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Computed Tomographic Diagnosis of Intracranial Granulomatous Lesions and Clinical Correlation

Shakilur Rahman[1], S P Mathur[1]

[1] Department of Radiodiagnosis, GSVM Medical College, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh-208026, India

Abstract

Background: The evaluation of intracranial granulomatous lesions with emphasis particularly on tuberculoma and neurocysticercosis. Intracranial granulomatous lesions especially tuberculosis and neurocysticercosis are potentially lethal diseases and therefore prompt diagnosis and treatment are imperative. Cysticercosis of the brain is a disease entity that is a easily demonstrable by CT and is confined to the endemic areas in majority of cases. **Aim:** To identify and the role of computed tomography (CT) in diagnosing intracranial granulomatous lesions and to correlate the findings with clinical health care. **Materials and Methods:** This study was done at Ganesh Shankar Vidyarthi Medical (GSVM) College, Kanpur, Uttar Pradesh, India during the period 2002 to 2003. The patients admitted with seizures were included after considering the exclusion of metabolic causes and infective causes. 50 cases of documented antecedent history suggestive of raised intracranial tension and seizure (focal or generalized) were evaluated and referred for CT scanning from out patients department and in patients department in Lala Lajpat Rai (LLR) and associated hospitals and GSVM College, Kanpur, India. **Results:** We prospectively noted in our study that more than half of the patients with chronic granulomatous lesions presented with raised intracranial tensions. Seizure was one of the most commonest presenting complaint in patients with neurocysticercosis diagnosis. Presumptive diagnosis of tuberculoma and neurocysticercosisis was based on clinical and other ancillary criteria. Associated family history and extracerebral tuberculosis are the important criteria for presumptive diagnosis of tuberculoma. Solitary lesions were more frequent CT finding in both tuberculoma and neurocysticercosis. Majority of tuberculomas and neurocysticercosis observed were supratentorial in location, regardless of their clinical presentation. Lesions were isodense or hyperdense on plain CT scan and showed peripheral enhancement with intravenous contrast injection. The lobulated masses represent coalesced small disc and rings forming a large tuberculoma. **Conclusion:** In our study we have tried to evaluate intracranial granulomatous lesions with emphasis particularly on tuberculoma and neurocysticercosis.

Keywords: Computed tomography, diagnosis, intracranial granulomatous lesions, clinical correlation, neurocysticercosis.

INTRODUCTION

Computed Tomography (CT) has been one of the most spectacular advances in medicine during recent years. This technique was invented by Sir Godfrey Hounsfield for which he was rewarded Nobel prize in 1979. Since its introduction, computed tomography (CT) has been shown to have wide application within all the radiological subspecialities. Indeed so successful has CT become that if has effectively replaced what used to be regarded as conventional "tomography" and many other radiological procedure (e.g.lymphangiography). New applications and clinical role for CT have emerged in the last few years including CT angiography, pulmonary embolism detection, the diagnosis of abdominal pain and appendicitis. Clinical studies indicated that computed tomography is likely to make an important contribution to the diagnosis and managemant of intracranial lesions [1].

Amongst the uses of CT described, one of the most important is the investigation of intracranial diseases. CT is an important technique for the evaluation of inflammatory conditions and for the detection of abscesses [2]. Intracranial granulomatous lesions especially tuberculosis and neurocysticercosis are potentially lethal diseases and therefore prompt diagnosis and treatment are imperative. Cysticercosis of the brain is a disease entity that is a easily demonstrable by CT and is confined to the endemic areas in majority of cases as reported by [3]. It is a parasitic disease which results when man serves as the intermediate host of Taenia solium (the pork tape worm). Cycticercus Cellulosae develop in various body tissues. Man may ingest the eggs in contaminated food or via self contamination by faeco-oral route. Intracranial compartment is involved in 60-90% of patients with cycticercosis [4]. The location of involvement can be meningobasal, parenchymal or combination of these sites (5) and more recently computed tomography features have been documented [6]. Cysticercosis like other parasitic disease is still endemic in many parts of world [7]. has reported an incidence of 3-6% in general autopsies in Mexico. Although it is rare in the United States, it occurs occassionally in immigrants and travellers from endemic areas. Larvae of T. solium develop in all parts of CNS and produces symptoms indistinguishable from many

***Corresponding author:**
Shakilur Rahman
Department of Radiodiagnosis, GSVM Medical College, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Predesh-208026, India
Email: docsr01@yahoo.com

other diseases including neoplastic processes and intracranial occclusive vascular diseases [8]. described the radiological criteria for a preoperative diagnosis of intracranial cysticercosis on the basis of pneumoventriculography and direct visualization of parasite by recognition of calcification of the shape and size of dead larvae and evidence of soft tissue masses like vesicle of cysticercosis usually inside the ventricle or cistern [9]. stated that the CNS lesions of cysticercosis may occur anywhere and can be single or multiple and clinical symptoms and sign may be widespread. Most common symptoms were seizure, increased intracranial pressure, meningitis and stroke. Small intracranial calcification and circular cystic lesion were commonly seen at computed tomography [10]. observed that cerebral manifestation of cysticercosis are diverse, related to the encystment and subsequent calcification of the larvae in the cerebral parenchyma subarachnoid spaces and ventricles. The cyst degenerates and eventually calcifies, CT scanning may actually visualise the scolex. Most of the neurological disease presents with siezures, although many patients are entirely asymptomatic, the cyst being discovered radiologically [11]. observed that cysticercosis is the most common parasitic infection of the human CNS worldwide. There are four types of neurocysticercosis, parenchymal, subarachnoid, intraventricular and mixed. Following initial infection cysticercus into a cyst within which is the commonest presentation (57%), raised intracranial tension(19%), meningoencephalitis (9%), stroke like onset (4%), progressive dementia (6%).

Intracranial tuberculosis is the result of haematogenous spread from primary focus which is characteristically from the lung. The lesions are usually hypodense or isodense with brain on unenhanced scans. Since tuberculoma is a specific form of granulomatous lesion on would expect its compound tomography appearance to be indistinguishable from sarcoidosis, fungal abscess, pyogenic abscess etc. Pyogenic brain abscess typically shows ring enhancement around a lucent center, however the lesions are usually larger than those seen in tuberculoma and do not show microring appearance. The capsule of tuberculous granuloma is often thicker than that of the pyogenic abscess. In general there is less edema in the brain surrounding a tuberculoma than that surrounding a pyogenic abscess [11].

In the early stages, CT shows an area of poorly circumscribed, low density suggestive of vasogenic oedema in which ring enhancement appears after intravenous contrast injestion**.** Later the tuberculoma becomes visible as an isodense or hyperdense disc or ring which also enhances though rarely becomes as dense as calcium. The rings may be small with thick wall and only images of good quality may reveal the central rather punctuate hypodensity. Less common forms include larger rings enclosing central material of higher attenuation and large lobulated solid or non homogenous masses resembling neoplasm. Such masses when located on brain surface can resemble a moningiomass [12]. On computed tomography large ring lesions, thick walled irregular lobulated ring or near solid masses may occurs and the usual diagnosis is of a malignant neoplasm [13]. Angiography often shows vasculities with major vessels occlusion and mycotic aneurysm as well as masses.

In the present study, patients with documented antecedent history suggestive of raised intracranial tension and seizure (focal or generalized) were evaluated. CT scan was closely observed to evaluate intracranial granulomatous lesions with emphasis particularly on tuberculoma and neurocysticercosis.

MATERIALS AND METHODS

This study was done at Ganesh Shankar Vidyarthi Medical (GSVM) College and associated hospitals, Kanpur, Uttar Pradesh, India during the period 2002 to 2003. The patients admitted with seizures were included after considering the exclusion of metabolic causes and infective causes. 50 cases of documented antecedent history suggestive of raised intracranial tension and seizure (focal or generalized) were evaluated and referred for CT scanning from out patients department and in patients department in Lala Lajpat Rai (LLR) and associated hospitals and GSVM College, Kanpur, India.These patients had undergone CT scan, NCCT followed by CECT scan.The machine used was CT/e spiral manufactured by GE.

RESULTS

Figure 1 shows the classsification of the clinical features of 50 selected cases of the intracranial granulomatous lesion. In spite of the varied clinical spectrum because of the location of the lesion, essentially these patients fall into two groups, i.e. those presenting as space occupying lesions (headace and vomiting etc) (64%) and those presenting with seizure (focal or genealized) (38%), with or without raised intracranial tension. Focal neurological deficit such as hemiparesis, gait disturbance and speech disturbances is observed in12%, 2% and 4% cases respectively. Altered sensorium was present in 6% cases whereas 8% cases presented with abnormal behaviour.

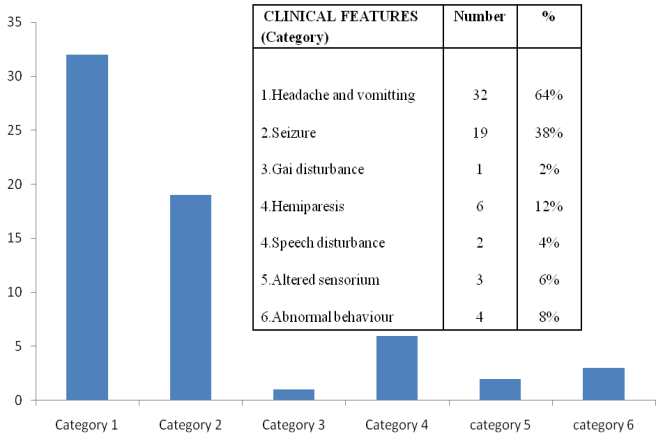

Figure 1: Clinical features of selected cases of intracranial granulomatous lesion

Table 1 shows criteria for making presumptive diagnosis of tuberculoma. Personal and family hisotry of tuberculosis is far from variable. Apart from personal history, 44% cases had history of tuberculosis in their family or close associates. Concomitant tuberculosis elsewhere in the body was found in 30% cases, who had radiological abnormalities suggestive of pulmonary tuberculosis. Parenchymal lesion was present in 12 patients and hilar lymphadenopathy was seen in 9 cases. One patient had associated plueral effusion. A hypochromic anaemia and relative lymphocytosis were seen in 12% cases. The ESR was raised in 40% of cases. The montoux test is not necessarily positive and indeed in patients of our series is positive in only 24%case. CSF analysis was suggestive in only 8% cases.

Table 1: Criteria for diagnosis of tuberculoma other than CT

CRITERIA	N	%
1. Headache and vomitting	22	44%
2. X-rays chest	15	30%
3. Laboratory test		
(a) Blood count	6	12%
(b) ESR	20	40%
(C) CSF analysis	4	8%
4. Montoux test	12	24%

The study of distribution of 50 selected cases of intracranial granulomatous lesions was done. These patients after complete workup for intracranial tuberculoma and neurocycticercosis had undergone CT examination. Though improved standard of living, anti-tuberculous immunization and modern chemotherapy have all

contributed to the improvement. In our study, the presumptive diagnosis of tuberculoma was made in 56% cases. In 26% cases presumptive diagnosis of neurocysticercosis was made. Of remaining 16% cases, 10% did not show any lesion whereas 6% cases had lesions other than tuberculoma and neurocysticercosis. In case of tuberculoma, single lesions was found in 71% cases whereas multiple irregular coalescing lesions with perilesional oedema was observed in 28% cases. Majority of the lesions were located supratentorially. While in case of neurocysticercosis, single lesion were slightly more common (51%) than multiple lesion (48% cases) (Figure 2). Majority of the lesion were supratentorially located. The location, multiplicity and calcification does not depend upon the duration of illness.

The distribution of intracranial tuberculoma and intracranial neurocysticercosis is as follows. No part of the brain is spared. Majority of the lesions were located supratentorially (96%) whereas infratentorial location of the lesion is seen in 10% cases. There was s significant relationship between the clinical the clinical feature and site of lesion in patients with tuberculoma. Among supratentorial lesions, parietal lobe is commonest site of involvement (46%). Majority of the patients with parietal lesions had contralateral siezure or contralateral hemiparesis. Correlation was difficult in patients having multiple lesions, frontal, temporal and occipital lesions. Frontal lobe location is seen in 25% cases. Occipital lobe is affected in 10% and temporal lobe in 11% cases. Basal ganglion and brainstem are atypical sites for tuberculoma and basal ganglion and are affected in 3% and no cases were reported in brainstem in this study. In infratentorial compartment all the lesions were confined to cerebellar hemispheres. None of the patients of our series showed lesion in vermis. In case of neurocysticercosis, supratentorial location of lesion is seen in 93% cases, parietal lobe was affected in 57% cases whereas 36% cases have lesion in frontal lobe, occipital 21% and temporal lobe contributed 14% basal ganglion and thalamus had lesion in only 7% cases while brain stem showed lesion in 14% cases. In infratentorial compartment, cerebellar hemispheres were involved in 21 % cases where as lesions in the vermis accounted for only 7% cases.

CT morphology of intracranial tuberculoma and neurocysticercosis. On non enhanced CT majority of the lesions are isodense (68%). Hyperdense lesions are seen in 39% cases. These hyperdense and isodense lesions enhances after administration of contrast material frequently in a ring like manner, although there may be homogenous enhancement of small lesions. In our series ring enhancing lesions are seen in 57% cases where as disc lesions seen in 39% cases. Non-enhancing hypodense lesion seen in 45 cases. coalescence of lesion is not an infrequent finding and is observed in 25% cases. Irregular contour was seen in 82% cases and regular contour in 18% cases. Calcification was observed in 7% cases. While basal exudates suggestive of associated meningitis was seen in 10% cases. Basal exudates were seen at suprasellar cistern; along the vessels, sylvian fissure and cortical sulci, which showed enhancement with the contrast administration. CT had allowed the detection of the parenchymal cysticercosis which in our experience constitutes the major portion of the disease. CT with infusion iodinated contrast medium demonstrated enhancement of the lesions in 100% of the cases(except the calcifies lesion). They were manifested by dense nodular (14%) cases and annular images (3%) cases. The abnormal enhancement persisted throughout the acute stage and it varied in intensity and duration with each individual. None of the patients of our series showed diffuse homogenous enhancing lesions. Mixed lesion was seen in 21% cases. Ventricular lesion is observed in 7% cases. Meningial or ependymal lesion are not seen in our series.

Further, the study on distribution of tuberculoma according to age and sex was carried out. It may occur at any stage of life, from infancy to old age. Majority of the patients were in first to third decade. Age range of patients was (6-40 yrs). No preponderance for either sex seen. However, age group (1-10) constituts 32% cases whereas age group (11-20) have 28% cases.in younger age group lesions are more common in females whereas in older age group lesions were more common in males. The distribution of neurocysticercosis according to age and sex shows that the age range of the patients was 5-58 years with predominance in the first and second decade 77%. No characteristic sex preponderance is seen. However in first to third decade of life females are dominant whereas in age group more than 30 males were dominant.

DISCUSSION

The clinical feature of the patients under study shows 64% of cases with headache and vomiting while 39% of cases presented seizures (either focal or generalized). Patients in which presumptive diagnosis of tuberculoma was made, showed commonest presentation as space occupying lesion. They reported symptoms of intracranial hypertension in 72 %. Headache occur in 60-75% of cases. Hemiparesis is seen in fewer patients. Our study was in accordance with the observation made by [14]. However these observations are not in conformity with the result of [15, 12], in which seizure was the mode of presentation. In patients of neurocysticercosis convulsion was the commonest presentation, which is similar to the study conducted by [16, 17]. However it differs from the study conducted by [18], in which the principal symptoms and sign were of raised intracranial tension.

In our series of data, 44% cases reported with history of tuberculosis in their family or close associates. While 30% cases are radiologically positive for tuberculosis, either in the form of parenchymal lesion, lymphadenopathy or plueral effusion [19]. reported a past history of pulmonary tuberculosis in 43% of his series of 201 cases and a history of tuberculosis in the patients family or close associates in 29%. Hypochromic anaemia and relative lymphocytosis was observed in 12% cases. ESR was raised in 40% cases. Montoux test is not necessarily positive and indeed is positive in only 24% cases. The radiological findings of our series correlates well with the observation made by [20] who found radiological abnormalities suggestive of tuberculosis in 38% cases. This could be because of high prevalence of tuberculosis in India, due to low socio-economic conditions. These variable results with the Montoux test could be due to various factors affecting the reactivity of tuberculin test e.g. inactive tuberculin, wrong technique, severe malnutrition, overwhelming infection wiyth tuberculosis, corticosteroid therapy, vaccination during incubation period or tuberculosis, before the hypersensitivity had developed. ESR is elevated during the active phase of the disease. The sedimantation rate is normal during quiescent phase of tuberculosis. The test is not specific. It may remain high even after recovery in some cases. It may be elevated in response to variety of infection and inflammatory disorder. Therefore, it has no diagnostic value

The patients after complete workup for intracranial garnulomatous lesion had undergone CT examination. In 56% cases presumptive diagnosis of tuberculoma was made. In 28% cases of remaining 44% cases were diagnosed to have findings of neurocycticercosis on the basis of clinical history, immonological test (serum and CSF), exclusion of other chronic infectious disease and CT morphology typical for cysticercosis. In rest of the 16 patients, 10% case showed no lesion. While 6% cases had lesion other than intracranial granulomatous lesion. Serological tests on CSF or serum were found to be helpful in making presumptive diagnosis of neurocysticercosis which is in similarity with the study conducted by [21], in which indirect haemagglutination tests on serum or CSF was found to be helpful in making the diagnosis of neurocysticercosis.

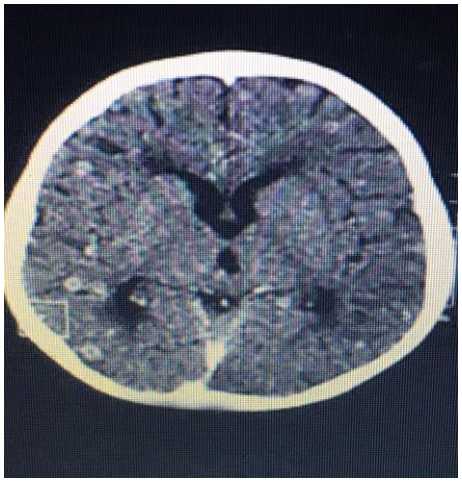

Figure 2: CECT Head - Miliary Tuberculoma of Brain

In case of tuberculoma, multiple lesions are less common than single lesion. The reported incidence of multiple lesions ranges from 10-34% (19,22,20,12,23). 28 % cases of our series had multiple lesion (Fig-2), whereas single lesion was found in 71 % cases. This is in accordance with study conducted by [14, 20]. In neurocysticercosis single lesion was observed in 51% cases. While multiple lesions were seen in 48 % cases. This is in accordance with the study conducted by [24].

In intracranial tuberculomas majority of the lesions are in the supratentorial compartment (96%) whereas lesions in the infratentorial compartment accounted for 10%. Lesions in the supratentorial compartment are most frequently present in parietal lobe (46%), particularly the left side of cerebral hemishpere. Lesions in frontal, occipital, temporal lobe accounted for 25%, 10%, 11% respectively. Atypical sites such as basal ganglion contributed to 3% and no cases of brainstem were reported in our series. Our findings are in conformation with the finding of (25,26,20,12)**,** who also found majority of the lesion in the supratentorial compartment as compared to inratentorial compartment.

As regards to neurocysticercosis most of the supratentorial lesions were in the pareital lobe (57%), followed by frontal lobe (36%) and than the occipital lobe (21%) and than temporal lobe (14%). While the infratentorial compartment showed 21% lesions in cerebellar hemisphere, followed by vermis showing lesion in 8% cases. Similarly findings were observed by *et al.* [24, 27], who also found maximum number of cases of supratentorial compartment. While [21] showed all the lesions in the supratentorial compartment.

Morphology of intracranial tuberculosis on non contrast CT, is that, majority of the lesions were isodense (68%) or hyperdense (39%). Only 4% cases showed hypodense lesion. On contrast enhanced computed tomography, ring lesion was the commonest presentation (57%), disc lesion in 39%. Contour of the lesion is irregular 82%. Calcification is much less common and seen in 7% cases. Basal exudates suggestive of meningitis is the finding in 10% cases. Our study is in the accordance with the study conducted by [25] who identified the two patterns of enhancement of tuberculoma, 4 cases showed small ring of enhancement surrounding lucent area. One of these patients had multiple such lesion. 6 cases showed nodular enhancing lesion, 2 of which had multiple lesion characterized by combination of micro-ring and nodular enhancement. 2 patients showed meningeal enhancement with contrast. In contrary of our study, calcified lesion were absent which could be due to to small sample of study.

CT morphology of neurocysticercosis,shows that, parenchymal form is the most commmon lesion in our series, completely calcified lesion is found in 3 patients, which does not show enhancement with the contrast. Diffusely scattered calcified lesion is seen in 1 patient. Other 2 have two or more than two calcified lesions. Cystic lesion was seen in 5 cases and were usually solitary. Homogenously enhancing lesions are seen in 2 cases. All the lesions shows small area or decreased density or normal parenchyma on non enhanced CT. Mixed lesions (combination of any of the above) was seen in 3 cases (Fig 3) None of the patients showed meningeal or ependymal lesion. Our findings are in keeping with the findings of [17], who in their study also found that the parenchymal lesions are the most commonest type (80% adult and 75% children) and demonstrated a spectrum of CT findings, including completely calcified lesions, cystic lesions,homogemously enhancing lesions and combination of these three types. Completely calcified lesion did not show any enhancement with the contrast administration.

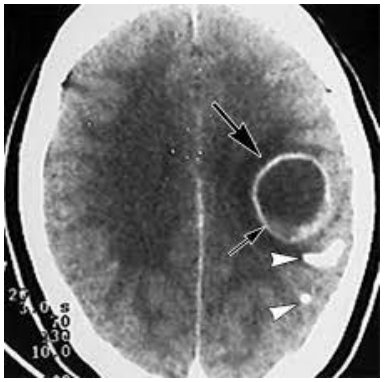

Figure 3: CECT Head: Various stages of Neurocysticercosis.

Most of the patients of our series were young (below the age 30). No characteristic sex preponderance seen, although in young adults, females predominate, while over 30 years age group, males were dominant. This was in accordance with the observation made by [12, 28, 29]. In our study, age of the patients ranged from 5-58 years. Maximum number of these patients were below 30 years of age. There is no significant sex preponderance. Females of the age group 1-30 years had more lesions. In the present series majority of our patients belonged to low socio-economic status. With poor hygenic condition making them more susceptible to infection through water and food sources.

All the patients in which presumptive diagnosis of tuberculoma was made, were given four antituberculous drugs for 12-18 months. Out of 28 cases only 22 reported for followup CT scan evaluation of response to chemotherapy. CT scan was performed at 12 weeks and 12 months after initiation of therapy. 19 patients showed resolution of lesion. The pattern of resolution was indicated by subsidense of oedema followed by regression of the high attenuation lesion. Clinical and radiological improvement may not proceed simultaneously. Two patients showed irregular calcification. Such type of partial resolution of tuberculoma might have been the result of non compliance of these patients as regard their antituberculous therapy. All the patients in which presumptive diagnosis of neurocysticercosis was made are given albendazole,except those who had completely calcified lesion (4 patients). Followup CT scan was done at 3 months and 12 months after the initiation of therapy. 1 patients of this series did not turn for the follow up.3 patients showed complete improvement both clinically and radilogically. 4 patients showed partial regression of lesions. 2 other showed no improvement. One patient who had hydrocephalus and ventricular lesion expired due to the surgical complication, other one was switched over to ATT considering tuberculoma as an important differential diagnosis. Our study was in accordance with the study conducted by [30].

CONCLUSION

The present study was conducted on 50 selected patients with antecedent history of raised intracranial tension and siezures (focal or generalised). After careful clinical history, examination and laboratory investigations, these patients were referred for CT scan. On the basis of

our observations, it was noted that more than half of the patients with chronic granulomatous lesions presented with raised intracranial tensions. Seizure was one of the most commonest presenting complaint in patients with neurocysticercosis. Presumptive diagnosis of tuberculoma and neurocysticercosis was based on clinical and other ancillary criteria. Associated family history and extracerebral tuberculosis are the important criteria for presumptive diagnosis of tuberculoma,however, immunological tests helped in making pressumptive diagnosis of neurocysticercosis. Solitary lesions were more frequent CT finding in both tuberculoma and neurocysticercosis. Majority of tuberculomas and neurocysticercosis observed were supratentorial in location, regardless of their clinical presentation. However, tuberculomas were frequently found in left parietal lobe. Lesions were isodense or hyperdense on plain CT scan showed peripheral enhancement with intravenous contrast injection. The lobulated masses represent coalesced small disc and rings forming a large tuberculoma. These images are consistently seen in tuberculomas. Cystic lesions were the commonest parenchymal form of neurocysticercosis,followed by completely calcified lesions, mixed lesion and homogenously enhancing solitary lesion. Majority of patients of both tuberculoma and neurocysticercosis were young adults. No characteristic sex preponderance was seen. Their clinical and CT appearance were analysed prospectively. CT offers a unique tool for accurate documentation of pathological-anatomical changes present in intracranial tuberculoma. Diagnosis of tuberculoma cannot be made with absolute certainity on CT alone,therefore, these lesions should be differentiated from the other important differential diagnoses of tuberculoma based on clinical and radiological monitoring. By and large, solid and ring enhancing lesions can be safely presumed to be tuberculous,if supported by ancillary data. Conservative treatment with antituberculous therapy should be the first line of treatment in all cases where tuberculoma is suspected. Response of tuberculous and neurocysticercosis lesions to treatment can be monitored by serial CT scanning.

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