The role of CT scan in diagnosing neurocysticercosis in patients with seizures: a case report

Luh Dindi Ayu Surya Kanti1*, I Gede Catur Wira Natanagara1, Ni Kadek Antari Darmasih2, Agus Antara3

ABSTRACT

Background: Neurocysticercosis is the most common parasitic infectious disease affecting the human central nervous system in endemic countries. It is caused by the ingestion of Taenia solium eggs excreted in the faeces of human tapeworm carriers. The disease is often asymptomatic, but can also cause seizures, disorientation, visual disturbances, focal neurologic deficits, psychiatric symptoms, strokes, and elevated intracranial blood pressure. Neuroimaging remains the gold standard for diagnosis, which includes the CT scan. This case report aimed to discuss the role of the CT scan in the diagnosis of neurocysticercosis in a 40-year-old male patient with a history of seizures.

Case presentation: A 40-year-old male complained of seizures one hour before admission. Before the seizure, the patient reported that he was active as usual and had no complaints. The patient stated that he likes to eat pork and red lawar, which is made from raw pig blood. Physical examination revealed that the patient had a fever. Neurologic examination was within the normal range. Axial view CT scan of the head without contrast showed multiple calcifications with a hypodense area around them. Then, the patient was diagnosed with serial seizures due to symptomatic epilepsy and cerebral neurocysticercosis. He was treated with anthelmintic, antiseizure and symptomatic medication. After one month following therapy, there were no reports of headaches or seizures. The follow-up CT scan at the same slice as the lesion decreased the amount of calcifications, but the right frontal and left parietal regions were still visible.

Conclusion: Neuroimaging studies such as CT scans are among the tests that can be performed on seizure patients to detect neurocysticercosis in endemic areas.

Key Words: CT scan, Neurocysticercosis, Neuroimaging Seizure.


INTRODUCTION

The most severe type of cysticercosis is neurocysticercosis (NCC), which is brought on by ingesting Taenia solium eggs that have been shed in human tapeworm carriers’ faeces. Taenia solium infection can happen when eating pork that has been contaminated with worms or when consuming worm eggs directly.1,3 In many parts of the world, neurocysticercosis is still prevalent. Approximately 2.56 to 8.30 million people globally have been predicted to have NCC, whereas an estimated 400,000 people in endemic areas are thought to have symptoms.1 An estimated 50,000 people per year pass away from neurocysticercosis. NCC is endemic in some parts of the world, such as Central Europe, Asia, Africa, and Latin America, and due to increased migration, it is now being diagnosed more frequently in the United States. The neurocysticercosis-endemic regions in Indonesia are Papua, Bali, North Sumatra, Flores, North Sulawesi and West Kalimantan.1,5 Neurocysticercosis can manifest in a variety of clinical presentations depending on the host’s immunological response to parasite antigens, the quantity and distribution of lesions, and the level of inflammation and edema surrounding the lesions.3 Neurocysticercosis can be asymptomatic or cause clinical symptoms. Seizures and headaches are the most frequent clinical manifestations of NCC. In many endemic countries, NCC is responsible for at least one-third of cases of acquired epilepsy. Patients with NCC can also show clinical manifestations such as disorientation, vision changes, focal neurologic deficits, psychiatric manifestations, stroke, increased intracranial hypertension, and meningitis.4,6,7

The diagnosis of NCC is sometimes difficult because of the heterogeneity in clinical presentation and neuropathology.1 History-taking, physical examination,
and supportive examinations can be used to establish the diagnosis of NCC. Neuroimaging tests like Computed Tomography (CT) scans and magnetic resonance imaging (MRI) continue to be the gold standard for diagnosis. In endemic countries, a CT scan is more accessible than an MRI. CT scan is more effective than an MRI for assessing calcified NCC and is also highly efficient for diagnosing parenchymal cysts. While MRI is good for assessing extra parenchymal cysts.\(^7\) Serological diagnostic assays such as the enzyme-linked immunosorbent assay (ELISA) and enzyme-linked immunoelectrotransfer blot (EITB) test are also useful tools to use, particularly when there is uncertainty about the results of the neuroimaging.\(^7\) Therefore, this case report aims to discuss the clinical manifestations and the role of CT scan imaging in diagnosing neurocysticercosis in a 40-year-old male patient with seizures.

### CASE PRESENTATION

A 40-year-old Balinese man came to the emergency department of our hospital after having a seizure about an hour before being admitted. The patient is said to have had convulsive seizures for about 5 minutes. During a seizure, the patient is said to be unconscious, but after a while, the patient regains consciousness. Before the seizure, the patient was said to be active as usual and had no complaints. The patient claims he has no recollection of what happened during the seizure. This is the third seizure. The patient said that the day before and four months ago, he had experienced similar complaints. In addition, the patient never had a seizure, even without taking any medication. The precipitating factor for seizures is unknown. Additionally, the patient reported right ankle pain and edema that had started three days earlier, as well as a fever that was present about six hours before admission. Other complaints such as headaches, weakness in half of the body, blurred eyes, behavioral disturbances, slurred speech, night sweats, coughing, shortness of breath, weight loss, nausea, or vomiting were denied. The history of trauma was denied. The patient has a history of gout but does not take medication. No family had similar complaints. The patient claimed that he enjoyed eating pork and red lawar, which is made from raw pig blood.

Examination of the vital signs revealed that peripheral oxygen saturation, respiration rate, blood pressure, and pulse were all within normal ranges. The patient has a fever with an axillary temperature of 37.9°C. On physical examination, there was a tophus in the right ankle region measuring 20 mm. Other physical examinations were within normal limits. The neurological examination revealed that the patient was awake and alert (Glasgow coma scale: E4V5M6), that both pupils were isochronous and had diameters of 2 mm and 2 mm, both pupils’ reflexes were good, and no neck stiffness was found. Other neurological examinations were within normal limits.

Laboratory investigations such as hematology, urea, creatinine, blood glucose, and electrolytes (Na, K, Cl, and Ca) were within normal limits. Rapid examination of the SARS CoV-2 antigen showed non-reactive. An electrocardiogram examination showed a sinus rhythm. The chest X-ray examination revealed no abnormalities in the heart or lungs. In the axial view CT scan of the head

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**Figure 1.** The axial view CT scan of the head without contrast. The red rings show calcification (density 36-204.8 HU) with hypodense areas around it in the cerebral parenchyma in the left-right frontoparietooccipital region and right-left basal ganglia.

**Figure 2.** The axial CT scan of the head without contrast one month after treatment. The red rings show calcification of the cerebral parenchyma in the right frontal and left parietal regions.
without contrast shows there are multiple calcifications with a hypodense area around them in the cerebral parenchymal (Fig. 1), suggesting neurocysticercosis and right maxillary sinusitis. We are unable to perform EEG, MRI, antibody, or cerebrospinal fluid ELISA testing at our hospital due to a lack of resources.

The patient was diagnosed with serial seizures due to symptomatic epilepsy and cerebral neurocysticercosis. The patient was treated with IVFD NaCl 0.9% 20 drops per minute, a low purine diet, three times daily 100 mg of phenytoin administered intravenously in 100 cc of 0.9% NaCl finished in 30 minutes, 10 mg of clonazepam every night, 400 mcg of folic acid twice daily, 650 mg of paracetamol three times daily, 15 mg of meloxicam once daily, and 400 mg of albendazole twice daily.

One month following therapy, there were no reports of headaches or seizures during follow-up monitoring. Examination of vital signs was within normal limits. Physical examination and neurological examination were within normal limits. In the same slice as the lesion on the previous CT scan, currently, calcification of the right frontal and left parietal regions is still visible (Fig. 2). Compared to the previous CT scan it is currently improving.

DISCUSSION

Neurocysticercosis is one of the most common parasitic infectious diseases affecting the human central nervous system in endemic countries and is also seen in non-endemic countries due to immigration and travel.\textsuperscript{7,8} One of Asia’s endemic regions for neurocysticercosis is Bali.\textsuperscript{3} NCC is a neurological condition brought on by ingesting Taenia solium embryonic eggs. Their embryos then penetrate the small intestinal mucosa, where they enter the bloodstream and go into the CNS.\textsuperscript{1,7}

Clinical presentations of NCC depend on the host's immunological response to parasite antigens, the quantity and distribution of lesions, and the level of inflammation and edema surrounding the lesions.\textsuperscript{3,9} A population-based study in an endemic area found that most infected people are asymptomatic, but NCC can also cause a variety of clinical manifestations.\textsuperscript{1,6-8} Clinical manifestations vary depending on whether the illness is parenchymal (inside the brain tissue) or extra parenchymal, most frequently affecting the subarachnoid spaces, ventricles, spine, and ocular.\textsuperscript{7,10}

In parenchymal lesion, epilepsy is the primary clinical manifestation of NCC. It occurs in 60-90% of patients. In around 70% of individuals with cysts in the extra parenchymal compartment, intracranial hypertension will be the primary symptom. Around 3% of the patients in this region have documented stroke symptoms, and 20% of people may exhibit various phenotypes of focal neurological symptoms which are often correlated with the start of therapy and the inflammatory response induced. The most common of them are motor symptoms due to pyramidal tract lesions, although they can also result in sensory or language issues, including involuntary movements.\textsuperscript{7} Patients with NCC may also show other clinical manifestations such as headache, disorientation, visual disturbances, and psychiatric manifestations.\textsuperscript{4,6,11}

In this case report, the patient came to the emergency department after experiencing a period of seizure. Seizures are the most common clinical manifestation in patients with parenchymal NCC, particularly in those with granular or calcified lesions. Seizures are caused by inflammation brought on by an immune system attack on cysts or antigens trapped inside calcified nodules. In patients with a single colloid cysticercus located in the brain parenchyma, seizures may stop when the inflammation subsides, but this occurs only when the lesion resolves rapidly. However, it should be remembered that most of the parasites are in a granular and calcified stage, which is a persistent epileptogenic focus, and if the patient is not treated with anti-seizure medication, it will result in recurring unprovoked seizures.\textsuperscript{9}

Because of the variety in clinical presentation and neuropathology, the diagnosis of NCC can occasionally be challenging.\textsuperscript{1} The gold standard for diagnosis continues to be neuroimaging procedures like CT and MRI. In endemic countries, most of which are developing countries, CT scan is more often used than MRI to diagnose NCC, this is because CT scans are less expensive and easier to find than MRI.\textsuperscript{11} CT scan is more effective than an MRI for assessing calcified NCC and is also highly efficient for diagnosing parenchymal cysts, while MRI is good for assessing extra parenchymal cysts.\textsuperscript{1,7}

According to some research, serological diagnostic assays like EITB and ELISA are also helpful techniques to use, particularly when there is uncertainty about the results of neuroimaging.\textsuperscript{7} However, not all hospitals have this facility.

According to Del Bruto’s diagnostic criteria for neurocysticercosis, the presence of scolex in cystic lesions on neuroimaging tests like CT scans or MRI is one of the absolute requirements for making the diagnosis of neurocysticercosis. On neuroimaging, it shows as a circular lesion that ranges in size from 10 to 20 mm, with contents that are isointense to cerebrospinal fluid (CSF), but with an important object (scolex) encapsulated within it, which is called the “hole-with-dot” imaging sign.\textsuperscript{9,10} Cystic lesions without scolex are another feature that can be seen on CT scans, although it can be challenging to tell them apart from other conditions including primary cystic tumours (epidermoid cysts and teratomas) and metastases, arachnoid cysts, hydatidosis, toxoplasmosis, and abscesses due to their similar appearance. When there are cystic lesions without scolex, an MRI is necessary. A ring-like lesion that enhances after gadolinium administration can be seen on an MRI. Perilesional edema might also be present. Additionally, CT scans may show multilobulated cystic lesions in the subarachnoid space (racemose NCC) and brain parenchymal calcifications. Calculations are a type of nonviable cysticerci that typically have well-defined borders and are less than 10 mm in diameter. Small, enhancing lesions that resolve or become calcifications after receiving antiparasitic medication can be used to make the diagnosis of NCC.\textsuperscript{9,11}

The appearance of the lesion on neuroimaging varies depending on the evolution of the cyst’s lifetime. There will be focal edema with some degree of contrast enhancement when the parasite invades the tissue. Additionally, a cystic lesion will develop with an isointense look
to the CSF and a scolex within it (vesicular stage). After the parasite dies within the cyst, an encapsulated cystic lesion with significant contrast enhancement remains which may be accompanied by perilesional edema due to the inflammatory response (colloid vesicular stage). In the following stage, known as the “granular nodular stage,” the cyst retracts and the capsule thickens, appearing hypointense on T2-weighted imaging with almost any surrounding edema. After some time, the lesion starts to calcify, usually without contrast enhancement or perilesional edema (nodular stage of calcification).10

The diagnosis of neurocysticercosis in the report was enforced simply by using a CT scan, which showed multiple circular cystic lesions that ranged in size from 10 to 20 mm with an image of a scolex in them in the brain parenchyma. In the brain parenchyma, there were also many calcifications. The diagnosis was further confirmed by the resolution of the lesion to multiple calcifications on a control CT scan one month after treatment with an anthelmintic.

Several methods are used to treat neurocysticercosis, including anti-parasitic medications, symptomatic treatment, and surgery.5,7 Symptomatic therapy is the first strategy for treating NCC. Administering analgesic, antiepileptic, anti-inflammatory and anti-edema drugs must be according to the indications. Carbamazepine, phenytoin, phenobarbital, and valproic acid are the most often prescribed antiepileptic medications. However, in some cases, levetiracetam and clobazam are also often prescribed. Corticosteroids can be given to patients who present with perilesional inflammation or intracranial hypertension. The use of antiparasitic medications to treat NCC is well documented in much of the literature. Albendazole and praziquantel are the most commonly used anthelminitics. The recommended dose of praziquantel in treating NCC is 50 mg/kg/day for 10 to 15 days, while the recommended dose for albendazole varies between 15 mg/kg/day for treating parenchymal NCC and 30 mg/kg/day for extra parenchymal NCC, taken in 2 doses per day for 8 to 10 days. Most experts agree that antiparasitic therapy is helpful in the majority of NCC cases, particularly in those with numerous cysts or subarachnoid NCC. Surgical management should be considered in cases with hydrocephalus or mass lesions. Excision of large intraparenchymal cysts, clusters of subarachnoid cysts, or intraventricular cysts are surgical possibilities in the management of NCC. A ventricular-peritoneal shunt can be implanted to control hydrocephalus.7,11 As in this case report, the patient was given three times a day 100 mg of phenytoin, which was administered intravenously in 100 cc of 0.9% NaCl in 30 minutes as an anti-epileptic and 400 mg of albendazole twice a day as an anthelmintic. In addition, the patient was also given 10 mg of clobazam every night, 400 mcg of folic acid twice daily, 650 mg of paracetamol three times daily, and 15 mg of meloxicam once daily.

The severity of the disease and the patient’s lifestyle modifications will determine the prognosis for neurocysticercosis. Neurocysticercosis with a single lesion has a good prognosis. In 60% of cases, the lesion will disappear after 6 months of treatment. However, if numerous lesions with calcifications are present, they will typically experience repeated seizures. It’s crucial to inform and educate patients, their families, and those around them about neurocysticercosis prevention. The provision of information includes avoiding contaminated food, treating the patient thoroughly, improving sanitation, and processing or cooking pork properly.5,11

Limitation
In this case report, the diagnosis was established only by a CT scan, and the lesion’s remission was confirmed on a follow-up CT scan one-month following anthelmintic medication treatment. This is because we do not have the resources at our facility to perform further supportive examination procedures, such as EEG, MRI, antibody, and cerebrospinal fluid ELISA testing.

CONCLUSIONS
Neurocysticercosis (NCC) is one of the most common parasitic infectious diseases affecting the human CNS in endemic and non-endemic countries due to immigration and travel. This condition was brought on by ingesting Taenia solium embryonic eggs, which then penetrated the small intestinal mucosa and entered the blood circulation system to reach the CNS. Neurocysticercosis is often asymptomatic, but patients with NCC may also show other clinical manifestations such as seizures, intracranial hypertension, stroke, focal neurological deficit, headache, disorientation, visual disturbances, and psychiatric manifestations. Seizures are the most common symptom. The gold standard for diagnosis continues to be neuroimaging, such as a CT scan or MRI. In endemic countries, most of which are developing countries, CT scans are more accessible than MRI because they are cheaper and more common. Several methods are used to treat neurocysticercosis, including anti-parasitic medications, symptomatic treatment, and surgery. However, the most frequently used are anthelminitics. The CT scan is an examination that can be performed on patients with seizures in endemic areas to make a diagnosis and assess the results of therapy after the administration of anthelmintics.

CONFLICT OF INTEREST
There are no conflicts of interest that the author has disclosed for this project.

ETHICS APPROVAL
For the purpose of publishing this case report, the patient’s written consent was acquired.

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All authors confirm equal responsibility for the study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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