

Original Research Article

Occurrence of neurocysticercosis in patients presenting with seizure and its serological evaluation

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ABSTRACT

Background: Aims and objectives was to diagnose neurocysticercosis among the patient admitted with seizure in Pediatric Department of TMMRC and to correlate the serological and radiological findings.

Methods: A total of 100 patients presenting with recent onset seizures were recruited from Pediatric department of a local major tertiary care teaching hospital during the period 2016-2017. Brain imaging was performed in all the above cases. Serological assessment was done using ELISA kit. Diagnosis of neurocysticercosis was done using Del Brutto's criteria.

Results: The recruited patients presented with generalized, simple partial, and focal seizures (68%, 21% and 11% respectively). NCC was diagnosed in 37 of 100 (37.0%) seizure cases based on imaging characteristics. There were 13% cases in whom, MRI showed calcified NCC/granuloma suggestive of NCC. In 24% cases, scolex suggestive of NCC was seen. A total of 15 (15%) cases were seropositive for Taenia. Using Del Brutto criteria, a total of 23% cases were diagnosed as probable NCC and 15% as definite neurocysticercosis. A total of 62% cases were confirmed as not having neurocysticercosis.

Conclusions: The findings of present study showed that neurocysticercosis still is a major diagnosis among children presenting with seizure from this endemic area. Neuroimaging was a useful tool in diagnosis and characterisation of NCC than serological tool. The study highlighted the need to create awareness regarding maintenance of hygiene and cleanliness.

Keywords: Del Brutto, Neurocysticercosis, Radiological evaluation, Seizure, Serology

INTRODUCTION

Seizure (from Latin word *sacire*, "to take possession of") is a paroxysmal event due to abnormal excessive synchronous neuronal discharge activity in the brain. It is defined as an episode of neurological dysfunction caused by abnormal neuronal activity that results in a sudden change in motor activity that results in a sudden change in motor activity, behaviour and sensory perception.¹

It is a commonly encountered and one of the important causes for hospital admission of children in underdeveloped and developing countries and generally affects the children at young age.

Seizures in children can be caused by a number of causes. It can be caused by infections; it may result from birth asphyxia or can be attributed to metabolic causes among neonates. On the other hand, febrile convulsions can be

attributed to bacterial (meningitis), viral (encephalitis), parasitic (neurocysticercosis, cerebral malaria) or epileptic (symptomatic, cryptogenic, and idiopathic) etiologies resulting in acute seizures in children.²⁻⁷

In the recent years, neurocysticercosis has been recognized as one of the major diagnoses among patients with seizures in both adult as well as paediatric age groups.⁸⁻¹¹ In some recent studies in children, its occurrence in seizure affected children has been reported to be as high as 40%.^{9,11} The increasing occurrence of neurocysticercosis in childhood seizures in recent years might be attributable to emergence of more sensitive imaging and immunological tests.¹²

Neurocysticercosis (NCC), also termed as intracerebral cysticercosis is common parasitic (zoonotic=animal borne) infection that affects the nervous system which manifest as seizure disorder.^{13,14} Neurocysticercosis is a global problem with endemic areas spread throughout the world. The most affected endemic areas in different continents include parts of South America, Eastern Europe, the Indian subcontinent, South East Asia and Sub-Saharan Africa.¹⁴ Reports from north India link neurocysticercosis as one of the most prominent etiologies behind focal seizures in children.¹⁵ Neurocysticercosis is resulted following infestation of the central nervous system with encysted larvae of *Taenia solium*.

A confirmed diagnosis of neurocysticercosis in seizure patients is the key to determine the course of treatment. Scientific bodies like American Academy of Neurology have recommended cysticidal therapy for treatment of seizures. Cysticidal therapy is a proven effective measure to reduce seizure frequency and in long-term helps in resolution of the lesions altogether.¹⁶

Clinical profile of NCC includes seizures as one of the important features with headache, vomiting and other neurological signs and symptoms. Pathologically, it is difficult to be performed and serological tests often have low sensitivity despite being reported for high specificity.^{17,18} Neuroimaging is the preferred modality for neurocysticercosis diagnosis. Computed tomography (CT), Magnetic resonance imaging (MRI) and Proton Magnetic Resonance Spectroscopy (MRS) are some of the neuroimaging modalities commonly used for diagnosis.

METHODS

The study was conducted in patients with seizure admitted to the Department of Paediatrics, TMMRC Moradabad.

Study design

A descriptive cross-sectional hospital based prospective study. Total 100 samples are included.

Inclusion criteria

- Patients between age group 18 months to 18 years.
- Patients presenting with seizure attending OPD or admitted in Ward/PICU.

Exclusion criteria

- Known seizure disorders on Treatment.
- Known case of NCC on Treatment.
- Pseudoseizures like hyperventilation, transient ischemic attacks, delusions, electrolyte disturbances.
- Febrile convulsion.

Method of collection of data

All consecutive children between 18 months to 18 years reporting to pediatric OPD / in-patient department of a tertiary care hospital, with seizure were enrolled in the study, after obtaining informed consent from the parents/ attendants. Demographic information was obtained from all the parents. Type of seizure was noted, details regarding family history of seizure and dietary preferences were noted. The patient's consciousness status was noted in terms of Glasgow Coma Scale. After obtaining the information, a thorough clinical evaluation was carried out, including detail neurological assessment to look for any neurological deficit. All the patients underwent necessary lab investigations like blood sugar, electrolytes and cerebrospinal fluid examination, if indicated. Neuroimaging was done by Magnetic Resonance Imaging using 1.5 Tesla Magnetom Avanto Siemens magnetic resonance imaging machine. Serological assessment was done using SCIMEDX CORPORATION ELISA kit. Diagnosis of neurocysticercosis was done using Del Brutto's criteria. Del Brutto's criteria¹⁷ is based on evaluation of clinical, epidemiological, neuroimaging and laboratory findings

Statistical analysis

Data was analyzed using Statistical Package for Social Sciences version 21.0. The values were represented in Number (%) and Mean \pm SD. Chi square test had been used to assess variables and p value less than 0.001 was considered statistically significant.

RESULTS

The present study was carried out with an aim to evaluate occurrence of Neurocysticercosis in patients presenting with seizures and to carry out its radiological evaluation. For this purpose, a total of 100 consecutive cases presenting with seizures falling in sampling frame were enrolled in the study. Table 1 shows the general profile of the patients enrolled in the study. Age of patients ranged from 2 to 18 years. There were 23% cases aged 2-5 years, 24% aged 6-9 years, 22% aged 10-12 years and 31% aged >12 years. Mean age of patients was 9.61 ± 4.58 years. Majority of patients were males (72%). There were

28% females. Male to female ratio was 2.57. Majority of patients were Hindus (55%). There were 45% Muslims.

Table 1: General profile of patients enrolled in the study.

Variable	No. & Percentage
Age	
2-5 Years	23
6-9 Years	24
10-12 Years	22
>12 Years	31
Mean age ±SD (range) in years	9.61±4.58 (2-18)
Gender	
Male	72
Female	28
Religion	
Hindu	55
Muslim	45

Table 2: Distribution of cases according to type of seizure.

Type of Seizure	No. & Percentage
Focal	11
Generalized tonic-clonic	66
Partial	21
Others (Tonic-1, Myoclonic-1)	2

Table 2 shows majority of cases had generalized tonic-clonic (GTCS) seizures (68%) followed by those having partial (n=21%) and focal (11%) seizures. There was one case each having myoclonic and tonic seizures (Table 2). Family history was positive in 5 cases. A total of 55% patients were non-vegetarian (Table 3).

Table 3: Family history and dietary preferences.

Variable	No. & Percentage
Family History	
Negative	95
Positive	5
Dietary preference	
Vegetarian	45
Non-vegetarian	55

MRI findings did not show any abnormality in 21% cases. There were 13% cases in whom, MRI showed calcified NCC/granuloma suggestive of NCC. In 24% cases, scolex suggestive of NCC was seen (Table 4).

Serological assessment for *Taenia* was done using ELISA. A total of 15 (15%) cases were seropositive for *Taenia* (Table 5).

Figure 1 shows cases having unilateral involvement, right side was more commonly involved (n=26; 32.9%) as compared to left side (n=19; 24.1%). Bilateral

involvement was seen in 7 (8.9%) cases. In 27 (34.2%) the side could not be specified.

Table 4: MRI findings.

Finding	No. (%)
Normal findings	21
Calcified NCC/Granuloma	13
NCC Scolex	24
Meningitis/Leptomeningitis	4
Meningoencephalitis	3
Others	22

Table 5: Seropositivity status.

Seropositivity Status	No. & Percentage
Positive	15
Negative	85

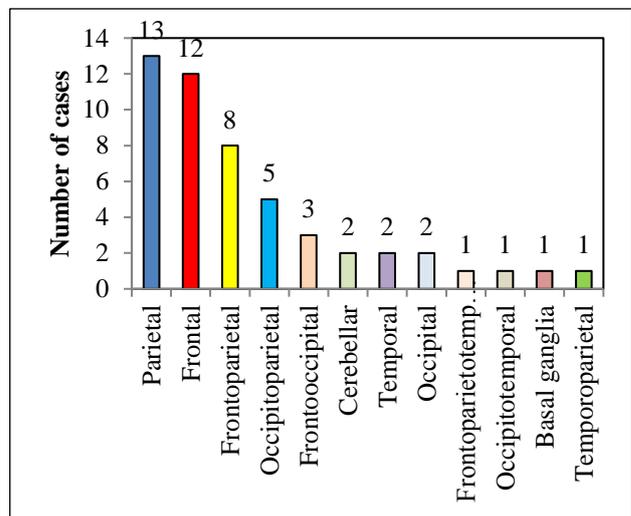


Figure 1: MRI findings-side, location and number of lesions (n=79).

Parietal (16.5%), frontal (15.2%) and frontoparietal (10.1%) locations were most commonly involved followed by occipitoparietal (6.3%), front occipital (3.8%), cerebellar (2.5%), temporal (2.5%) and occipital (2.5%) locations. There was 1 case each having front oparietoemporal, occipitotemporal, basal ganglia and temporoparietal involvement.

Using Del Brutto criteria, a total of 23% cases were diagnosed as probable NCC and 15% as definite neurocysticercosis. A total of 62% cases were confirmed as not having neurocysticercosis (Table 6).

Table 6: Final diagnosis (Del Brutto criteria).

Finding	No. (%)
Probable Neurocysticercosis	23
Definitive Neurocysticercosis	15
No neurocysticercosis	62

Table 7: Association of combined neurocysticercosis diagnosis (Probable+Definite NCC) with different demographic and clinical variables.

Variable	Probable/ Definite NCC (n=38)	No NCC (n=62)	Statistical significance
Mean Age ±SD	11.24±4.00	8.60±4.66	t=2.889; p=0.005
Gender			
Male	29 (76.3%)	43 (69.4%)	$\chi^2=0.566$; p=0.452
Female	9 (23.7%)	19 (30.6%)	
Religion			
Hindu	26 (68.4%)	29 (46.9%)	$\chi^2=4.461$; p=0.035
Muslim	12 (31.6%)	33 (53.2%)	
Convulsion type			
GTCS	17 (44.7%)	49 (79%)	$\chi^2=12.3$; p<0.001
Others	21 (55.3%)	13 (21%)	
Family history			
Positive	1 (2.6%)	4 (6.5%)	$\chi^2=0.724$; p=0.395
Negative	37 (97.4%)	58 (93.5%)	
Dietary preference			
Non-vegetarian	19 (50.0%)	36 (58.1%)	$\chi^2=0.619$; p=0.431
Vegetarian	19 (50.0%)	26 (41.9%)	
Seropositivity			
Positive	15 (39.5%)	0	$\chi^2=28.79$; p<0.001
Negative	23 (60.5%)	62 (100%)	
MRI for NCC			
Positive	37 (97.4%)	0 (0%)	$\chi^2=95.8$; p<0.001
Negative	1 (2.6%)	62 (100%)	
Side involved			
Unilateral	34 (89.5%)	11 (17.7%)	$\chi^2=49.0$; p<0.001
Bilateral	4 (10.5%)	51 (82.3%)	
Region involved			
Frontal	18 (47.4%)	7 (11.3%)	$\chi^2=16.4$; p<0.001
Others	20 (52.6%)	55 (88.7%)	
No. of lesions			
		n=7	
Single	26 (68.4%)	1 (14.3%)	$\chi^2=11.0$; p=0.001
Multiple	12 (31.6%)	6 (85.7%)	

Table 7 shows combined analysis (Definite+Probable) older age, Hindu religion, other than GTCS convulsion, seropositivity, MRI positivity, unilateral location, frontal lobe involvement and single lesion were significantly associated with a probable/definite diagnosis of neurocysticercosis.

DISCUSSION

The present study was carried out to diagnose neurocysticercosis among the pediatric patients admitted with seizure in Pediatric Department of TMMRC, Moradabad and on the basis of data of 100 pediatric cases of seizure, the diagnosis of NCC was confirmed in 38 (38%) patients. The positivity rate for NCC in different contemporary series has varied substantially. Sahu et al, in their study found positivity rate of 37.7% which is similar to ours (38%).⁹ Chaudhary et al, reported this rate

to be 42.9%, which is slightly higher than that observed in present study.¹¹ Kumar et al, on the other hand found positivity rate of 71% which is much higher than that observed in present study.¹⁸ Variability in NCC rate in different studies might be dependent on the sampling frame, endemicity and profile of the study population being studied.

As far as profile of study population is concerned, the present study was carried out in children aged 2 to 18 years having a mean age of 9.61±4.58 years and a male-female ratio of 2.57 with majority being Hindus (55%). Compared to present study, Basu et al, although included children aged 11 months to 15 years in their study but found their mean age to be 10.8 years which is higher than the present study.⁷ Bhattacharjee et al, on the other hand had included children aged 1 to 13 years in their study and reported their mean age as 8.47 years.¹⁹ Most

of the other studies had limited the age range of children to 15 years only.^{9,20,21} However, Pandit et al, in their study extended the maximum age to 16 years yet reported the mean age of patients as 8.68 years.²⁰ The age variability in different studies generally depends on the hospital policy that determines the upper level of age of patients that are admitted/frequented at the pediatric population.

As for the gender ratio, the present study was predominated by males (72%). However, extreme variability is seen in gender profile in different studies. Bhattacharjee et al and Pandit et al in their study had predominance of females (58% and 52%), while Sahu et al.^{21,20} Similar to our study had a dominance of males (77%).⁹ Kumar et al, also reported a dominance of males (55.8%).¹⁸ These findings in general suggest that gender related differences in different studies are incidental and does not indicate any gender associated risk of seizures.

As far as religion proportion is concerned, most of the studies do not report on it. In present study, the religion proportion was in accordance with the population proportions in our study area. However, religion was recorded as a variable in order to assess whether Muslims, in whom Pork is prohibited as a food, have a lower risk of NCC which is the commonest source of transmission to human beings.²¹

In present study, majority of cases had Generalized tonic-clonic seizures (66%). The spectrum of type of seizures have shown a variability in different series. Basu et al, who presented the profile of 124 children with neurocysticercosis only reported the simple partial seizures to be the most common seizure type.⁷ However, Bhattacharjee et al, who also reported the profile of 38 children with NCC, similar to our study found generalized tonic clonic seizures to be most common (55.3%).¹⁹ Similarly, Chaudhary et al, also reported a dominance of GCTS (82.1%) in their study.¹¹ On the other hand Sahu et al, who similar to our study included children with seizures as the study population reported generalized seizures (49.2%) to be the most common type of seizure.⁹ Dominance of generalized seizures among seizure patients was also reported by Pappala et al, in their study (55%) and Pandit et al (76%).^{8,20} The findings suggest that the spectrum of seizures might vary in different case series and this might either be incidental or dependent on the underlying etiology.

In present study, a total of 5 cases had a positive family history of NCC, thus indicating the relevance of endemicity. Majority were non-vegetarian (55%). This finding is similar to the observation of Kumar et al, who in a study of 120 cases of NCC reported a dominance of non-vegetarians (64.2%), however, Pandit et al, in their study of 50 cases of NCC had only 32% non-vegetarians.^{18,20} These findings suggest that non-vegetarian diet necessarily need not be the source of transmission of NCC.

One of the most important findings was that in present study, neuroimaging was a dominant mode of confirming NCC etiology. It was more sensitive than seropositivity which was positive only in 15 cases, and of these 15, a total of 14 were also diagnosed to be positive on neuroimaging, thus highlighting the role of neuroimaging.

In present study, MRI positivity rate was 37%. A total of 13 cases were identified as calcified NCC/granuloma and 24 had evidence of NCC scolex. Neuroimaging has been considered to be the most popular and established method of establishing NCC. MRI provides useful information regarding the laterality, location and number of lesions responsible for seizure activity due to NCC. Neuroimaging findings were predominantly unilateral (57%), had maximum involvement of frontal lobe and parietal lobes (28%) either alone or in combination and showed lesions in 45% of these 27 (60%) were single lesions.

Similar to our findings among seizure patients dominance of single lesion (62.3%) was also reported by Sahu et al, in their study.⁹ However, Pappala et al, showed parietal lobe involvement to be most commonly involved (38.1%).⁸ Rao et al, too in their study showed dominance of single lesion (78.2%) to be more common than multiple lesions.¹⁰

On evaluating the different demographic and clinical risk factors for NCC we found older age, Hindu religion, other than GTCS convulsion, seropositivity, MRI positivity, unilateral location, frontal lobe involvement and single lesion were significantly associated with a probable/definite diagnosis of neurocysticercosis while independent analysis revealed mean age of those with probable NCC diagnosis was found to be significantly lower as compared to that of No NCC group while proportion of those not having GTCS was significantly higher in Definite NCC and probable NCC groups as compared to No NCC group. Definite NCC and probable NCC groups showed a significant difference from No NCC groups for seropositivity, MR positivity, unilateral involvement, single lesion and frontal lobe involvement. On evaluating the literature reviewed by us, we did not find any study evaluating the role of different demographic and clinical factors for the diagnosis of NCC.

As far as relatively significantly higher age of patients with NCC diagnosis is concerned, it might be attributable to the age when a child starts to experiment on his/her own regarding dietary practices. A lower prevalence of NCC among Muslims as compared to Hindus might be attributable owing to prohibition of pork in their religion. One of the most important findings was that in present study, neuroimaging was a dominant mode of confirming NCC etiology.

The findings of present study thus confirm that neurocysticercosis is an important etiology of seizures especially in endemic areas like ours. The findings also showed that neuroimaging is a useful diagnostic modality and should be carried out in all the cases in order to confirm the diagnosis. The findings of present study are thus in agreement with the previous studies that have laid emphasis on neuroimaging assessment rather than serology.

CONCLUSION

On the basis of findings of present study conducted on 100 children presenting with seizures, the following clinico-radiological profile of seizure patients was revealed that age of patients ranged from 2 to 18 years. Maximum were aged above 12 years (31%). Mean age of patients was 9.61 ± 4.58 years. Majority were males (72%). Male to female ratio was 2.57. Generalized tonic-clonic (GTCS) was the most common type (68%) followed by partial (n=21%) and focal (11%) seizures. Family history was positive in 5 cases. A total of 55% patients were non-vegetarian. MRI scan was normal in 21% cases, were suggestive of NCC in 37%, meningitis/leptomeningitis in 4%, meningoencephalitis in 3% and others in 22%. Among 79 cases with positive MRI findings, right side was more commonly involved (n=26; 32.9%) as compared to left side (n=19; 24.1%). Bilateral involvement was seen in 7 (8.9%) cases. In 27 (34.2%) the side could not be specified. Parietal (16.5%), frontal (15.2%) and frontoparietal (10.1%) locations were most commonly involved. Lesions could be located in 45 cases. Among these majority (60%) were single lesions while 9 (20%) cases had two lesions. Three or more lesions were seen in remaining 9 (20%) cases. Serological assessment for *Taenia* was done using ELISA. A total of 15 (15%) cases were seropositive for *Taenia*. Using Del Brutto's criteria definitive and probable NCC was detected in 23% and 15% cases respectively

The findings of present study showed that neurocysticercosis still is a major diagnosis among children presenting with seizure from this endemic area. Neuroimaging was a useful tool in diagnosis and characterisation of NCC. The sensitivity and specificity of serology appeared to be low in comparison to neuroimaging. There needs to be further study regarding application of Del Brutto criteria in pediatric population.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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