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Neurocysticercosis: A Review

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Abstract

Neurocysticercosis is the most common infection affecting the central nervous system and a leading cause of acquired epilepsy in India. The wide variety of clinical manifestations is based on the stage of the infection, size and location of cysticerci. Due to the pleomorphism, the management is a challenge in several cases. The use of cysticidal drugs helps in reducing the disease burden in the community. This review discusses the clinical features and management of Neurocysticercosis.

Introduction

Neurocysticercosis (NCC), an infestation with the larval form of Taenia Solium is one of the widely prevalent infections in India. It is the most common treatable acquired cause of epilepsy in India, and other developing countries. The prevalence of epilepsy due to NCC ranges from 1.3-4.5 per 1000 population [1] The clinical manifestations of neurocysticercosis can be widely variable. Patient can be asymptomatic or can present with life threatening raised ICP symptoms or hydrocephalus.

Clinical manifestations of Neuocysticercosis

Clinical manifestations in Neurocysticercosis are based on the form of involvement and the stage of NCC [2, 3]

There are four pathological stages of Neurocysticercosis. These are the vesicular stage, colloidal vesicular stage, granular nodular stage and the calcified stage. The vesicular stage is generally asymptomatic. The cyst starts degenerating in colloidal vesicular stage when the host response begins and there will be signs of inflammation. This is the stage where patient becomes symptomatic.

The two major forms are the Intra parenchymal and Extraparenchymal forms:

Intra parenchymal form: This is the most common form which is seen in about 60% of the individuals. This form can present with seizures which is the most common manifestation. The other less common clinical manifestations in intraparenchymal forms would be focal neurological deficits, altered vision and altered mental status.

Extra parenchymal form: These can be intraventricular, subarachnoid, ocular and spinal forms:

Intraventricular cysticerci: They constitute about 10-20% of cases. Intraventricular cysts can get lodged in the outflow tracks and can cause obstructive hydrocephalus. There can be free-floating cysts in the ventricular cavity or they can be attached to the choroid plexus.

Subarachnoid form: They are the most severe form and constitute about 5% of cases. They can be associated with chronic meningitis and signs of raised intracranial pressure.

Spinal form: They can cause inflammatory and demyelinating changes in peripheral nerve roots and constitute about 1% of cases. They can cause severe radicular pains and paresthesias.

Ocular form: They can be seen in subretinal space, vitreous humor, anterior chamber, conjunctiva, or extraocular muscles. They constitute about 1 to 3% of cases.

The Clinical manifestations, Diagnosis and Management vary according to the location and stage of cysticerci. These are the single enhancing lesion, the viable and calcified parenchymal cysticerci, the ventricular, the subarachnoid, the ocular and the spinal.

Diagnostic tools

Imaging:

CT: CT scan is most sensitive in detecting calcified cysticerci. If a scolex can be identified certainly on a CT scan, the diagnosis of Neurocysticercosis can be made even without an MRI. But MRI will still be of help in any case of parenchymal NCC as a patient with parenchymal NCC can have NCC at other sites which may not be visualized on CT scan. Hence when MRI is feasible it is always advised[4].

MRI: MRI brain is sensitive in detecting small lesions, evaluating degenerative changes, staging and visualizing scolices better than a CT scan within the lesions. They are also useful in detecting intraventricular and subarachnoid cysts. The important MRI sequences helpful in detecting cysticerci are the routine T1/T2/FLAIR and 3D CISS sequences. DWI sequence and MR Spectroscopy are helpful in conditions where NCC has to be differentiated from an abscess/ tuberculoma in case of any single enhancing lesion as the latter shows diffusion restriction. Evaluation of cysticerci has become challenging with conventional MRI and CT techniques and there is requirement of advanced MRI imaging techniques[5].

Imaging in various stages:

Vesicular stage: In vesicular stage, the imaging hallmark would be visualization of scolex within the cyst and the cyst wall enhancement is either absent or only a thin linear enhancement is seen.5 On all imaging sequences the cyst fluid demonstrates the same signal intensity as the CSF. FLAIR sequence improves the visualization of scolex within the CSF.4

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Colloidal stage: As the cyst degenerates, there is proteinaceous deposits with inflammatory response within the cyst fluid and the signal on imaging changes. CT shows hyperdense fluid within the cyst and the rim enhancement. T1 weighted MR imaging shows absence of scolex and hyperintense cyst fluid. T1 weighted contrast images also show enhancement of the rim. However in T2 weighted images, rim of the cyst of low signal intensity with adjacent edema[6]. This can be differentiated from abscess by the absence of diffusion restriction on DWI sequences.

Granular Nodular Stage: CT and MR imaging demonstrate enhancement of the nodular lesion or a small ring-enhancing lesion at this stage. The wall of the cyst is thicker than the colloidal stage and shows retraction of the wall. This stage represents a degenerative and active form of cysticercosis.5 Nodular Calcified Stage: This is the final stage of cysticercal degeneration where the cyst is transformed into a calcified lesion. CT scan is most sensitive as these appear hypointense on both T1 and T2 weighted images [5].

Intraventricular Cysticercosis: Usually it is associated with parenchymal neurocysticercosis but in upto 76% of cases it can be the isolated manifestation. Fourth ventricle is the most common location for solitary intraventricular cyst followed by third ventricle. The lateral ventricles and the cerebral aqueduct are least commonly involved. Migration of the cysts has been demonstrated. Hence the follow up sans have been advised to follow up especially when surgical management is planned. Ependymal inflammation and subsequent adhesions cause obstructive hydrocephalus. They are challenging to identify on CT scan and conventional MR imaging. On T1 and T2 weighted MR imaging they are isointense to CSF and are occasionally hyperintense on T1 and FLAIR sequences. The wall of the cyst may occasionally show contrast enhancement. They are generally detected owing to ventricular deformity, distension and hydrocephalus. The scolex may be missed on routine sequences, but a 3D sequence like CISS will demonstrate it. Three-dimensional CISS sequence provides superior topographic information that helps to delineate the exact location of cysticerci.[7] Cyst walls, degenerated scolex, and associated distortion of cranial nerves and vascular structures can be best visualized with this technique[8].

Subarachnoid form

Cysticerci in this region are difficult to detect on CT. Even on MR imaging these lesions are often poorly visualized, owing to the is intensity of the lesions to CSF on all sequences similar to surrounding normal cisterns. The cysticerci reach the subarachnoid spaces through the hematogenous spread. The cisterns are involved where the cysts are degenerated and the scolex is not visible. The multiloculated appearance of these fluid filled lesions lacking scolex has been likened to a cluster of grapes and hence the name “racemose cysticercosis”. The cysts may be identified in the cisterns as the cisterns are distorted and involve the adjacent structures. There could be an inflammation of the adjacent leptomeninges which may show enhancement, which can lead to the formation of adhesions, calcifications and thickening [9].

Spinal form: They are generally seen in the subarachnoid space as these are the cysts which are migrated from the intracranial compartment. Intramedullary cysticerci are less common and they are as a result of hematogenous spread[8, 9].

Ocular Cysticerci

The common location is the extraocular muscles in the orbit. They are seen in the posterior wall of the globe, because of dissemination of the larvae via the choroidal vasculature in this region.9

MR Cisternography

High resolution MR Cisternography can help in the identification and characterization of neurocysticercosis. MR Cisternography is performed using T2/FLAIR sequence with 100% Oxygen inhalation. High levels of ox hemoglobin in CSF increases the signal intensity on CSF in T2/FLAIR sequences which helps in localization of subtle subarachnoid lesions [10].

Serological tests

Serological tests are not helpful much in the diagnosis of NCC due to their limited sensitivity and specificity. They only support the diagnosis in addition to the imaging. The antigen test and ELISA are of limited value due to poor sensitivity and specificity. Enzyme linked Immunotransfer Blot(EITB) is preferred as its sensitivity and specificity has been well characterized in published assays. The access to EITB is limited in our country. The other limitation of serological tests is that they can be false negative in conditions lie single enhancing lesions or calcified lesions. In single lesion, the immune response is not sufficient enough to produce detectable antibodies. In calcified lesions the antibodies have already disappeared from the circulation [11].

Treatment of Neurocysticercosis: Anti-inflammatory agents, Anti-epileptic drugs, Anti-parasitic agents and surgical procedures when indicated remain the mainstay in the treatment of Neurocysticercosis[12]. Initial focus is always on the symptomatic management. Seizures should be treated with

Antiepileptic drugs and the signs and symptoms of raised ICP are treated with corticosteroids[13]. The indications for the start of anti-parasitic drugs remains still controversial and there are various factors which have to be considered before the start of anti-parasitic drugs [14].

Anti-parasitic drugs

The two important antiparasitic drugs being used in the treatment are Albendazole and Praziquantel. The mechanism of action of albendazole is it causes inhibition of glucose uptake by the parasite. The mechanism of action of praziquantel is the paralysis of musculature of the parasite. There are various features which makes albendazole the drug of choice when compared to praziquantel. First of all the cost of albendazole makes it affordable for patients in developing countries like India. The CSF penetration of Albendazole is better than that of Praziquantel. The drug interactions are lesser when compared to Praziquantel. And many trials prove that Albendazole has a better cysticidal effect than praziquantel. However, Albendazole has no effect on the adult Taenia Solium tapeworm.14

There are various controversies regarding the use of cysticidal drugs in Neurocysticercosis. There are many points for and against the use of cysticidal drugs. The points in favor of the use are that they cause rapid disappearance of cysts, reduce the calcifications and hence seizures. The points against the use of these drugs are that they cause acute cerebral inflammation after the death of the cyst which is severe and is unnecessary and can be fatal[14].

Albendazole remains the mainstay of therapy in the treatment of cysticercosis. The randomized trials conducted from our institute on albendazole vs placebo in 1994 and 1995 did not prove to be efficacious in the management of Neurocysticercosis[12,13]. However the subsequent trials on Albendazole have proven that they are effective in

treatment of viable parenchymal neurocysticercosis as they cause the disappearance of the cysts and reduce the number of calcifications and thus the future seizures. The Cochrane review which was published in 2010 showed that in patients with viable lesions, evidence from trials of adults suggests albendazole may reduce the number of lesions. In trials of non-viable lesions, seizure recurrence was substantially lower with albendazole. The duration of therapy in albendazole as per the review was that it favored a shorter duration[15]. One randomized controlled trial which was published in 2010 by Prabhjeet Kaur et al which was conducted at Chandigarh in 120 children with SSECTL proved that one week of albendazole therapy was as effective as 4 weeks of therapy[16].

When it comes to the safety of Albendazole the adverse effects associated with Albendazole are relatively mild and rare. Hepatotoxicity and Leukopenia are the main concerns and the patient with any of these complications before the start of therapy.

Contraindication for the therapy as it can further worsen these. One the patient is started on Albendazole, the monitoring of liver function tests and complete blood counts should be done weekly till the drugs are given. Any rise in the liver enzymes two times the normal range after the start of therapy should be considered as a drug related adverse effects and the drug should be stopped. Once the liver enzymes return to baseline, the drug can be restarted [17].

The other drug which is used in the cysticidal therapy in Neurocysticercosis is Praziquantel. A meta-analysis which was published in 2008 which included 4 prospective cohorts and one RCT comprising of 335 patients compared Albendazole and Praziquantel with an outcome of reduction of seizures and disappearance of lesions. They concluded that Albendazole was associated with better control of seizures than praziquantel in the pooled data analysis and it was associated with better effectiveness than praziquantel in disappearance of cysts [18].

When it comes to the indication of cysticidal drugs in Neurocysticercosis several important features have to be considered. These are the signs of raised intracranial pressure, intraocular cysts and intraventricular cysts which are the main contraindications for cysticidal therapy. The main indications for cysticidal therapy are the viable parenchymal cysts. If there are 1-2 cysts Albendazole alone is given and in case of more than two cysts a combination therapy of Albendazole and praziquantel has proved to be beneficial than Albendazole alone [17]. In case of single enhancing lesion Albendazole has shown to cause disappearance of lesion as well as the reduced seizure recurrence as the chances of calcification is reduced.

As per the recent guidelines by IDSA17, cysticidal drugs are also indicated in intraventriclular cysts after the placement of VP shunt. Lower rates of shunt failure have been noted in those who received antiphrastic drugs and corticosteroids after shunt placement.9 However cysticidal drugs are contraindicated before the placement of shunt. In case of subarachnoid Neurocysticercosis cysticidal drugs are indicated for prolonged periods of time until there is radiological resolution of the cysts. In some cases the drugs have been continued for a year. So the exact duration of therapy is not known and there are no studies or specific guidelines available. In cases of spinal neurocysticercosis, cysticidal drugs are advised in the guidelines based on some case reports. However several large scale studies are required to prove the benefit and the risks associated.

Symptomatic management: The two important group of drugs in the symptomatic management of cysticercosis are the anti-inflammatory drugs and the anti-epileptic drugs.

Anti-inflammatory drugs

Whenever a patient presents with symptoms and signs of raised intracranial pressure, anti-edema measures are indicated which mainly the corticosteroids are whoever receives anti-parasitic drugs should be given steroids till they are given anti parasitic drugs, as they are at an increased risk of raised ICP due to the inflammation induced by the death of the parasite by the anti-parasitic drugs. As per a Meta analysis19 published on corticosteroids in Neurocysticercosis in 2013 which included 1373 patients, it was concluded that steroids are not beneficial in long term reduction in seizure recurrence or in disappearance of cysts. When it comes to the duration of steroids there are no specific guidelines regarding the duration. The current practice is to continue the steroids as long as the anti-parasitic drugs are continued.

Whenever there is intolerance to steroids or the steroids are required for a long duration of time steroid sparing drugs such as methotrexate has been tried with beneficial results. However this evidence is based on only few case reports and we require further large scale studies to prove the benefits.

Anti-epileptic drugs: The most common symptom with which a patient with Neurocysticercosis can present is the seizures. These seizures can be focal or with secondary generalization. As there are no comparative trials on efficacy of different anti-epileptic drugs, there are no specific guidelines on any specific drug to be used. The choice of AED should be based on the drug interaction with cysticidal drugs and the corticosteroids.

There are trials on the duration of anti-epileptic drugs in Neurocysticercosis. The Cochrane review which was published in 2015 compared 6 months vs 12-24 months and 6-12 months vs 24 months of corticosteroids for the treatment of Neurocysticercosis. It was concluded that both the comparisons were not statistically significant.

Surgical management:

Surgical management in neurocysticercosis comes into picture when there are intraventricular cysts, intraocular cysts, subarachnoid NCC, hydrocephalus and some rare cases of drug refractory epilepsy in case of parenchymal neurocysticercosis.

Pregnancy

In pregnant ladies, the raised ICP should be aggressively managed. The anti parasitic drugs should be withheld until after delivery as the safety of these drugs is questionable.

References

1. Amudhan S, Gururaj G, Satishchandra P (2015) Epilepsy in India I: Epidemiology and public health. Ann Indian Acad Neurol 18: 263-277.
2. Nash TE, Garcia HH (2011) Diagnosis and Treatment of Neurocysticercosis. Nature reviews Neurology 7: 584-594.
3. Garcia HH, Nash TE, Del Brutto OH (2014) Clinical symptoms, diagnosis, and treatment of neurocysticercosis. Lancet Neurol 13: 1202-1215.
4. Kimura-Hayama E T, Higuera J A, Corona-Cedillo R, Chávez-Macías L, Perochena A, et al. (2010) Neurocysticercosis: radiologic-pathologic correlation. Radiographics 30: 1705-1719.
5. Lerner A, Shiroishi MS, Zee CS (2012) Imaging of neurocysticercosis. Neuroimaging Clin N Am 22: 659.
6. Castillo M (2004) Imaging of neurocysticercosis. Semin Roentgenol 39: 465-473.
7. Hingwala, Divyata (2011) Applications of 3D CISS Sequence for Problem Solving in Neuroimaging. The Indian Journal of Radiology Imaging 21: 90-97.

8. Govindappa SS, Narayanan JP, Krishnamurthy VM (2000) Improved detection of intraventricular cysticercal cysts with the use of three-dimensional constructive interference in steady state MR sequence. AJNR Am J Neuroradiol 21: 679-684.

9. Zhao J L, Lerner A, Sh Z, Gao X J, Zee C S (2015) Imaging spectrum of neurocysticercosis. Radiology of Infectious Diseases, 1: 94-102.

10. Braga F, Rocha A J, Gomes H R, Hernandez Filho G, Fonseca RB (2004) Noninvasive MR cisternography with fluid-attenuated inversion recovery and 100% supplemental O2 in the evaluation of neurocysticercosis. AJNR Am J Neuroradiol 25: 295-297.

11. Garcia H H, Castillo Y, Gonzales I, Bustos J A , Saavedra H, et al. (2018) Cysticercosis Working Group in Peru. Low sensitivity and frequent crossreactions in commercially available antibody detection ELISA assays for Taenia solium cysticercosis. Tropical Medicine & International Health 23:101-105.

12. Padma M V, Behari M, Misra N K, Ahuja G K (1995) Albendazole in neurocysticercosis. Natl Med J India 8: 255-258.

13. Padma M V, Behari M, Misra N K, Ahuja G K (1994) Albendazole in single CT ring lesions in epilepsy. Neurology 44: 1344-1344.

14. Garcia H H, Lescano A G, Lanchote V L, Pretell E J, Gonzales I, et al. (2011). Pharmacokinetics of combined treatment with praziquantel and albendazole in neurocysticercosis. British journal of clinical pharmacology 72: 77-84.

15. Abba, Katharine, Sridharan Ramaratnam, Ranganathan L N (2010) Anthelmintics for people with neurocysticercosis. Cochrane Database Syst Rev 3.

16. Kaur P, Dhiman P, Dhawan N, Nijhawan R, Pandit S (2010) Comparison of 1 week versus 4 weeks of albendazole therapy in single small enhancing computed tomography lesion. Neurology India 58: 560.

17. White Jr A, Clinton (2018) Diagnosis and Treatment of Neurocysticercosis: 2017 Clinical Practice Guidelines by the Infectious Diseases Society of America (IDSA) and the American Society of Tropical Medicine and Hygiene (ASTMH). Cli Infec Di 66: e49-e75.

18. Matthaiou D K, Panos G, Adamidi E S, Falagas M E (2008) Albendazole versus praziquantel in the treatment of neurocysticercosis: a meta-analysis of comparative trials. PLoS neglected tropical diseases 2(3), e194.