Clinico-Radiological Profile of Neurocysticercosis in Children

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ABSTRACT

Introduction: Neurocysticercosis (NCC) is the most common parasitic disease of the nervous system caused by the larval stage of Taenia solium (also known as pork tapeworm). Clinical manifestations are pleomorphic and determined mainly by the location, number and viability of cysts as well as by the host response. Neuroimaging is the most useful diagnostic study for parenchymal disease.

Methods: The study was conducted in the Paediatric Ward of a tertiary care teaching institute, Bareilly, India. The study was conducted on 50 subjects. The study was a hospital based, prospective, observational study. All admitted children between one year to 18 years and diagnosed to have neurocysticercosis were included the study. Statistical analysis was done by single and double sample proportion test. P value of less than 0.05 was considered significant.

Results: Maximum numbers of patients were in age group of five-14 years. Males (62%) were more commonly affected than females. Seizure was found to be the commonest presentation of NCC. In our study majority of cases were diagnosed by CT scan. 70% of the patients enrolled in this study demonstrated ring enhancing lesions on neuroimaging. Maximum number of patients had lesions in the parietal lobe followed by frontal lobe.

Conclusions: NCC is common in the age group of five to 14 years. Focal seizures were the most common presentation. Other symptoms were headache and vomiting. Vegetarians were more commonly affected than non vegetarians. Single ring enhancing lesion in parietal area was the commonest neuroimaging findings.

Key words: Neurocysticercosis; radiological findings; symptomatology

INTRODUCTION

Neurocysticercosis (NCC) is the most common parasitic disease of the nervous system caused by the larval stage of the Taenia Solium (also known as pork tapeworm).[1] NCC is identified as the cause of active epilepsy in 26.3% to 53.8% of cases, in developing world.[2] Majority of cases with NCC present with seizures. Less-common manifestations include hydrocephalus, diffuse cerebral edema, or focal neurologic signs.[3] Neuroimaging is the most useful diagnostic study for parenchymal disease. It gives information about cyst location, viability, and associated inflammation. MRI also helps in better detection of basilar arachnoiditis, intraventricular cysts and cysts in the spinal cord. However, CT scan is the best modality to identify calcifications. The CT and MRI findings in parenchymal NCC depend on the stage of development of the parasites.[4] Prognosis and management vary with location.[5]

NCC is rampant in the Rohilkhand region in Bareily, India despite the fact that it can easily be prevented by proper hygienic measures and health education. This work aimed to study the clinico - radiological profile of NCC in children to be able to gauge the magnitude of problem and to take adequate preventive measures as well as making public aware about the disease by appropriate methods.

METHODS

The study was conducted in the Paediatric Ward of a tertiary care hospital of Rohilkhand region from 1 November 2017 to 31 October 2018. It was a hospital based, prospective, observational study done for a period of 12 months period. All admitted children one year to 18 years and diagnosed as neurocysticercosis were included in the study.[5] Moribund cases and seizures due to any other cause were excluded. Statistical analysis was done by multivariate analysis. P-value of less than 0.05 was considered significant.

RESULTS

Maximum number of patients were in age group of five to 14 years. Males (62%) were more commonly affected than females (38%). Majority of lesions were diagnosed by the definite criteria given by Del Brutto criteria. Probable diagnosis of NCC was made in 36% of the cases. Seizure was the commonest presentation of NCC. Other manifestations include focal neurologic signs, recurrent vomiting and headache as a sign of raised intracranial pressure. In our study, majority of cases were diagnosed by CT scan. 70% of the patients enrolled in this study demonstrated ring enhancing lesions on neuroimaging. The other 30% cases showed either granulomatous lesions or the calcified stage of NCC without any ring enhancement. Single and non-calcified lesions were more common. It was found that only two patients had starry sky pattern on MRI brain and were diagnosed to have cysticercal encephalitis. Seizures was the most common presenting complaint. Maximum number of patients had lesions in the parietal lobe followed by frontal lobe. We found lesions in the brain parenchyma only. No lesions were found in the basal ganglia, brainstem or cerebellum. Similarly no cases of subarachnoid and intraventricular NCC was found. Majority of patients who presented with headache showed ring enhancing lesions (75%) and this observation is statistically significant.

DISCUSSION

Neurocysticercosis (NCC) is the most common parasitic disease of the nervous system. Larval stage of the Taenia Solium (also known as pork tapeworm) is the causative organism.[1] The cyst may remain dormant for many years. As soon as larval death occurs antigens are liberated leading to intense inflammatory reactions and onset of symptoms. Majority of cases of NCC present with seizures. Other features with which a child might present include hydrocephalus, diffuse cerebral edema, or focal neurologic signs.[4] CT scan and MRI help in identifying the number and topography of lesions, their stage of involution and degree of inflammatory reaction. CT scan is used for screening and MRI is used for confirming diagnosis. MRI is also superior in following up patients on therapy.[6]

NCC usually has small cysts varying from 0.2 – 0.5 cm in diameter and may be single or multiple. Maximum number (76%) of patients were in age group of five to 14 years and mean age being 8.7 years. Children above the age of 15 years had lesser

Table 1. Radiological findings

Radiological findings	Number (n)	Percentage (%)	Z-score (single sample proportion test)
Ring enhancing lesions	35	70	0.0002* p < 0.01
-Single	31	62	
-Multiple	04	08	
Starry sky pattern	2	4	
Calcified(C) lesions	6	12	0.4887** p > 0.01

frequency of NCC. Pandit et al and Yadav et al. also found nearly 70% cases between five to nine years age group and six to 10 years age group respectively.[5,7] A study in rural population of West Bengal found commonest age being a little higher than as observed by M.S Pandit et al. and Yadav et al. 54.9% cases were between 10 to 12 years of age.[8] A study done in Rohilkhand Medical College, Bareilly on 62 subjects in the year 2013 to 2014 observed that peak age of presentation was 5 to 12 years (80%) with 9.8 years being the mean age of NCC.[9] Thus, the mean age of presentation in our study was similar to that seen in other studies done in India and abroad.

In our study males were more commonly affected than females. 62% of affected children were males. A study done by Pandit MS et al. concluded that NCC didn't have any sex predilection and male: female ratio was 0.92:1.[10] However Yadav et al. conducted a study in 2012 in Saifai, Uttar Pradesh which concluded that 60.7% of affected individuals were males.[11] A study done on 40 patients in Andhra Pradesh also had male predominance with male : female ratio being 2.07:1.[12] In a study in West Bengal male predominance was observed with male : female ratio being 1.2:1. 54.9% of cases were boys and 45.1% were girls.[13] Male preponderance in our study might be possible because majority of the population presenting to our hospital was from rural and less literate areas where there is preferential treatment of male children at the best medical facility with negligence towards female health.

Table 2. Correlation between clinical and radiological features in total patients

Clinical features	Radiological features					
	Ring enhancing lesions			Number of lesions		Calcified/non calcified
	Yes n (%)		No n (%)	Single n (%)	Multiple n (%)	Calcified n (%)	Non Calcified
Headache (n = 24)	18(75) P = 0.0013* P < 0.01		6 (25) P = 0.4798** P > 0.01	19 (79.17) P = 0013* P < 0.01	5 (20.3) P = 4996** P > 0.01	3 (12.5) P = 5420** P > 0.01	21 (87.5) P = 0.0013 P < 0.01
Seizures/ focal / generalize	F = 31	22 (70.97) P = 0.001* P < 0.01	9 (29.0) P = 0.4116** P > 0.01	26 (83.87) P = 0.0013* P < 0.01	5 (16.3) P = 0.5119** P > 0.01	2 (6.45) P = 0.5887** P > 0.01	29 (93.55) P = 0.0013* P < 0.01
	G = 09	6 (66.67) P = 0.002* P < 0.01	3 (33.3) P = 0.4365** P > 0.01	5 (55.56) P = 0.0013* P < 0.01	4 (44.4) P = 0.2498** P > 0.01	3 (33.3) P = 0.4365** P > 0.01	6 (66.67) P = 0.0029* P < 0.01
	N = 10	7 (70) P = 0.002* P < 0.01	3 (30) P = 0.4492** P > 0.01	8 (80) P = 0.0017* P < 0.01	2 (20) P = 0.5004** P > 0.01	3 (30) P = 0.4492** P > 0.01	7 (70) P = 0.0021* P < 0.01
Vomiting (n= 21)	15 (71.3) P = 0.0013* P < 0.01		6 (28.5) P = 4005** P > 0.01	12 (57.1) P = 0.0013* P < 0.01	9 (42.86) P = 0.2498** P > 0.01	4(19.05) P = 0.2778** P > 0.01	17(80.9) P = 0.0013* P < 0.01

Seizure is the commonest presentation of NCC. Other manifestations include recurrent vomiting and headache as a sign of raised intracranial pressure and focal neurologic signs. Parenchymal NCC presents typically with seizures. Child may present with single seizure or recurrent epilepsy. Fulminant encephalitis like picture may also be seen. Obstructive hydrocephalus is found in intraventricular NCC.[4] We observed focal seizures in 62% cases and generalised seizures among 31% cases. Headache (48%), vomiting (42%), and focal neurological signs (18%) were other presentations. Patil et al. also found seizures as the most common clinical manifestation.[12] Yadav et al. also found seizures as the commonest presentation of NCC. Though only seizures were seen in 14.8% cases yet seizure with headache, vomiting and other symptoms were seen in 84% of cases. In their study, also focal seizures were more common than generalised seizures. Only 14.8% cases presented with isolated seizure. Recurrent seizures had upper hand over single seizures.[11] A study done in rural Western Uttar Pradesh on 57 children showed all of them presented with seizures out of which 56.1% had focal seizures and 43.9% had generalised seizures. Mostly seizures were associated with headache and vomiting; only 15.8% patients had isolated seizures.[14]

In a study done in 68 children in Lumbini Zonal Hospital, Lumbini Nepal stated seizures as initial presentation in 91% cases, headache with or without vomiting (38%) and focal neurological deficit in the form of hemiparesis or monoparesis (15%). One patient also presented with sensory disturbance of one limb. 85% of cases had partial seizures with complex partial seizures being more common (48.5%).[15] Contrary to other studies focal neurological deficit was found in 18% of the cases, only likely reason could be less extensive parenchymal involvement seen in our patients.

NCC is caused by ingestion of food which is contaminated with the eggs of T. Solium. These eggs hatch in human intestine and release larvae which penetrate the intestinal mucosa and migrate throughout the body to produce cysts. Cysts are found usually in areas having high blood flow eg: CNS, skeletal muscles, subcutaneous tissues and eyes. Other areas have also been found to have such cysts. This may or may not be due to consumption of undercooked pork. Majority of cases (62%) diagnosed with NCC in our study were vegetarians. 31 out of 50 patients (62%) were vegetarians. Similar findings have been observed by Pandit et al. wherein 32 subjects (64%) were pure vegetarians and 18 were non-vegetarians. Out of 18 non-vegetarian subjects, only two confirmed the ingestion of pork. They opined that consumption of pork or a non-vegetarian diet does not affect occurrence of NCC.[7]

In a study in West Bengal, Mondal et al. observed that 91.2% cases of NCC were non-vegetarians and about 8.8% were vegetarians. They have not mentioned the reason for their findings.[8] A study done in Rohilkhand Medical College on 62 patients found that NCC was common in those who had consumed a mixed diet (52.5% cases) than those who were pure vegetarians (47.5%). No one had consumed pork or had occupational exposure to pigs.[9] Similarly Arora et al. observed NCC in 70% of children who were non-vegetarians. However none of the 60 subjects had consumed pork.[16] A study done in the state of Uttarakhand found that most cases diagnosed with NCC were vegetarians and their observation was statistically significant.[17]

Hence, the previously considered myth that NCC occurs in pork eaters and non-vegetarians has not been found to be true in our study and some other studies. It is very well known that improperly cut and cleaned vegetables may predispose to a greater risk of developing NCC. The main route of transmission of NCC is by feco-oral route which may be due to ingestion of contaminated vegetables and water. However, people living in same household with someone who has tapeworm infection have a greater risk of getting infected. Poor sanitation is another risk factor.

70% of the patients enrolled in this study demonstrated ring enhancing lesions on neuroimaging. Out of 50 patients 39 patients had single lesions contrary to which only 11 had multiple lesions on CT scan/MRI. Thus single lesions were more common (78%). 88% of the lesions visualised on CT/MRI were non-calcified with calcifications seen only in 12% of the cases.

Thus solitary and non-calcified lesions were more predominant. We found only two cases of cysticercal encephalitis showing starry sky pattern on MRI Brain. Patil et al. concluded in their study that solitary lesions were more common (72.5%).[12] A study done by Pandit et al. demonstrated that 90% of cases had single lesion on MRI Brain.[10] A study done in UP Rural Institute of Medical Sciences, Saifai revealed solitary lesions in 93.4% of cases. Only five subjects had multiple lesions. Five patients had calcified lesions.[11] A study done in rural population of West Bengal showed that 90.3% had single lesions. Only 11 patients had multiple lesions.[13] A study done in a Medical College in Bareilly diagnosed on neuroimaging that 82.5% cases had solitary lesions.[9] Arora et al. concluded that patients predominantly had single lesions with only 6% of the cases having multiple lesions.[16]

A study done in Lumbini Zonal Hospital in Lumbini, Nepal demonstrated that 84% cases had single ring enhancing lesions. Only seven cases showed multiple ring enhancing lesions. 5.9% of the lesions were calcified.[15] In Gandaki Medical College, Gandaki, Nepal a study was done on 217 subjects, where it was found out that 89.8% of lesions were single. No association was present between the CT findings and the type of seizure.[18] A study done in Government Medical College, Haldwani, India showed that 72.2% of lesions were single, 17.7% were multiple with eight patients having calcified lesions.[17] Thus the results found in our study were similar to other studies such that majority of the patients had solitary lesions on neuroimaging. Moreover calcifications were seen in few children only. This observation was again similar to results obtained in studies done in India and abroad.

The symptoms and signs depend on the location, number and viability of the cysts, and the host immune response. Seizures are commonest presentation of parenchymal NCC. Involvement of frontal lobe can lead to cognitive impairment and loss of voluntary movement. Parietal lobe involvement will affect the temperature, taste and touch sensations and movement. Visual disturbances might be seen in occipital lobe involvement. Integration and processing of memories might be affected in temporal lobe involvement. It was found in our study that majority of lesions (56%) were seen in the parietal lobe on neuroimaging. No lesions were found in the basal ganglia, brainstem or cerebellum. Similarly no case of subarachnoid and intraventricular NCC was found.

A study done in a Medical College of Western Uttar Pradesh, India on 62 subjects found out that parietal lobe was most commonly involved (45%).[9] Similarly another study done in West Bengal, India concluded that parietal region specially on the right side was most commonly involved (61.1%).[8] Patil et al concluded that 45 % of cases had lesions in parietal lobe followed by frontal lobe involvement in 22.5 % of the cases.[12] In a study conducted in Gandaki Medical College, Nepal, about 61.2% of the lesions were found in parietal lobe.[18] Arora et al. found 41% of the lesions were in parietal lobe followed by involvement of frontal and occipital lobe with each being 10% and lastly temporal lobe (8%).[16] A study done in Government Medical College, Haldwani, India concluded that most commonly involved lobe was parietal lobe (59.7%), followed by frontal lobe (25%) and occipital lobe (12.5 %).[17] Yadav et al concluded that parietal lobe was most commonly involved site (55.7%).[11] Thus results found in our study were similar to other studies with parietal lobe being most commonly involved.

Majority of patients presented with headache, showed ring enhancing lesions (75%). P value was significant. Only six cases (25%) did not have ring enhancing lesions on neuroimaging. Patients who had headache as a presenting feature predominantly showed solitary lesion on neuroimaging. 83.87% of cases with headache had solitary lesion with only 20.83% having multiple lesions. Similarly the p value was significant for non-calcified lesion in patients who presented with headache. Patients who presented with focal seizures had significant association with single, ring enhancing lesions and non-calcified lesion with the respective percentages being 83.87%, 70.97% and 93.55%. Out of nine patients who presented with generalised seizures, six (66.67%) had ring enhancing lesions, five

(55.56%) presented as solitary lesion, only six (66.67%) cases showed calcifications on neuroimaging. Out of 21 patients who presented with vomiting 71.43% had ring enhancing lesions on neuroimaging which was found to be significant. Similarly p value was significant for solitary lesions such that 80% of patients had single lesions on neuroimaging. Majority of lesions were not calcified (80.95%).

CONCLUSIONS

NCC is common in the age group of five to 14 years. Focal seizures were the most common presentation. Other symptoms were headache and vomiting. Vegetarians were more commonly affected than non vegetarians. Single ring enhancing lesion in parietal area was the commonest neuroimaging findings. The belief that NCC is more common in non-vegetarians is not found to be true.

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