DISSERTATION ON

# CLINICAL AND RADIOLOGICAL PROFILE OF PATIENTS WITH BRAIN GRANULOMA

Submitted in partial fulfilment of

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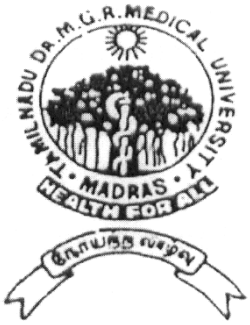


MADRAS MEDICAL COLLEGE

CHENNAI – 600 003.

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# CERTIFICATE

Certified that this dissertation entitled ***"CLINICAL AND RADIOLOGICAL PROFILE OF PATIENTS WITH BRAIN GRANULOMA"*** is a bonafide work done by **DR.B.GOKULAKRISHNAN,** post graduate student of internal medicine, Institute of Internal Medicine, Madras Medical College, Chennai - 600 003, during the academic year 2005-2008.

Prof. Dr.P.Thirumalaikolundusubramanian, M.D.,
Director and Professor,
Institute of Internal Medicine,
Madras Medical College & Govt. General Hospital,
Chennai – 600 003.

Prof.V. K.Rajamani, M.D.,
Addl. Professor,
Institute of Internal Medicine,
Madras Medical College &
Govt. General Hospital,
Chennai - 600 003.

**THE DEAN,**

Madras Medical College & Govt. General Hospital,

Chennai - 600 003.

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# CONTENTS

**ABBREVIATIONS AND ACRONYMS**

| | |
|---|---|
| EEG | Electroencephalogram. |
| NCC | Neurocysticercosis |
| CSF | Cerebrospinalfluid. |
| CT | Computerized Tomogram. |
| MRI | Magnetic Resonance Imaging. |
| EIA | Enzyme Immuno assay |
| GTCS | Generalized Tonic-Clonic Seizure |
| PCR | Polymerase chain reaction |
| AED | AntiEpilepticDrug. |
| TB | Tuberculosis |

# INTRODUCTION

Brain granuloma is most common cause of seizures in young individuals in developing countries like India.. Neurocysticercosis and Tuberculoma are common etiology for the Brain granuloma .Cysticercosis, the infection caused by the larval stage of the tapeworm *Taenia solium*, is the most common parasitic disease of the nervous system in humans and the single most common cause of acquired epileptic seizures in the developing world. [1,3,4]

Mycobacterium Tuberculosis (TB), the organism historically responsible for “white plague and galloping consumption,” is still a major cause of morbidity and mortality across the world. The emergence of HIV, often in conjunction with intravenous (i.v.) drug use, has hampered efforts to control this microorganism and predisposed to the emergence of resistant . [12,44]

Although important advances in the diagnosis, immunology, and pathophysiology of neurocysticercosis and tuberculoma have been achieved in the past two decades, much of the natural history of the parasite infestation, its epidemiology, and clinical features remains uncertain. Disease may go undetected in patients or it may produce florid symptoms. [2,6]

Despite its high frequency, the precise incidence and prevalence of NCC and Tuberculoma are difficult to obtain due to different factors, such as the high number of asymptomatic infections, the pleomorphism of clinical manifestations, the lack of a reliable test for serological screening, and the necessary use of expensive neuroimaging studies for diagnosis and therapeutic decisions. This study is intended to uncover the clinical and radiological features of the brain granuloma. There by ,we can identify characteristics of the disease process in our setup.

# AIM OF THE STUDY

1. To study the etiologic profiles of patients with Brain granuloma .

2. To analyze the age and sex distribution, presenting history, clinical findings and investigations at admission in the study group**.**

# Review of Literature

## NEUROCYSTICERCOSIS

### INTRODUCTION

The geographic distribution of cysticercosis is wide, with high prevalence reported from Mexico, Central and South America, India and Sub-Saharan Africa. One or several parasites may go undetected in the brain of a host throughout his or her lifetime; alternately, the parasites can trigger florid symptoms. NCC is the most common parasitic disease of the human nervous system. [1,4,5]

In India, the commonest form of NCC is the solitary parenchymal cyst. It is seen as a single, small (< 2 cm) enhancing lesion on the CT scans. This lesion commonly presents as simple partial or secondarily generalised seizures. In South India, single CT enhancing lesions (SCTEL) and NCC together accounted for 67% of provoking factors for acute symptomatic seizures. [2]

Cysticercosis is a frequent infection in developing countries where pigs are raised . Population-based studies show substantially higher epilepsy rates in developing countries than in industrialized countries, a difference attributed in part to neurocysticercosis .Cysticercosis, the infection caused by the larval stage of the tapeworm *Taenia solium*, is the most common parasitic disease of the nervous system in humans.

It is the single most common cause of acquired epileptic seizures in the developing world, where prevalence rates of active epilepsy are twice those in developed countries . [2,4]

# EPIDEMIOLOGY

Its prevalence varies greatly according to the geographical region and is not yet precisely known. The increased ease of international travel, increasing number of migrants from developing countries and improved diagnostic techniques have led to widespread recognition of NCC as a common infection not only in developing countries, but also in developed countries.

In the pre-computerised tomography (CT) scan era, NCC as a cause of epilepsy in India was reported to vary from 2.2 to 9.6%.After the advent of CT and magnetic resonance imaging , NCC has been identified as the cause in 9 to 18.6% of patients with epilepsy. In a study from

Delhi, as high as 24% of 361 epileptic patients had unequivocal NCC on MRI. [2,14,23]

This parasitic diseases are related to poverty, illiteracy, and deficient sanitary infrastructures. For these reasons, cysticercosis has been designated a “biologic marker” of the social and economic development of a community. [23]

# PATHOGENESIS

## LIFE CYCLE

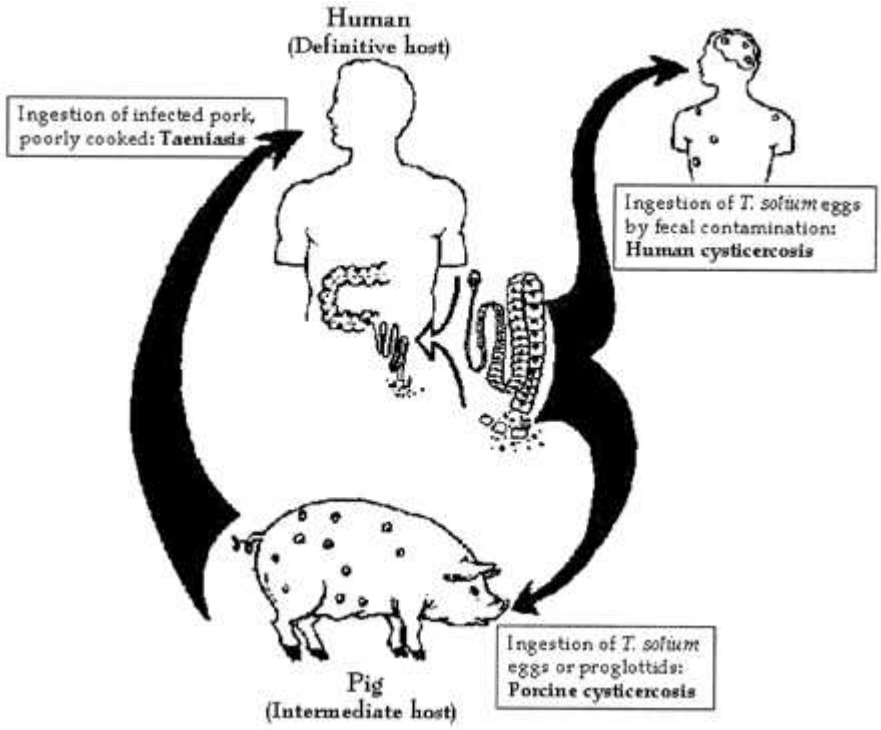
The disease Taeniasis or pork tapeworm infection results from infestation of the small intestine by *Taenia solium*, the adult tapeworm. Humans are both the definitive and intermediate hosts for *Taenia solium*. Cysticercosis is a disease caused by the presence of *Cysticercus cellulosae* and *Cysticercus racemose*, the larval forms of *Taenia solium* in tissues. Humans can acquire the disease with either or sometimes with both. Cysticerci have a predilection for migrating to the central nervous system(CNS), eyes and striated muscle. The high glycogen or glucose content of these tissues may be responsible for such a tropism exhibited by cysticerci. When the CNS or eye is involved by cysticercosis, the patient has Neurocysticercosis (NCC). [23,28]

Cysticercosis is the larval tissue stage of the pork tapeworm, Taenia solium. When humans consume undercooked cysticercotic pork, the larva attaches to the gut wall and grows into the intestinal tapeworm. The life cycle is maintained when pigs eat human feces containing tapeworm eggs and develop porcine cysticercosis, a process facilitated by husbandry practices in villages where pigs are free-roaming scavengers and human fecal contamination is widespread. These life-cycle stages are benign in comparison with those of human cysticercosis, defined by the presence of T. solium larvae in human tissues, which occurs when people ingest tapeworm eggs from food, drink, or soil contaminated by the feces of a tapeworm carrier. [33,28]

Seizures are the most common manifestation of symptomatic human cysticercosis . The disease may also be associated with headache, hydrocephalus, chronic meningitis, or symptoms due to a space-occupying central nervous system (CNS) lesion . Isolated nonneurological manifestations, such as ocular or dermal cysts, account for 15% of cases of

symptomatic disease . We therefore use the term neurocysticercosis interchangeably with the phrase symptomatic human cysticercosis.

LIFE CYCLE




CHARACTERSITCS OF CYSTICERCI

Cysticerci are vesicles consisting of two main parts, the vesicle and the scolex. The vesicular wall is composed of three layers: an outer layer; a

middle or cellular layer with pseudoepithelial structure, and an inner or reticular layer . The invaginated scolex has a structure similar to the adult cestode, with a rostellum armed with suckers and hooks, and a rudimentary body or strobila that includes the spiral canal. However, in some cysticerci the scolex cannot be identified. These parasites are composed of several membranes *attached* to each other that form clusters resembling a bunch of grapes. Because these cysticerci are usually

located within the subarachnoid space, it is believed that their scolex disappeared as the result of hydatoid degeneration. It is common practice to call cysts with scolex, *Cysticercus cellulosae* and those lacking the scolex, *Cysticercus racemosus.*

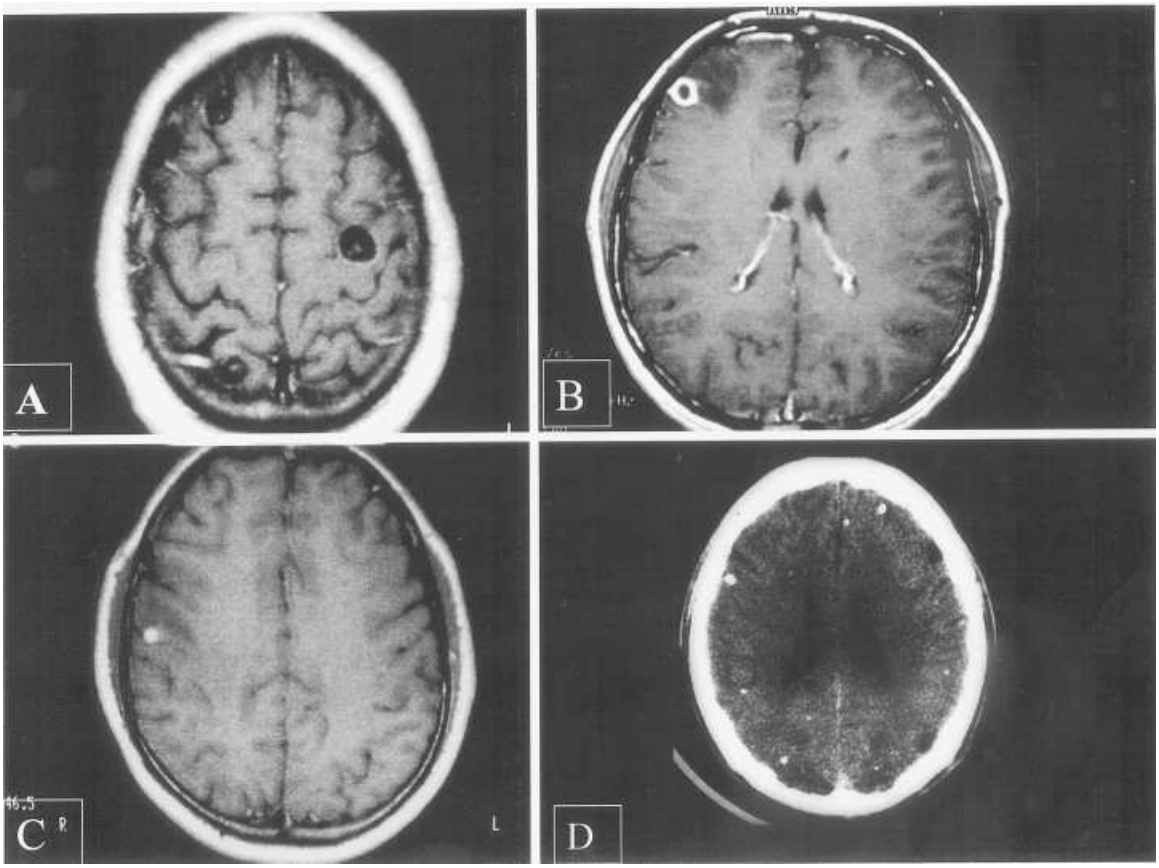
Macroscopic appearance of cysticerci varies according to their location. Cysticerci within the brain parenchyma usually measure around 1 cm and tend to lodge in the cerebral cortex or basal ganglia . Subarachnoid cysticerci may also be small when they are located in the depth of cortical sulci between two cerebral convolutions. However, cysticerci within the sylvian fissure or CSF cisterns at the base of the skull may reach a size as large as 5 cm or more because their growth is not limited by the pressure of the brain parenchymal. Giant cysts usually lack the scolex due to the mechanism of hydatidiform degeneration previously described. Ventricular cysticerci are usually single and large, and may not have a scolex. They can attach to the choroid plexus or float freely in the ventricular cavity. The most common location of these cysts is the also fourth ventricle. Spinal cysticerci may be found at both the cord parenchyma and the subarachnoid space and their morphology is similar to cysticerci located within the brain. .[5,15,23]

## PATHOLOGICAL CHANGES IN BRAIN

The inflammatory reaction around cysticerci usually induces multiple changes in the brain parenchyma, the meninges, the cerebral ventricles,and the spinal cord. The inflammatory reaction around parenchymal brain cysticerci is composed of lymphocytes, plasma cells, and eosinophils. It is usually associated with some degree of edema and reactive gliosis and varies according to the stage of cysticerci development . Meningeal cysticerci elicit an intense inflammatory reaction within the subarachnoid space. This causes thickening of the leptomeninges at the base of the skull. Chronic arachnoiditis and fibrosis produce deficits in the absorption of CSF. In addition, Luschka's and Magendie's foraminae may be occluded by thickened leptomeninges, with subsequent development of hydrocephalus . Blood vessels arising from the circle of Willis may also be affected. The walls of the small penetrating arteries are invaded by inflammatory cells, leading to proliferative endarteritis with occlusion of the lumen. This vascular involvement can result in the development of a cerebral infarct .

Ventricular cysticerci also elicit a local inflammatory reaction if they are attached to the choroid plexus or the ventricular wall. Ependymal cells proliferate and protrude toward the ventricular cavities, and may block the transit of CSF at the level of the cerebral aqueduct or Monro's foraminae. This process is called granular ependymitis and is usually

associated with obstructive hydrocephalus. Cysticerci located in the spinal subarachnoid space may induce inflammatory and demyelinating changes in the ventral and dorsal roots of peripheral nerves in a similar way to cranial nerves. Likewise, inflammatory changes in the parenchyma of the spinal cord resemble those observed in the brain parenchyma. [23,15]




Brain imaging demonstrating the four stages of parenchymal neurocysticercosis. **A**: Magnetic resonance imaging (MRI) of a **vesicular cyst**. Note the well-defined scolex, minimal contrast enhancement, and

mass effect. **B**: MRI of a colloidal cyst. Note ring enhancement, loss of the scolex, and perilesional edema. **C**: MRI of the **nodular/granular stage**. Note nodule with diffuse enhancement and no cystic component**.** **D**: Noncontrast computed tomography showing multiple punctuate **calcification**.

# CLINICAL FEATURES

NCC indistinctly affects men and women from birth to senility, although it is more prevalent in middle-aged adults. Due to peculiarities of the immune response, it tends to be more severe in women than in men. It is a pleomorphic disease that may manifest a variety of unspecific clinical

manifestations. This pleomorphism is related to individual differences in the number and location of lesions as well as to the extent of the host's immune response to the parasite. Epilepsy, focal neurological deficits, increased intracranial pressure, and intellectual deterioration are the most common clinical manifestations of NCC, but are also observed in many other diseases of the nervous system. Therefore, in endemic areas this parasitic disease may mimic almost any neurological disorder. [15,28,37]

### *Epilepsy*

Epilepsy is the most common clinical manifestation of NCC and usually represents its primary manifestation .Indeed, NCC is the leading cause of adult-onset epilepsy in areas of the world where the disease is endemic . Seizures due to NCC are most commonly generalized tonic-clonic or simple partial, although some patients may experience complex partial seizures, myoclonic seizures, or even specific epileptic syndromes. No clear correlation between number and location of brain cysticerci and electroencephalographic and clinical characteristics of the seizure.

### *Focal neurological signs*

A variety of focal neurological findings usually related to parasite size, number, and location are described in patients with NCC. Pyramidal tract signs predominate, but nearly every focal sign that may occur in nervous system disorders has been described in NCC, including vascular headache, sensory deficits, language disturbances, involuntary movements, parkinsonian rigidity, gait disturbances, and signs of brainstem dysfunction.

***Stroke syndrome***

Cerebrovascular complications of NCC include transient ischemic attacks, lacunar infarcts, large cerebral infarcts and rarely, subarachnoid hemorrhages . Lacunar infarcts are usually located in the posterior limb of the internal capsule or in the corona radiata, and produce typical lacunar syndromes such as pure motor hemiparesis and ataxic hemiparesis, clinically indistinguishable from those caused by atherosclerosis . While lacunar infarct was formerly considered the most common cerebrovascular complication of NCC, recent evidence suggests that largecerebral infarcts are more common. The cysticercal etiology of ischemic cerebral lesions should be considered in patients without risk factors for cerebrovascular disease, particularly in young adults with neuroimaging evidence of cystic lesions in the vicinity of the infarction area and evidence of inflammatory signs in the CSF analysis .

***Psychiatric disturbances***`

Many patients with NCC present psychiatric manifestations or organic mental disorders ranging from poor performance on neuropsychological testing to dementia. Psychotic episodes characterized by confusion, paranoid ideation, psychomotor agitation, violent behavior, and visual hallucinations have also been described in patients with parenchymal brain lesions. Severity of psychiatric manifestations correlated with presence of increased intracranial pressure

but not with number and location of parenchymal brain lesions or with coexistence of seizures.

***Intracranial hypertension***

Patients with NCC present with increased intracranial pressure associated with seizures, focal neurological signs, or dementia. Hydrocephalus related to cysticercotic arachnoiditis, granular ependymitis, or ventricular cysts is the most common cause of this syndrome . In these cases, intracranial hypertension has a subacute onset and a slowly progressive course that may be punctuated by episodes of sudden loss of consciousness related to movements of the head (Bruns' syndrome) when the cause of hydrocephalus is a fourth-ventricle cyst . Increased intracranial pressure also occurs in patients with giant cysts and in those with cysticercotic encephalitis. The latter is a particularly severe form of NCC that occurs as the result of a massive cysticerci infection of the brain parenchyma, inducing an intense immune response from the host. This condition is more frequent among children and young women, and is characterized by a clinical picture of subacute encephalitis associated with clouding of consciousness, seizures, diminution of visual acuity, headache, vomiting, and papilledema. Such cases resemble the pseudotumor cerebri syndrome except for the fact that CSF examination usually shows abnormalities that lead to diagnosis .

***Other manifestations***

Intrasellar NCC presents with ophthalmologic and endocrinologic disturbances similar to those produced by pituitary tumors or craniopharyngiomas . Spinal arachnoiditis is characterized by root pain and weakness of subacute onset, and cysts in the cord parenchyma usually produce motor and sensory deficits that vary according to the level of the

lesion . Intraocular cysticerci are most oftenlocated in the subretinal space and are the cause of a clinical picture characterized by progressive decrease of visual acuity or visual field defects . In addition, the presence of the cysts may induce vitritis, uveitis, and endophthalmitis. Massive cysticercal infection of the striated muscles occasionally produces a clinical picture of pseudohypertrophic myopathy with generalized weakness associated

with painless and progressive muscle enlargement . [5,28]

# DIAGNOSIS

## DIAGNOSTIC CRITERIA

### Proposed Diagnostic criteria for Human cysticercosis ,2001

(Del Brutto et al) [1,37]

**Absolute**

Histologic demonstration of the parasite from biopsy of a brain or spinal cord lesion

Cystic lesions showing the scolex on CT or MRI

Direct visualization of subretinal parasites by fundoscopic examination

**Major**

Lesions highly suggestive of neurocysticercosis on neuroimagingstudies

Positive serum immunoblot for the detection of anticysticercal antibodies

Resolution of intracranial cystic lesions after therapy with albendazole or praziquantel

Spontaneous resolution of small single enhancing lesions

**Minor**

Lesions compatible with neurocysticercosis on neuroimaging studies

Clinical manifestations suggestive of neurocysticercosis

Positive CSF ELISA for detection of anticysticercal antibodies or

cysticercal antigens

Cysticercosis outside the central nervous system

**Epidemiologic**

Evidence of a household contact with T. solium infection

Individuals coming from or living in an area where cysticercosis is endemic

History of frequent travel to disease-endemic areas a CSF, cerebrospinal fluid; ELISA, enzyme-linked immunosorbent assay

No diagnostic test identifies all cases of cysticercosis, and each test identifies a somewhat different group of individuals .

**SEROLOGY:**

**EITB:**

The current serological assay of choice for the diagnosis of neurocysticercosis is EITB; this assay has a specificity approaching 100 % and a sensitivity of 94 to 98 % for patients with two or more cystic or enhancing lesions. A major weakness of this test is frequent false negative results in patients with a single intracranial cysticercus lesion, in whom fewer than 50 % test positive. The sensitivity and specificity of this test is also low in patients with calcified lesions. In a survey of patients who presented with seizures to emergency departments, several patients had positive EITB assays but without CT abnormalities or

exposure history suggestive of neurocysticercosis. Access to EITB in India is limited

**ELISA :**

In India, the ELISA test is extensively used for the diagnosis of cysticercosis. However, recent studies on serum have demonstrated a large number of false positive and false negative results. In contrast, ELISA using CSF was 87 % sensitive and 95 % specific and remains a useful supportive tool for the diagnosis.

**IMAGING:**

Once the oncosphere has passed into the parenchyma, it grows and evolves through vesicular, colloidal, granular-nodular, and calcified phases. CT scans or MRIs can identify these four phases.

VESICULAR PHASE:

In the vesicular phase, the host tends to show immune tolerance. In most cases, there is no surrounding parenchymal reaction; the larva lives inside a translucent liquid-filled cystic structure surrounded by a thin membrane, where it can remain viable from a few months to several years . When the larva is viable, the CT scan-without enhancement by contrast media-depicts circumscribed, rounded, hypodense areas, varying in size and

number. The average size of the cyst is 10 mm in diameter, but ranges from 4 to 20 mm. In the MRI, the vesicular larva appears with a cerebrospinal fluid (CSF)- like intensity signal on all sequences and no surrounding high signal on T,-weighted images . Both MRI and CT may show a high intensity, 2-4 mm mural nodule depicting the scolex in the interior of some parenchymal vesicular cysts . This picture has been named “hole-with eccentric dot imaging” or “starry night effect” and could be considered pathognomonic of cysticercosis; this phase corresponds to the active parenchymal form of

the proposed classification of NC . Two pathologic changes take place when the host immune system reacts against the parasite .

COLLOIDAL PHASE:

First in the colloidal phase, the parasite begins to show degenerative changes, the vesicular fluid takes on a gelatinous colloidal aspect, and the wall thickens . In this phase, the contrast-enhanced CT scan shows an annular enhancement surrounded by irregular perilesional edema. The fluid content gives slightly higher signal than CSF and is sometimes isodense with the parenchyma on T, - or proton densityweighted images or both, and gives high signal on T,- weighted images . The capsule shows higher signal than the adjacent brain with thick ring enhancement on T, -weighted images, whereas on T,-weighted

images, there is a low ring signal surrounded by high-signal lesion, due mostly to edema .

NODULAR-GRANULAR PHASE:

The second pathologic change that takes place occurs in the nodular-granular phase. The vesicle tends to shrink, its content becoming semisolid as it is progressively replaced by granulomatous tissue. By using noncontrasted CT scan, these findings could correspond to a diffuse hypodense area with irregular borders.

After the administration of contrast media, a small, hyperdense, rounded, nodular image surrounded by edema is observed . In this stage, T,-weighted images are the most striking, as they show the change in the signal from the cyst fluid. The nodular isointense or low signal seen in some lesions is probably the result of early mineralization of the cystassociated with hyaline degeneration . The low signal probably represents the marginal mineralized scolex inside the residual cyst, which will show as a bulls-eye on CT (58). In these two consecutive phases, the parasite shows a progressive decay;*)*..

CALCIFICATION:

Finally, when the parasite dies, a mineralization and resorption process occurs, ending in a calcified nodule that lodges permanently in the CNS . The noncontrasted CT shows a rounded, homogeneous hyperdense

area, showing no enhancement of the contrast media. In the MRI, only the proton density-weighted image shows a low-intensity lesion . This phase corresponds to the inactive parenchymal form of the proposed classifications of NCC.

VARIANT :

One form of NCC that has different clinical and radiologic characteristics from those described is the so-called ‘‘cysticercotic encephalitis” that occurs mainly in children and young women . The noncontrast CT image shows diffuse and intense cerebral edema and small or collapsed ventricles; with contrast media, multiple, small, hyperdense, nodular, or annular images appear disseminated throughout the whole cerebral parenchyma . Being immersed in a CSF-rich environment, these cysticerci can evolve into the racemose form of NCC . These types of cysts are most frequently located either in the basal cisterns or inside the sylvian valley and can reach 100 mm in diameter . The noncontrasted CT depicts a hypodense image in the subarachnoid or ventricular space; the cysts deform the surrounding structures, and noncommunicating hydrocephalus occurs . The MRI (proton or T,- weighted) more precisely shows the cyst as a hypointense CSF-like image in all phases; it permits a direct visualization of intraventricular cysticercosis by identifying the cyst wall, scolex, or both . The ventricular ependymal lining reacts to the cysts, causing an inflammatory reaction or ependymitis, which can be

visualized by CT or MRI as a high-intensity signal in the ependymal layer. Gadolinium-enhanced MRI is more sensitive than contrast-enhanced CT to detect ependymitis

**TUBERCULOMA VS NEUROCYSTICERCOSIS**.[27]

Rajshekhar et al made an attempt to differentiate between these two entities on the basis of clinical and imaging features and subsequently, on the basis of this study and their experience Rajshekhar and Chandy noted that cysticerci are usually round in shape, 20 mm or less in size with ring enhancement or visible scolex, and cerebral edema severe enough to produce midline shift or focal neurological deficit is not seen. Tuberculomas are usually irregular, solid and greater than 20 mm in size. They are often associated with severe perifocal edema and focal neurological deficit 12 . No histopathological study has ever demonstrated that all large lesions (>20 mm) are tuberculomas and nothing else.

On the contrary, every retrospective and prospective follow-up study of single enhancing CT lesions in patients with new-onset seizures observed the spontaneous resolution of the lesions irrespective of their size, shape and amount of surrounding edema. Another important point is that, in none of these series worsening (enlargement of CT lesion and appearance of new symptoms or focal

deficit) has been noted though such a fear has always been expressed.In fact, several series which included patients with CT lesions of varied sizes, shapes and perifocal edema, identical favorable clinical and radiological courses were obtained.

**MRI VS CT IMAGING**

MRI is more sensitive than CT scans for the diagnosis of NCC since it improves recognition of the perilesional edema and degenerative changes of the parasite, as well as small cysts or those located inside the ventricles, brain stem, cerebellum and the racemose vesicles at the level of the posterior fossae and basal cisterns. However, CT scans are more sensitive for the detection of calcifications.

**EEG:**

There is a poor correlation between seizure type and EEG findings in patients with epilepsy due to neurocysticercosis. The EEGs are normal in more than 50% of these patients and when present EEG abnormalities correlate poorly with the clinical characteristics of the seizures or with the location of parasites within the brain parenchyma. It is quiet common to have generalized abnormalities in patients with a single parenchyma cyst and focal paroxysmal activity in patients with disseminated infection. The two possible explanations for this phenomenon are 1.some cerebral areas are resistant to epileptogenic effects of cysticerci, and 2. the

parasite may generate local epileptogenic activity and activate distant sites by cortical or subcortical spread. [33,14]

# MANAGEMENT

Characterization of the disease in terms of cyst viability, degree of host immune response to parasites, and lesion location is of major importance for rational therapy, which includes a combination of symptomatic therapy (e.g., antiepileptic drugs), specific cysticidal drugs, steroid antiinflammatory therapy, surgical resection of lesions, and placement of ventricular shunts.

### *Cysticidal drugs*

Praziquantel is an isoquinoline with proven cysticidal properties used to treat human NCC since 1979 . Subsequent studies show that praziquantel eliminates up to 70% of parenchymal brain cysticerci after a 15-day course of treatment at daily doses of 50 mg/kg. Albendazole is an imidazole that also has cysticidal properties.This drug was initially administered at doses of 15 mg/kg/ day during 1 month .

Nevertheless, additional studies showed that at similar doses, length of therapy could be shortened to 1 week without lessening the efficacy of the drug . Albendazole destroys 75–90% of parenchymal brain

cysts and has been superior to praziquantel in several trials comparing the efficacy of both drugs .

Another advantage of albendazole over praziquantel is that the former also destroys subarachnoid and ventricular cysts, due to its better penetration of CSF .Recommended regimen of praziquantel have ranged from 10–100 mg/kg for periods of 3–21 days . In these studies, praziquantel was administered every 8 h..The percentage of cyst disappearance in neuroimaging studies was similar to that observed in patients receiving longer courses of the drug at conventional doses .

Albendazole (ABZ) is considered the medication of choice for the antiparasitic therapy of NCC, in a regimen of 15 mg/kg/day divided into two doses every 12 h for 8 days.Its main use is for symptomatic patients showing multiple viable brain parenchymal cysticerci. The viability of cysticerci is characterized by the presence of rounded areas of hypodense lesions seen on CT with a scolex inside the cyst, better shown on MRI, without contrast enhancement or surrounding edema.

***Symptomatic therapy***

***Antiepileptics***

Most patients with NCC present with seizures and the administration of standard doses of single first-line antiepileptic drugs,

such as phenytoin or carbamazepine, usually results in adequate seizure control. Patients with parenchymal brain cysts must be treated with anticysticercal drugs to eliminate infection, prevent development of a granuloma, and achieve adequate control of seizures with antiepileptic drugs. The optimal length of antiepileptic drug therapy in patients with NCC has not been settled. A recent prospective study showed that up to 50% of these patients had relapses after withdrawal of antiepileptic drugs . These patients had been free of seizures for 2 years, and their parenchymal brain cysts had been successfully destroyed with albendazole. Prognostic factors associated with seizure recurrence include secondary development of parenchymal granulomas or calcifications and the presence of both recurrent seizures and multiple brain cysts before institution of cysticidal therapy.

***Steroids***

Corticosteroids are frequently used in patients with NCC, and represent the primary form of therapy for cysticercotic encephalitis, angiitis, and arachnoiditis causing hydrocephalus and progressive entrapment of cranial nerves . In patients with cysticercotic encephalitis, corticosteroids may be used alone or in association with mannitol at doses of 2 mg/kg/day . In these cases, the initial trial with high doses of intravenous dexamethasone may be followed by chronic oral therapy with

prednisone (50 mg) or dexamethasone (10 mg) 3 days a week .Association with dexamethasone has been recommended to ameliorate the secondary effects of headache and vomiting that may occur during the first 2 days of praziquantel or albendazole therapy.These manifestations are not related to the toxic effects of cysticidal therapy but rather to the acute destruction of parasites within the brain, and are reliable indicators of drug efficacyAbsolute indications for corticosteroid administration during cysticidal drug therapy include management of patients with giant subarachnoid cysticerci, ventricular cysts, spinal cysts, and multiple parenchymal brain cysts. In these cases, corticosteroids mustbe administered before, during, and even some days after the course of anticysticercal drugs to avoid the risk of cerebral infarcts, acute hydrocephalus, spinal cord swelling, and massive brain edema, respectively .

The goal of anticysticercal therapy is the simultaneous destruction of multiple cysts then controlling the resulting inflammatory reaction with steroids. .[33,14,23,25)]

**Guidelines for use of antiparasitic treatment in neurocysticercosis**. [1]

| Type | Infection burden | Recommendations | Evidence |
|---|---|---|---|
| Parenchymal neurocysticercosis | | | |
| Viable (live cysts) | Mild (1 to 5 cysts) | (a) Antiparasitic treatment, with steroids | II-3 |
| | | (b) Antiparasitic treatment; steroids used only if side effects related to therapy appear | II-3 |
| | | (c) No antiparasitic treatment; neuroimaging follow-up | II-3 |
| | Moderate | Consensus: antiparasitic | II-3 |

| | | | |
|---|---|---|---|
| | (more than 5 cysts) | treatment with steroids | |
| | Heavy (more than 100 cysts) | (a) Antiparasitic treatment with high-dose steroids | III |
| | | (b) Chronic steroid management; no antiparasitic treatment; neuroimaging follow-up | III |
| Enhancing lesions (degenerating cysts) | Mild or moderate | (a) No antiparasitic treatment; neuroimaging follow-up | I |
| | | (b) Antiparasitic treatment with steroids | II-3 |
| | | (c) Antiparasitic treatment; steroids only if side effects develop | II-3 |
| | Heavy (cysticercotic | Consensus: no antiparasitic treatment; | III |

| | | | |
|---|---|---|---|
| | encephalitis) | high-dose steroids and osmotic diuretics | |
| Calcified cysticerci | Any number | Consensus: no antiparasitic treatment | |
| Extraparenchymal neurocysticercosis | | | |
| Ventricular cysticercosis | | Consensus: neuroendoscopic removal, when available. If not available: | III |
| | | (a) CSF diversion followed by antiparasitic treatment, with steroids | III |
| | | (b) open surgery (mainly for ventricle cysts) | III |
| Subarachnoid cysts, including giant cysts or racemose cysticercosis, | | Consensus: antiparasitic treatment with steroids, ventricular shunt if there | II-3 |

| | | |
|---|---|---|
| and chronic meningitis | is hydrocephalus | |
| Hydrocephalus with no visible cysts on neuroimaging | Consensus: ventricular shunt; no antiparasitic treatment | III |
| Spinal cysticercosis, intra- or extramedullary[b] | Consensus: primarily surgical; anecdotal reports of successful use of albendazole with steroids | III |
| Ophthalmic cysticercosis[b] | Consensus: surgical resection of cysts[c] | II-3 |

[a] Levels of recommendations (a, b, and c) and quality of evidence are defined in the text.

[b] Given the rarity of these presentations, treatment was discussed based on the published literature .

[c] Experience in the use of albendazole with methylprednisolone for treatment of retinal cysticercosis and as a presurgical treatment for intravitreal cysticercosis has been published but not yet replicated.

**Arguments in favor of and against antiparasitic treatment for neurocysticercosis**

| Argument | Reply |
|---|---|
| Protreatment | |
| Rapid disappearance of cysts | No evidence that faster disappearance of cysts will result in better epilepsy control |
| Severe cases seen less frequently now | Less severe cases reflect improved sanitation and fewer massive infections |
| Series of albendazole- or praziquantel-treated patients have better evolution (fewer seizures) than untreated patients seen at the same centers | Inadequate "control" groups in initial studies |
| Fewer residual calcifications | No evidence that antiparasitic |

| | |
|---|---|
| | therapy results in fewer calcifications |
| Antitreatment | |
| Neurocysticercosis becomes symptomatic after a period of years as a result of onset of the process of parasite death | Questionable methodology of "controlled" studies; some patients persist with symptoms and live cysts for years |
| Antiparasitic treatment leads to acute cerebral inflammation and is severe and unnecessary | Inflammation can be controlled with steroids; chronic, moderate inflammation may lead to scars similar or worse than those from a short, acute, severe process |
| Reactions to treatment may lead to the death of the patient | Less than 10 deaths reported (mainly massive infections) among many albendazole or praziquantel-treated cases |

## Surgery

Prior to the advent of antiparasitic drugs, surgery was the primary therapy for neurocysticercosis, mainly open surgery for excision of large cysts or cysts in the ventricles. The role of surgical therapy in the management of neurocysticercosis has significantly decreased over time and is now mainlyrestricted to placement of ventricular shunts for hydrocephalus secondary to neurocysticercosis. The main problem in these cases is the high prevalence of shunt dysfunction; indeed, it is common for patients with hydrocephalus secondary to neurocysticercosis to have two or three shunt revisions.The protracted clinical course of these patients and their high mortality rates (up to 50% in two years) were directly related to the number of surgical interventions to change the shunt.

Many authors advocate shunting combined with antiparasitic drugs to further reduce the incidence of shunt failure . Recently, less invasive procedures have been described, specifically the use of neuroendoscopic resection for ventricular cysts. Overall results have been excellent, with much less morbidity than with open surgery. . [25,33]

## PROGNOSIS

In , adults first seen with new onset seizures and active cyst recurrences rates at 4 years are as high as 49%. After a second seizures , the estimated risk of the recurrence is 68% at 6 years . Prognosis is best for those patients in whom imaging studies normalize.

The recurrence rate for those patients with persisting , active cyst is more than double the rate of patients with normal imaging. Seizures recurrences and reduced in patients who initially have calcifications rather than active cyst. [37,25]

# TUBERCULOMA

## INTRODUCTION:

Mycobacterium tuberculosis is an aerobic nonmotile bacteria characterized by slow growth . The frequency of CNS involvement of tuberculosis ranges from 0.5% to 5.0% in the literature and is seen most commonly in the developing countries. The most frequent manifestation of CNS tuberculosis is tuberculous meningitis, followed by tuberculoma and tuberculous abcesses. Tuberculoma is encountered in only 15% to 30% cases of CNS tuberculosis and are mostly hemispheric.

In the early 20th century, central nervous system (CNS) tuberculoma constituted 34% of all intracranial mass lesions identified at

autopsy.This ratio was found to be 0.2% in all biopsied brain tumours between the years 1955 and 1980 at a neurological institute in a developed country. Although large series from developing countries continue to be reported and incidence has increased for the last 20 years due to human immunodeficiency virus (HIV) infection and drug-resistant microorganisms. . [27,44,12]

# EPIDEMIOLOGY

Tuberculosis, an ancient disease, continues even today to be a major public health concern in many parts of the world. An estimated 1.7 billion persons, one-third of the world's population, are infected. This reservoir of infected persons results in 8 million cases of active tuberculosis and 2.9 million deaths annually. Disease's manifests in both genders, with a 3:2 male/female rate and, with a greater frequency with the age ranging between the 2nd and 3rd decades. It reaches young adults and it is less common among children. This affection negative impact becomes evident for the most assailed subgroups, either from the occupational or from the educational point of view.

It has had a recent resurgence consequent to the emergence of AIDS in epidemic propor Intracranial tuberculomas develop in approximately 1% of all patients with active tuberculosis and 4·5–28%

of those with tuberculous meningitis, but they may develop without any evidence of active disease. [31,34,12]

Intracranial tuberculomas constitute the most common intracranial mass lesions in neurotuberculosis, accounting for 5–11% of all intracranial space occupying lesions . Most often these lesions are diagnosed on the basis of neuroimaging studies and ATT is administered on a presumptive basis .

# PATHOGENESIS

It is believed that TB of the CNS, like any other forms of TB, begins with inhalation of aerosolized droplet nuclei, each containing a few tubercle bacilli. They reach the alveoli, where they multiply in alveolar spaces or in alveolar macrophages, and in macrophages derived from the circulation.

During the first three weeks, virtually no immune response occurs; tubercle bacilli are disseminated hematogenously to extra-pulmonary sites, including the CNS. Mycobacteria are filtered from the blood by lungs, liver, spleen, and bone marrow, while they get trapped in organs like brain where there is no reticuloendothelial system. Following infection, because of the cell-mediated immune response, tubercle bacilli may get killed intracellularly within activated macrophages. Tubercles,

consisting of mononuclear cells surrounding a necrotic caseous center, are formed in the lungs as well as

in secondary sites. The fate of these tubercles and the subsequent course of infection are functions of both the immunologic capacity of the host and poorly understood genetic factors. In the absence of effective host cell-mediated immunity, tubercles continue to grow, bacilli multiply, the caseous center liquefies, and finally the tubercles rupture. As a result, bacilli and their antigenically potent products are released into the surrounding tissues. If this progression occurs in the brain and meninges, different forms

of cerebral TB can develop .

Cerebral TB develops in two stages. Initially, small intracerebral tuberculous lesions called “Rich Foci” develop in the CNS, either during the stage of bacteremia of the primary TB infection or shortly afterwards. These initial tuberculous lesions may be in the subpial or subependymal surface of the brain or the spinal cord may become active after several years of initial

infection. Later these small tuberculous lesions located on the surface of the brain or the ependyma will rupture into the subarachnoid space or the ventricular region to cause meningitis. Those deep within the brain or spinal

cord parenchyma will enlarge to form tuberculoma or tuberculous abscess . Although the specific stimulus for the rupture or growth of Rich foci is not known, immunological mechanisms are believed to play an important role.

The tuberculoma may also originate in the meninges, and may be found in the superficial cortex. The meningeal form may resemble a meningioma.

Findings of systemic infection and many of the usual laboratory correlates of infection may be absent because tuberculous bacilli are not always evident in the CSF and even in the excised mass. Therefore, negative results from the bacterial examination do not eliminate the possibility of tuberculous infection. [36,39]

Tuberculomas are avascular, spherical granulamatous masses of small tubercles. A tubercle consists of a central core of epithelioid cells surrounded by lymphocytes and Langerhans giant cells. The inside of these masses contain necrotic areas composed of caseous material, occasionally thick and purulent, in which TB bacilli could be demonstrated. Tuberculomas are predominant in infratentorial regions in children, whereas they are observed in supratentorial regions in adults . Tuberculomas in sellar and pineal regions mimicking brain tumors are seen occasionally.

Tuberculoma en-plaque, an uncommon manifestation of tuberculoma, develops from the enlargement of one or more meningeal tubercles, leading to a distinctive, flat, adherent mass . It is considered to be a likely source of diffuse meningitis and is the result of bacillemia that occurs during the development of a primary lesion or after progressive infection . Paradoxical enlargement or development of tuberculomas during antituberculous treatment can occur . [36,39]

# CLINICAL FEATURES :

Tuberculoma of the brain equally affects men and women at any age, although children are more prone to this affliction in developing countries. In light of the non-specific common presentation, which is usually subacuteat onset, any infectious or tumoral processes can be evoked. Any personal history of tuberculosis, past or present, is of course highly contributive for the diagnosis, as is the overall general physical examination. Intracranial hypertension is noted in 72 to 75% of the cases and requires surgical ventriculo-peritoneal derivation in 12.5%, and papilloedema is seen in 42 to 93% . Seizures and focal epilepsy are reported in 42 to 85% of the cases, hemiparesis in 19 to 38%, isolated cranial nerve palsy in 12%, poor general health in 15% and fever in only 10 to 25% . Other neurological symptoms attributable to the location of the lesion may be seen. HIV patients have seizures less frequently (38%)

but fever is almost a constant finding, with a reported frequency of 76% in one study . They also are commonly confused at presentation (52% of the cases) and have a previous or active extracerebral tuberculosis in 66% of the cases . .[31,34]

The diagnosis is difficult because an active tuberculous infection of other organs is frequently not, or no longer, apparent. Depending on their size and location, intracranial tuberculomas can have many signs mimicking primary central nervous system tumors, such as high intracranial pressure, focal neurologic deficits, and seizures.

SYMPTOMS

-seizures (60 to 100%)

- Head ache (56- 93%)

- focal neurological deficits (33-68%).

Tuberculomas are usually solitary lesions, but they can be multiple in 15–34% of cases.

# DIAGNOSIS

# IMAGING

On CT scan, tuberculomas are defined as low- or high-density, rounded or lobulated masses with irregular walls of varying thickness that

show homogeneous or ring enhancement after the contrast administration. Moderate to marked perilesional edema has been observed frequently. Tuberculomas may be single or multiple  and are common in the frontal and parietal lobes in parasagittal areas. A central calcification surrounded by a hypodense area with peripheral ring enhancement, called the “target sign”, is considered as characteristic of tuberculoma.

Based on CT images, tuberculomas are classifyed into immature forms, consisting of small discs and rings with a massive edema, and mature forms, appearingas large rings or lobulated masses . Neuroradiological imaging with CT and MR imaging are highly sensitive for tuberculoma, but their specificity for a definite diagnosis is low .

Although tuberculoma appears avascular when studied angiographically, its appearance on computerised tomographic (CT) scan and MRI varies. It is consistent with the evolving granulomatous nature of the disease. During the initial phase of the disease, oedema and necrosis may appear as a low attenuating area on CT scan. Once the granuloma has begun to organize, there may be high attenuation, contrast enhancement and calcification, as well as ring enhancement and a variable degree of surrounding oedema. The enhancement may be homogenous or there may be a central radiolucent area corresponding o the central zone of necrosis.

MRI is considered to be more sensitive than CT in detecting tuberculomas of the cerebral parenchyma. Tuberculoma are isointense with grey matter on Tl-weighted MR images. On T2- weighted images, lesions show central hyperintensity. .In some cases, a hypointense ring is present within the wall of the tuberculoma on T2 weighted images. Most tuberculomas are further outlined by a collar of high signal, resulting from oedema, on T2-weighted images. Tuberculomas, typically, “enhance” after the intravenous administration of gadopentetate dimeglumine in a solid or ring pattern.

MRI is more sensitive than CT in diagnosing central nervous system tuberculomas, especially for tuberculomas in the posterior fossa. Biopsy remains the gold standard for diagnosing intracranial tuberculomas; no imaging study can reliably rule out other causes of intracranial brain lesions. Stereotactic brain biopsy is preferred over craniotomy because of the reduced surgical risk. .[26,28,12,7]

Other Investigations:

In cases of intracranial tuberculomas and tubercular abscesses,

the CSF analyses are unremarkable or show a mild, nonspecific increased protein content and usually negative bacteriology . The “gold standard” remains histologic. Approximately 60% of tissue specimens from tuberculomas show AFB in smear and culture. in most cases; often only

the CSF protein level is raised. Cultures for *Myobacterium tuberculosis* of CSF are rarely positive .

The polymerase chain reaction of CSF, appears to be the sensitive diagnostic tool, with a reported sensitivity of 75%.

Laboratory tests, such as differential cell counts of blood leukocytes and erythrocyte sedimentation rate, can be normal. Hints with regard to the differential diagnosis of an intracranial space-occupying lesion for a tuberculous focus are a positive tuberculin skin test (25-75%), signs of an active or healed pulmonary tuberculosis on chest radiograph (25-50%), relapsing cough, and the appearance of the lesion on cranial computed tomography or MRI. [12,7,26]

# MANAGEMENT

Before the introduction of antituberculous therapy the only treatment available for intracranial tuberculomas was surgery, which was associated with high mortality and postoperative meningitis. The general operative mortality was 10%, and the mortality from subsequent meningitis was an additional 40%. In more radical operations, mortality from surgery and postoperative meningitis approached 85%, with

mortality as high as 100% for posterior fossa tuberculomas. With the observation that streptomycin is effective in treating tuberculosis, mortality rates for tuberculoma excision decreased dramatically.

MEDICAL MANAGEMENT :

The treatment of cerebral TB, like that of other forms of TB, is aimed at killing both intracellular and extracellular organisms and in preventing the development of drug resistance by using several drugs in combination. Early diagnosis, clinical staging of patients at the time of presentation, and the institution of prompt anti-tubercular treatment (ATT) are important factors in determining the outcome of cerebral TB.

Currently there is no general consensus on the number of drugs to be used and their optimal duration. However, based on their efficacy and toxicity, anti-tubercular drugs have been classified into first-line and second-line agents . The first line of antitubercular drugs , namely isoniazid, rifampicin, and pyrazinamide, penetrate well into the CSF . In inflamed meninges, the CSF concentrations of these drugs is at least equal to or higher than those in non-inflamed meninges. Isoniazid, pyrazinamide, ethionamide, and cycloserine penetrate into the CSF well in both inflamed and non-inflamed meninges. Rifampicin penetrates less

well . Rifampicin, streptomycin,and ethambutol penetrate in adequate concentrations only when the meninges is inflamed . [31,10,16,22,26]

**Treatment regimen**

There have been no randomised controlled trails to evaluate which antituberculous regimens are most effective in treating intracranial tuberculomas.The recommended initial therapy is isoniazid, rifampicin, ethambutol, and pyrazinamide, unless exposure to a multidrug-resistant pathogen is suspected. If the organism is sensitive, three-drug therapy with isoniazid, rifampicin,Ethambutol and pyrazinamide is given for 2 months. Pyrazinamide and Ethambutol is then stopped, and isoniazid and rifampicin are continued until the completion of treatment.

ANTI TUBERCULOUS THERAPY :

| Drugs | Penetration Into CSF | Dosage in mg/kg/day | | | Duration in months | Efficacy | Major side effects |
|---|---|---|---|---|---|---|---|
| | | *children* | *adult* | *maximum mg/day* | | | |
| **First line** | | | | | | | |
| 1. Isoniazid | yes | 5–15 | 5 | 300 | 6–12 | Bactericidal both intra- and extracellular | Hepatotoxicity, peripheral neuropathy |
| 2. Rifampicin | yes | 10–20 | 10 | 600 | 6–12 | Bactericidal, both intra- and extracellular | Hepatotoxicity, GI, fever, cutaneous rashes |
| 3. Pyrazinamide | yes | 35 | 15–30 | 1500–2000 | 2 | Bactericidal, both intra- and extracellular | Hepatotoxicity, nausea, anorexia, arthralgia, cutaneous hypersensitivity |
| 4. Ethambutol | yes* | 15–25 | 15–25 | 2500 | 2 | Bacteriostatic | Ocular neuritis, arthralgia |
| 5. Streptomycin | yes* | 15–20 | 15 | 1000 | 2 | Bacteriostatic** extracellular only | Ototoxicity, renal vertigo, vestibular disturbances |
| **Second line** | | | | | | | |
| 1. Para-amino salicylic acid | yes* | 300 | 5000–10000 | | | Bacteriostatic | Hepatotoxicity, GI, fever, cutaneous rashes, hypothyroidism |
| 2. Ethionamide or Pro-thionamide | yes | 15–20 | 375–500 | | | Bactericidal | Hepatotoxicity, GI |
| 3. Cycloserine | yes | — | 250–500 | | | Bacteriostatic | Neurotoxic (fits, depression) |
| 4. Fluoroquinalones | | | | | | | |
| Ofloxacin | yes | | 400 | | | Bacteriostatic | CNS effects, GI |
| Ciprofloxacin | yes | | 750 | | | Bacteriostatic | |
| 5. Aminoglycosides | low | | | | | | |
| Amikacin | | 15 | 15 | | | Bacteriostatic | Ototoxicity, vertigo, renal toxicity |
| Kanamycin | | | | | | | |
| Capreomycin | | 15 | 15 | | | | |

Recommended duration of therapy is 12 months in uncomplicated cases of cerebral TB, prolonged to 18 months if PZA is omitted or not tolerated.

Tuberculomas usually decrease in size and resolve completely within 2–3 months of instituting ATT, though sometimes it takes longer, even years, to resolve or leave a residual calcification . [16,22,26]

ROLE OF CORTICOSTEROIDS :

Corticosteroids are administered early in the course of treatment, its morbidity and complications may be reduced . In a trial, Schoeman et al. assessed the efficacy of CS and observed that, in addition to survival, it significantly improved the intellectual outcome and enhanced resolution of basal exudates and intracranial tuberculoma as shown by serial CT scans. Although studies have attempted to control paradoxical growth of the cerebral mass lesion or cerebral edema, the effect of steroids to suppress the paradoxical response is not clear.

Possible indications for the administration of corticosteroids in TB of the CNS are raised intracranial pressure, cerebral edema, focal neurological signs, hydrocephalus, infarcts, and basal optico-chiasmatic pachymeningitis. Now, most authorities to recommend medical management as the preferred treatment for intracranial tuberculomas, reserving surgical intervention for patients who require decompression or biopsy for definitive diagnosis.

The recommended dose of prednisone is 60 mg in adults and 1–2.5 mg/kg/day in children; dexamethasone is 8–16 mg/day in both adults and children for 3–6 weeks, tapered over 2–4 weeks .

SURGERY:

Surgical intervention is reserved for patients with significant raised intracranial pressure, impending visual failure, hydrocephalus, or those in whom paradoxical increase in size is noted during treatment .

Surgical decompression or excision is often required in large masses which cause significant increased intracranial pressure or impending loss of vision. A CSF diversion procedure may be performed in cases of obstructive hydrocephalus caused by tuberculomas. [10,22,26]

PROGNOSIS :

Rajeswari et al. reported that 88% of intracranial “tuberculomas” had resolved at the end of 9 months of ATT and repeat imaging performed 15 months later demonstrated resolution of 80% of lesions. A study by Wanget al. demonstrated that 80% of intracranial tuberculomas had resolved by the end of 6 months of ATT. In a recent study by Awada et al. , complete resolution of intracranial tuberculomas was noted for all 18 patients within 12 months after initiation of ATT . Those authors suggested that a longtreatment regimen (15–18 mo) might not be necessary for intracranial tuberculomas occurring among nonimmunocompromised patients. However, all of the studies cited above and in suffer from the lack of clear criteria for the diagnosis of tuberculomas. The diagnoses were based almost entirely on radiological criteria and not on histopathological studies. The presence of coma and

delay in instituting ATT for more than 3 days would have poor outcome . Delays in treatment may be due to lack of a multi-pronged diagnostic approach, a lack of characteristic CSF parameters, and no evidence of previous exposure to TB. Other prognostic factors correlating with poor performance to ATT are age (children <3 years and adults >50 years of age) and co-existence of miliary TB. Other CSF parameters that are associated with poor prognosis are decreased glucose level and a markedly elevated protein level. None of these have an established predictor value of mortality . Nearly 20–25% of survivors manifest a variety of neurological sequelae. [39,42,16]

# MATERIALS AND METHODS

## SETTING

The study was conducted on the inpatients of the Institute of Internal Medicine and Department of Neurology, Madras Medical College and Government General Hospital, Chennai.

## COLLABORATION DEPARTMENTS

Institute of Internal Medicine

Department of Neurology

Department of Microbiology

## ETHICAL APPROVAL

Institute Ethical Committee approved the study

## STUDY DESIGN

Single Center

Non randomized cross sectional study

## STUDY PERIOD

Study was conducted between September 2005 and September 2007 for a period of 2 years.

## SAMPLE SIZE

In the study period of 2 years among the patients with brain granuloma, attending the Institute of Internal Medicine and Dept of

Neurology, after applying inclusion and exclusion criteria 43 patients were included in this study.

**SELECTION OF STUDY SUBJECTS**

Newly detected patients with solitary brain granuloma attending the Medicine and Neurology department during the study period.

**INCLUSION CRITERIA**

1. All newly detected patients who have granulomatous lesions in the brain, detected by C.T.Scan.
2. The patients should have no other neurological problems and should not be on any medications previously..

**EXCLUSION CRITERIA**

1. Patients who have neurological problems other than due to granulomatous lesions, of the brain.
2. More or equal to two lesions in C.T.Brain.
3. Patients who are less than 12 years of age and over 60 years of age
4. Pregnant women.

**CONSENT**

All participants gave written informed consent

## METHODOLOGY

A detailed history was obtained from the patients with relevant to brain granuloma .Past history of tuberculosis and history of contact with tuberculous patient were obtained. A thorough clinical examination was performed at the time of admission and relevant findings were recorded.

CT brain plain and contrast study were done in all patients in the study group. MRI brain was done when indicated .The solitary ring enhancing lesions were categorized as tuberculoma and neurocysticercosis according to the Rajasekar's criteria.Lumbar puncture and CSF analysis was done for TB-PCR and EIA(Enzyme ImmunoAssay) for cysticeral antigen in all patients in the study group. Earliest possible EEG was attempted and was performed using 32 channel digital EEG recorder.

In view of tuberculoma, Mantoux testing and Chest X ray were performed in all cases in the study group. Clinical data was collected from patients and witnesses in a systematic manner and added to a database, which included a checklist of the symptoms associated with brain granuloma.The results of the investigation and symptomatology were stastically analysed.

## STASTISCAL ANALYSIS

SPSS 12 and Excel were used for data analysis

## LIMITATIONS

Small number of study subjects. Lack of Brain biopsy of the granulomatous lesion.

**CONFLICT OF INTEREST :** Nil conflict of interest

# *Results*

# *and*

# *Observations*

## RESULTS AND OBSERVATIONS

### POPULATION CHARACTERISTICS

Among the 43 patients included in this study, 23 patients were men accounting for 54% of the total cases. The remaining 20 patients were women (46%).

**TABLE 1 : SEX DISTIBUTION OF THE STUDY**

| SEX | NO.OF PATIENTS | PERCENTAGE |
|---|---|---|
| MALE | 23 | 54% |
| FEMALE | 20 | 46% |

p>0.05

According to the age, patients' aged below 20 years were 12 in number (28%). Majority of the patients were in the age group between 21 and 30 years - 15 patients (35% of study population) were in this group. Only 9 patients (21%) were between the age of 31 and 40 years. And 7 patients (16%) were above the age of 40. Population characteristics are shown in table 2.

**TABLE 2 : POPULATION DISTRIBUTION**

| AGE GROUP (in years) | NO. OF PATIENTS | PERCENTAGE |
|---|---|---|
| <20 | 12 | 28% |

| | | |
|---|---|---|
| 21-30 | 15 | 35% |
| 31-40 | 9 | 21% |
| >40 | 7 | 16% |

p>0.05

In our study, the most common presentation is seizure. Fourty patients had seizures at the time of presentation, forming 93% of the total patients. Only 5% of patients had head ache as the initial complaint .And 1 % patient had focal deficit.

Nearly 53% of patients had generalize tonic clonic seizures as the initial complaint. Secondary generalized tonic clonic seizures were seen in 21% of the total patients. Complex partial seizures and simple partial seizures are seen in 7% and 12 % of the patients respectively.

**TABLE 3 : PRESENTATION IN OUR STUDY**

| PRESENTATION | NO.OF PATIENTS | PERCENTAGE |
|---|---|---|
| | | |

| | | |
|---|---|---|
| GENERALIZED SEIZURES | 23 | 53% |
| SECONDARY GENERALIZED SEIZURES | 9 | 21% |
| COMPLEX PARTIAL SEIZURES | 3 | 7% |
| SIMPLE PARTIAL SEIZURES | 5 | 12% |
| HEAD ACHE | 2 | 5% |
| FOCAL DEFICIT | 1 | 2% |

$p>0.05$

Base upon the criteria described by Rajasekar et al and other supportive evidences, the granulomas are differentiated into tuberculoma and neurocysticercosis. Thirty one patients(72%) are found to have neurocysticercosis and twelve patients (28%) had tuberculoma.

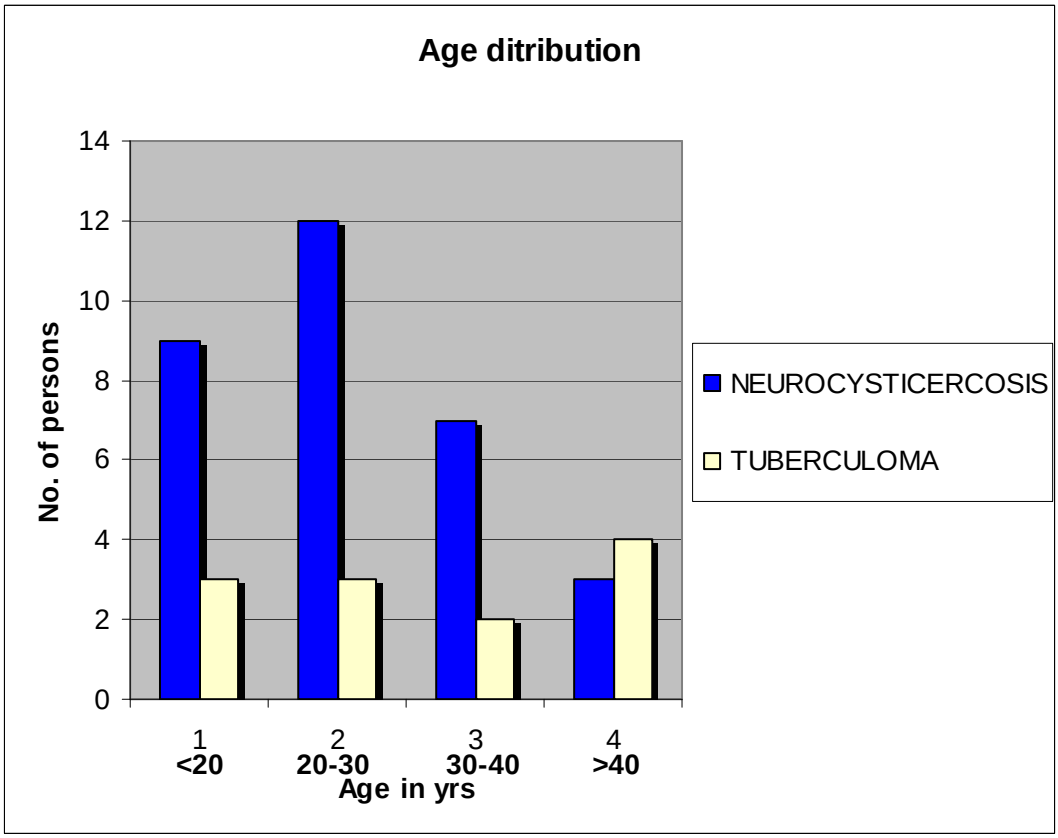
**TABLE 4 : TYPE OF BRAIN GRANULOMA**

| TYPE | NO. OF PATIENTS | PERCENTAGE |
|---|---|---|
| NEUROCYSTICERCOSIS | 31 | 72% |
| TUBERCULOMA | 12 | 28% |

$p>0.05$

Majority of Neurocysticercosis were found in third decade of life (39%).Age groups less than 20 years and 31-40 formed 29% and 27% respectively. Only 10% of patients with neurocysticercosis were above 40 years of age group.Most of Tubberculoma patients were above forty years (33%).Age group less than 20 years and 21 – 30 constituted 25 % of patients with Tuberculoma. Only 17% of patients with Tuberculoma were within 21 – 30 years age group.

**FIGURE 1: AGE DISTRIBUTION**




In this study , 61% of patients with Neurocysticercosis most often presented with generalized tonic clonic seizures. And 16% of patients presented with secondary generalized seizures .Only 3 % of patient with neurocysticercosis had head ache as the chief complaint. Simple partial seizures and Complex partial seizures accounts for 13% and 7 % of patient with neurocysticercosis.

Generalized tonic clonic seizures and secondary seizures are equally seen in patients with tuberculoma , about 4 patients each

(34%).Simple partial seizures , complex partial seizures ,focal deficit and head ache constituted 8 % of patient each with tuberculoma.

**TABLE 5 :CLINICAL PRESENTATION IN BRAIN GRANULOMA**

| PRESENTATION | NEUROCYSTICERCOSIS | TUBERCULOMA |
|---|---|---|
| GENERALIZED SEIZURES | 19(61%) | 4(34%) |
| SECONDARY GENERALIZED SEIZURES | 5(16%) | 4(34%) |
| COMPLEX PARTIAL SEIZURES | 2(7%) | 1(8%) |
| SIMPLE PARTIAL SEIZURES | 4(13%) | 1(8%) |
| HEAD ACHE | 1(3%) | 1(8%) |
| FOCAL DEFICIT | 0 | 1(8%) |

p>0.05

Most of the lesions were found in Parietal region (58%).About 14% patients had lesion in the Temporal region. Frontal lobe granuloma are seen in 16% of patients.Only 12 % of patients had brain granuloma in the Occipital region .

**FIGURE 2 : LOCALISTION OF BRAIN GRANULOMA**

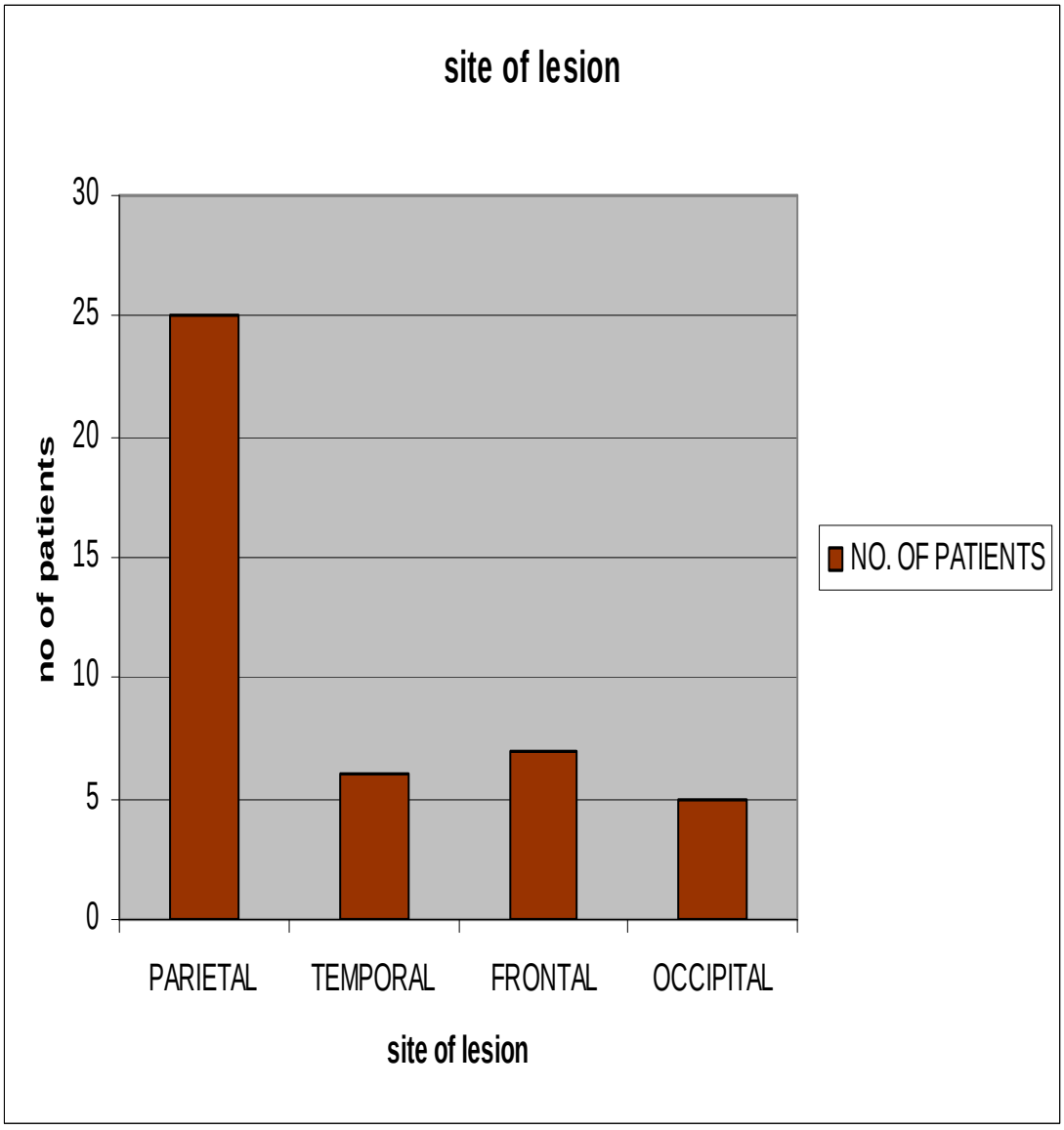


**TABLE 6 : SITE OF BRAIN GRANULOMA**

| SITE OF BRAIN GRANULOMA | NO. OF PATIENTS | PERCENTAGE |
|---|---|---|
| PARIETAL | 25 | 58% |
| TEMPORAL | 6 | 14% |
| FRONTAL | 7 | 16% |
| OCCIPITAL | 5 | 12% |

$p>0.05$

In our study ,most of the neurocysticercosis were found in Parietal lobe(55%).Temporal lobe , Frontal lobe and Occipital lobe accounted for 13% , 19% and 13% respectively.

Tuberculoma were mostly seen in the Parietal region(67%).Only 67% of patients had the lesion over the Temporal region. Tuberculoma were seen in frontal and occipital region in 8 % of patient .

**TABLE 7 : LOCALISATION OF BRAIN GRANULOMA**

| SITE OF BRAIN GRANULOMA | NEUROCYSTICERCOSIS | TUBERCULOMA |
|---|---|---|
| PARIETAL | 17 (55%) | 8(67%) |
| TEMPORAL | 4(13%) | 2(17%) |
| FRONTAL | 6(20%) | 1(8%) |
| OCCIPITAL | 4(13%) | 1(8%) |

p>0.05

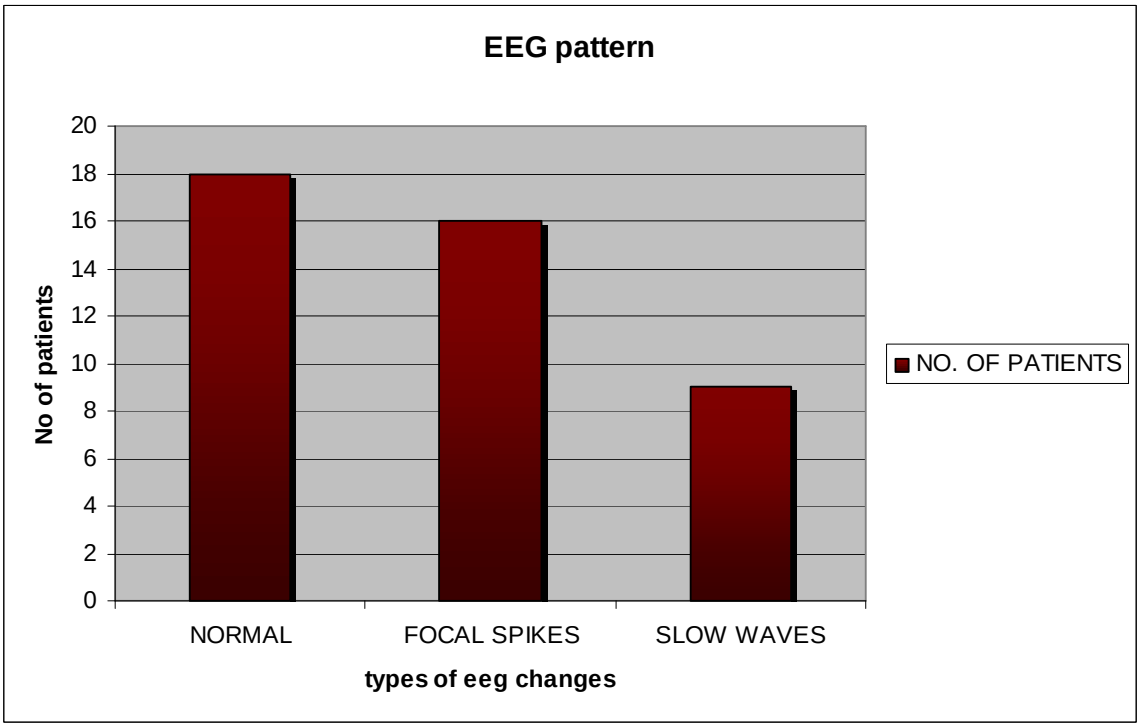
Electroencephalogram (EEG) was found to be normal in 18 patients(42%) in our study. Diffuse slowing was noted in 37% of patient. Focal spikes formed 21% of the patients.

**TABLE8 : EEG FINDINGS IN OUR STUDY**

| EEG PATTERN | NO. OF PATIENTS | PERCENTAGE |
|---|---|---|
| NORMAL | 18 | 42% |
| FOCAL SPIKES | 16 | 37% |
| SLOW WAVES | 9 | 21% |

p>0.05

**FIGURE 3 : EEG PATTERN IN BRAIN GRANULOMA**




EEG findings showed focal spikes in 42% and 25 % of patients with Neurocysticercosis and Tuberculoma respectively. About 58% of patients with tuberculoma had Normal EEG pattern. Diffuse Slow waves are seen in 23% and 17% of the patients with Neurocysticercosis and Tuberculoma.

**TABLE 9 : EEG PATTERN IN BRAIN GRANULOMA**

| TYPE OF BRAIN GRANULOMA | NORMAL | FOCAL SPIKES | SLOW WAVES |
|---|---|---|---|
| NEUROCYSTICERCOSIS | 11(36%) | 13(42%) | 7(23%) |
| TUBERCULOMA | 7(58%) | 3(25%) | 2(17%) |

p> 0.05

In this study,Enzyme ImmunoAssay (EIA) of cysticercal antigen was positive in 81% of patients with neurocysticercosis.

**TABLE 10: ENZYME IMMUNO ASSAY IN NEUROCYSTICERCOSIS**

| EIA | POSITIVE | NEGATIVE |
|---|---|---|
| NEUROCYSTICERCOSIS | 25(81%) | 6(19%) |

P<0.05

Tb- PCR showed 42% positivity in patients with Tuberculoma. Chest X Ray showed Upper Zone Infiltrates in 25% of cases with Tuberculoma . And Mantoux was positive in 25% of patients with Tuberculoma.

**TABLE 11: SUPPORTIVE INVESTIGATION IN TUBERCULOMA**

| INVESTIGATIONS | POSITIVE | NEGATIVE |
|---|---|---|
| CHEST X RAY | 3(25%) | 9(75%) |
| MANTOUX | 3(25%) | 9(75%) |
| TB-PCR | 5(42%) | 7(58%) |

P > 0.05

# *Discussion*

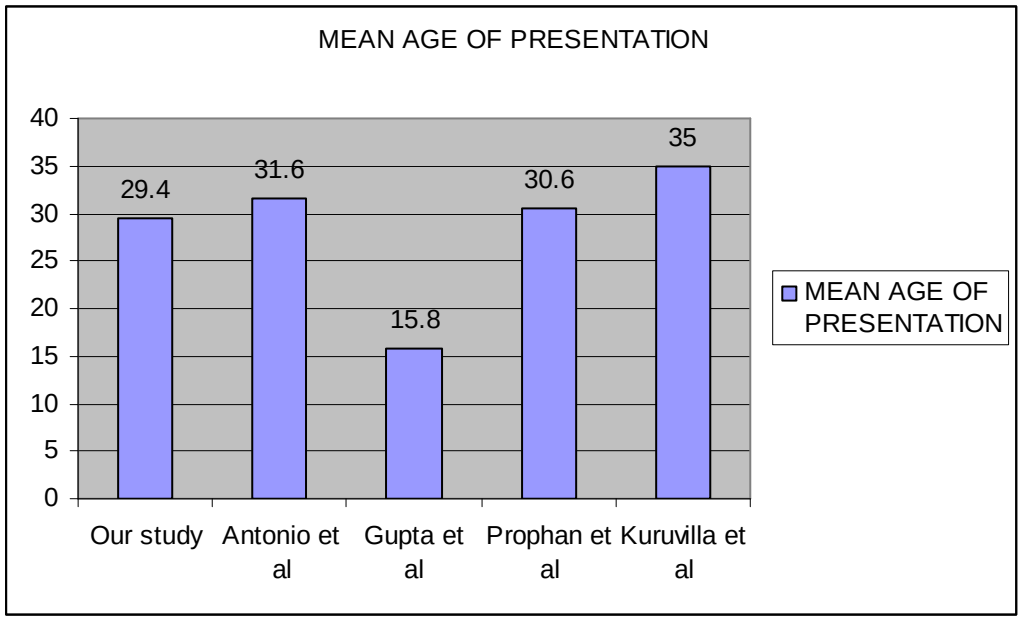
# DISCUSSION

Brain granuloma continues to be the most common cause of seizures in young people in the developing world. It continues to be a considerable cause of morbidity and mortality affecting both males and females . Despite its high frequency, the precise incidence and prevalence of NCC and Tuberculoma were difficult to obtain due to different factors, such as the high number of asymptomatic infections, the pleomorphism of clinical manifestations, the lack of a reliable test for serological screening, and the necessary use of expensive neuroimaging studies for diagnosis and therapeutic decisions.

In this study , male to female ratio is 1.2 : 1 which is similar to other studies of Antônio de Souza et al where 53% of patients were males and 47% of patients were female and M.Gupta et al, a study on solitary brain granuloma where the male to female ratio was 1.3 to 1.

Most of the patients with brain granuloma were from 20 to 30 years of age (35%). And 63% of the patients were less than 30 years of age group. The Mean Age of presentation was 29.4 years, again it proves that the disease primarily affects the working population .This is similar to other studies of Antonio et al, Praphan et al and Kuruvilla et al. Majority of Tuberculoma were seen in greater than 40 years of Age (33%) .But Neurocysticercosis were seen in commonly in lessthan 30 years of age (68%).

**FIGURE 4 :MEAN AGE OF PRESENTATION**

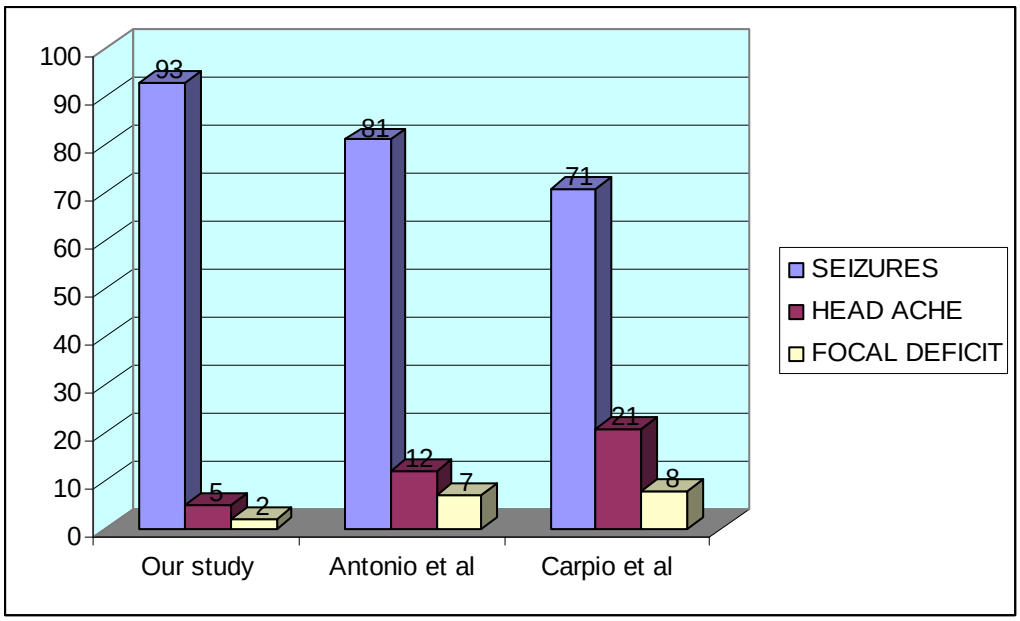


About 93% of the patients in the present study , came with seizures similar to most of the other studies. Most studies have describes seizures as the most common presentation.In this study , most common presentation was generalised tonic clonic seizures. But other studies have quoted partial seizures as a common presentation. This may be because the seizure typing in this study was entirely made on history. The grey area in relying on history in classification of seizures is in the fact that the focal onset of a seizure is often missed and witnesses' attention is often drawn to the person only after an event becomes generalized. Secondly, this study included lesser number of patients .

According to a study done in Brazil, the proportion of patients with seizures was less common compared to the present study. In Antonio de souza et al, around 81% had seizures ,12% of the patients had head ache and 7 % of them had focal deficit.

In another study by Carpio et al, about 71% of patients had seizures. About 21% and 7% of the patients had head ache and focal abnormalities respectively.

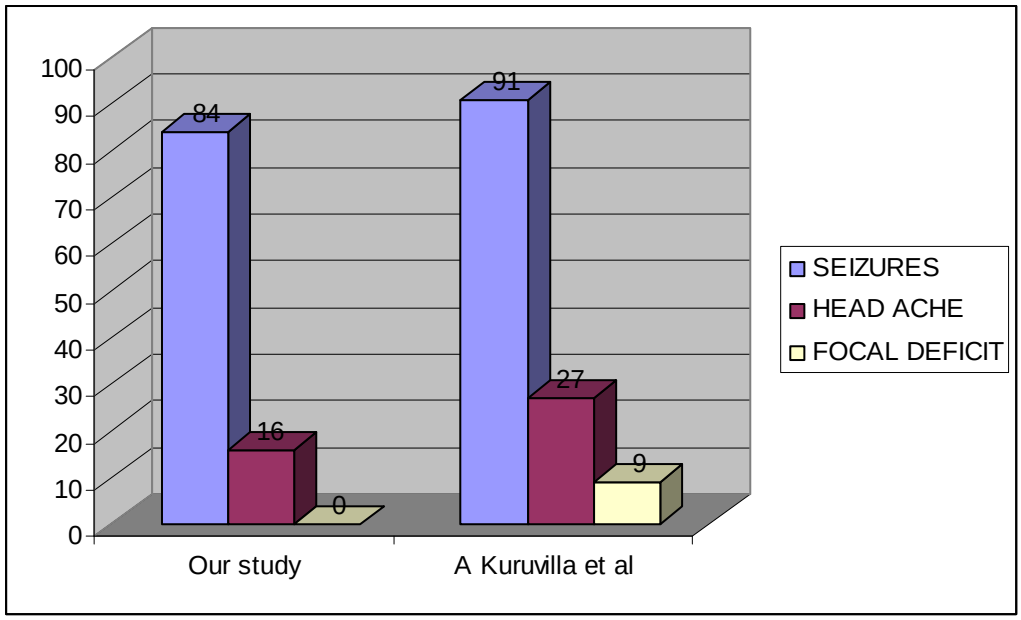
**FIGURE 5 :CLINICAL PRESENTATION IN VARIOUS STUDIES**




In this study ,about 84% of patients with neurocysticercosis presented with seizures similar to the study by A Kuruvilla et al showing that nearly 90% of patient had seizures. There was no patient with neurocysticercosis who had focal deficit in this study.On contrary , nine percent of patients

had focal deficit in Kuruvilla et al.The prevalence of head ache was comparable in both the studies.

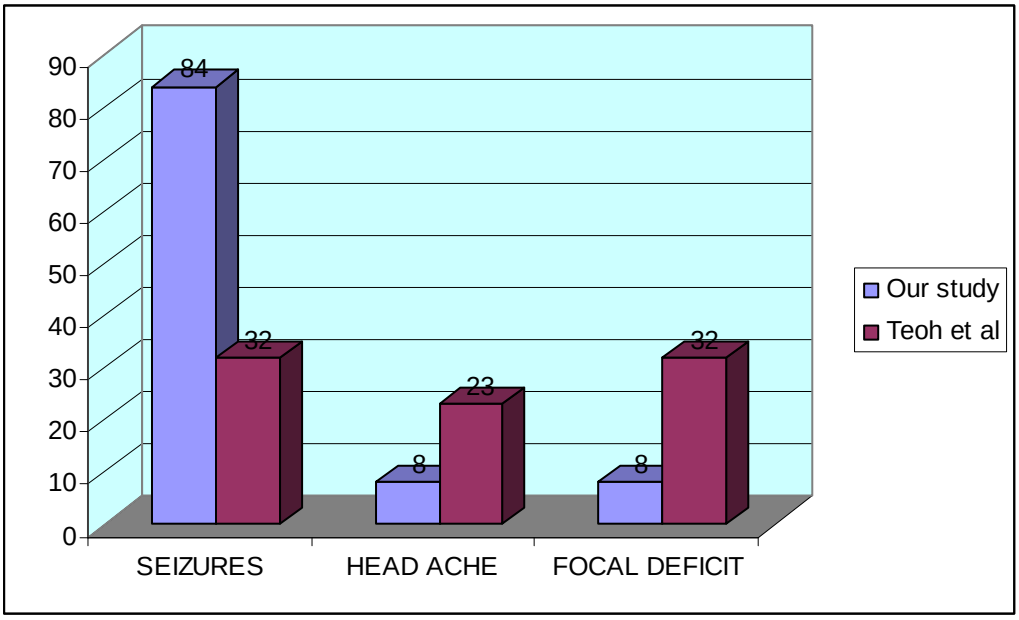
**FIGURE 6 :PRESENTATION IN NEUROCYSTICERCOSIS**




PRESENTATION IN TUBERCULOMA:

In a study done by Teoh et al the proportion of patients with focal deficit and head ache were more common compared to this study. Seizure was more common in the present study accounting for 84% of the patients.

**FIGURE 7 : PRESENTATION IN TUBERCULOMA**



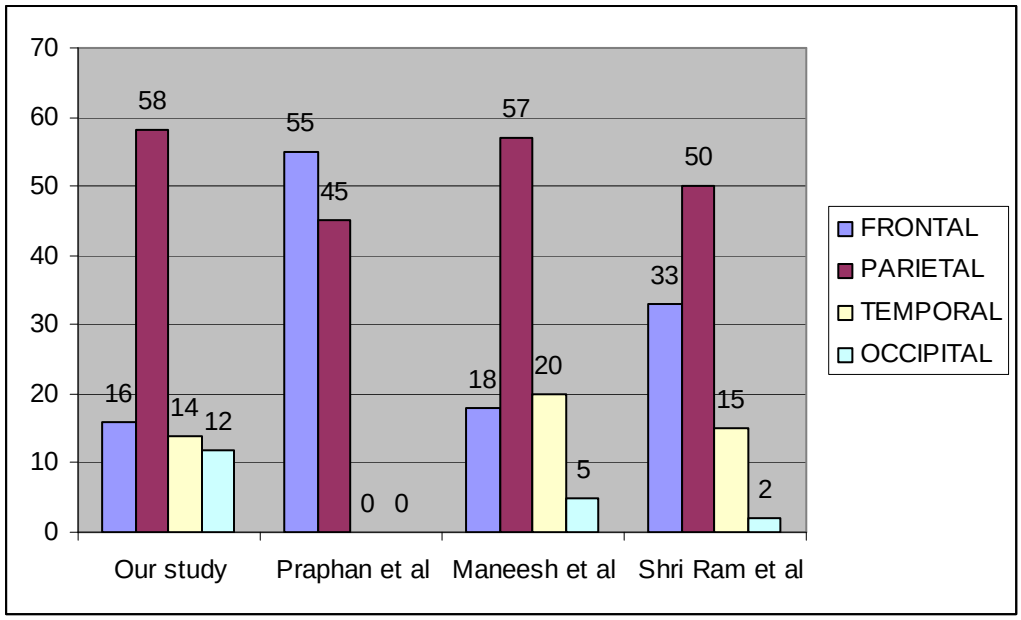

SITE OF BRAIN GRANULOMA IN VARIOUS STUDIES

This study showed that parietal region was the most common site of brain granuloma accounting for 58%.Temporal,Frontal and Occipital regions had 14%,16% and 12% of the brain granulomas.

This pattern of distribution of brain granuloma is similar to other studies (Maneesh et al and Shri ram et al).But a study by

Prophan et al showed Frontal lobe granuloma to be more common than Parietal lobe granuloma.

**FIGURE 9 : LOCALISATION OF BRAIN GRANULOMA**

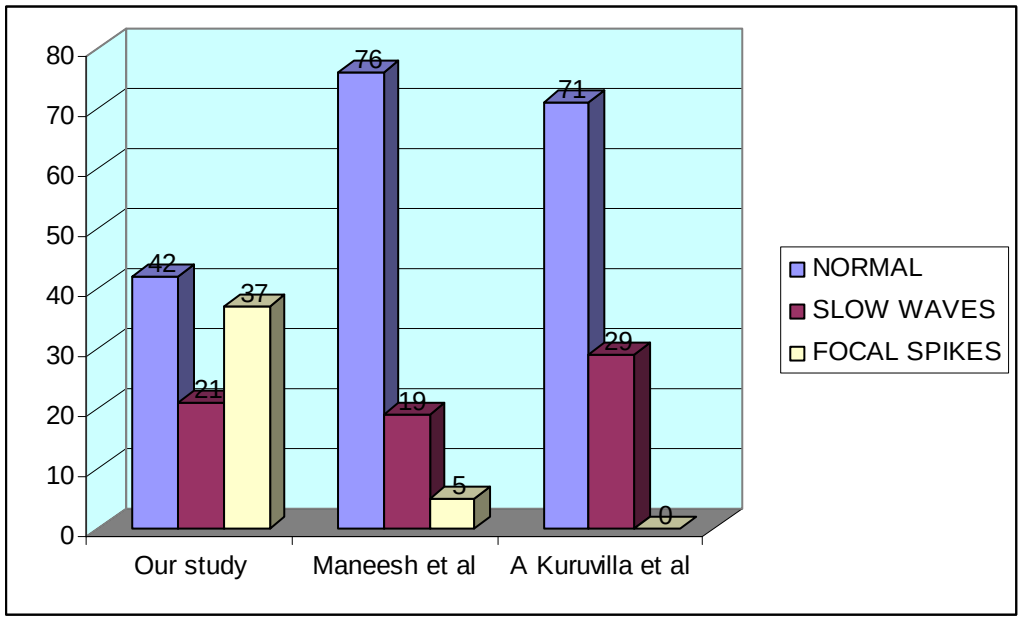



There was no correlation between EEG findings and the type of brain granuloma . Present study also showed that there was no correlation between the site of granuloma and the type of seizures. Majority of the patients had normal findings in EEG comparable to other studies.

In a study by Maneesh et al nearly 76% of patients had normal EEG findings .Nineteen percent of individuals had slow waves in EEG .Only 5% of patients had focal Spikes.

In a study by Kuruvilla et al, 71% had normal EEG findings and 29% of them had a slow wave pattern.

**FIGURE 8 : EEG PATTERN IN VARIOUS STUDIES**




TB-PCR was sensitive in 42% of patients with tuberculoma in our study. According to Muralidhar K. Katti et al the sensitivity for TB-PCR was 48% in patients with Tuberculoma.

In this study, the chest X ray and Mantoux was positive in 25% of patients with Tuberculoma. Christian Pagnoux et al the chest x ray was positive in 25 to 83% of patients with Tuberculoma. He reported the positive Mantoux was seen in 25 to 75% of patients with Tuberculoma

The Enzyme Immunoassay(EIA) for cysticercal antigen was positive in 81% of patients with Neurocysticercosis in our study. Alessandra Xavier Pardini et al showed that EIA for cysticeral antigen was positive in 82 to 96% of individuals with Neurocysticercosis.

# *Conclusions*

# CONCLUSIONS

1. There was No sex Predilection seen in patients with Brain Granuloma.

2. In this study population, Neurocysticercosis formed the Most common cause of Brain Granuloma .

3. The Mean Age of presentation of Brain Granuloma was 29.4 years

4. Most patients with Neurocysticercosis were in the Third decade of life

5. Most patients with Tuberculoma were Above Forty years of age.

6. In this study , Most Common Presentation was Generalized Tonic Clonic Seizures.

7. In this study , about 97% of patients with Neurocysticercosis presented with seizures.

8. Seizure was seen in 84% of the patients with Tuberculoma.

9. This study showed that Parietal region was the Most Common Site of brain granuloma accounting for 58%.

10.There was No correlation between EEG findings and the Type Of Brain Granuloma.

11.TB-PCR was sensitive in 42% of patients with tuberculoma in our study.

12.In this study, the chest X ray was positive in 25% of patients with Tuberculoma.

13. Mantoux was positive in 25% of patients with Tuberculoma.

14.The Enzyme Immunoassay(EIA) for cysticercal antigen was positive in 81% of patients with Neurocysticercosis .

# *Summary*

## SUMMARY


- **Brain Granuloma** Must be ruled out in all cases presenting **with new onset seizures among young individuals**.

- **Neurocysticercosis** was the **most common cause** of brain granuloma.

- **Tuberculoma** was prevalent among **Older** people whereas **Neurocysticerrcosis** was prevalent among **Young** individuals.

- **Most common presentation** among Brain granuloma patients was **Generalized tonic clonic seizures**.

- Electroencephalogram had **No correlation** with the Type of Brain Granuloma.

# LIST OF TABLES

# LIST OF FIGURES

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# *Institute Ethical Committee Approval*

**INSTITUTIONAL ETHICAL COMMITTEE**
**Government General Hospital & Madras Medical College,**
**Chennai – 600 003, India.**
**Off. Ph. No. 044-25305000**
**Fax: 044-25305115**

Ref. No.: 12299 / P&D / Ethics / Dean / GGH / Chennai, dated July 19th, 2007

**Title of the Work:** Clinical and radiological profile of patients with brain granuloma

**Principal Investigator:** B. Gokulakrishnan

**Department:** Institute of Internal Medicine, MMC, Chennai

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on **July 19th 2007**, at the conference hall of the Dean, Tower Block I, GGH, Chennai.

The members of the committee, the secretary, and the chairman are pleased to
- approve the proposed work mentioned above, submitted by the principal investigator /
- ~~consider the proposed work but advised for revision and resubmission.~~

The principal investigator and their team are directed to adhere the guidelines given below:

01. You should get detailed informed consent from the patients / participants and maintain confidentiality.
02. You should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.
03. You should inform the IEC in case of any change of study procedure, site and investigation or guide.
04. You should not deviate form the area of the work for which I applied for ethical clearance.
05. You should inform the IEC immediately, in case of any adverse events or serious adverse reactions.
06. You should abide to the rules and regulations of the institutions(s).
07. You should complete the work within the specific period, and if any extension of time is required, you should apply for permission again and do the work.
08. You should submit the summary of the work to the ethical committee on completion of the work.
09. You should not claim funds from the Institution while doing the work or on completion.
10. You should understand that the members of IEC have the right to monitor the work with prior intimation.

19/7/07

Secretary,
IEC, GGH, Chennai.

Chairman,
IEC, GGH, Chennai.

Dean,
GGH & MMC, Chennai.

*Proforma*

MADRAS INSTITUTE OF NEUROLOGY AND MEDICINE
PATIENT PROFORMA
FOR GRANULOMATOUS LESIONS OF THE BRAIN,
CLINICAL AND RADIOLOGICAL OUTCOME

NAME AGE SEX IP.,NO.,
MIN.,NO.,

ADDRESS

CLINICAL HISTORY

SYMPTOMS.

HEADACHE

SEIZURES

NEUROLOGICAL DEFICITS

SIGNS OF INTRACRANIAL HYPERTENSION

DEMENTIA

AGGRESSIVENESS,MANIC EPISODES

SPINAL CORD SYMPTOMS

PAST AND PERSONAL HISTORY

FAMILY HISTORY

ANY OTHER DETAILS

CLINICAL FINDINGS

PROBABLE DIAGNOSIS

INVESTIGATIONS

HAEMOGRAM, URINE STOOL.

MANTOUX, SPUTUM FOR AFB

CHEST XRAY.

CT SCAN PLAIN MRI

CONTRAST

URINE FOR CYSTICERCAL ANTIGEN

CEREBROSPINAL FLUID FOR CYSTICERCAL ANTIGEN AND PCR FOR TUBERCLE BACILI

CEREBROSPINAL FLUID FOR TOTAL COUNT AND DC AND BIOCHEMISTRY

SERUM FOR CYSTICERCAL ANTIBODIES

EEG

OTHER INVESTIGATIONS

FOLLOW UP

SYMPTOMS.

HEADACHE

SEIZURES

NEUROLOGICAL DEFICITS

SIGNS OF INTRACRANIAL HYPERTENSION

DEMENTIA

AGGRESSIVENESS,MANIC EPISODES

SPINAL CORD SYMPTOMS

SYMPTOM ANALYSIS

REPEAT CT SCANS AT 2 MONTHS AND 6 MONTHS

OTHER INVESTIGATIONS

# *Master Chart*

| S.No | Name | Age | Sex | Presenting Complaint | CT/MRI | Type of Lesion | EEG | EIA | TBPCR | Chest X-Ray | Man Toux |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Divyalakshmi | 19 | F | Generalised tonic clonic seizures | Left Parietal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Negative | Normal | Negative |
| 2 | Subburaj | 38 | M | Generalised tonic clonic seizures | Left Frontal Ring Enhancing Lesion | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 3 | Vasantha | 25 | F | Simple partial seizures | Right Fronto Parietal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 4 | Dhanalakshmi | 13 | F | Secondary GTCS | Right Dorsolateral Frontal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Positive | Upper Zone Infiltrates + | Positive |
| 5 | Venkatesh | 37 | M | Headache | Left Parietal Calcification | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 6 | Pradeep | 20 | M | Generalised tonic clonic seizures | Left Posterior Parietal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 7 | Kalaivanan | 17 | M | Generalised tonic clonic seizures | Right Tempero Parietal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Negative | Normal | Negative |
| 8 | Durai Kannu | 28 | M | Simple partial seizures | Left Fronto Parietal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 9 | Ramya | 26 | F | Generalised tonic clonic seizures | Right Occipital Ring Enhancing Lesion | Neurocysticercosis | Normal | Positive | Negative | Normal | Negative |
| 10 | Muthu | 29 | M | Secondary GTCS | Right High Parietal Ring Enhancing Lesion | Neurocysticercosis | Normal | Positive | Negative | Normal | Negative |
| 11 | Shivamani | 42 | F | Complex partial seizures | Left Temporal Calcification | Neurocysticercosis | Slow Delta Waves | Negative | Negative | Normal | Negative |
| 12 | Rani | 37 | F | Left side hemiparesis | Right Tempero Parietal Ring Enhancing Lesion | Tuberculoma | Focal Spikes | Negative | Negative | Upper Zone Infiltrates + | Positive |
| 13 | Durga | 18 | F | Generalised tonic clonic seizures | Right Parietal Calcification | Neurocysticercosis | Normal | Positive | Negative | Normal | Negative |
| 14 | Mari | 44 | M | Secondary GTCS | Right Temporal Ring Enhancing Lesion | Tuberculoma | Slow Delta Waves | Negative | Negative | Normal | Negative |
| 15 | Kannan | 36 | M | Generalised tonic clonic seizures | Multiple Ring Enhancing Lesion | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |

| S.No | Name | Age | Sex | Presenting Complaint | CT/MRI | Type of Lesion | EEG | EIA | TBPCR | Chest X-Ray | Man Toux |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | Mohammed Fakrudin | 38 | M | Generalised tonic clonic seizures | Left Frontal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 17 | Suresh | 28 | M | Simple partial seizures | Left Parietal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Negative | Normal | Negative |
| 18 | Krishnasami | 29 | M | Generalised tonic clonic seizures | Right Tempero Parietal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 19 | Stella | 24 | F | Generalised tonic clonic seizures | Left Parietal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 20 | Manickam | 42 | M | Secondary GTCS | Left Occipital Ring Enhancing Lesion | Tuberculoma | Focal Spikes | Negative | Negative | Normal | Negative |
| 21 | Karthik | 22 | M | Generalised tonic clonic seizures | Right Frontal Ring Enhancing Lesion | Neurocysticercosis | Normal | Negative | Negative | Normal | Negative |
| 22 | Muthu | 19 | M | Generalised tonic clonic seizures | Right Parietal Calcification | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 23 | Lakshmi | 36 | F | Complex partial seizures | Left Parietal Ring Enhancing Lesion | Tuberculoma | Focal Spikes | Negative | Positive | Normal | Negative |
| 24 | Gomathi | 16 | F | Secondary GTCS | Left Parietal Ring Enhancing Lesion | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 25 | Shankar | 35 | M | Generalised tonic clonic seizures | Right Frontal Calcification | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 26 | Maragatham | 24 | F | Generalised tonic clonic seizures | Left Tempero Parietal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Negative | Normal | Positive |
| 27 | Sushila | 21 | F | Generalised tonic clonic seizures | Right Frontal Ring Enhancing Lesion | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 28 | Kanniammal | 51 | F | Headache | Left Parietal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Positive | Upper Zone Infiltrates + | Negative |
| 29 | Anandan | 22 | M | Secondary GTCS | Left Temporal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 30 | Nithya | 27 | F | Generalised tonic clonic seizures | Right Parietal Calcification | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |

| S.No | Name | Age | Sex | Presenting Complaint | CT/MRI | Type of Lesion | EEG | EIA | TBPCR | Chest X-Ray | Man Toux |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | Murugan | 19 | M | Generalised tonic clonic seizures | Multiple Ring Enhancing Lesion | Neurocysticercosis | Slow Delta Waves | Negative | Negative | Normal | Negative |
| 32 | Shanthi | 44 | F | Complex partial seizures | Left Parietal Ring Enhancing Lesion | Neurocysticercosis | Normal | Negative | Negative | Normal | Negative |
| 33 | Mala | 20 | F | Generalised tonic clonic seizures | Left Frontal Ring Enhancing Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 34 | Rizwan | 32 | M | Secondary GTCS | Right Occipital Ring Enhancing Lesion | Neurocysticercosis | Slow Delta Waves | Negative | Negative | Normal | Negative |
| 35 | Chelladurai | 29 | M | Generalised tonic clonic seizures | Right Temporal Ring Enhancing Lesion | Neurocysticercosis | Normal | Positive | Negative | Normal | Negative |
| 36 | Deepa | 13 | F | Simple partial seizures | Left Parietal Calcification | Neurocysticercosis | Normal | Positive | Negative | Normal | Negative |
| 37 | Kandasami | 37 | M | Simple partial seizures | Left Temporal Ring Enhancing Lesion | Neurocysticercosis | Normal | Negative | Negative | Normal | Negative |
| 38 | Ravi | 16 | M | Generalised tonic clonic seizures | Right Tempero Parietal Calcification | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 39 | Swarnam | 20 | F | Generalised tonic clonic seizures | Right Parietal Ring Enhanching Lesion | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 40 | Maheshwari | 24 | F | Secondary GTCS | Left Parietal Ring Enhancing Lesion | Tuberculoma | Slow Delta Waves | Negative | Positive | Normal | Negative |
| 41 | Kamakshi | 53 | F | Generalised tonic clonic seizures | Right Parietal Calcification | Neurocysticercosis | Focal Spikes | Positive | Negative | Normal | Negative |
| 42 | Ponnusamy | 28 | M | Secondary GTCS | Right Parietal Ring Enhanching Lesion | Neurocysticercosis | Slow Delta Waves | Positive | Negative | Normal | Negative |
| 43 | Govindraj | 65 | M | Generalised tonic clonic seizures | Left Temporal Ring Enhancing Lesion | Tuberculoma | Normal | Negative | Positive | Normal | Negative |