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Research Article

Role of computed tomography scan in diagnosing suspected cases of infective granuloma with clinical correlation in a tertiary care research center

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ABSTRACT

Background: Tuberculomas are a rare and serious form of tuberculosis due to the haematogenous spread of mycobacterium tuberculosis. The incidence of intracranial tuberculoma is higher in the paediatric age group because of their greater susceptibility to infections. The incidence of intracranial tuberculoma is higher in the paediatric age group because of their greater susceptibility to infections. CNS involvement, one of the most devastating clinical manifestations of tuberculosis is noted in 5 to 10% of extrapulmonary tuberculosis cases and accounts for approximately 1% of all tuberculosis cases. Tuberculoma still constitute about 5 to 10% of intracranial space occupying lesions in the developing world. Typically they appear as isodense, disc or ring enhancing lesions on CT (computed tomography) and range in size from 0.5 to 3.0 cm. Tuberculomas are thought to arise when tubercles in the brain parenchyma enlarge without rupturing into the subarachnoid space. They more commonly arise as solitary lesions, but multiple tuberculomas are seen. The aim of this study was to observe the role of CT scan in diagnosing suspected cases of infective granuloma with clinical correlation in a tertiary care research centre.
Methods: CT scan examination of brain of each of the above patients was done with the help of single slice spiral CT/e (GE) machine at radiodiagnosis department of Katihar medical college and hospital, Katihar. Both plain and contrast study was done by sequential sections of the brain are taken upto thickness of few millimetres. Standard deviation (SD), mean, median and mode were calculated. Newer modification and sophisticated scanners provide 3D images, volumetric data and quick sequential images. CT evaluates anatomy of supratentorial brain structures well. Myelination, posterior fossa and brain stem structures are not well visualized. Calcification is best visualized by CT scan.
Results: 8% of total cases in this study presented with the disease. Incidence of disease was between 10-20 years of age. There was no predilection for any sex and was observed to be commoner in lower and middle socio-economic class. Seizures were the most common presenting feature and lesions were mainly located in the brain parenchyma. Presence of both hypodense and hyperdense was observed.
Conclusions: Most common radiological finding of infective granulomas on CT scan was ring enhancing lesions. Cerebral oedema and ventricular dilatation were also found and more commonly seen with tuberculoma rather than neurocysticercosis. Most of the lesions were parenchymatous, usually supratentorial, predominantly in the parietal lobe. Smaller lesions (<10 mm) favoured more towards neurocysticercosis. Bigger ones (>10 mm) favoured more towards tuberculomas. CT scan was not only diagnostic tool but also helped us to plan treatment and evaluate efforts of treatment on long term basis. It is of prime importance to stress the importance of preventive aspect of disease. Proper vaccination and maintenance of hygiene and sanitary measures are of vital importance.

Keywords: CT scan, Infective granuloma, Neurocysticercosis, Tuberculoma

INTRODUCTION

Infective granuloma is a broad term, which is defined as any granulomatous lesion known to be caused by a living agent; bacteria, fungi, helminthes. It includes bacterial infection like tuberculoma, parasitic infections like neurocysticercosis, toxoplasmosis, fungal infections like aspergillosis, cryptococcosis, mucormycosis, coccidiomycosis, candidiasis, nocardiosis and amoebic organism infections. In view of CT scan, infective granuloma means nodular or ring enhancing lesion of brain in post contrast studies, which represents the granulomatous stage of above-mentioned disease involving CNS.[1] On plain CT scans, at times, some abnormality is demonstrated. The characteristic ring or disc enhancing CT lesions are seen after intravenous contrast administration. The most common abnormality observed on plain scans is irregular low attenuation areas of vasogenic cerebral oedema.[2] Infrequently, a tiny speck of calcification is demonstrated within the area of hypodensity. After contrast administration, there is a ring or a homogeneous disclike enhancement within the region of hypodensity. Clinical feature of ring enhancing lesions are epilepsy, raised intracranial tension, meningoencephalitis, focal neurological deficit and altered mental state. Almost all patients had an acute seizure episode or a cluster of seizures.[3] Tuberculomas are a rare and serious form of tuberculosis due to the haematogenous spread of mycobacterium tuberculosis. The incidence of intracranial tuberculoma is higher in the paediatric age group because of their greater susceptibility to infections. CNS involvement, one of the most devastating clinical manifestations of tuberculosis is noted in 5 to 10% of extrapulmonary tuberculosis cases & accounts for approximately 1% of all tuberculosis cases.[4] Tuberculoma still constitute about 5 to 10% of intracranial space occupying lesions in the developing world. Typically they appear as isodense, disc or ring enhancing lesions on CT and range in size from 0.5 to 3.0 cm. Tuberculomas are thought to arise when tubercles in the brain parenchyma enlarge without rupturing into the subarachnoid space.[5] They more commonly arise as solitary lesions, but multiple tuberculomas are seen. Clinical manifestations of tuberculoma depends largely on their location and patients often present with headaches, seizures, papilloedema, or other signs of increased intracranial pressure.[6] The pace of symptom development usually is measured in weeks to months with tuberculoma.

Its appearance on Computed Tomography (CT) scan varies. Tuberculomas are normally defined as low or high density round or lobulated masses with irregular walls and show homogenous or ring enhancement after administration of intravenous contrast.[7] They are typically found in the frontal and parietal lobes.[8] The "target sign" central nidus of calcification surrounded by a ring of enhancement was once considered pathognomonic for the radiographic presentation of tuberculomas depends largely on whether the lesion is non caseating, caseating with a solid center or caseating with a liquid, the degree of oedema surrounding the tuberculoma is thought to be inversely proportional to the age of the lesion.[9] Extensive surrounding oedema and mass effect is usually seen in acute inflammatory stage but are not as prominent in chronic tuberculosis. With treatment these lesions resolve, at first the perifocal oedema regress, then the lesion. Following resolution there may be gliosis or resolution. Neurocysticercosis is a leading cause of acquired epilepsy worldwide and endemic in underdeveloped and developing regions.[10] Neurocysticercosis is a parasitic disease caused by the larval (cystic) form of the pork cestode tapeworm. The WHO lists neurocysticercosis as a neglected tropical disease. It estimates that about 50 million people worldwide have neurocysticercosis in the world and that it causes about 50,000 deaths each year.[11] Parenchymal cysts usually measure 10mm or less in size. Central nervous system involvement occurs in 60% to 90% of patients with cysticercosis. The brain parenchyma is the most common affected site.[12] The corticomedullary junction is the primary location. Intraventricular cysticercosis cysts are seen in 20% to 50% of cases, with fourth ventricle a common site. Only 10% have isolated subarachnoid disease. Common clinical presentations include seizures, headaches, syncope, dementia, diplopia, visual field defects, arachnoiditis, hydrocephalus, focal neurological deficits and stroke.[13] Neurocysticercosis induced seizures are most commonly generalized tonic clonic or simple partial, although some patients may present with complex partial seizures. A variety of focal neurological findings related to the size, number and location of the parasites have been described in patients with NCC.

Neurotoxoplasmosis, also known as cerebral toxoplasmosis, is an opportunistic infection, caused by the parasite *Toxoplasma gondii*, which typically affects patients with HIV/AIDS. A large number of people worldwide are infected by this pathogen but rare in developing countries, and most of these cases are sub clinical.[14] Most frequently seen in immunosuppressed host and comprised one of the commonest opportunistic infection of the CNS. On NCCT, toxoplasma characteristically appears as multiple areas of hypodensity.[15] There is a predilection for the basal ganglia (in 75 to 88%) and the corticomedullary junction and lesions may involve the posterior fossa. Lesions vary in size from less than 1 cm to over 3 cm and there is surrounding mass effect and oedema of variable degree. Post contrast CT demonstrates ring or nodular enhancement.[16] A brain biopsy is the only method for definitive diagnosis of CNS toxoplasmosis. However, due to the risks involved in this procedure, a presumptive diagnosis is usually made. Fungal infections may involve intracranial blood vessels, leptomeninges, and brain parenchyma.[17] Before the era of immunosuppressive therapy in organ transplant patients and the increase in HIV infection, fungal infection of the CNS was rare. Other conditions that predispose patients to fungal

infection include diabetes, pregnancy and malignancy. *Aspergillus fumigatus* infection is seen predominantly in immunocompromised patients. Central nervous system aspergillosis is more commonly caused by haematogenous spread of pulmonary disease and less commonly caused by direct extension of disease in the nasal cavity and paranasal sinuses. It may manifest as a solitary brain abscess; alternatively, vascular involvement may occur and result in thrombosis with hemorrhagic necrosis and / or massive subarachnoid and intracranial haemorrhage. On CT, low density areas with little or no contrast enhancement and mass effect, representing areas of infarction are seen.[18] Cerebritis or abscess formation may also be seen secondary to haematogenous spread of the disease. Slightly hyperdense, ring like lesion with central low density and surrounding oedema may be seen. Cryptococcosis is the most common fungal infection to involve the central nervous system and the most common fungal infection in patients with AIDS.[19] Intracranial cryptococcomas (torulomas) may exhibit ring like contrast enhancement. Mucormycosis is the most aggressive of the fungal infections. The triad of diabetic ketoacidosis, meningoencephalitis and a naso-orbital infection highly suggests the diagnosis of mucormycosis. Primary intracerebral mucormycosis may reveal low density on NECT scans.[20] Patchy, irregular enhancement is seen on CECT scans. CNS infections due to *Candida* species are rare, difficult to diagnose, and two primary forms exist – exogenous and endogenous infection. Candidiasis occurs in immuno compromised patients. CNS involvement occurs as a result of haematogenous spread or direct invasion from the oral cavity or orbit. NECT scans usually show low density areas. CECT scans or MRI may show little or no enhancement or irregular, ring like, or nodular enhancement. NECT scans show low density areas. CECT scanning shows ring like enhancement, which may be multiple or multiloculated. Amoebic organisms may also involve the CNS although rarely. On imaging multiple hemorrhagic ring enhancing lesions are identified. During Jan 2014 to Jan 2015, 6450 cases were registered in the department of radiology CT scan unit for scanning brain. Out of these 6450 cases, 2600 (40.0%) were having neurological manifestation, among which 200 cases (7.69%) were diagnosed as Infective granuloma among which 130 cases (5.0%) were tuberculoma and 70 cases (2.69%) were neurocysticercosis found no other infective granuloma diagnosed. Pathologists have described several stages of these CNS infections, almost all recognizable on modern radio imaging modalities like CT and MRI and give a milestone in the correct diagnosis and follow up of these similar presenting diseases. Although, MRI is generally considered more sensitive than CT to evaluate activity of lesion by demonstrating perilesional oedema and enhancement.[21] CT is far superior in demonstration of calcifications and is preferred excellent in initial imaging and screening modality due to easy accessibility and cost effectiveness.[22] The diagnostic difficulty can be confirmed by newer MRI and nuclear scan.

METHODS

The present study was carried out in the Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar. After obtaining ethical clearance from the institution, CT scans were performed in CT scan unit, Department of Radiodiagnosis, Katihar Medical College and Hospital. Results were statistically analyzed by conventional Standard deviation (SD), mean, median and mode.

Inclusion criteria

All suspected cases of granulomatous diseases were included in this study.

Exclusion criteria

Pregnant women.

Patient with history of contrast reaction/hypersensitivity.

The patients of different age groups of either sex were scanned in CT scan unit.

Materials

Number of patients

Number of studies

CT scan- Single Slice Spiral CT/e (GE)

Contrast used was a non-ionic water soluble medium, OMNIPAQUE 300mg I/ml.

Other equipment's used were a 20 ml syringe and a scan vein set no. 20.

These patients were evaluated according to a pre-designed proforma

CT scan examination of brain of each of the above patients was done with the help of single slice spiral CT/e (GE) machine at radio-diagnosis department of Katihar Medical College and Hospital, Katihar. Both plain and contrast study was done. Thin sequential sections of the brain are taken upto thickness of few millimetres. Newer modification and sophisticated scanners provide 3D images, volumetric data and quick sequential images. CT evaluates anatomy of supratentorial brain structures well. Myelination, posterior fossa and brain stem structures are not well visualized. Calcification is best visualized by CT scan. The patient was fasted for four hours before CT scan Examination. In case of children, sedation with trichlofos orally (under two years of age) or diazepam 0.2 mg/kg intravenously (above two years of age). In supine position, thin axial cuts were taken 5mm slice thickness was used. In regions of interest 2mm slice thickness were used.

This plain study was analyzed for the following findings:

A. Lesions
   i. Number of lesions
   ii. Size of lesions
   iii. Location of lesions
B. Ring lesions
C. Hyperdense or Hypodense lesion
D. Perilesional oedema
E. Midline shift
F. Ventricular dilatation
G. Calcification-eccentric or central

Contrast CT scan

The intravenous injection of radiographic contrast medium enhances the areas of increased vascular permeability due to abnormalities of blood brain barrier and highlights abnormal collection of blood vessels in arterio-venous malformations. If intravenous injection of contrast media is made, the enhanced images can show opacified vessels and extracellular space. It can also distinguish among structure and permit deduction to be made about vascularity.

Procedure

i. Non-ionic water soluble contrast medium: Lohexol (OMNIPAQUE) approx 20 ml was administered intravenously and again slices were taken to obtain contrast enhanced pictures. Dose – 1 ml of Lohexol contains 300 mg of iodine. Dose of iodine is 300 mg/kg body weight, so the dose of dye comes to 1 ml/kg.
ii. Ionic: contrast medium: Sodium diatriazoate / Meglumine diatriazoate was administered intravenously and again slice were taken.

Non-ionic contrast media were preferred during the study unless the cost factor and no absolute or relative contraindication of the ionic contrast media were present.

Post contrast CT scan of brain was analyzed for the following findings:

A. Enhancement pattern
   i. Ring like Enhancement
   ii. Disc type Enhancement
B. Vascular malformation

RESULTS

200 cases of infective granuloma of brain were studied with clinical presentation and detailed radiological findings in CT scan. Analysis of study is as follows.

It is observed that among the cases presenting with neurological features, the final diagnosis of infective granuloma was only 8% of the total cases which is a small ratio of CNS cases (Table 1).

Table 1: Incidence of infective granuloma in case presenting with neurological manifestation.

Type of cases	Total number of cases	Percentage
With neurology manifestation	2600	
Diagnosed as neurocysticercosis	70	2.69%
Diagnosed as tuberculoma	130	5%

Table 2: Age distribution of cases of infective granuloma neurocysticercosis.

Age in years	Total number of cases	Percentage
1 – 9 years	14	20%
10 – 20 years	36	51.4%
21 onwards	20	28.57%

It is observed that incidence of infective granuloma are in most of the cases were between 10 to 20 years of age (Table 2).

Table 3: Sex distribution of cases of infective granuloma neurocysticercosis.

Sex	Number of cases	Percentage
Male	38	54.28%
Female	32	45.71%

Table 3 shows that there is no specific predilection for any sex. The incidence was more or less same in both sexes.

Table 4: Socio-economic status of cases of infective granuloma neurocysticercosis.

Socio-economic status	Number of cases	Percentage
Lower	36	51.42%
Middle	22	31.42%
Upper	10	14.28%

Table 4 shows that in hospital brought patients, the incidence of disease was more in lower and middle socio-economic group.

In the present study, seizures were the most common presentation in cases of infective granuloma. A feature of increased ICP is the second most common presentation in cases of tuberculoma (Table 5).

Table 6 shows that the generalized seizure was more common than the partial seizure in cases neurocysticercosis presenting with epilepsy. The partial seizures were more common in cases of tuberculomas.

Table 5: Presenting symptoms and signs in patients with infective granuloma neurocysticercosis.

Presentation	Number of cases	Percentage
Seizures	60	85.71%
Increased intracranial pressure (headache, papilloedema)	14	20.0%
(Altered mental status dementia, confusion, stupor)	20	22.85%
Focal neurological findings (hemi paresis, Para paresis, visual loss)	6	8.57%

Table 6: Spectrum of seizures in cases of infective granuloma neurocysticercosis.

Type of epilepsy	Number of cases	Percentage
Generalized	46	76.66%
Partial	14	23.33%

Table 7: CT scan of location of lesion of infective granuloma neurocysticercosis.

Location	Number of cases	Percentage
Parenchyma only	50	71.42%
Combination (Parenchymatous & Ventricular)	20	28.57%

Table 7 shows that the most common site of lesions is parenchyma and other presentations are found usually in combination of two or more sites.

Table 8: Type of lesion in patients with infective group (CT scan) neurocysticercosis.

Findings	Total number of cases	Percentage
Calcification	18	25.71%
Hyperdense lesions	40	57.14%
Hypodense Lesions	18	25.71%
Cerebral oedema	14	20.0%

Table 8 shows that, in several different findings, hyperdense lesions most commonly found. Hypodense lesion, cerebral oedema and calcification also present.

DISCUSSION

In the present study, cases were scanned in the Department of Radiodiagnosis during November 2013 to November 2015 and were classified according to different systems involved. 2600 cases presented with neurological manifestations. Out of these 200 (8%) cases diagnosed as infective granuloma. Of these 130 cases (5%) were of tuberculoma and 60 cases (3%) were of neurocysticercosis. Infective granulomas especially both the common causes i.e. Tuberculoma and neurocysticercosis are endemic in developing countries and in India too and the tuberculomas are more common than neurocysticercosis.[23-26] The prevalence of tuberculosis in developing countries is estimated at 10 – 20%. Each untreated source infects about 10-13 new persons per year, yet, if treated, that person would only infect 2-3 people per year. Neurocysticercosis is the second most cause of space occupying lesions after tuberculoma.[27,28] In Mexico the prevalence of NCC may be as high as 2-3% based on patients autopsied at general hospital.[29] It is observed that incidence of infective granuloma in most of the cases were between 10 to 20 years of age group as compared to other age group. Cerebral manifestations may be asymptomatic for a considerable period of time. The incidence of infective granuloma was found to be higher in children and juvenile patients who lived in rural areas.[30] In the present study of 200 cases of infective granuloma of brain, 106 cases (52.6%) were male and 94 cases (47.4%) were female. There is no specific predilection for any sex.[31,32] The incidence was more or less same in both cases. The incidence goes on improving, as the socio-economic status improves, lower socioeconomic strata people show incidence of 56% and upper strata people shows incidence of only 10.6%.[32-34] These findings directly suggest the need of hygiene and health education by which the incidence can be brought down. The present study shows that convulsion is the most common presentation in cases of infective granuloma. 132 out of 160 cases (82.5%) presented with seizures, which was either generalized or focal in nature. Symptoms and signs of increased intracranial pressure such as headache, papilloedema, vomiting, visual disturbances, vertigo buzzing in ears were present in 60 cases (60%) out of 100 cases in patients of tuberculoma whereas only 20% cases in neurocysticercosis. Altered mental status such as dementia, confusion, stupor, amnesia and emotional disturbance were present in 27.3% (26.6%) in cases of neurocysticercosis and 28% in cases of tuberculoma.[35]

Focal neurological complaints were more common with tuberculoma patients (40%) as compared to neurocysticercosis (only 6.6%). Associated findings like raised intracranial pressure and focal neurological complaints with seizure were the usual presentation in case of tuberculoma whereas seizures were the foremost in cases of neurocysticercosis.[36,37] The present study that out of 52 cases presented with epilepsy in neurocysticercosis patients 40 cases (76.9%) and generalized convulsion and 12 cases (23.07%) had partial seizures. The partial seizures had motor, sensory or visual symptoms. It has assumed that the presentation in adult and children are more or less common. In contrast 80 cases of tuberculoma presented with epilepsy 52 cases (65%) had partial seizure and 28 cases (35%) had generalized seizure. It is concluded that the generalized

seizure was more common in cases of neurocysticercosis whereas partial seizures were more common in cases of tuberculomas in the patients presenting with epilepsy. The location of the lesions in cases of infective granuloma was seen in the parenchyma and other locations like ventricles, cisterns are rare when taken into consideration alone as a single site.[38] The next common presentation was mixed in which the lesions lie in more than one site. Parenchymatous lesion comprise of 116 cases (72.5%) out of total 160 cases. Both tuberculoma and cysticercosis had almost same percentage. Computed tomography is highly sensitive in demonstrating parenchymal infective granuloma and its wider use more and more cases of epilepsy are being diagnosed due to these granuloma which were begin labelled as 'idiopathic'. The most common radiological manifestations are hyperdense lesions with ring enhancement. In cases of neurocysticercosis hyperdense lesions are more common and account for 53% and Hypodense lesions were 26% calcifications present in about 26.6%. This findings and calcification goes in accordance to the work done by Mazer et al 1983. Cerebral oedema was present in 12 out of 60 patients (20%). Degenerating cysts often demonstrate an area of surroundings area.[39,40] Ventricular dilatation also observed in few patients, this could be due to a cyst in pathway of CSF flow, causing obstruction and thereby leading in hydrocephalus. In cases of tuberculoma hyperdense lesions are more common and account for 48% and hypodense lesions were 28%, calcifications present in about 8%. This findings and calcification goes in accordance to the work done by Wasey M, Zaheer J et al work done at Department of Neurology, Aga Khan Road, Karachi, Pakistan.

CONCLUSION

Infective granuloma of brain contributed to 8% of the total cases presenting with neurological signs & symptoms. 130 cases (5%) were of tuberculoma and 70 cases (3%) of neurocysticercosis, no other infective granuloma found in CNS. Most of the cases were present between 10-20 years of age and there was no predilection for any age. It was seen that the incidence of disease was more in lower socioeconomic group. This might have been due to the fact that hygiene was not proper in these people. The clinical presentation was based on the location of lesion in the brain and correlated with the typical stages of granuloma formation. The basic symptoms were convulsion, raised ICP and psychiatric disorders which occurred separately or in combination. Most of the patients presented with seizure disorders. This was either alone or combined with other symptoms of raised intra cranial pressure (headache, vomiting, papilloedema), altered mental status (dementia, confusion, stupor), focal neurological manifestations (hemiparesis, paraparesis, visual loss.) Generalized seizures were most common in cases of neurocysticercosis whereas partial seizures were more common in cases of tuberculoma (in cases presenting with epilepsy). Most common radiological finding of infective granulomas on CT scan was ring enhancing lesions. Cerebral oedema and ventricular dilatation were also found and more commonly seen with tuberculoma rather than neurocysticercosis. Most of the lesions were parenchymatous, usually supratentorial, predominantly in the parietal lobe. Smaller lesions (<10 mm) favoured more towards neurocysticercosis. Bigger ones (>10 mm) favoured more towards tuberculomas. CT scan was not only diagnostic tool but also helped us to plan treatment and evaluate efforts of treatment on long term basis. It is of prime importance to stress the importance of preventive aspect of disease. Proper vaccination and maintenance of hygiene and sanitary measures are of vital importance. Health education is of critical importance. Recently newer modality, MRI has been reported to be more sensitive than CT scan in detecting non-calcified lesions.

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