

Intraspinal Sparganosis Diagnosed by Metagenomics Next Generation Sequencing—An Uncommon Infection

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Short report

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Abstract

In this paper, we report a case of lumbago with lower limb fatigue. After a series of biochemical, immunological, imaging, and pathological examinations, the patient was diagnosed with intraspinal sparganosis based on metagenomics next generation sequencing. Due to the length of infection, the presence of multiple complex lesions, and the high risk of surgical treatment with poor prognosis, we did not advocate surgical treatment, but chose to administer a high dose and long course of praziquantel treatment for this case.

Case Presentation

A 39-year-old man suffered from lumbago for 4 years without any known causes. On February 15, 2020, he was hospitalized with aggravated lumbago, accompanied by numbness and weakness in both lower limbs. At the local hospital, A multiphase and contrast-enhanced magnetic resonance imaging (MRI) of the lumbar spine showed lesions in the lumbar spinal canal and the sacral canal, and the intervertebral discs between the fourth and fifth lumbar vertebrae (L4/5) had degenerative changes. Head multiphase and contrast-enhanced MRI showed multiple lesions of the brain parenchyma, cerebromalacia in the near-midline area of the bilateral cerebellar hemispheres, and proliferation of the peripheral glial cells. The local hospital performed posterior lumbar spinal canal exploration and spinal canal decompression surgery. Pathological examination of the spinal tissue suggested cysticercosis. After receiving five courses of praziquantel anthelmintic treatment, the patient felt a worsening of the lower back pain, numbness, and fatigue of both lower limbs, and attended our hospital on October 14, 2020.

On admission, the patient was unable to walk. Physical examination showed that there were no subcutaneous nodules throughout the whole body, mild depressed edemas of the right lower limb, muscle atrophy of both lower limbs, hypoesthesia of the skin, and the extensor muscle strength was grade 1. The deep and shallow reflexes could be induced, and the pathological sign and meningeal irritation sign were negative. All other physical examinations were normal.

To render a definite diagnosis, we performed a series of biochemical and immunological examinations after admission, and enzyme-linked immunosorbent assays (ELISAs) showed that antibodies of cysticercosis and *Clonorchis hepatica* were weakly positive. No parasite eggs were found in the patient's feces, and no tapeworm segments were previously observed. After performing a detailed medical history inquiry, we learned that the patient had a history of eating raw pork, raw snake gall, drinking wine, and catching frogs.

On the second day after admission, we performed a lumbar puncture, hoping to observe pathogenic evidence in the cerebrospinal fluid to assist in diagnosis. However, there was no cerebrospinal fluid outflow when the puncture needle entered the spinal canal. Similar findings were also observed following the puncture of different lumbar intervertebral spaces. This abnormal phenomenon made us consider the abnormality of the anatomical structure of the patient's spinal canal. We immediately examined the

patient's brain and entire spine using multiphase and contrast-enhanced MRI. The results revealed that the patient had abnormal changes in the posterior horn of the left lateral ventricle, the semi-oval center and the parietal lobe, softened foci in the midline area of the cerebellum on both sides, spinal cord changes from the 11th thoracic vertebra (T11) to the 2nd sacral vertebra (S2), and spinal meningeal enhancement was found in the thoracic, lumbar, and sacral vertebrae. Spinal cord edema was observed from the 8th to 10th thoracic vertebrae (T8-T10), and intervertebral discs between the fourth and fifth lumbar spine (L4/5) and the fifth lumbar spine and the first sacral vertebra (L5/S1) had degenerative changes (Fig. 1&2).

As the patient felt that the numbness of both lower limbs was gradually aggravated, physical examination found that the sensation of both lower limbs decreased and spread below the navel. The muscle strength of both lower limbs was reduced to grade 0, and the muscle tension was increased, resulting in foot drop. We immediately ordered a spinal orthopedic consultation. The spinal orthopedist reviewed the MRI images and concluded that the patient's symptoms were likely caused by a tumor in the spine. After fully assessing the patient's condition, the spine orthopedist performed an operation of posterior intraspinal lesion resection and spinal decompression on October 30, 2020 to solve the existing problems and make a diagnosis. During the operation, the thoracic and lumbar spinal canals were found to be full of solid lesions, which were sent for pathological examination. Under the microscope, an unidentified parasite could be seen in the pathological section. Chronic inflammation and fibrous tissue wrapping were observed around the parasite, and no special staining results were observed (Fig. 3). Because the parasite's scolex was not observed in the pathological section, the identity of the parasite could not be determined. Although there are cases of cysticercus colonization in the spinal canal, the macroscopic appearance and the microscopic pathological findings did not support that it was cysticercosis. Thus, the patient was deemed to have been infected by a different parasite.

To make a diagnosis, we carried out PMseq pathogenic microbial next generation sequencing (NGS) testing on the remaining specimens on November 12, 2020 (BGI Genomics, BGI-Shenzhen, Shenzhen, China). The results showed that 1,228,955 sequences mapped to *Spirometra erinaceieuropaei*, while 106 sequences mapped to *Dibothriocephalus latus*. Therefore, the final diagnosis was intraspinal sparganosis.

After posterior intraspinal lesion resection and spinal decompression, the patient's lumbago improved slightly, but the lower limb fatigue and hypoesthesia did not improve, and progressively worsened, which may have been related to a series of inflammatory reactions caused by insect death after anthelmintic treatment. To explore the follow-up treatment, we invited radiologists, pathologists, spine orthopedists, and neurosurgeons for multidisciplinary consultations. After discussion, it was considered that there were too many lesions in the cone and cauda equina of the patient, and we had to consider the fact that the surgical removal of the worm in the spinal canal may put the patient at a great risk of paralysis. Injury to the sacral plexus nerve during surgery would result in paralysis of both lower limbs and incontinence of urine and feces. Therefore, surgical treatment was not recommended, and we chose the conservative treatment plan. In order to achieve the therapeutic objective, we increased the dose of praziquantel and

extended the treatment time. Considering that killing the worm with drugs can cause allergic reactions and inflammatory reactions, which in turn can lead to edema in the spinal canal and pressure on the spinal cord, the use of hormones and dehydrating agents would be a good solution to this thorny problem. In addition, neurotrophic drugs can promote the regeneration and repair of nerve cells. Rehabilitation exercises and follow-up evaluations will be performed.

Discussion

Sparganosis is a rare parasitic infectious disease that is caused by Sparganum infection, which is the larva of *Spirometra erinaceieuropaei*^[1, 2]. Sparganum has a strong ability to contract and move^[3]. It often lives in the muscles of frogs, especially in the muscles of the thighs and legs. The main route of Sparganum infection is via the skin or mucosal invasion^[4, 5]. Sparganum usually parasitizes in the eyes, mouth, face, brain, subcutaneously, or in other parts of the human body^[6]. Intraspinal sparganosis infection is relatively rare. The predominant parts of the brain in which sparganosis occurs is in the parietal lobe, frontal lobe, occipital lobe, thalamus, basal ganglia and brainstem, especially in the deep white matter^[7, 8]. If brain sparganosis enters the spinal canal, it can cause intraspinal sparganosis.

In this case, the patient had a clear epidemiological history of eating raw pork, drinking uncooked snake gall, and catching frogs. ELISAs for cysticercosis were weakly positive for cysticercosis enzyme-linked antibody, and the cranial MRI showed obvious changes in the cerebellar vermis, left parietal lobe, and frontal lobe. However, the specificity of the imaging examination was not high, and no parasite eggs were found in the patient's feces. The patient's epidemiological history, immunology results and imaging examinations failed to confirm the parasitic infection.

Etiological diagnosis is the most important part in the diagnosis of infectious diseases. Pathological examination has always been the gold standard for the diagnosis of parasite infections^[9], and a diagnosis can be made when the parasitic scolex is observed in the cyst cavity in the pathological section. However, although the pathology of the resected spinal canal in this case indicated a parasitic infection, no parasite scolex was found in the pathological section. Thus, it was difficult to identify the species of parasite by pathology.

Since NGS technology was first used in the etiological diagnosis of clinical cases in 2014, it has been increasingly used in clinical practice^[10, 11]. Compared with traditional etiological examinations, NGS can detect a wide range of pathogens, such as viruses, bacteria, fungi, and parasites at the same time^[12, 13]. Regardless of whether the clinical samples can be successfully cultured or not, a diagnosis can be made as long as the sample contains detectable levels of DNA or RNA^[14, 15]. In this case, the results of NGS indicated an intraspinal sparganosis infection. The epidemiological history, clinical manifestations, immunological data, imaging examinations, pathological examinations, and NGS results confirmed the diagnosis of brain and intraspinal sparganosis.

At present, surgical treatment is the first choice for the treatment of sparganosis [16]. The key to cure sparganosis is to completely remove the parasites. The patient in this case was infected with sparganosis in the spinal canal. Due to the length of infection, the presence of multiple complex lesions, and the high risk of surgical treatment with poor prognosis, we did not advocate surgical treatment. The main nonsurgical treatment is praziquantel deworming treatment, but the efficacy of praziquantel remains unclear [17]. In addition, it has been reported that high doses and long-term treatments of sparganosis can achieve good curative effects [18, 19]. Thus, we hypothesized that the previously-reported poor efficacy of praziquantel in the treatment of sparganosis may be related to the low dose and short course of treatment.

The patient in this case had previously completed five courses of deworming treatment in a local hospital, but the treatment was not effective, and the condition progressively worsened. Based on this information, we choose to administer a conservative treatment plan and gradually increase the dose of the deworming treatment, while closely observing the side effects to prevent complications.

Sparganosis is not only harmful, but is also difficult to cure and has a poor prognosis. Therefore, effective measures to prevent this disease include changing poor eating habits, and not eating frog meat, snake meat, or snake skin. Nor should individuals eat raw or semi-raw meat from frogs, snakes, birds, pigs or other animals. Individuals should also not eat snake gall or drink water that may be contaminated with parasite eggs.

Abbreviations

MRI: magnetic resonance imaging; ELISAs: enzyme-linked immunosorbent assays; NGS: next generation sequencing.

Declarations

- **Ethics approval and consent to participate**

This study was approved by the Institute Review Board of the First Affiliated Hospital of Guangxi Medical University. Written informed consent for publication of patient's details was obtained from the patient. A copy of the consent form is available for review by the Editor of this journal.

- **Consent for publication**

The patient gave his consent for publication.

- **Availability of data and materials**

Not applicable.

- **Competing interests**

Not applicable.

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- **Authors' contributions**

Rongming Wang and Bobin Hu conducted data gathering and wrote the article; Minghua Su and Jianning Jiang conceived and designed the study.

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Figures

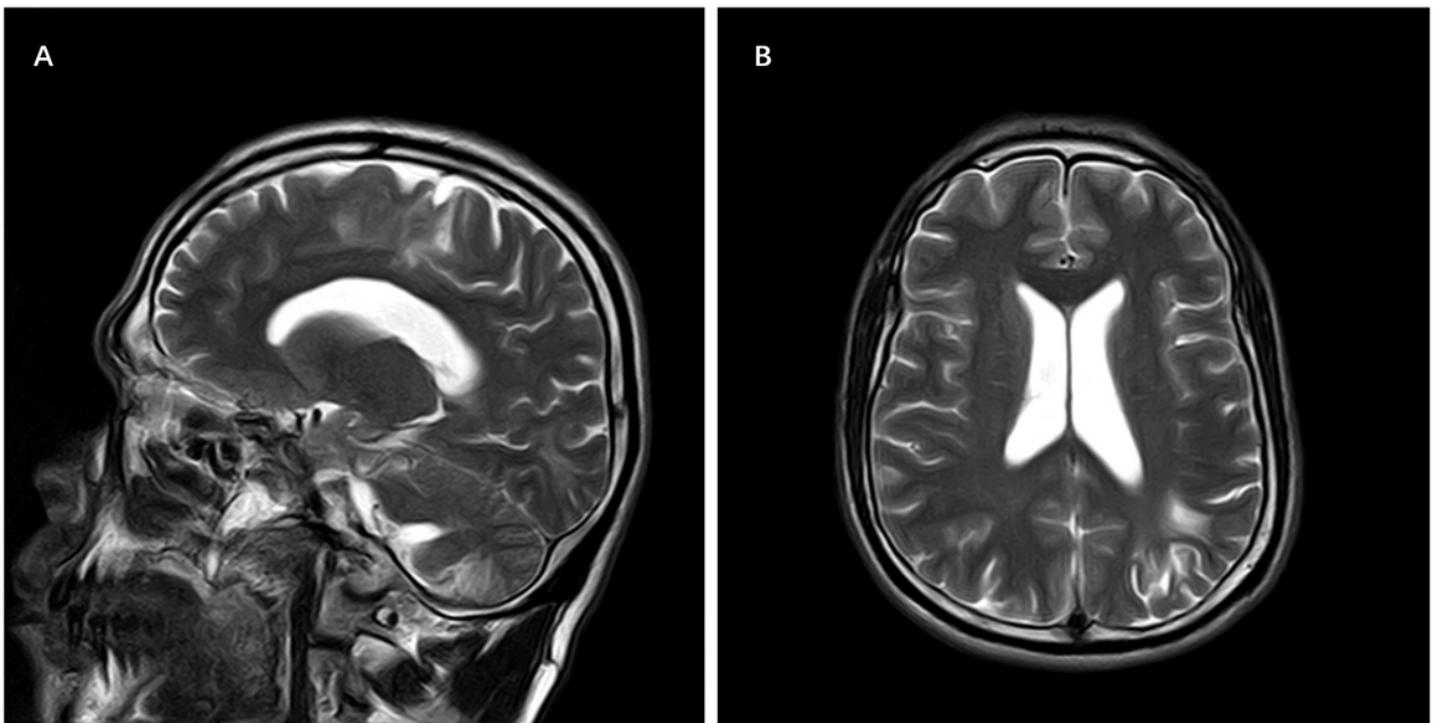


Figure 1

Brain multiphase MRI. (A) Patch-like long T1 and long T2 signals are seen in the posterior horn of the left lateral ventricle, the semi-oval center and the parietal lobe. flair showed high signals, and there is no obvious diffusion-limited hyperintensity on DWI; (B) A round long T1 and long T2 signals were seen in the near midline areas of the cerebellar hemispheres on both sides, and flair showed low signals.



Figure 2

Thoracolumbar multiphase and contrast-enhanced MRI (A&B): spinal cord changes from the 11th thoracic vertebra to the 2nd sacral vertebra (T11-S2), and spinal meningeal enhancement was found in the thoracic, lumbar, and sacral vertebrae. Spinal cord edema was observed from the 8th to 10th thoracic vertebrae (T8-T10).Lumbosacral multiphase and contrast-enhanced MRI (C&D): L1, L2 spinous process and lamina is absent, intervertebral discs between the fourth and fifth lumbar spine (L4/5), the fifth lumbar spine and the first sacral vertebra (L5/S1) had degenerative changes, the anterior edge of the dural sac is compressed.

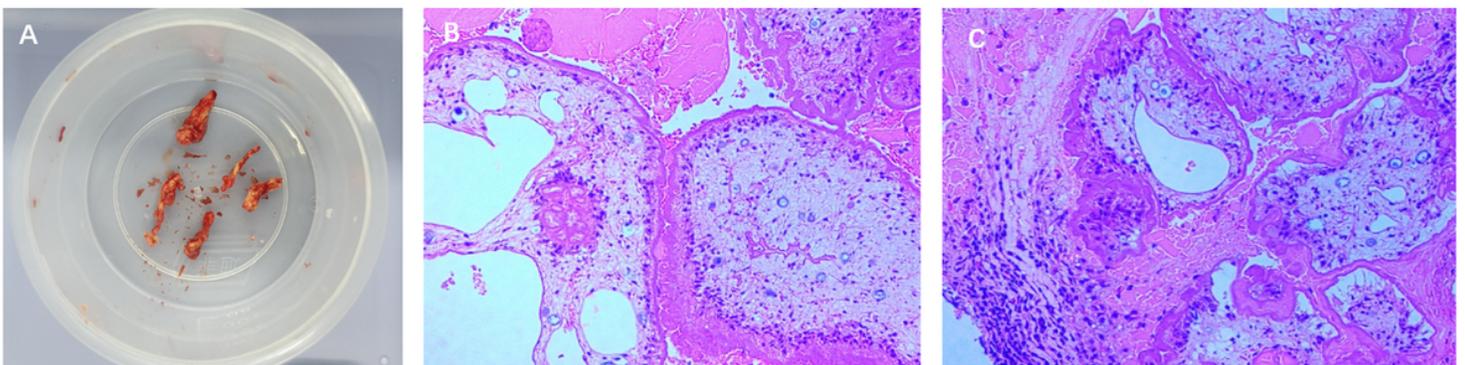


Figure 3

General image(A): A pile of gray-brown pieces of tissue seen by the naked eye, about 2.5×2×0.6 cm in size. Pathological microscopic image(B&C): an unidentified parasite could be seen in the pathological section. Chronic inflammation and fibrous tissue wrapping were observed around the parasite.