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## RESEARCH ARTICLE

# NEUROCYSTICERCOSIS: A STUDY OF CLINICAL PROFILE FROM A SERVICES HOSPITAL IN INDIA

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**ABSTRACT**

**Introduction:** This study was carried out at a tertiary care services hospital in central India. The main aim of the study was to evaluate the clinical profile, diagnosis, treatment and follow-up in 26 pediatric neurocysticercosis patients over a duration of five years (from Jul 2011 To Jul 2016).

**Materials and Methods:** Detailed history, Clinical features, Computed tomography (CT) and or Magnetic Resonance Imaging scan were the basis of diagnosis of neurocysticercosis along with exclusion of other causes. Patients symptomatic with seizures and active, transitional cysts treated with anticonvulsants, steroids, and albendazole. Seven of the children required multiple courses of albendazole.

**Results:** A total of 26 patients completed this study. Mean age of the presentation was 9.6 ± 4.9 years, 58% of the patients were female. The clinical profile of patients was as follows - partial seizures 63.3%, generalized seizures- 37.7%, headache - 67%, vomiting in 19 %, focal neurological deficit in 11% and a combination of symptoms in 70% cases. Contrast CT brain showed a solitary lesion in 18 (71.1%) and multiple lesions in the rest. To begin with CT/MRI lesions were transitional in 64%, inactive in 21% and mixed in 36%, All the children were seizure free after two years of treatment and follow up, with normal electroencephalography (EEG). During the course of follow-up CT scan brain, lesions disappeared in 69.4% of the cases and 29.6% of them got calcified,

**Conclusion:** Neurocysticercosis was the commonest cause of seizure disorder in children in this study**.** The commonest CT picture at presentation was a Solitary ring enhancing lesions (transitional stage) involving the parietal lobe. Partial/focal seizure was the most common type of seizure. Albendazole is effective in single as well as multiple ring enhancing lesions of neurocysticercosis. Praziquantel alone or in combination was not tried in this study.



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## INTRODUCTION

Neurocysticercosis is an helminthic infection of the central nervous system. It is caused by the larval stage i.e. (cysticercus) of the cestode Taenia solium, also known as the pork tapeworm. This causes substantial health and economic burden in the affected population (Garcia *et al.,* 2003). Neurocysticercosis is a public health problem with wide distribution in the world, especially in developing countries, and increasingly growing in developed countries, due to the high rates of immigration. It affects children as well as adults. Neurocysticercosis is endemic in India and most of the cases have been reported from South East Asia, Central and Latin American nations (Clinton White and Philip Fischer; Bhattacharjee and Biswas, 2011; Singhi *et al.,* 2000; Cuellar *et al.,* 1999; Antoniuk *et al.,* 2006). It is the commonest parasitic central nervous infection world-wide (Clinton White and Philip Fischer; Bhattacharjee and Biswas, 2011). Human beings acquire cysticercosis through faecaloral contamination with *T. solium* eggs or poor hygiene practices in food handling by tape-worm carriers. Seizures partial or generalized are the commonest clinical. Headache, vomiting and impaired vision are usually associated. It is the leading cause of morbidity. Presentation along with headache and impaired vision are common clinical presentations of NCC and leading causes of morbidity.

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Dementia, learning difficulties and changes in cognition are often secondary sequelae in humans with NCC (Garcia *et al.,* 2003). The transmission of the infection has been reported from all continents. Neurocysticercosis ranks highest among CNS infections caused by this parasite worldwide and 29-35 % of epilepsies may be attributable to neurocysticercosis in these countries (Antoniuk *et al.,* 2006 Medina and Degiorgio, 2002; Commission on tropical diseases of the international league against epilepsy, 1994; Caprio, 2002; Del Brutto *et al.,* 1992; Flisser, 1994; Garcia and Del Brutto, 2003; Del Brutto, 2005; Garcia and Del Brutto, 2002; Sinha and Sharma, 2009; Sotelo *et al.,* 2012). Infection is acquired by ingestion of gravid segments of the adult worm, called proglottids, either from the environment because of soil contamination of the food chain, or by infection following direct hand-to-mouth transfer. Once exposed to gastric acid and bile, infective oncospheres are released in the upper small intestines of the human host, penetrate the intestinal wall, and disseminate throughout the body, including the CNS (Del Brutto *et al.,* 2001; Caprio *et al.,* 1994; Kalra *et al.,* 2009; Basu *et al.,* 2007). In this study we have tried to assess the clinical features, diagnostic modalities available with special emphasis on imaging modalities, treatment modalities and its outcome and follow-up of pediatric neurocysticercosis cases. This study was conducted over a period of 5 years from Jul 2011 To Jul 2016. Cysticide treatment in neurocysticercosis has been controversial, because its efficacy is partial against vesicular and colloidal cystic forms in the face of the persistence of the parasite after a course of albendazole or praziquantel, the only two therapeutic options currently available.

## MATERIALS AND METHODS

The study was carried out in the Department of Pediatrics at a services hospital in central India in children with seizure disorder in whom computed tomography brain scan had shown active or ring enhancing lesions or mixed lesions, All children outdoor and indoor having any combination of active, ring enhancing, or calcified were included in this study. The study period was from Jul 2011 to Jul 2016. The children along with their parents and witnesses were interviewed separately with the help of a predesigned questionnaire. All the parents and legal guardians of children enrolled for the study, confirmed participation freely and voluntarily. A separate questionnaire was prepared to interview every child, their parents and witnesses and followed. Written permission for the same was taken in writing from the parents. Permission was also obtained from the ethical committee of the institute. To begin with 26 children whose history, signs, symptoms, clinical examination and investigation confirmed them to be suffering from neurocysticercosis were selected for the study. After 2 years, only 21 children could be followed-up as the rest dropped out. We followed the diagnostic criteria by Del Brutto *et al*, in this study (Del Brutto *et al.,* 2001; Caprio *et al.,* 1994). According to this criteria, either one absolute criteria or a combination of 2 major, 2 minor and 1 epidemiologic criterion are necessary for the definitive diagnosis (Table-1). Probable diagnosis is made by 1 major plus 2 minor or 1 major plus 1 minor plus 1 epidemiologic criterions or 3 minor plus 1 epidemiologic criterion. The investigation carried out were CT/MRI, EEG, stool microscopy for ova, cysts or parasites, absolute eosinophil count, chest X-ray, Mantoux test, sputum and gastric lavage for acid fast bacilli were also performed to rule out tuberculosis, tubercular meningitis or tuberculoma, a very common differential diagnosis in India.

DCSF examination was not done in any of these cases. Immunological studies against cysticercus could be done only in three cases. Serological result was considered as diagnostic when the serum titer was ~1:160 (Singhi *et al.,* 2000). MRI brain was done only in multiple lesion cases (06 in number) already detected by CT scan brain. Number of lesions were counted in CT scan and the disease activity was classified as active (appearance on CT as hypodense cyst without enhancement), transitional (appearance of a ring or nodular shadow with contrast enhancement) and inactive (calcified lesions) based on the viability of the parasite as proposed by Carpio *et al*. (2008) Patients with active, transitional or mixed cysts and seizure were treated with oral albendazole (15 mg/kg/day) in two divided doses for total duration of 28 days as definitive therapy for active and transitional cysts (Garcia *et al.,* 2003; Kalra, 2009). All patients who were started on albendazole therapy, irrespective of any features of raised intracranial tension (ICT) were given oral Prednisolone (1 mg/kg/dose with the maximum dose of 50 mg/day) 48 hours before starting albendazole therapy as seizure could be precipitated by the introduction of albendazole because of inflammatory reaction by the breakdown of cysts (Garcia *et al.,* 2003). Prednisolone was continued for a total period of 07 days, i.e., two days before and five days after the start of albendazole therapy. The drugs used for the control of seizure were midazolam, carbmezapine and phenytoin in appropriate doses. Once the patient's condition was stabilized, they were placed on oral carbmezapine (15-30 mg/kg), which was continued for 2 yrs or more. In children with recurrent seizures, persistent lesions and in seizure-free patients with calcification of cysts, carbmezapine was continued for a longer period. Out of this, eight children required multiple courses of albendazole of 28 days each, as the symptoms persisted in the form of vomiting, headache seizures and appearance of new lesions on CT/MRI. Follow up protocol was in the form of regular clinical evaluation, repeat CT scan at intervals of 06 weeks, 03 months, 06 months and 24 months along with, EEG during first diagnosis and after 24 months. This was a prospective observational study. Permission from the parents and institutional ethical committee was obtained. When the size of lesions regressed by > 50% of the original size, it was considered as regression/reduction on CT scan. Persistence of lesions was defined as no reduction in number and size < 50% of the original (Basu *et al.,* 2007). This was evaluated along with clinical presentation, investigation findings, response to therapy and follow- up.

## RESULTS

Out of the total 26 patients 5 dropped out at different stages of the study. The youngest child was 5 years old. Nine children belonged to 10-12 years old age group. Children who required repeated dosage of albendazole and ivermectin were all > 13 yrs old. Among the 21 patients who completed the study the mean age of onset of symptoms was 8.4 years with a range of 4-15 years. 15 patients were female while 11 were male. All of these children were from a rural background and the parents were defense forces personal. 19 were pure vegetarians and the rest were non-vegetarians, but none of them never consumed pork at any stage. Three children hailed from North-Eastern part of India. Incidentally two parents were in charge of the butchery (animal slaughter house). Amongst these 26 patients seizure was the most common presentation at the onset except in one in whom the seizure started after one course of albendazole therapy on day 29 of treatment.

**Table-1-Revised Diagnostic Criteria for Neurocysticercosis (Del Brutto *et al*.)**

| Absolute criteria | Major criteria | Minor criteria | Epidemiologic criteria |
|---|---|---|---|
| • Histological demonstration of the parasite from biopsy of brain or spinal cord lesion | •Lesions highly suggestive of NCC on neuroimaging* | • Lesions compatible with NCC on neuroimaging# | • Evidence of household contact with Taenea Solium infection. |
| • Cystic lesions with scolex on CT or MRI | •Positive serum EITB for detection of anti-cysticercus antibodies | • Clinical manifestations suggestive of NCC† | • Individual coming from living in an endemic area. |
| • Direct visualization of sub retinal parasite by fundoscopy | •Resolution of cysts after antiparasitic therapy | • Positive CSF-ELISA for detection of anti cysticercus antibodies or cysticercus antigens | • History of travel to an endemic area. |
| | •Spontaneous resolution of small single enhancing lesions | • Cysticercosis outside the CNS | |

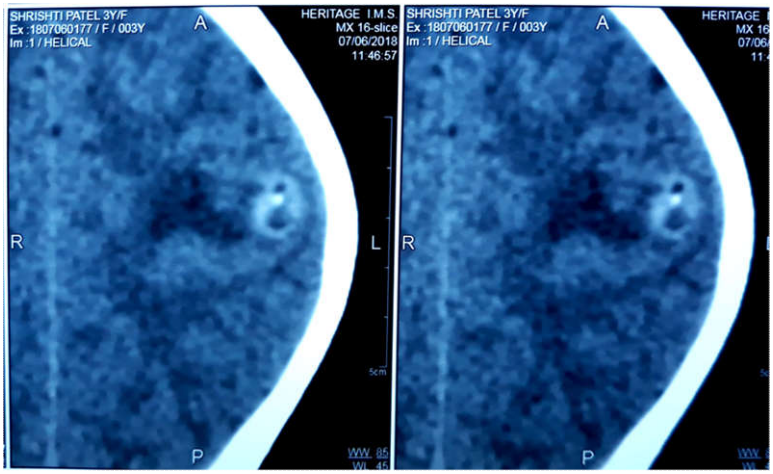


**Figure 1A.**

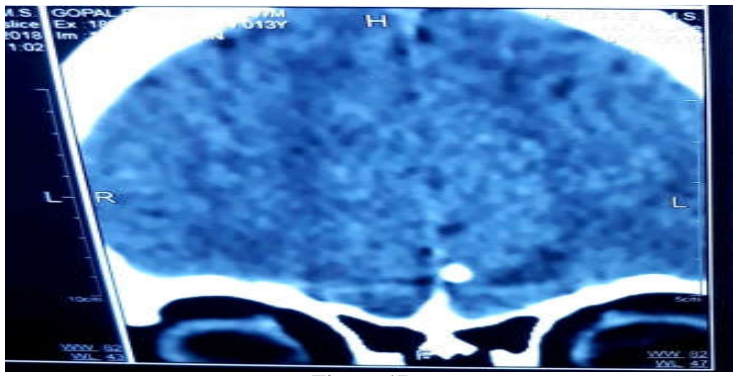


**Figure 1B.**

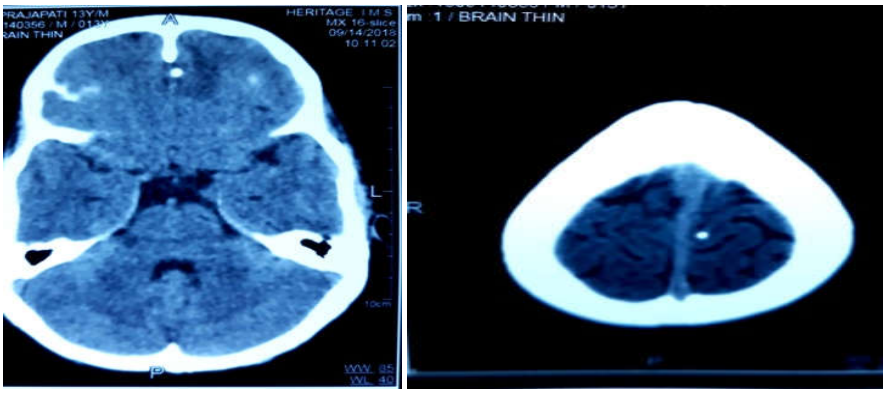


**Figure 1C.**

**Figure 1. A to D -Contrast-enhanced axial section showing a single, small (<20 mm), hypodensity lesion with (A) ring and (B) disc enhancement, termed as single small enhancing computed tomographic lesion (SSECTL) representing a degenerating cyst with associated mild-to-moderate perilesional edema and bright, hyperdense, eccentric scolex pathognomonic for NCC. (C)(D) Small calcified nodule with mild perilesional edema**

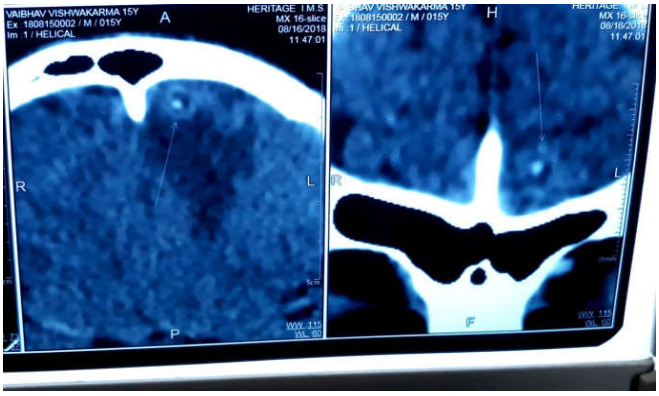

**Figure 2A. Single, small, contrast enhancing CT lesion: ring with scolex and perilesional oedema**

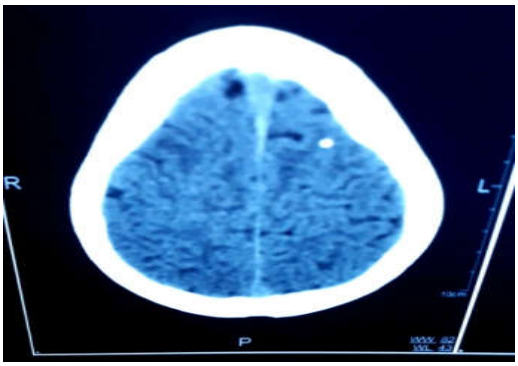

**Figure 2B. A single, small, contrast enhancing CT lesion: disc**

Simple partial seizure was seen in 63.33% of cases at presentation, complex partial seizure in 37.77% (Table-2). Two children presented with status epilepticus additionally. Symptoms of raised intracranial tension like headache with or without vomiting was there in many of the cases at initial presentation. Neuropsychiatric disturbances in the form of violent behavior and irrelevant talking was observed in two children. In children who dropped out, the CT scan brain revealed active lesion in three patients, transitional lesion in 02 cases. Total 26 lesions were detected from CT scan at the presentation, fourteen of which were noted in the parietal lobe, five each in the frontal lobe and temporal lobe and one in the occipital lobe. Five of them never turned up at six weeks of follow-up, rest all came for follow up regularly. Out of the 21 patients who attended after 6 weeks nine had persistence of symptoms and increase in the number of lesions. They were subjected to repeat courses of albendazole (three cycles of 28 days each). Reassessment was done with repeat MRI where five patients responded but four patients showed new lesions. Out of the 21 patients who completed the study 71% patients showed solitary lesion while the rest revealed multiple (>2) lesions at different stages of development in the CT scan brain (Table 3). Amongst the solitary lesions parietal lobe was the most common site of involvement, followed by frontal and temporal lobes. Eleven children had multiple lesions in the CT brain. Parietal lobe was the commonest to be involved. Transitional stage lesion was the most common CT finding comprising most of the cases, presenting as ring enhancing lesions. There were few inactive lesions also. Five of these cases revealed "starry sky" appearance and one had ventricular involvement. 11 cases revealed the presence of scolex in the form of eccentric nodules, 15 cases revealed perilesional edema on CT/MRI at presentation. Stool microscopy revealed the presence of ova in 09 cases.

**Table 2. Clinical Profile of 26 patients completing the study**

| Symptoms at presentation | Total number =26 . (F-16, M-09) |
|---|---|
| Simple partial seizure | 16(63.33%) |
| Complex partial seizure | 03(34.61%) |
| Headache | 17(67%) |
| Vomiting | 05(19%) |
| Neuropsychiatric presentation | 3(13.33%) |
| Cranial nerve palsy | 3(13.33%) |
| Fundal edema | 5(19%) |

**Table 3. Lesions, site, Type, nature, EEG changes**

| Lesion(number, location ,type) EEG changes | Absolute number and percentage in each case |
|---|---|
| Type of lesion | 26 |
| Single | 18 |
| multiple | 08 |
| Site of lesion | |
| Frontal | 05 |
| Parietal | 14 |
| Temporal, | 05 |
| Occipital | 01 |
| Mixed | 11 |
| Nature of lesions | |
| Active | 17 |
| Transitional | 06 |
| Inactive | 05 |
| EEG | |
| Type of abnormality | |
| Epileptic discharges | 09 |
| Nonspecific background discharges | 17 |
| Absolute eosinophil count(V><500/cu mm | 11 |
| Stool microscopy | 09 |

Raised peripheral blood eosinophil count was observed in around 11 cases. At sixteen weeks of follow-up seizures disappeared in most cases and were seizure free till the end of 24 months. To begin with all children presented with headache with or without vomiting, after 6 months of follow up, headache was present in only three cases. This also resolved after 2 years. three cases had focal neurodeficit in the form of sixth cranial nerve paresis. At the end of two years of follow up this also recovered. Only three children had abnormal behavior in the form of violent attitude, irrelevant talking and forgetfulness and poor performance at school, but at the end of mean of 2 year they also recovered completely. At 2 years on follow up calcification was noted only in 25% of cases and lesions disappeared in rest of cases.

## DISCUSSION

India is endemic for pediatric neurocysticercosis and it is the commonest cause of seizures in children. The neurocysticercosis presents with seizures without any neurological deficit, with ring enhancing brain CT/MRI lesion of less than 2 cm. Commonly this disease is acquired by ingestion of undercooked meat (pork, beef),but pure vegetarians can also get infected by consuming food and water contaminated with eggs or by autoinfection or fecal oral route. Differentiation from tuberculoma can be made if CT brain enhancing lesion is > 20 mm diameter, the wall thickness > 2mm, and midline shift if any, absence of white dot like scolices, and if there is lack of spontaneous resolution. The absence of permanent focal neurodeficit strongly supports the diagnosis of neurocysticercosis (Kalra, 2009; Sinha and Sharma, 2009). Partial seizure was the commonest presentation in our study unlike most other literatures worldwide. (Sinha S, Sharma, 2009; Singhi, 2004; Morales *et al.,* 2000; Garcia *et al.,* 2000; Gauchan *et al.,* 2011).

However, one study from Western Nepal recorded almost 30% incidence of partial seizures at presentation (Singhi, 2004). Interestingly two large case series published very recently from Nepal and India cited incidences of generalized seizure at presentation 52% and 65% respectively (34,35). Incidences of status epilepticus or convulsive crisis were less than 6% in our observation, but Cuéllar *et al*. and Terraza *et al*, reported high incidences of convulsive crisis (Kalra, 2009; Morales *et al.,* 2000). Headache and vomiting were observed in 19 % and 11% in our study group. Singhi *et al* recorded almost 33% incidences of headache and vomiting (Kalra, 2009). Kalra and Sethi cited 44% incidences of headache because of raised intracranial tensions (Kalra, 2009). Since many of our patients had multitude of symptoms at the beginning and in many patients multiple stages of the cysts coexisted it was not possible to find any particular stage specific symptoms except the fact that seizure was the most common presentation during transitional stages of the cyst and persistent headache was common in children with calcified cyst. We found slight female preponderance with female: male ratio of 1.3:1.

Higher female predominance was observed from one article in Chicago and also from a small observation by Morgado *et al*. 1994 (Kalra, 2009) Youngest patient in our series was 04 year old. Cuéllar *et al*, found a large number of cases of below 4 year age. Incidence of a single ring enhancing lesion on imaging was almost 71% in our study consistent with most of the other major studies (50-80%) (Kalra and Sethi, 1992; Morgado *et al.,* 1994; Carpio, 2002). However, a study from Western Nepal recorded only 41% solitary lesions (Prasad *et al.,* 2012). Cyst morphology/stage and number did not correlate with different patterns of clinical presentations. Parietal lobe was the overwhelmingly common site in our series (74% involvement), like the western Nepalese study. Probably cysticercus larva have a tendency to involve middle cerebral artery and its branches so parietal lobe involvement is common (Carpio, 2002).

Only one of our cases showed extra-parenchymal lesion with involvement. Antoniuk *et al*. and Singhi and Singhi also observed that extraparenchymal neurocysticercosis was rare in pediatric age group (Morales *et al.,* 2000; Morgado *et al.,* 1994). However, Basu *et al*. showed more than 20% extraparenchymal involvement. Use of multiple cycles of albendazole or even higher dosage 25 mg/kg is a established fact in treatment of neurocysticercosis. After 2 years, nearly 81% of the lesions disappeared and 19% lesions healed by calcification in our study. Basu *et al*, who recorded almost 70% disappearance and 7% calcification of the lesions after 12 months (Prasad *et al.,* 2012). Another large series from India noted complete disappearance in more than 90% of solitary lesions (Bhattacharjee and Biswas, 2011). There was no permanent neurodeficit or behavioral abnormality and had recurrence of seizures. Similar excellent outcome has been shown by by other large studies on pediatric neurocysticercosis (Kalra, 2009; Singhi, 2011; Prasad *et al.,* 2012). Singhi *et al* found multiple lesions, persistence of lesions, calcification and extra-parenchymal forms of cysts to be associated with recurrence of the seizures (Cruz *et al.,* 1995). There is growing evidence that so-called "inactive" form i.e. calcification can cause many symptoms like headache or seizure (Kaur *et al.,* 2010). Indian Academy of Pediatrics recommends at least 12-18 months of therapy for convulsion (Morgado *et al.,* 1994).

Some authors also advocate continuation of anticonvulsants until the resolution of lesions. However, if seizures are recurrent or associated with calcified lesions treatment should be continued for 2-3 years before any attempt to wean from anticonvulsants. Carbamazepine and phenytoin are the commonly used anticonvulsants. Albendazole in the treatment of pediatric neurocysticercosis in the context of resolution of active or transitional cysts and better clinical progress is a controversial subject. There are proponents of no albendazole therapy, short course therapy (7 days) and 28 days course of full dose albendazole therapy (Singhi, 2004; Prasad *et al.,* 2012 Morgado *et al.,* 1994; Del Brutto, 2013). However, Albendazole or other anticysticercal drugs are contraindicated for spinal and ocular involvement as drug induced inflammation may result in irreversible damage to the respective organs. Ivermectin is the new promising drug in the management of neurocysticercosis.

**Conclusion**

Children in the age group of 10 to 12 years are the commonest victims of pediatric neurocysticercosis and it is the commonest cause of seizure disorder in them. As is evidenced in this study Localized or focal seizure is the most common variety of seizure at presentation followed by generalized seizure. Transitional type is the most common variety of the cyst to be discovered at CT scan. Parietal lobe is the most common location of cyst on CT scan. Transitional cyst commonly appears as ring enhancing lesion with or without perilesional edema. Solitary cyst is much more common than multiple cysts with not a single case of extraparenchymal type of lesion found in our study. Calcification of the cyst is the commonest mode of healing followed by spontaneous resolution after a mean duration of 2 years of follow-up. Prognosis is excellent as almost 80% had complete disappearance of seizure after 2 years of follow-up. None of the children had any features of neurodeficit at the end of 2 years. The commonest CT picture at presentation was a Solitary ring enhancing lesions (transitional stage) involving the parietal lobe. Partial/focal seizure was the most common type of seizure. Albendazole is effective in single as well as multiple ring enhancing lesions of neurocysticercosis.

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