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▣ CASE REPORT

A Retrieved Sparganum of *Spirometra erinaceieuropaei* from a Korean Man during Mechanical Thrombectomy

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Abstract: Human sparganosis is a zoonotic disease caused by infection and migration of the plerocercoid of *Spirometra* spp. Although sparganosis were reported from most parts of the body, the sparganum parasitizing inside cerebral artery is remarkably uncommon. We report a case of cerebral intravascular sparganosis in an elderly patient with acute ischemic stroke who was diagnosed by retrieving sparganum during mechanical thrombectomy. Finally, the parasites were identified as *Spirometra erinaceieuropaei* using multiplex PCR and *cox*1 gene sequencing.

Key words: *Spirometra erinaceieuropaei*, intravascular, sparganosis, stroke

INTRODUCTION

Human sparganosis is a zoonotic disease caused by infection and migration of the plerocercoid of *Spirometra* spp. Human is almost always the intermediate host, rarely infected with developing intraintestinal adult worms [1,2]. The routes of sparganum infection involve either drinking water contaminated with procercoid-infected copepods or consumption of undercooked meat of plerocerciod-infected snakes or frogs. The infection can occur by placing poultices that use the skin of infected snakes or frogs on applied to inflamed eyes, skin and teeth [3-5].

The clinical presentations of sparganosis are widely varied and dependent on location of the infection. The larvae invade throughout the body, including the brain, spine, eyes, skin, lungs, abdominal viscera, and genitourinary tract, and can live in humans for up to 20 years [2]. Central nervous system infection can present with headache, seizure, confusion, weakness, and/or paresthesia, depending on location of the larvae and migrating path [6]. Cerebral sparganosis is a rare complication of the infection, although there have been a few reports in Republic of Korea, Japan, Thailand, and China [7,8]. In the Republic of Korea, cerebral hemorrhage and symptoms of spinal cord involvement, such as back pain and weakness, resulted from the sparganum infection have been reported [9,10]. However, the alive sparganum inside the cerebral vessels, which could be a source of acute ischemic stroke have not been found in human brain to date.

The species of the genus *Spirometra*, including *S. erinaceieuropaei*, *S. decipiens*, *S. mansoni*, *S. ranarum*, and *S. mansonoides* occasionally reside in human as paratenic or intermediate hosts [11-15]. After the Korean human sparganosis case in 1924 has been named as *Sparganum mansoni*, 2 human cases infected with *S. erinaceieuropaei* were reported based on morphological study in 1984 [16]. The morphological identification of *Spirometra* species infected in human host is difficult because they usually found as plerocercoid that lacks distinguishing characteristics. Lately, molecular approaches to identify *Spirometra* species have been introduced in human spargana cases, revealing that *S. erinaceieuropaei* and *S. decipiens* cause human sparganosis in Korea [17]. However, *S. erinaceieuropaei* did not found in terrestrial snakes, the known infectious source of spargana to human, collected from Republic of Korea and China [18]. After those previous studies, molecular diagnosis

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of sparganosis in species level becomes more important to make clear its life cycle and transmission route of this infectious disease. Therefore, we report here an intravascular sparganosis retrieved during endovascular mechanical thrombectomy for the treatment of acute ischemic stroke due to left middle cerebral artery occlusion in an elderly male and identified *S. erinaceieuropaei* using multiplex polymerase chain reaction (PCR) and cytochrome c oxidase subunit 1 (*cox*1) gene sequencing.

CASE RECORD

An 89-year-old man was admitted to the Emergency Center, Kyungpook National University Hospital on August 17, 2018 due to right side weakness and altered consciousness after one hour of symptom onset. He had medical history of hypertension and had been taking medicines for the hypertension. According to his wife, he had not had uncooked frog or water from the ponds. Routine laboratory test results were unremarkable, and no eosinophilia was noted. Neurological examination revealed global aphasia, right facial palsy of central type, right hemiparesis with Medical Research Council grade 1/5 in the right upper extremity and 1/5 right lower extremity, right homonymous hemianopsia, and Babinski sign with a National Institutes of Health Stroke Scale score of 22.

Initial brain computed tomography (CT) and supra-aortic CT angiography revealed subtle early ischemic changes on the left temporal area and acute occlusion of left middle cerebral artery (Fig. 1A). Subsequent diffusion-weighted imaging was performed to define the extent of ischemic lesions and to guide acute stroke therapies, which showed fuzzy hyperintensities on the left fronto-temporo-parietal area including left basal ganglia (Fig. 1B). Considering his clinical and imaging status, endovascular mechanical thrombectomy was performed to reperfuse the occluded vessel after 1.5 hr from symptom onset. Using contact aspiration and stent retriever techniques, partial reperfusion of occluded vessel was achieved (Fig. 1C, D). During mechanical thrombectomy, multiple fragmented whitish or reddish materials were retrieved from the occluded vessel. Among the retrieved materials, one whitish long segment material was mobile (Fig. 1E). To identify species, these retrieved materials were sent to the Department of Parasitology and Tropical medicine. At one day after index stroke, follow-up brain CT revealed hypodensities on left fron-

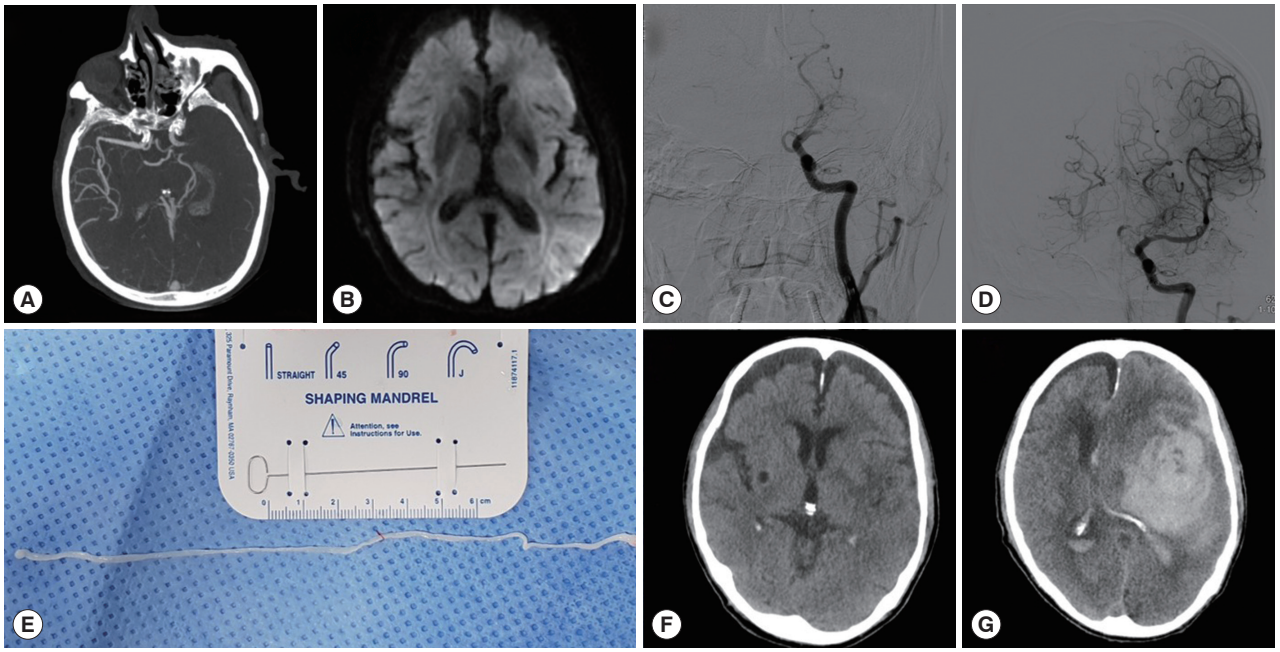

Fig. 1. Findings of an 89-year-old male with acute ischemic stroke. (A) Initial supra-aortic CT angiography showing acute occlusion of left middle cerebral artery. (B) Subsequent diffusion-weighted imaging at same day. (C) Initial left carotid angiography for endovascular mechanical thrombectomy. (D) Partial reperfusion of occluded artery was achieved. (E) One whitish long worm with sluggish movement. (F) Follow-up brain CT image at day 1. (G) After neurological worsening, a follow-up brain CT image showing massive parenchymal hematoma on the affected hemisphere.

to-temporal area including left basal ganglia without any evidence of hemorrhagic conversions (Fig. 1F). During hospital stay, his neurological status was unchanged compared to baseline status despite the partial reperfusion of occluded vessels. At 15-days after index stroke, he suffered massive intracerebral hemorrhage on the affected hemisphere (Fig. 1G), and he died at the same day despite the medical management.

In order to identify *Spirometra* species, molecular analyses using multiplex PCR and partial sequencing of *cox*1 were performed in Department of Parasitology and Tropical medicine. Genomic DNA was extracted from the larva of *Spirometra* with QIAamp DNA Mini kit (Qiagen, Hilden, Germany) according to the manufacturer's instructions. Multiplex PCR on *cox*1 gene was performed with reference to the previous reports with some modifications [17,18]. Briefly, the forward primer, Se/Sd-7963F (5′-ACG TGG TTT GTG GTG GCT CAT TTT-3′), for the conserved sequence of both *Spirometra* species, and 2 specific primers for *S. decipiens* (Sd-8584R, 5′-GTA TCA AGT TGG TTA GGA AGT TAA-3′) and for *S. erinaceieuropaei* (Se-8344R, 5′-ATG ATA GGG TAT AGG TGA CCA-3′) were employed for multiplex PCR using ExTaq DNA polymerase (Takara, Osaka, Japan). Thermal cycles were as following: initial denaturation at 98℃ for 3 min, followed by 30 cycles of denaturation at 98℃ for 30 sec, annealing at 55℃ for 30 sec and extension at 72℃ for 30 sec, and a final extension at 72℃ for 10 min. For reference, genomic DNA of *S. erinaceieuropaei* and *S. decipiens* were obtained from Parasite Resource Bank, Republic of Korea. A multiplex PCR amplicon of current sample showed a band close to *S. erinaceieuropaei* (Fig. 2). This *cox*1 sequence of current specimen had identity 99.4% to *S. erinaceieuropaei* (KJ599680) and 90.2% to *S. decipiens* (KJ599679). Taken together, molecular analyses on this cerebral sparganosis revealed an infection with *S. erinaceieuropaei*.

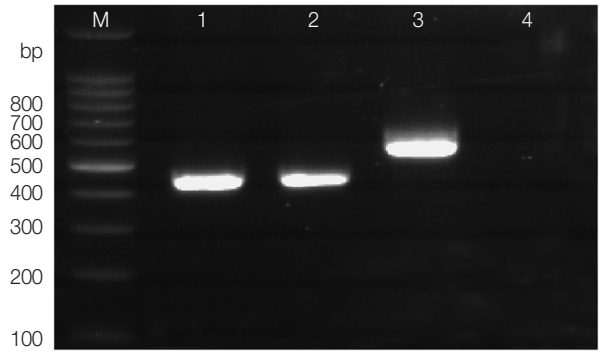

Fig. 2. Multiplex PCR of retrieved sparganum from a patient. Lane M, DNA size marker. Lane 1, genomic DNA of retrieved sparganum of present patient. Lane 2, genomic DNA of *S. erinaceieuropaei*. Lane 3, genomic DNA of *S. decipiens*. Lane 4, negative control.

DISCUSSION

Cerebral sparganosis is a rare complication of *Spirometra* spp. infection caused by their plerocercoid invading and living in the brain. Symptoms of the cerebral sparganosis are complex and diverse depending on location of the parasite in the brain. The patients present with focal neurological dysfunction including chronic paroxysmal headache, epilepsy, increased intracranial pressure, disturbance of consciousness, limb numbness and visual impairment [19]. The neurological symptoms were evoked by inflammatory reaction and granuloma formation around the spargana, as well as petechial hemorrhage and hematoma due to capillary or venous injury by the migrating worm [9,20,21]. Among the cases of the cerebral sparganosis, the case that the plerocercoid is parasitized in brain artery are significantly unique. Previously, 2 cases of sparganum infection related to cerebral infarction were reported to date; however, none of them found the parasite inside the artery. One case reported in 1951 by Takeuchi was the sparganosis diagnosed during autopsy in cerebral infarction patient, and another one was cerebral infarction induced by vasculitis possibly caused by sparganum mass [22,23]. It is not clear how the worm is migrated in cerebral artery. In general, when a patient gets infected, the larvae enter the abdominal cavity by passing through the alimentary canal. Then they further migrate into the diaphragm and mediastinum to reach the neck. At last, they pass through the foramen magnum and enter the brain [24]. The larvae may be incidentally entered into artery and migrated to brain during the process. Nevertheless, the location in the cerebral artery was unusual for a sparganum, as was the size of about 13 cm.

The clinical manifestation and epidemiological history of *Spirometra* infection are often not specific for the sparganosis diagnosis. Therefore, characteristic signs on brain computed tomography (CT) and magnetic resonance imaging (MRI) have been used to make an accurate diagnosis. It was first reported that MRI on sparganosis showed white matter degeneration, as indicated by weak T1WI signal and strong T2WI signal in the low density CT [20]. Rate of accurate diagnosis of cerebral sparganosis could be increased from 0 to 11.8% and 28.6% with multiple follow-up examinations [25]. In addi-

tion, the most typical MRI manifestation was tunnel-like or rope-like, with the most common being bead-shaped enhancement [26]. CT findings of cerebral sparganosis usually demonstrated presence of the white matter hypoattenuation with dilatation of adjacent ventricle, irregular or nodular enhancing lesion, small punctate calcification, and a change in the location of the enhancing nodule on the follow-up CTs [20,27]. In present case, those signs of sparganosis shown in CT images were not critically appeared, which may be because the sparganum manifested only vessel occlusion, but not the inflammatory reaction or hemorrhage in brain in current case.

In general, *S. erinaceieuropaei* was considered only *Spirometra* species in Republic of Korea. Therefore, a differentiation of species level using molecular method has not been considered. However, recent study suggested that *S. decipiens* is another cause of human sparganosis in Republic of Korea. Moreover, it was also reported that *S. erinaceieuropaei* may have other intermediate host, not snakes [17,18]. These previous observations support that molecular diagnosis of species level of sparganosis is needed to understand epidemiology of sparganosis. This present specimen was identified as *S. erinaceieuropaei* based on multiplex PCR and *cox*1 sequencing. According to his wife, there are few possibility that the patient was infected with the sparganum by frogs or snake consumption. The only *S. decipiens* was found in snakes in the previous study [18]. Therefore, it seems that the *S. erinaceieuropaei* has infection route different from *S. decipiens*. To clarify the transmission route and life cycle of *S. erinaceieuropaei*, further studies using a number of samples from humans and wild animals (possible final hosts) would be required.

CONFLICT OF INTEREST

We have no conflict of interest related to this work.

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