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Comprehensive management of neurocysticercosis: A case report

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Abstract
Neurocysticercosis, a frequent parasitic disease of the central nervous system, is a result of Taenia solium infection. Typically, it manifests with seizures, headaches, worsening focal neurologic symptoms, visual disturbances, loss of bladder control, etc. CT scans play a crucial role in diagnosing parenchymal neurocysticercosis due to their high sensitivity and specificity. Using albendazole (ALB) and praziquantel (PZQ) together was found to be more effective in treating anthelmintic drugs (AHD) compared to administering each drug individually. In this case, conservative therapy was used for treating parenchymal neurocysticercosis, with physiotherapy helping to achieve gradual clinical enhancement.

Keywords: Neurocysticercosis, diagnosis, treatment, physiotherapy

Introduction
Neurocysticercosis (NCC) is a disease in the central nervous system caused by the larval form of the pork tapeworm Taenia solium [1]. It is the most prevalent parasitic illness affecting the CNS, resulting from consuming the developed eggs of the tapeworm Taenia solium. Poverty is closely linked to this issue, as inadequate sanitation and hygiene allow for food and water to become contaminated with human feces, while unrestricted pigs are exposed to these same contaminated areas. Inadequate waste management and consumption of raw pork play crucial roles in its spread [2]. Consuming undercooked pork, contaminated water, or poor hygiene can lead to humans getting infected with NCC. It is a significant health problem in India, Latin America, and Southeast Asia. Global travel and migration have led to the rise of NCC as a growing infection in developed nations [3]. Neurocysticercosis is the most prevalent parasitic infection in the central nervous system, impacting more than 50 million individuals worldwide [4]. In this report, we share a case study of a patient with parenchymal neurocysticercosis who received conservative treatment and physiotherapy at our facility.

Case Report
A 37 year old male tile worker was brought to the emergency room with a 2-day history of fever, chills, and overall weakness. He also reported experiencing breathing troubles and coughing up white frothy sputum for the last 24 hours. Upon reaching the hospital, the individual was unconscious and had a GCS score of 4/15, signaling significant neurological issues. His Glasgow Coma Scale showed eye response 1, Verbal response 2, and Motor response 1 (no movement). He was classified as non responsive according to the AVPU scale (Alert, Voice, Pain, and Unresponsive). In the Emergency Department, he needed intubation and mechanical ventilation with the following parameters: Assist Control/Volume Control mode (AC/VC), PEEP - 6 cm H2O, FiO2 60%, inspiration-expiration ratio 1:2, Tidal volume 425 mL, Respiratory rate 18 breaths/min for airway protection and also catheterization were done for urinary and bladder incontinence. The patient's background revealed he had experience working in hot conditions (such as a tile worker), suggesting a potential past episode of heat exhaustion without sweat, resulting in initial concern for heat stroke. There was no relevant medical history present, as there were no significant conditions such as hypertension, diabetes, thyroid disorders, tuberculosis, or past surgeries. There are no previous instances of vomiting, diarrhea, and cough. He had been smoking habitually for 20-25 years and occasionally drank alcohol. He had been consuming a diet that included meat and had recently eaten pork in the past few months. After observing, it was discovered that the patient had a moderate body structure and was adequately nourished. The vital signs displayed a Pulse rate (PR) of 160 beats/min (indicating tachycardia), Blood pressure (BP) of 100/68 mmHg, Respiratory rate (RR) of 32 breaths/min, Temperature of 102.5°F (showing fever), and Oxygen saturation of 96% while on mechanical ventilation (Table 1).

No indications of pallor, icterus, clubbing, cyanosis, lymphadenopathy, or edema were observed during the physical examination. Coarse crepitations were heard on both sides of the chest during auscultation, indicating possible issues in the lower respiratory system. The arms and legs were flaccid (0/5) and areflexic, showing no muscle strength in both upper and lower limbs, possibly indicating a neurological issue. The patient was unable to respond to commands, so a sensory examination was not conducted. The chest X-ray revealed secretions in the right middle and lower sections of the lungs as shown in (Fig 1), suggesting there may be a respiratory infection present. Laboratory tests such as full blood count, electrolytes, C-reactive protein, erythrocyte sedimentation rate, vitamin B12, thyroid, and renal function were all within normal range. Considering the patient's past and symptoms, heat stroke was the primary potential diagnosis. He began receiving supportive care including antibiotics, sedatives, painkillers, and intravenous fluids. Furthermore, chest physiotherapy was started to assist with clearing the airways.

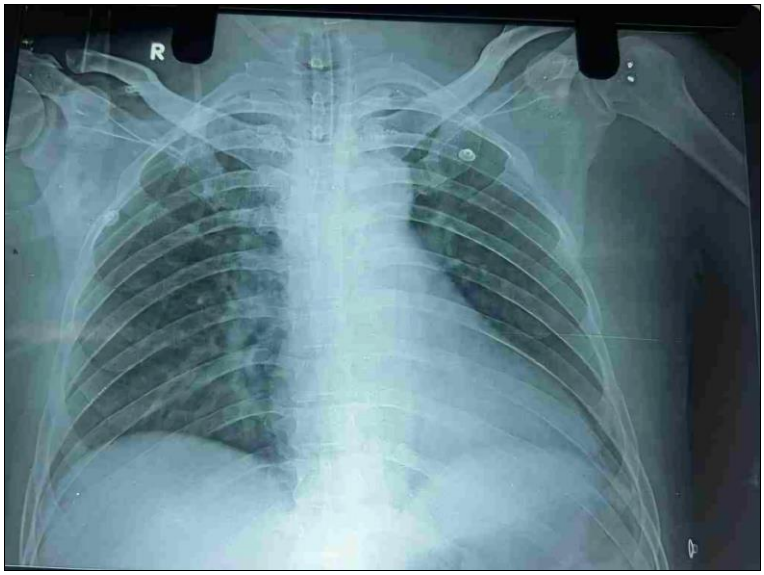

Fig 1: Showing secretions in right lung

During the following week, the patient's condition deteriorated. He experienced seizures and a prolonged fever. This led to additional neurological assessment, which found Papilledema (swelling of the optic disc), suggesting elevated intracranial pressure (ICP), presence of meningeal signs, fundoscopy displayed mid-dilated pupils and neurological exam showed doll's eye reflex (indicative of brainstem involvement). These results led to concerns about meningoencephalitis. Additional examination of cerebrospinal fluid (CSF) revealed elevated protein at 135 mg/dl, glucose at 76 mg/dl, and cell count at 30 cells/ml. Additional microbiological results revealed acinetobacter species in the ET secretions culture, confirming sepsis, candida species in the Urine culture, indicating a fungal infection, and negative results in the blood cultures. A head NCCT scan showed a calcified granuloma cyst in the brain tissue, supporting the diagnosis of Parenchymal Neurocysticercosis (Fig 2). The patient began a thorough treatment plan with antiepileptic medications for seizures, Tigecycline antibiotics for Acinetobacter sepsis, Dexamethasone corticosteroids to decrease inflammation and manage ICP, Mannitol diuretics to lower ICP, and anthelmintics (Albendazole and Praziquantel) were given together to treat the neurocysticercosis infection. Continuing care involved the use of a ventilator and physiotherapy. Physiotherapy on the chest and limbs was ongoing to avoid complications of immobility and respiratory failure.

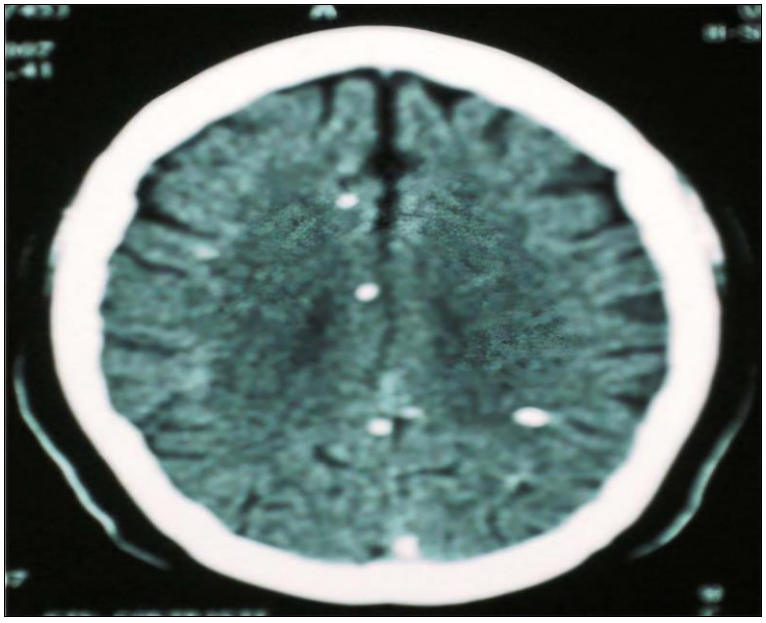

Fig 2: Calcified granuloma cyst in brain parenchyma (non contrast CT scan)

Table 1: Vitals charting per week

Vitals	1st week	2nd week	3rd week
HR	160 bpm	92 bpm	115 bpm
RR	32/min	28/min	20/min
BP	100/68 mmhg	146/88 mmhg	112/98 mmhg
Spo2	96% on AC/VC	97% on HFNC	97% on room air
Temperature	102°F	104° F	99°F

Physiotherapy intervention

Physiotherapy played a crucial role in the treatment of NCC by addressing both respiratory and musculoskeletal issues for the patient. Chest physiotherapy is administered to patients with respiratory compromise (indicated by coarse crepitations and secretions on chest X-ray) to enhance lung function and clear the airways. Postural drainage techniques were used to help drain secretions from the lungs, particularly from the right middle and lower lobes. Percussion and vibration techniques were then used to loosen thick secretions before suctioning them out. Incentive spirometry was used to improve oxygen levels, while deep breathing exercises like diaphragmatic and pursed lip breathing were also utilized to improve lung function and prevent airway collapse. The program advanced step by step each week from basic positioning and suctioning to more advance breathing exercises as the patient's condition improved (Table 2). The aim was to enhance lung function and oxygen levels, resulting in improved breathing and decreased reliance on mechanical ventilation. To address the patient's flaccid limbs and lack of reflexes in all limbs, the objective was to enhance muscle tone, avoid muscle wastage, sustain range of motion (ROM), and enhance strength in order to support general autonomy and prevent issues like deep vein thrombosis (DVT) and pressure sores. Physiotherapy included early passive ROM exercises to prevent muscle wasting and sustain limb flexibility. As muscle tone improved, active-assisted and active exercises were introduced, followed by strengthening exercises to enhance muscle strength and prevent DVT through passive movements, DVT pump and early mobilization (Table 3).

Table 2: chest clearance techniques to improve lung function in NCC

Weeks	Chest physiotherapy treatment
Week 1	Mechanical vibrator in both right and left lobes of the lung 5–7 minutes/segment 2–3 times/day. percussion (anterior lobe) 3–5 minutes per area 2–3 sessions/day Postural Drainage 10–15 minutes per position 2–3 times/day
Week 2	Mechanical vibrator in both right and left lobes of the lung 5–7 minutes/segment 2–3 times/day percussion (anterior and posterior lobe) 5–10 minutes total 2–3 times/day Postural drainage 5–10 minutes total 2–3 times/day Incentive spirometry exercise 10–15 breaths/session Every 2–3 hours (≈ 5–6 sessions/day)
Week 3	Mechanical vibrator in both right and left lobes of the lung 5–10 minutes 1–2 times/day Percussion (anterior and posterior lobe) 5–10 minutes 1–2 times/day Incentive spirometry exercise 10–15 reps/session 5–6 times/day Deep breathing exercises 10–15 breaths/set 3–4 times/day Assisted cough technique 3–5 coughs per set 2–3 times/day (or as needed after drainage)

Table 3: Rehabilitation protocol for limb physiotherapy

Week	Limb physiotherapy treatment
Week 1	Passive ROM exercises of major joints Passive ankle pump exercise Passive ROM (all major joints) 10–15 reps per joint 2–3 times/day Passive Ankle Pump 20–30 reps 3–4 times/day
Week 2	Active assisted ROM exercises of major joints Assisted ankle pump exercise Passive ROM (all major joints) 10–15 reps per joint 2–3 times/day Passive Ankle Pump 20–30 reps 3–4 times/day
Week 3	Active ROM exercises of major joints strengthening exercises Passive ROM (all major joints) 10–15 reps per joint 2–3 times/day Passive Ankle Pump 20–30 reps 3–4 times/day

During a three week physiotherapy program, patients with neurocysticercosis (NCC) experienced gradual yet significant enhancement in their respiratory function, with improvements in oxygenation leading to successful removal from mechanical ventilation (Fig 3). Chest physiotherapy improved airway secretion clearance and increased lung

expansion (Table 4). The patient improved muscle strength, going from 0/5 power to 3/5 in both upper limb and lower limb. The patient started to demonstrate better functional mobility, being able to execute simple actions like sitting up. Regrettably, the patient was not seen for a follow-up appointment three weeks after being discharged from our facility.

Follow-up and outcome measures

Table 4: The outcome measures and the Manual Muscle Testing (MMT) score improved.

Week	MMT	
	Upper limb (R&L)	Lower limb (R&L)
Week 1	0/5	0/5
Week 2	2/5	2/5
Week 3	3/5	3/5

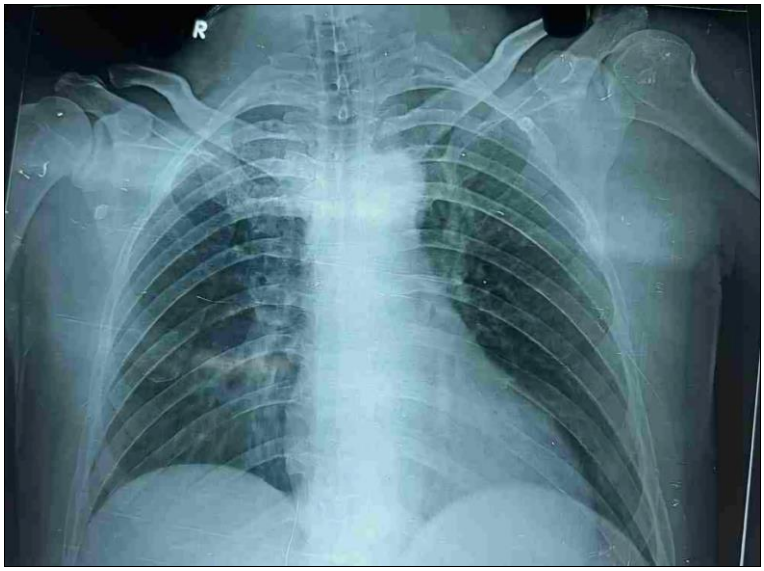

Fig 3: shows significant improvement in lung

Discussion

Neurocysticercosis is a significant illness in humans resulting from parasites, posing a public health concern due to the high rates of sickness and death in endemic areas [5]. Cysticercal infection happens when individuals consume Taenia solium eggs from pork that is not fully cooked or vegetables that are not properly cleaned. Embryos infiltrate the intestinal wall, travel through the bloodstream, and settle in tissues such as muscles, eyes, and the central nervous system. Cysticerci develop in the brain from larvae, with Cysticercus cellulosae commonly found in the parenchyma, distinguished by its scolex [6]. Neurocysticercosis is divided into intracranial and extracranial (spinal) types, with spinal participation being uncommon, representing just 0.7–11.1% of occurrences. Intracranial neurocysticercosis is classified into parenchymal, ventricular, and cisternal (subarachnoid) types depending on which areas of the brain are involved. Ocular involvement may be classified as a fourth intracranial subtype in certain classifications. Of these areas, the brain parenchyma is typically affected the most, with the subarachnoid space being the least commonly involved, occurring in about 12% of cases.The diagnosis of neurocysticercosis depends on globally accepted criteria, needing neuroimaging methods such as CT or MRI, supported by serological testing for confirmation [7]. Brain imaging is crucial for diagnosis, and CT scans are the most commonly utilized initial method because they are widely accessible. CT scans are highly sensitive and specific in detecting parenchymal neurocysticercosis [8].

The manifestations of neurocysticercosis differ greatly and are influenced by host characteristics such as age, gender, geographical location, and genetic variations, along with parasite-related factors like the quantity, dimensions, kind, and position of cysts in the brain. These variables impact how the clinical symptoms appear, which can vary from seizures and headaches to more serious neurological impairments [9]. In regions where the disease is common, the majority of people with neurocysticercosis do not show any symptoms. In medical situations, most patients exhibit symptoms like seizures or epilepsy (70-75% of cases), headaches, focal neurological deficits, cognitive decline, or signs of increased intracranial pressure [10]. Patients with neurocysticercosis in the brain parenchyma are more likely to experience seizures than those with subarachnoid or ventricular forms, as the cysts cause direct irritation or damage to neural tissue, leading to the seizures [11].

The management of NCC relies primarily on how each person reacts and is guided by the symptoms they exhibit. Treatment options for neurocysticercosis (NCC) include anthelmintic drugs (AHD) and surgery, which are chosen based on the viability of cysticerci and clinical symptoms. Anti-epileptic medications are given to treat seizures caused by cysticercosis, pain relievers for headaches, steroids to decrease prolonged inflammation and swelling around brain cysts and inflammation of the arachnoid membrane. The antihelminthic drug has been part of the treatment regimen for the past 30 years. The use of albendazole (ALB) and praziquantel (PZQ) together was discovered to be more

successful in treating anthelmintic drugs (AHD) than using each drug separately [12, 13]. Physiotherapy for neurocysticercosis aims to enhance respiratory function, muscle strength, and overall independence in daily activities. Regular physiotherapy sessions improve muscle strength and respiratory function, resulting in improved mobility and daily abilities in patients who are affected [5, 6, 14]. This case highlights the difficulties in treating neurocysticercosis (NCC) with sepsis and respiratory failure. The patient required stabilization, treatment for infection, and specific NCC therapy, all verified by neuroimaging and CSF analysis. Anthelmintics, corticosteroids, and diuretics were effective in managing intracranial pressure, while physiotherapy enhanced respiratory function, avoided complications, and regained mobility. Prompt detection, comprehensive treatment, and rehabilitation were essential for the patient to recover fully and improve their quality of life.

Conclusion

The patient's recovery from Neurocysticercosis (NCC) was greatly improved by both pharmacological management and physiotherapy as part of a multidisciplinary approach, early physiotherapy in the case was vital in enhancing the patient's functional outcomes, respiratory function, and muscle strength, ultimately contributing to a more positive recovery path in this complex situation. Future research should incorporate timely detection methods, uniform rehabilitation plans, and evaluations of long-lasting results.

Study limitations

The study is limited by a delayed diagnosis of neurocysticercosis (NCC) initially thought to be heat stroke, leading to delayed treatment. Advanced diagnostic tools such as MRI and serological tests were not utilized, which could have impeded a faster diagnosis. Focusing on just one patient in the study restricts its applicability, while secondary infections (such as sepsis and fungal infections) impact the effectiveness of treatments. There was no long-term follow-up conducted to evaluate sustained recovery, and the physiotherapy interventions lacked sufficient details. Socioeconomic factors and access to healthcare were not taken into account, and biases in reporting improvements were not acknowledged.

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