a disease affecting immigrants. In developing countries, NCC is the most common parasitic disease of the nervous system and the main cause of acquired epilepsy. NCC is also an unrecognized cause of strokes and could account for 4%-12% of strokes.
Here, I report a case of a 58-year-old woman who presented to the emergency department (ED) with severe headache, vomiting, and sudden loss of consciousness. Multiple NCC and Fisher grade 4 aneurysmal subarachnoid hemorrhage (SAH) were demonstrated by neuroimaging. This patient evolved favorably with albendazole and corticosteroids. This case exemplifies that NCC must be considered in the differential diagnosis of stroke in younger and middle-aged patients, especially if they do not have classical cardiovascular risk factors and come from endemic regions for cysticercosis.

Keywords: Neurocysticercosis, cysticercosis, stroke, aneurysm, subarachnoid hemorrhage.

INTRODUCTION

Neurocysticercosis (NCC) is caused by the larval stage of *Taenia solium* [1, 2]. Herein, the first Peruvian case of multiple NCC associated with aneurysmal subarachnoid hemorrhage (SAH) is presented.
A systematic search of Pubmed, EBSCO, Google Scholar, and Medline databases was conducted (January 2020) using keywords "neurocysticercosis", "subarachnoid hemorrhage", "hemorrhagic cerebrovascular event", and "stroke". The aim of this paper is to communicate this case, and to review the state of the art about this little-known association.

Corresponding author
Edinson Dante Meregildo Rodriguez
E-mail: dante_meregildo@hotmail.com

CASE REPORT

A 58-year-old woman with hypertension and irregular captopril treatment, presented to the emergency department (ED) with a two-week history of moderate intensity, persistent gravative occipital headache. Blurred vision, dizziness, tinnitus, and morning nauseas were also associated symptoms. Twelve hours before admission, headache suddenly became severe, and explosive vomiting and transient loss of consciousness were observed.
Physical examination Blood pressure: 130/80 mmHg; respiratory rate: 20 bpm; heart rate: 120 bpm; T°: 37°C; and Sat.O_2: 95%. Body weight: 84 kg; BMI: 32 kg/m^2. Respiratory, cardiovascular, and gastrointestinal systems were almost unremarkable, except for tachycardia. Neurologic exam showed a stuporous (Glasgow coma scale 12), responsive to calling, confused but collabo-

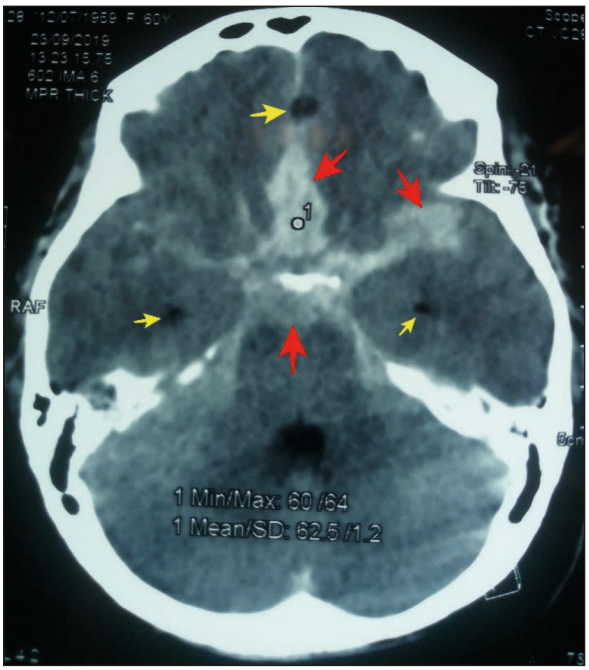

Figure 1 - Non-contrast brain CT (September 23rd, 2019) at admission showing bleeding in the basal cisterns, Sylvian fissures and surrounding The Circle of Willis (red arrows); some hypodense lesions with cystic appearance (yellow arrows). Images are compatible with Fisher grade 4 SAH and multiple active NCC.

rative patient, without focal deficit or meningeal signs, and pupils were isochoric and normally reactive to light.

Non-contrast brain computed tomography (CT) showed multiple viable cysticerci and no edema, and Fisher grade 4 SAH (Figure 1). Treatment with mannitol 20% (2 ml/kg IV every 4 h), dexamethasone 0.1 mg/kg/d IV, fentanyl 50 µg/h IV, and nimodipine 30 mg PO every 4 h was initiated. Contrast-enhanced brain magnetic resonance imaging (MRI) (Figure 2) and angiotomography (angio-CT) (Figure 3) confirmed multiple active NCC and grade 4 Fisher SAH due to ruptured aneurysm of the anterior communicating cerebral artery. Routine laboratory analyses were normal. Western blot for cysticercosis for specific IgG and IgM was reactive.

Evolution Ten days after admission, the patient showed good neurological recovery, and 15 mg/kg/d albendazole was initiated. One week afterward, the patient was sent to another hospital for definitive surgical treatment of the aneurism.

DISCUSSION

Neurological complications of NCC are pleomorphic and depend on the number, size, location, stage of the cysts, and the immune response of the host [2-5]. In our patient, despite the great number of cysts, the fact that she showed few neurological symptoms until just before the aneurysmal rupture was remarkable. Probably, this could be explained by the scarce inflammatory reaction surrounding viable cysts, as can be seen in neuroimaging studies (Figures 1 and 2).

Patients with stroke associated with NCC usually have fewer classic cardiovascular risk factors compared to patients with stroke non-associated with NCC. NCC predominates in younger adults

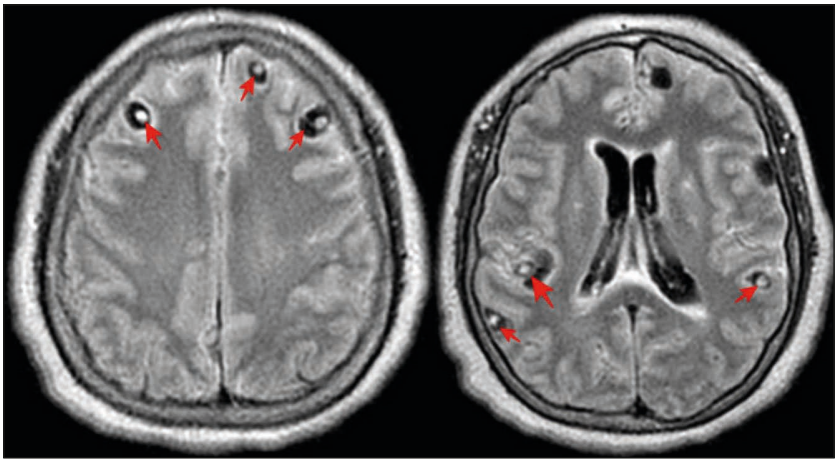

Figure 2 - Gadolinium-enhanced axial FLAIR-weighted brain MRI (September 25th, 2019), showing several cystic lesions with central hyperintense content (scolex) compatible with multiple viable NCC (red arrows).

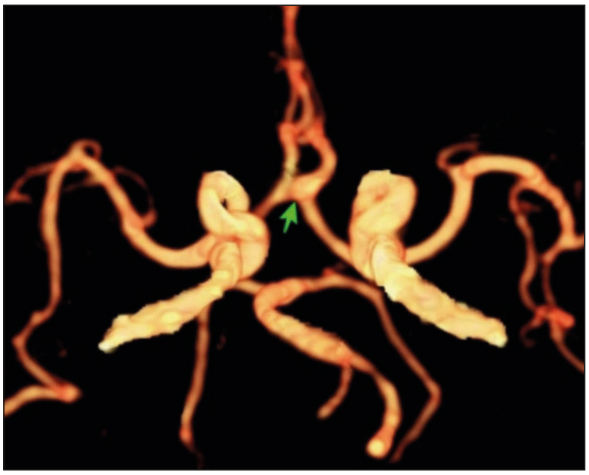

Figure 3 - Contrast-enhanced brain angio-CT (September 25th, 2019) showing lateral fusiform aneurism of 2.8 mm located in anterior communicating artery (green arrow).

which is the reason why patients with stroke associated with NCC are younger than patients with other types of strokes [5-9]. In young and middle-aged patients NCC is an independent risk factor for stroke [4-6]. In our patient¸ the risk factors for stroke were NCC, age, obesity, and hypertension.

The association between NCC and stroke is well established. It has been reported that NCC is associated with ischemic and hemorrhagic strokes, including aneurysmal and non-aneurysmal SAH [5-7]. NCC accounts for 4%-12% of stroke cases [5-13]. However, in cysticercosis-endemic regions, according to the study by Alarcon et al., NCC can be the aetiology of over 10% of strokes [4, 5]. The aetiopathogenesis of strokes in NCC comprises several mechanisms: thrombosis of penetrating and small superficial cortical vessels in the brain base caused by arteriopathy - the most frequent mechanism -; occlusive endarteritis caused by thickening of the adventitious layer of small perforating arteries; focal arteritis with endothelial hyperplasia; medial fibrosis due to local inflammation and inflammatory aneurisms [5-8]. Cerebrovascular disease associated with NCC predominantly involves small vessels. Over 50% of patients with subarachnoid NCC have angiographic evidence of vasculitis. In our patient, the only vascular finding in neuroimaging studies was the presence of a fusiform aneurism located in the left anterior communicating artery. There are no diagnostic criteria of aneurysmal SAH associated to neurocysticercosis (ASAHNCC). The diagnosis of ASAHNCC is usually made upon the simultaneous coexistence of both diseases [7-9, 11-15]. In most cases in which surgery was performed, a dense inflammatory reaction/infiltrate was noted along with the presence of cysticerci surrounding and adhered to the involved vessel, which, in most cases, was the MCA. Only three reports described histological findings of the aneurysm wall. Two of them showed diffuse lymphocytic infiltration and thinning of the vessel wall with no internal elastic lamina, which are "typical" findings of inflammatory aneurysms [11, 15]. In the other report, a cysticercus located in the distal portion of the aneurysm was found, but because of the absence of inflammation, the aneurysm was considered "congenital" [14].

Kim et al. in their study stated that inflammatory aneurysms have several characteristics that are distinguishable from congenital aneurysms: they are located at distal intracranial arteries, not at bifurcations; and are more commonly fusiform in shape [15]. These affirmations are not true. In fact, of twelve cases of ASAHNCC, only four were located on a distal branch, - one was located on bifurcation -, and only four were fusiform or pseudofusiform in shape (Table 1). Some authors have reported that clinical and radiological improvement with conservative treatment (albendazole and prednisone) of aneurysm could be a clue of parasitic aneurism [10, 12]. Vieira et al. in their study argued that there is sufficient evidence that NCC, through an extravascular inflammatory mechanism affecting the wall of the involved vessel, may lead to the development of a parasitic aneurism and should be listed among the possible aetiological agents, along with bacterial and fungal agents [13]. In our patient, I cannot undoubtedly assure that this case corresponds to a case of neurocysticercosis causally associated to aneurysmal SAH, or that it is just a casual or spurious association. Although this patient improved with medical treatment, surgical findings or histopathology were unknown because the patient was transferred to another hospital.

To date, a total of 20 cases of SAH associated with NCC were found in the published literature (twelve of them corresponded to ASAHNCC) (Table 1). Mean age was 41 years for total cases of

Table 1 - Cases of aneurysmal and non-aneurysmal subarachnoid hemorrhage associated with neurocysticercosis published to present*.

Case	*Author*	*Year*	*Age*	*Gender*	*Aneurysmal localization*	*Aneurysmal morphology*	*Surgery*	*Antiparasitic agent*	*Outcome*	*Aneurysmal histopathology*
Aneurysmal Subarachnoid Hemorrhage associated with neurocysticercosis										
1	Zee	1980	23	M	MCA (right, distal)	Mycotic	Clipping	INA	INA	INA
2	Guevara	1998	38	M	Basilar	INA	INA	INA	INA	INA
3	Soto-Hernandez	1996	32	M	AICA (right).	Fusiform	Wrapping	Albendazole	Improved	INA
4	Huang	2000	32	M	MCA (left, M2)	Pseudo-fusiform	Clipping	Albendazole	Improved	INA
5	Kim	2005	69	M	ATA (right, distal)	Fusiform	Trapping	Albendazole	Improved	Inflammatory
6	Agapejev	2011	49	F	MCA (right, bifurcation)	Saccular	Clipping	Albendazole	Improved	Congenital
7	Cárdenas	2012	39	F	MCA (right)	Saccular	Trapping	Albendazole	Improved	INA
8	Cárdenas	2012	33	M	MCA (left, distal)	Saccular	None	Albendazole	Improved	INA
9	Eboli	2012	80	M	MCA (left, distal)	INA	Clipping	Albendazole	Improved	INA
10	Marquez-Romero	2012	38	M	MCA (left, M3)	Saccular	None	Albendazole	Improved	None
11	Ordoñez-Granja	2016	44	M	MCA (right, M4)	Saccular	Clipping	INA	INA	Inflammatory
12	Vieira	2019	42	F	MCA (left, M2)	Fusiform	Wrapping	Albendazole	Improved	INA
Non-Aneurysmal Subarachnoid Hemorrhage associated with neurocysticercosis										
13	Iwanowski	1987	56	F	NA	NA	NA	INA	Dead	INA
14	Iwanowski	1987	54	M	NA	NA	NA	INA	Dead	INA
15	Alarcon	1992	INA	INA	NA	NA	None	INA	Dead	INA
16	Sawhney	1998	10	M	NA	NA	INA	Albendazole	Not improved	NA
17	Tellez-Zenteno	2003	32	F	NA	NA	None	Albendazole	Improved	NA
18	Tellez-Zenteno	2003	34	M	NA	NA	None	Albendazole	Improved	NA
29	Viola	2011	39	F	NA	NA	None	Albendazole	Improved	NA
20	Cárdenas	2012	38	F	NA	NA	None	Albendazole	Improved	NA

MCA: middle cerebral artery; AICA: anterior inferior cerebellar artery; ATA: Anterior temporal artery; ACA: anterior communicating artery. NA: not apply; INA: information not available; None: Not performed. *Source: information collected by the author from previous reports.

SAH; 43.2 years for aneurysmal SAH; and 37.5 years for non-aneurysmal SAH. Male sex was predominant: 60% for total cases of SAH; and 69.2% for aneurysmal SAH. Among patients with aneurysmal SAH, the most frequent (75%) aneurysmal localization was MCA, 75% were treated with albendazole and any modality of surgery; the most common (42%) aneurysmal morphology was saccular. Most cases (65%) of SAH associated with NCC improved (75% among cases of aneurysmal SAH) with medical and/or surgical therapy [7-9, 11-15]. This contrasts with the outcomes of a series of aneurysmal SAH - not related with NCC - reported in Peru and other occidental countries, which are as follows: mean age was 50 years; there was a preponderance of women; predominance of saccular aneurisms (over 90%); and greater mortality [16]. The rapid recovery and better prognosis of aneurysmal SAH associated with NCC was previously highlighted and attributed to the fact that this entity preferably involves small arteries, and prompt improvement of NCC with antiparasitic drugs and corticosteroids [4-11].

From a public health perspective, this case is very

instructive mainly for two reasons. Firstly, because NCC is a little-known aetiology of stroke, even in endemic countries. Secondly, this case could serve as a pertinent reminder that although NCC is rare in developed countries, this might become a more common disease because of the rising trend of immigration. Consequently, clinicians in these countries must be aware of NCC and its complications. Therefore, NCC should be included in the differential diagnosis of aetiologies of stroke, especially in young and middle-aged adults, and in residents in or migrants coming from cysticercosis endemic countries.

Conflict of interest
None to declare.

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