

Epidemiological and Clinical Status of Neurocysticercosis in a Tertiary Healthcare Centre- A Prospective, Cross-Sectional Study

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ABSTRACT

BACKGROUND

Neurocysticercosis (NCC) is most common parasitic infection of the CNS & an important cause for epileptic seizures. It is caused by the larva of the pork tapeworm, *T. solium*. We wanted to study the epidemiology, clinical status, distribution, magnitude, pathogenesis, of neurocysticercosis in neurology OPD of a tertiary care hospital and provide data to improve health services towards NCC patients.

METHODS

Patients who had attended epilepsy outpatient department (OPD) with complaints of seizure and confirmed by neurologist were included in the study (sample size 100) as per criteria. The CRFs were filled from case paper & patients were interviewed for personal history and socioeconomic status. The assessment of socioeconomic status was recorded as per Kuppaswamy Socio Economic Scales. Analysis was performed using descriptive statistics.

RESULTS

Clinical presentation was studied for seizure types and other symptoms. The mean magnitude of NCC patients was found to be 11.97% in an epileptic patient population. Most patients of NCC were put on AED & some on Albendazole & steroids.

CONCLUSIONS

The major presenting symptom in all patients was epilepsy & raised ICT. Calcified granulomas can also be potential triggers for epilepsy. Majority of patients were on mixed diet, but those who were pure vegetarians were also exposed to NCC. Poor sanitation facility was also a major risk factor. The majority of population which was affected by NCC belonged to the lower socioeconomic class as per Kuppaswamy SES scale. Migrants from North India were more frequently affected by NCC. All patients presenting with seizures required to be treated with antiepileptic drugs & Albendazole with or without steroids.

KEYWORDS

Neurocysticercosis (NCC), Socioeconomic Status (SES), Seizure Disorder, Granulomas, Raised Intracranial Tension, Epilepsy

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BACKGROUND

Neurocysticercosis is a disease caused by Cestode. It is the infection of the CNS by the larva of the Pork tapeworm, *T. solium*. This disorder ensues after the ingestion of raw food & water born ova, humans become intermediate host.¹ Larval forms of pork tapeworm migrates to CNS, eyes, striated muscle perhaps due their high glucose content leading to pathogenesis of cysticercosis. It is the most common parasitic disease.¹ It is a major problem in the developing countries & an important cause for epileptic seizures. *T. solium* Pork Tapeworm is common in central Europe, South Africa, South America & parts of Asia. *T. solium* infects perhaps 2.5 million people. It is more prevalent in poorer communities where humans live in close contact with pigs & eat undercooked pork. It is very rare in Muslim countries. In endemic areas as many as 4% of the population affected by NCC.²

Cysticercosis has been designated as a “biological marker” of the social and economic development of a community. All the biological markers for transmission of *T. solium* taeniasis and cysticercosis exist in India. It is likely that the disease is under reported in India because due attention has not been given to this neglected disease and systematic population-based studies are lacking. 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. Consequently, there are wide variations in the frequency of cysticercosis in India.³ The infection occurs from contamination of food (usually vegetables), with viable eggs from human excreta, from faecal excreta, from faeco-oral contact or from autoinfection due to reverse peristalsis of proglottids into the stomach. NCC is the result of blood stream of larvae to neuroaxial & skeletal muscle sites & these subsequent development into cysticerci.¹

Criteria	Characteristics
1. Absolute Criteria	<ol style="list-style-type: none"> 1. Histological confirmation of parasite from biopsy of brain/spinal cord lesion. 2. Cystic lesion showing the scolex on CT or MRI. 3. Direct visualization of subretinal parasite on fundoscopic examination.
2. Major Criteria	<ol style="list-style-type: none"> 1. Lesion highly s/o NCC on CT or MRI (Cyst or scolex or calcified lesion) 2. Positive serum immunoelectrotransferblot (EITB) for the detection of anticysticercosis antibodies. 3. Resolution of intracranial cystic lesion after therapy with Albendazole or Praziquantel. 4. Spontaneous resolution of small single enhancing lesion.
3. Minor Criteria	<ol style="list-style-type: none"> 1. Lesions compatible with NCC on Neuroimaging studies. 2. Clinical manifestations s/o NCC. 3. Positive CSF enzyme linked immunosorbent assay. 4. Cysticercosis outside CNS.
4. Epidemiological Criteria	<ol style="list-style-type: none"> 1. Evidence of household contact with <i>T. solium</i> infection. 2. Individuals coming from or living in a area where cysticercosis is endemic. 3. History of frequent travel to endemic areas.

Diagnostic Criteria for NCC (Del Brutto's Criteria et al, 2003)⁸

The most common symptom is headache, vomiting, seizure, papilloedema, hemiparesis, cerebellar ataxia which can occur with NCC. In India the commonest form of NCC is

the solitary parenchymal cyst. Earlier, NCC as a cause of epilepsy in India was reported to vary from 2.2% to 9.6% of patient with epilepsy. Now with brain CT & MRI it is 9% to 18.6%.¹

Calcified cysts in muscle can be recognized by radiologically. In the brain less calcification takes place & larvae are only occasionally demonstrated radiologically, usually CT or MRI will show them. Antibody detection by fluorescent antibody test, ELISA or immunoblotting is available for serodiagnosis.² Praziquantel improves the prognosis of cerebral cysticercosis, the dose is 50 mg / kg in 3 divided doses daily for 14 days. Albendazole 15 mg/kg for 4 weeks, parenteral steroids can control adverse reaction during therapy. Cooking pork well will prevent infection with *T. solium*. NCC is avoided if food is not contaminated by ova or segments¹.

Study Rationale

Human neurocysticercosis, the infection of the nervous system by the larvae of *Taenia solium*, is a major cause of epileptic seizures and other neurologic morbidity worldwide. The diagnosis and treatment of neurocysticercosis have been considerably improved in recent years. In spite of innovative diagnostic technique like serological testing, MRI scan the disease is increasing day by day not only in developing countries but also in developed countries. There are potential risk factors which are associated with pathogenesis of neurocysticercosis. To reduce the morbidity as well as mortality of NCC it is essential to perform epidemiological survey to detect potential risk factors of NCC even in developing countries like India. At the same time NCC patients shows various presentations so one need to check the clinical presentation of NCC like simple partial seizure or Complex partial seizure etc.

We wanted to study the epidemiology, clinical status, distribution, magnitude, pathogenesis, of neurocysticercosis in neurology OPD of a tertiary care hospital and provide data to improve health services towards NCC patients.

METHODS

King Edward Memorial (KEM) Hospital is a tertiary health care center situated in Mumbai. This hospital provides super-specialty services in neurological diseases & it is under the Municipal Corporation of Mumbai. The department has one of the largest epilepsy OPD. We saw 40 - 50 new patients and 150 - 200 old patients per week. We collected patients' data from November 2009 to April 2010 (6 months) and attended 52 epilepsy OPDs. We prospectively evaluated patients with complaints of seizure visiting Epilepsy OPD of KEM hospital Mumbai. NCC Patients were confirmed by neurologist with the help of CT Scan & MRI Scan of brain. Screening of patients was done according to inclusion & exclusion criteria.

a) Inclusion Criteria

1. Positive cases of NCC Patients confirmed by investigations (CT Scan & MRI scan of brain, stool examination) by neurologist, attending the Neurology OPD.
2. Patients who are willing to sign informed consent and participate in the study.

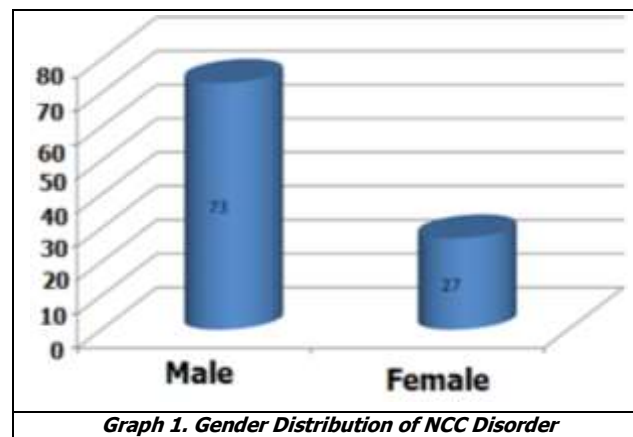
b) Exclusion Criteria

Positive cases of NCC patients who are not willing to sign informed consent and participate in the study.

After obtaining an informed consent of patients a proforma which contains details about demographic details, clinical manifestations, past history, family history, personal history, CNS examination, investigations like CT, scan, MRI scan, stool examination such data collected from the patients case paper. Then CRFs were filled from the case paper & the patients' interview taken by co-investigators for personal history and socioeconomic status information.

The assessment of socioeconomic status was based on total monthly household income as per Kuppuswamy scale. Patients were then divided in different categories. We evaluated total 100 patients. Their data was compiled in tabular forms and were studied in detail. Descriptive statistics (Mean, Standard deviation, Range, Percentage) was used for analysis of data. The information was presented as percentage distribution of particular characteristic among sample size. Results were interpreted in the forms of tables & graphs.

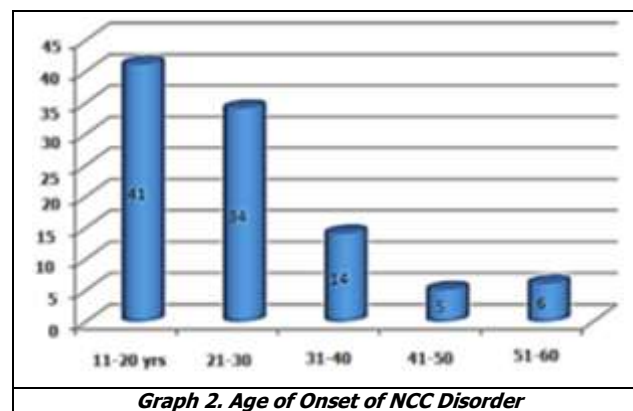
seizure, 62 with Simple partial seizure and 4 patients with Complex partial seizure. Other clinical manifestations like headache, vomiting were observed. In that 70 patients presented with headache & 27 with vomiting and 21 patients had papilloedema, suggestive of raised intracranial tension.



From the graph 1 it can be seen that out of 100 patients of NCC 73 were male and 27 female patients. This indicates that male to female ratio of NCC patients visiting to epilepsy OPD was 2.7:1.

RESULTS

This hospital based epidemiological & prospective clinical study of Neurocysticercosis patients was carried out at epilepsy OPD, KEM Hospital (Parel, Mumbai) which is the tertiary health care center. At the time of enrolment, the demographic variables of the patients were as mentioned below-



There were 41 patients who had NCC in between age 11-20 years, 34 patients between 21-30 years, 14 patients between 31-40 years, 5 patients between 41-50 years, 6 patients between 51-60 years. The mean age of NCC patients to be 25.51± 11.89 years. The frequency of NCC patients was found to be highest in 11-20 years & second highest in 21-30 years. (Graph 2)

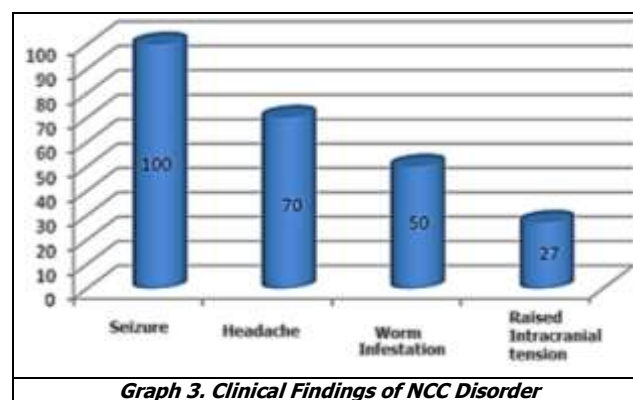
	Male	Female
No. of patients	73	27

Table 1

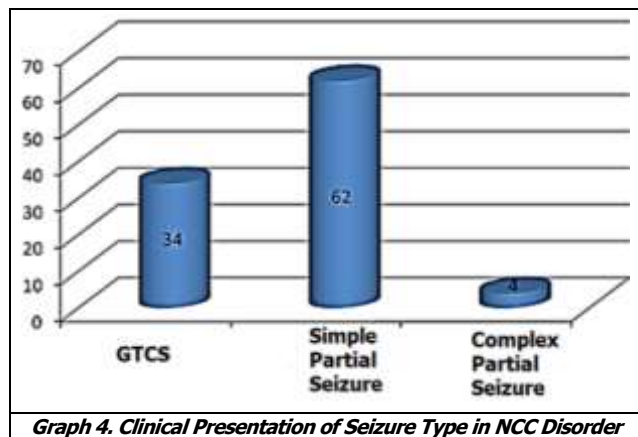
Age of Patients	11-20	21-30	31-40	41-50	51-60
No. of Patients	41	34	14	05	06

Table 2

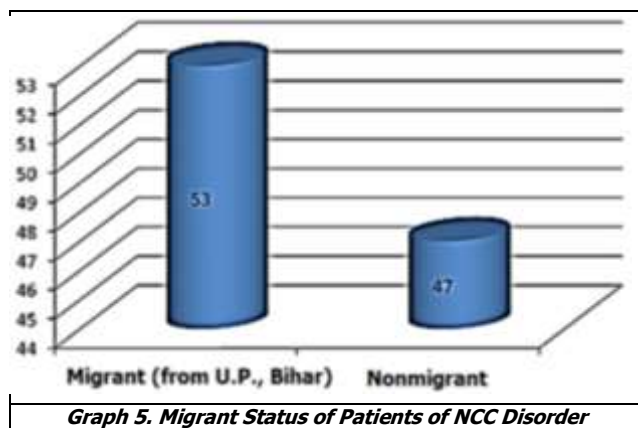
The mean age of patients visiting to epilepsy OPD was 25.51± 11.89 years. The male to female ratio was 2.7: 1. Total 835 patients visited at epilepsy OPD out of that 100 were NCC patients. The mean magnitude of Neurocysticercosis patients was found to be 11.97%, in patients visiting to epilepsy OPD of tertiary health care hospital. In this study patients visiting to epilepsy OPD with confirmed diagnosis of NCC were taken. Diagnosis was confirmed by the neurologist through CT & MRI scan report of patients. After the confirmation of diagnosis it was found that 34 patients presented with generalized tonic clonic



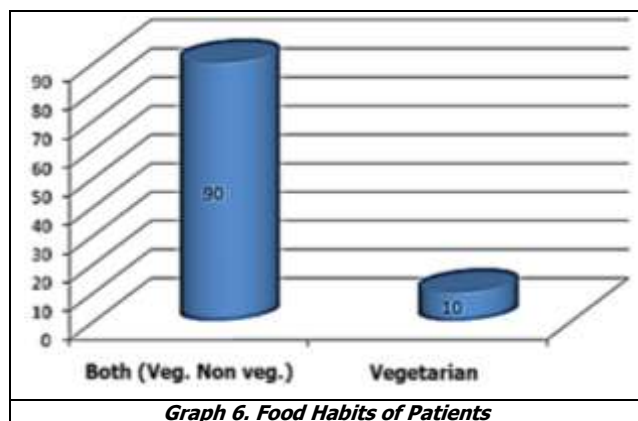
The clinical status of NCC patients shows us that all 100 patients of NCC presented with seizure disorder. 70 patients also had headache and 50 patients gave history of recurrent abdominal pain, frequent history of passing worms in stool, suggestive of worm infestation. 27 patients had signs and symptoms of raised intracranial pressure. As indicated here by Graph 3.



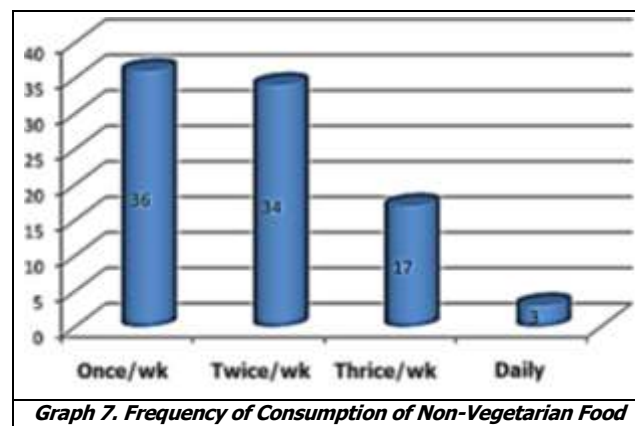
Graph 4 shows that all patients of NCC presented with main symptom seizure disorder, there were 34 patients who presented with Generalized Tonic Clonic, 62 with Simple Partial Seizure and 4 patients with Complex Partial Seizure.



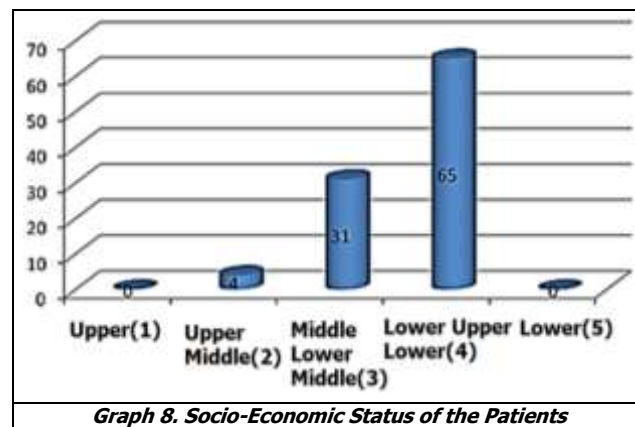
Graph 5 shows that 53 patients were migrants who had migrated from states like Uttar Pradesh, Bihar & remaining 47 patients were from Maharashtra.



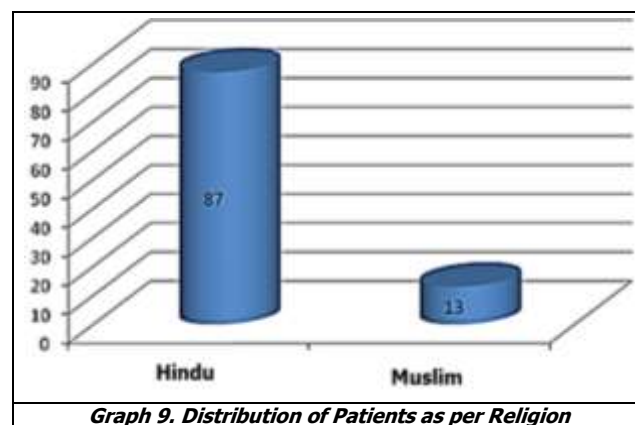
90 patients were non vegetarians, 10 were pure vegetarians, and only 2 were pork eaters among non-vegetarians. (Graph 6)



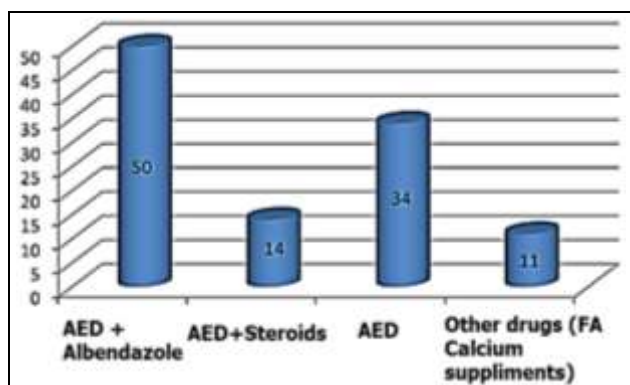
Out of 90 non vegetarians, 36 were consuming non-veg once/week, 34 consumed twice/week, 17 consumed thrice/week & only 3 were non vegetarian's eaters daily. As indicated in Graph 7.



As per the Kuppaswamy socioeconomic status scale the median monthly household income of patients were low, 65 patients' monthly income was less than Rs. 4893 & they belonged to Lower Upper Lower category (4), 31 Middle Lower Middle (3) category, & only 4 were Upper Middle (2) category. (Graph 8). (for Kuppaswamy socioeconomic scale see Appendix 2)

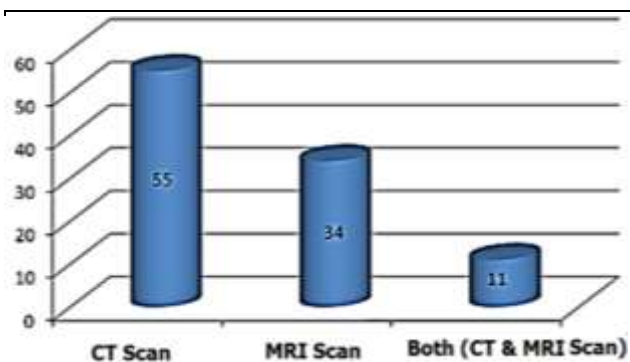


Graph 9 shows that as per religion in 100 patients of NCC there were 87 Hindus & 13 were Muslims.



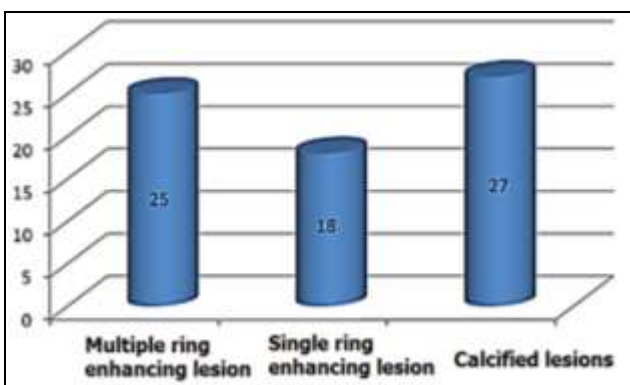
Graph 10. Pattern of Treatment in Patients of NCC Disorder

Graph 10 shows that all 100 patients of NCC were put on AED, out of that 50 on AED +Albendazole, 14 on AED + Steroids, 34 on AED & 11 on other drugs (folic acid, calcium supplements).



Graph 11. Radiological Findings of NCC Disorder

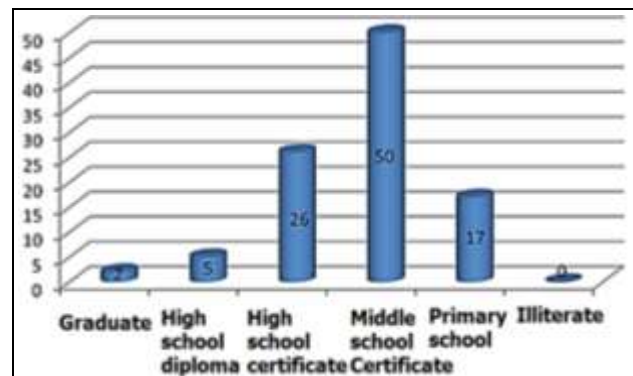
In radiological findings of 100 patients, CT scan was done in 55 patients, MRI brain in 34 patients & both CT and MRI brain in 11 patients (Graph 11).



Graph 12. Imaging Findings of NCC Disorder

25 patient's shows multiple ring enhancing lesions, 18 single ring enhancing lesions & 27 patients shows calcified lesions. (Graph 12).

Other findings show that 23 patients of NCC had contact with pigs, 56 patients had limited or common toilet facility while 38 patients had home toilet facility & remaining 6 had no toilet facility. Out of 100 patients, 72 were consuming salads and raw vegetables. All patients were using boiling and frying methods for cooking.



Graph 13. Education Score of NCC

Above graph shows that 50 patients educated till middle school certificate, 26 had high school certificate, 17 studied up to primary school, 5 had high school diploma and 2 with graduation. No one patient is illiterate.

DISCUSSION

This hospital based prospective epidemiological & clinical study in Neurocysticercosis patients was carried out at epilepsy OPD, KEM Hospital (Parel, Mumbai) which is the tertiary health care center. NCC is the most common cause of acquired epilepsy being a preventable disease with tendency to increase all over the country gradually, if effective measures are not taken. Cysticercosis has been designated as a "Biological Marker of the social & economic development of a community."⁴

In this study patients visiting to epilepsy OPD with confirmed diagnosis (based on CT & MRI scan brain) of Neurocysticercosis were taken. After the confirmation of diagnosis it was found that in 100 patients of NCC there were 34 patients of GTC Seizure, 62 patients with simple partial seizure and 4 patients with complex partial seizure. Other clinical manifestations like headache, vomiting were observed. In that 70 patients presented with headache & 27 with vomiting & 21 patients had papilloedema. Kuruvilla A et al evaluated retrospectively 11 patients with diagnosis of NCC. Seizure was a major presenting symptom which occurred in all patients. Simple partial seizure & complex partial seizure occurred in 5 (46%) & 1 (9%) patients respectively. Generalized seizure was the presenting symptom in 4 (36%) patients. Headache & vomiting occurred in 7 patients of these papilloedema was seen in 3 (27%). Thus supporting that complex partial seizure is infrequent in NCC.⁴ Yazmin DG et al studied 54 patients diagnosed with NCC and showed that 40 patients had seizure as a predominating clinical manifestation & headache was seen in 8 patients.⁵ this study was done in epilepsy OPD,

so all patients who presented with seizures were studied. Patients presenting with other symptoms who may present in general neurology OPD were not included. NCC is endemic in most developing countries of Asia, Latin America, and Central & South Africa. Overall NCC is identified as the cause of active epilepsy in 26.3% to 53.8% in the developing world. Cysticercosis appears to be more prevalent in the Northern states of Bihar, Uttar Pradesh.⁴

Present study shows that there were total 100 patients including 73 males & 27 females in the age range 11 to 57 year, mean age of 25.51 years with standard deviation ± 11.89 . This indicates that Male to female ratio of NCC visiting to epilepsy OPD was 2.7: 1. Kuruvilla et al studied 11 patients of which 9 were males & 2 females.⁴ Retrospective study at Nepalganj Medical College, Teaching Hospital, Kohalpur conducted by Piryani RM et al studied 15 NCC diagnosed cases of which 12 (80%) were males & 3 (20%) females. This matches with our study showing predominance of NCC in males than females.⁶ Male work outside the house in Indian community as they are supporting the family financially. So they stay outside the house for long period and may have to eat outside food from hotels which may make them prone to infection. Females are spending major time at home as housewives eat self-cooked clean food at home so they may be getting less exposure to infected food. This may be the reason for male predominance.

Present study shows total 100 patients studied in the age range 11-57 year and mean age was 25.51 years. Kuruvilla et al studied 11 patients in the age range 24-62 years.⁴ Priyani RM et al studied 15 patients in the age range 15-56 years and mean age was 21 years.⁶ Our study also shows similar peak in Second and Third decade of age. Younger population in Second and Third decade are most prone to NCC. This may be due to food habits of eating outside, work stress leading to neglect of food, personal hygiene etc. This study also shows that 90 patients were non vegetarians, 10 were pure vegetarians, and only 2 were pork eaters among non-vegetarians. In Kuruvilla et al study, all 11 patients were non vegetarians & 4 (36%) reported intake of pork meat.⁴

Yazmin et al studied 54 NCC diagnosed patients in which 35 immigrants had ingested pork meat. 5 patients (45%) had no history of travel outside state while 6 (55%) were migrants.⁵ Present study shows that 53% patients were migrants from other states like U.P., Bihar, while 47% patients had no history of travel or migration. Our center being a tertiary referral center, we get patients from all over country. This may be the reason for high percentage of migrants. Mumbai being a major financial hub, there are many migrants who came for earning and doing business in city.

Those who are eating non-veg. daily should more prone to NCC than that of once a week eaters. But in our study we found a paradoxical result of those who were eating nonveg. Once a week are more prone to NCC as compared to who were daily non-veg eaters. This may indicate that they were not affording to eat nonveg. More often. These patients

therefore may be from low socioeconomic class and were of poor hygiene, improper toilet facility, lack of literacy, eating low quality cheap food. Those eating non-veg everyday were of better economy class and probably had good hygiene, well-educated and proper home toilet facilities. This may be the reason for low incidence in daily non-veg eaters compared to high incidence in weekly non-veg eaters.

Present study shows that the median household income of patients were low. According to Kuppuswamy socioeconomic status scale that 65 patients had monthly income less than Rs 4893 & they belonged to Lower Upper Lower category (4), 31 patients belonged to the Middle Lower Middle category (3) & 4 patients were Upper Middle category (2). In a study comprising 11 cases of NCC described by Kuruvilla et al, the median monthly household income of all patients was Rs 1500. 8 (73%) patients belonged to lower socioeconomic status (category A), while 3 (27%) belonged to higher socioeconomic status (category B)⁴ this matches with our result.

In the present study it was found that 23 patients of NCC had contact with pigs & 47 patients had limited or common toilet facility. Neuroepidemiological survey for epilepsy & knowledge about NCC carried out by Foyaca SH et al in 100 patients shows that most of population did not know about NCC, socioeconomic status was low, limited access to toilet facility & free range pig farming is commonly practiced.⁷ Yazmin et al diagnosed 54 NCC cases, 41 patients reported significant risk factors for infection including ingestion of undercooked pork meat, immigration & frequent travel to villages in disease endemic areas or personal history of taeniasis.⁵ This matches with our data which also shows relevance of above risk factors with NCC.

Present study shows that all the 100 patients of NCC were put on AED, 50 patients treated with Albendazole for 3 weeks, 14 patients were on steroid and 11 were given other drug like folic acid, calcium supplements. Major presenting symptom in all patients was epilepsy. All patients presenting with seizures required to treated with antiepileptic drugs. Those who had active NCC on imaging were treated with Albendazole. Those who had lot of oedema on scan were also give short course of steroids. Kuruvilla et al study shows that all the 11 patients received anticonvulsant besides anticysticercal therapy.⁷ (64%) patients were treated with Albendazole for 4 weeks, while 2 (18%) received Praziquantel for 14 days and 2 (18%) patients were given a combination of Albendazole and praziquantel.⁴

In Kuruvilla et al patient studied & it was found that CT scan done in 10 patients & MRI brain done in 8 patients. Multiple ring enhancing lesions constituted the major abnormality in CT & MRI scan in 6 patients (60%) and single ring enhancing region lesion formed in 4 patients (40%) of findings.⁴ In present study of 100 patients, CT scan was done in 56 patients, MRI brain in 34 patients & both CT and MRI brain in 11 patients. 25 patients showed multiple ring enhancing lesions, 18 single ring enhancing lesions & 27 patients showed calcified lesions. This shows that calcified lesions can also be a major cause of seizures.

This data collected at tertiary health care center is an indicator of risk factor for NCC are socioeconomic status, travelling in endemic areas, contact with pigs, undercooked or raw vegetables, fruit salads, undercooked meat & sanitation, personal hygiene. Attempt should be made to reduce risk factors and increase awareness among patients about causative factors and knowledge about NCC. Since cysticercosis is preventable & eradicable disease, appropriate measures like health education, mass awareness, better medical facilities, mass treatment of *T. solium* carriers may help to reduce the disease burden in endemic areas.

Advantages of Study

The data collected for epidemiological survey is usually community based. In most of community based studies because of lack of access to EEG or neuroimaging facilities may lead to inaccurate diagnosis of NCC. This may lead to bias. As this study was carried out in tertiary health care center with easy access to EEG and neuroimaging facilities, it minimizes the bias due to inappropriate diagnosis. On the other hand the study being carried out at tertiary care center it is not ideal representative of community statistics. But this study can add very important pool of information during meta-analysis of hospital based studies to give a more realistic estimate of national figures.

Limitations

For getting accurate idea about infection of *T. solium* this design of epidemiological survey is inadequate. For that prospective study for longer duration is needed with maintenance of patients' daily diary. Limitation of this study is small sample size. It is required to carry out this type of study in larger sample size to get statistically significant results. Patient compliance to medicine and other things like awareness about seizure disorder & NCC could not be achieved. Incidence, prevalence rates (for extrapolation to population parameter) could not be calculated. This study had been conducted on the age group of population more than 10 years. Hence NCC in less than 10 years of age has not been studied. This study was done in epilepsy OPD, so all patients who presented with seizures were studied. Patients presenting with other symptoms who may present in general neurology OPD were not included.

Recommendations

Efforts should be made to control NCC associated with epileptic seizures so that it would be helpful to reduce the epilepsy associated burden on individual and society. Attempt should be made to improve sanitation, personal hygiene in NCC patients. Community should be educated to identify the warning symptoms of these diseases so as to enable them to seek early help from health professionals. Neurocysticercosis is preventable & eradicable disease, by taking appropriate measures like health education, mass awareness, better medical facilities, mass treatment of *T. solium* carriers.

CONCLUSIONS

The major presenting symptom in all patients was epilepsy. The commonest seizure type is simple partial seizure followed by generalized seizure and complex partial seizure is very rare as a presenting symptom of NCC. Presentation with symptoms of raised ICT is also common. Younger population in second and third decade are most prone to NCC as compared to the other age group. The mean magnitude of NCC in epilepsy OPD of tertiary health care center was 11.97%. Males who are working outside are seen to be more prone to NCC as indicated by our study in comparison to females. Majority of patients were on mixed diet, but those who were pure vegetarians were also exposed to NCC via salad, raw vegetables. The frequency of non-veg was not important but cleanliness and well-cooked non-veg was more important. Majority of population which was affected by NCC belonged to the lower socioeconomic class as per Kuppaswamy SES scale. Majority of patients were less educated (only up to school level). Majority of patients had no proper toilet facility suggestive of poor sanitation & low standard of living. Migrants from North India were more frequently affected by NCC. Hindu's are more often affected. This may be due to the fact that KEM Hospital does not cater to Muslim population much. Calcified granulomas can also be potential triggers for epilepsy. All patients presenting with seizures required to be treated with antiepileptic drugs. Those who had active NCC on imaging were treated with Albendazole with or without steroids. NCC is one of the commonest causes of partial seizures. Lower socioeconomic class, poor sanitation, improper toilet facilities, improper food habits, lower education level are some of the major risk factors for cysticercosis. It is highly recommended that public awareness programs should be conducted emphasizing that good hygiene & ideal cooking methods reduce cysticercosis.

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