



## Neurocysticercosis: Trends in Diagnosis and Management

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### Abstract

Neurocysticercosis (NCC) is a major cause of neurological morbidity in the world. The diagnosis of NCC is challenging in endemic and resource-limited countries where laboratory and imaging techniques are not available. Clinical manifestations are non-specific, most neuroimaging findings are non-pathognomonic, and some serologic tests have low sensitivity or specificity. The treatment of the NCC includes cysticidal drugs (e.g., albendazole and praziquantel), and neurosurgical procedure, depending upon the situation. Currently, there are several diagnostic and management issues which remain unresolved. This review will help to look the recently going diagnostic procedures and the medical management of the disease.

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### Introduction

Neurocysticercosis (NCC), a parasitic infection of the nervous system caused by the encysted larval stage of the tapeworm *Taenia solium*. Neurocysticercosis is considered by the World Health Organization to be the most common preventable cause of epilepsy in the developing world, with an estimated 2 million people having epilepsy caused by *T. solium* infection.<sup>(1, 2, 3)</sup>

Human is the only definitive host of *T. solium* harboring adult tapeworm in the intestine (taeniasis), whereas both man and pig can act as intermediate hosts and harbor the larvae in different internal organs (cysticercosis) including brain (NCC).<sup>(4, 5)</sup>

### Epidemiology

NCC was first reported in a coolie from Madras, who died due to seizure and was found to be infected with

cyst on autopsy.<sup>(6)</sup> In 1934, high rate of new onset epilepsy related to cysticercosis in the British army deployed in India was noticed.<sup>(7)</sup> Estimation of the prevalence of NCC in the general population is challenging because it is difficult to perform neuroimaging in a large population. Moreover, poor record keeping in several developing countries and socioeconomic issues gets adds to this also.<sup>(8)</sup> NCC is asymptomatic in approximately 50% of cases.<sup>(9)</sup>

### Disease burden in India

All the biological markers for transmission of *T. solium* taeniasis and cysticercosis exist in India. There are great disparities within the country in geography, ethnicity religion rituals, income, food habits, personal hygiene, level of education and standards of living, which are likely to influence the disease burden.<sup>(10)</sup> Consequently there are wide variations in the frequency of cysticercosis in India shown in Figure 1.

In a community survey of 50,617 individuals from South India, the prevalence of active epilepsy was 3.83 per 1000 and NCC was detected in 28.4% of them by CT.<sup>(11)</sup>

In a study based on 30 cluster sampling approach suggested by WHO in the rural pig farming community of Mohanlalganj block, Lucknow district, Uttar Pradesh, the prevalence of taeniasis was 18.6%; factors associated with taeniasis were age above 15 years.

In the same community active epilepsy was identified and clinically confirmed in 5.8% of the populations during door to door survey and 48.3% of them fulfilled either definitive or probable diagnostic criteria of NCC.<sup>(12)</sup>

## Life cycle

*Taenia solium* completes its life cycle in two hosts-

Man: Definitive host

Pig: Intermediate host

## Clinical picture

It depends on the site involved. Any organ or tissue may be affected but the most common being subcutaneous tissues, muscles, Central nervous system (CNS) and eyes.

Neurocysticercosis is the most common cause of epilepsy in the world. It is of two types-

Parenchymal: Involves brain parenchyma

Extraparenchymal: Involves meninges, ventricles and spinal cord

Manifestations are mainly due to the calcified form of cysticercus cellulosae leading to behavioural disorders, increased intracranial pressure, chronic meningitis, hydrocephalus.

## Laboratory diagnosis

### 1. Biopsy:

Histological confirmation of neurocysticercosis in most of the cases is not possible. However, Detection of the parasite in a biopsy specimen of skin nodules may also aid in the diagnosis.<sup>(14,15)</sup>

### 2. Imaging methods:

The mainstay of diagnosis of NCC is neuroimaging using contrast enhanced computerized tomography (CECT) or magnetic resonance imaging (MRI). CT scan is preferred for identifying parenchymal calcifications while MRI is the preferred modality for parenchymal lesions which are in the temporal lobe and frontal lobe close to the skull base, intraventricular cysts and subarachnoid cysts.<sup>(16)</sup>

While CT and MRI will almost invariably identify the NCC lesions, there may be diagnostic difficulties in differentiating NCC from other lesions of the brain such as tuberculomas, other parasitic cysts such as hydatid cysts, neoplastic lesions such as gliomas and metastatic lesions.<sup>(17)</sup>

### 3. Serological tests:

A major disadvantage of this approach is that false positive results can be obtained as antibodies do not necessarily indicate an active infection whereas presence of antigens indicates an active infection.<sup>(18, 19, 20)</sup>

#### a. Enzyme Linked Immunotransfer Blot (EITB)

This assay tests for antibodies to seven larval specific antigens. It has a sensitivity of 98% and specificity of 100% in patients with more than one live cyst or subarachnoid disease.<sup>(21)</sup> This technique uses lentil lectin purified glycoprotein antigens to detect antibodies to *T. solium* in serum.<sup>(22)</sup>

#### b. Enzyme Linked Immunosorbent Assay (ELISA)

**Antibody detection:** It can detect IgG antibody against parasite antigens in serum or CSF sample, although IgA, IgE, and IgM can also be detected but have little value in diagnosis.<sup>(23, 24)</sup>

In a study, Anti-*T. solium* Ab levels were determined by an in-house ELISA.

Vesicular fluid was recovered from *T. solium* cysticerci and used as the source of Antigen.<sup>(25)</sup>

**Dot ELISA:** The Dot-ELISA constitutes a nitrocellulose membrane bound with the cysticercus antigen, the specific cysticercus antibodies, if present in the serum, will bind to the antigen and is detected visually by addition of an enzyme-labeled second antibody.<sup>(26)</sup>

**Antigen Detection:** Enzyme Linked Immunosorbent Assay detects circulating antigens from the *T. solium* metacestode (B158/B60 Ag-ELISA or HP10 Ag-ELISA).<sup>(27)</sup>

It is almost always positive in patients with subarachnoid disease but like the EITB, is likely to be negative in those with calcific lesions and with one or two parenchymal lesions.<sup>(1)</sup>

The Ag-ELISA could be used to monitor the effects of therapy as its levels fall rapidly following successful therapy.<sup>(28)</sup>

#### 4. Molecular methods

Polymerase Chain Reaction (PCR): This technique detects the DNA of *T. solium* in the sample. The target element is pTsol9, which is highly repetitive in parasite genome. A study was done by Michelet *et al.*, (2011) they used primers 5-CAGGGTGTGACGTCATGG-3 (forward primer; positions 21 to 38, 179 to 196, or 336 to 353) and 5-GCTAGGCAACTGGCCTCCT-3 (reverse primer; positions 122 to 140, 280 to 298, or 437 to 455) for the amplification of pTsol9 and found PCR 80% specific for the diagnosis of NCC.<sup>(29)</sup>

#### Management

The initial approach to the management of the cysticercosis includes symptomatic treatment as well as depends upon the viability of the parasite. As the agent of the cysticercosis affects four major systems of the human body (Skin, Muscles, Nervous system & Ocular system).

##### 1. Medical management

The treatment of choice for medications includes:<sup>(30)</sup>

- (a) Larvicidal agents
- (b) Corticosteroids
- (c) Antiepileptic Drugs

##### (a) Larvicidal agents

This drug is given only if the larval agent is viable. This is administered to kill the larval agent. It includes:

Praziquantel is a quinolone which produces spastic paralysis of the parasite musculature and destroy the Scolex.<sup>(31)</sup>

Albendazole is an imidazole which acts by inability the uptake of glucose by parasitic membranes thus causing energy depletion.<sup>(32)</sup>

##### (b) Corticosteroid medication

It is used to treat inflammation. Prednisolone and dexamethasone are the drugs of choice.

##### (c) Antiepileptic drugs

It is helpful to control the seizures.

Example includes Phenytoin and Carbamazepine.

#### 2. Surgical management

The surgical management is according to the affected area of body as follows:<sup>(33)</sup>

- (a) **Cyst in skin/muscle:** If the cyst is present under the skin or muscle then surgical excision is necessary to treat this condition.
- (b) **Cyst in eye:** If the cyst is located in anterior chamber than Viscoexpression and for posterior chamber, Vitrectomy is the surgery of choice.
- (c) **Cyst in nervous system (Brain and spinal cord):** Ventriculo-peritoneal shunt placement is needed, if the cyst develops into the ventricles of the brain causing increased intracranial pressure.

#### Nursing management

Nurses play a key role in the care of patients with neurocysticercosis.

The first step of the nursing management is assessment which includes history taking and performing an accurate physical/neurological examination to recognize changes.

##### 3. Nursing diagnosis

##### Preoperative nursing diagnosis

Headache related to increased intracranial pressure secondary to hydrocephalies as evidenced by pain scale.

Risk of injury related to seizures secondary to disease condition as evidenced by verbalization with the patient.

Visual impairment related to ocular cyst.

Fig.1 Geographical distribution of cysticercosis and *Taeniasolium*taenais in India<sup>(10)</sup>

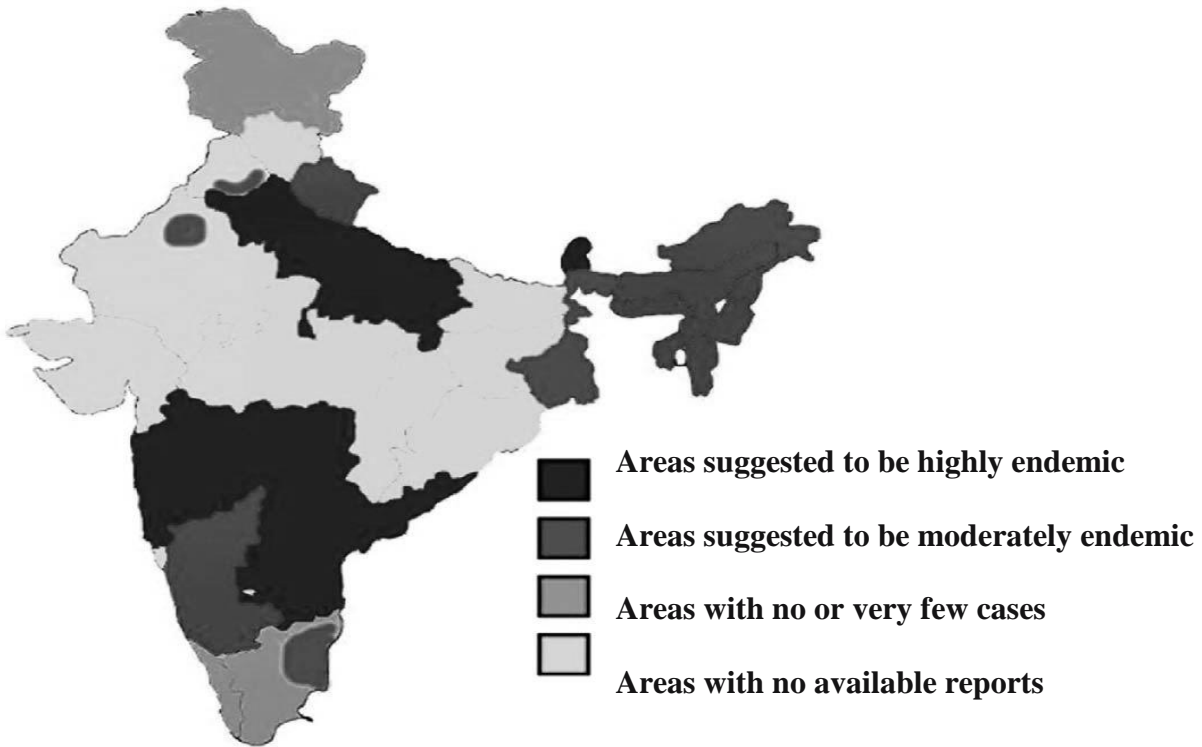
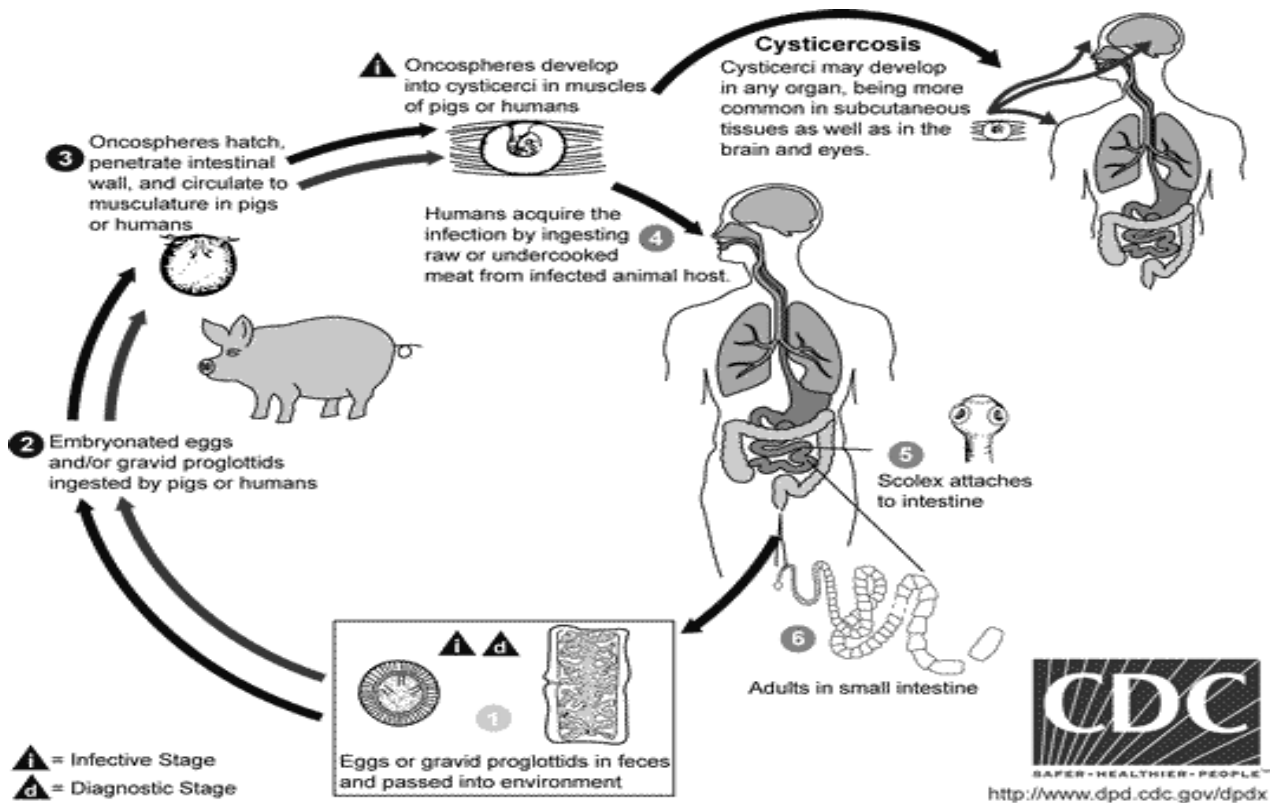
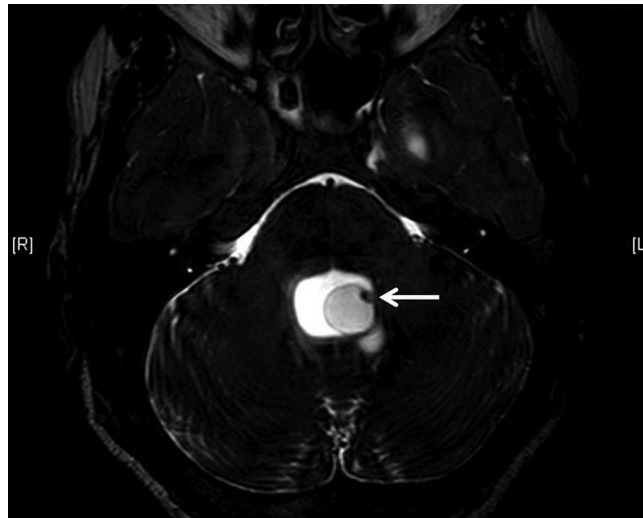


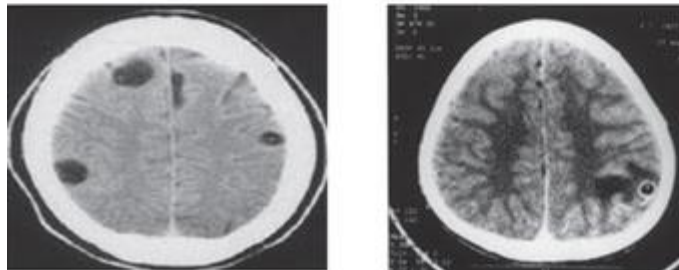
Fig.2 Life cycle of *T. solium*<sup>(13)</sup>



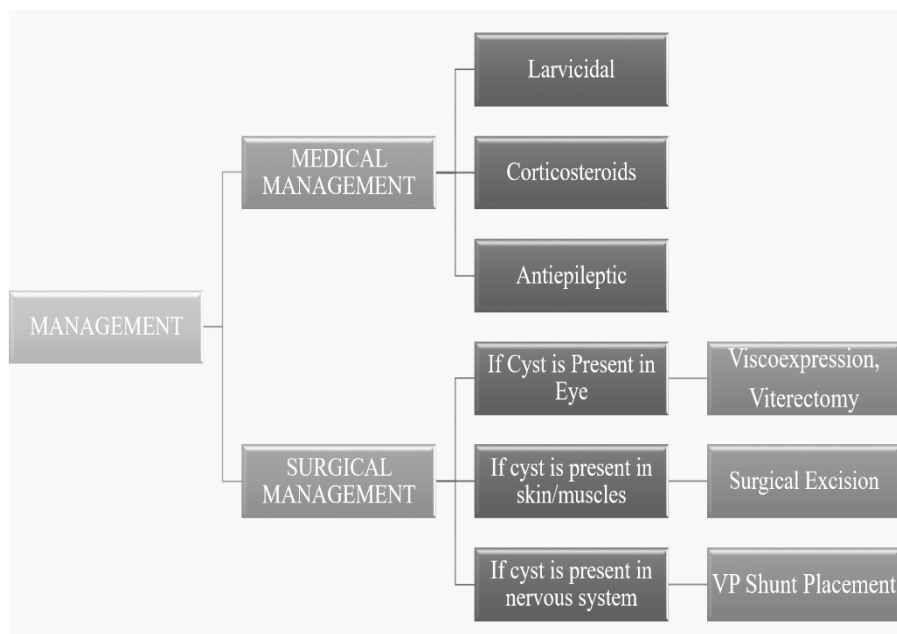
**Fig.3** A driven equilibrium sequence axial magnetic resonance image showing a fourth ventricular cysticercal cyst with the scolex seen as a hypointense (dark) dot (arrow)



**Fig.4** 1. Unenhanced CT showing multiple active vesicular cysts. 2. contrast-enhanced CT showing a similar ring-enhancing lesion probably corresponding to the granular-nodular pathologic stage. Epilepsia © ILAE



### Medical Management





## Postoperative nursing diagnosis

Pain related to surgical procedure as evidenced by facial expression of the patient.

Risk of infection related to surgical procedure as evidenced by vital signs of the patient.

Knowledge deficit related to treatment and prognosis of disease.

## Prevention

Wash hands with soap and warm water after using the toilet, changing diapers, and before handling food

Wash and peel all raw vegetables and fruits before eating

Use fresh food and water safety practices while travelling in developing countries such as:

Drink only bottled or boiled (1 minute) water

Avoid eating meat: Since pork is the prime culprit for spreading *T. solium*, their eggs can be found on meat that was stored or transported alongside pork.

Cook the meat properly to destroy potential infestation of *T. solium*.

Proper disposal of feces and prevention of contamination with food given to pigs is also important.

It is concluded that NCC is the most common parasitic infection of the CNS and identified as the most important cause of acquired active epilepsy.

However there is a lack of highly sensitive, specific and cost-effective tools for diagnosis of NCC but there is also progress in development of immunological tests in the last two decades. In the diagnosis of NCC neuroimaging still remains the central. Appropriate measures like health education, mass awareness, better medical facilities, mass treatment of *T. solium* carriers, and restriction on sale of measly pork may help in reducing the disease burden in the endemic areas.

The management of NCC is debated especially with respect to the use of cysticidal drugs as their benefits have not been conclusively proven. There are several other management issues awaiting resolution.

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