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ROLE OF CT SCAN AND MRI IN DIAGNOSIS OF TUBERCULOSIS OF BRAIN AND TUBERCULOSIS OF SPINE

Radiodiagnosis

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ABSTRACT

INTRODUCTION: Tuberculous involvement of the central nervous system (CNS) is an important and serious type of extra-pulmonary involvement. It has been estimated that approximately 10% of tuberculosis have CNS involvement. MRI and CT imaging is the preferred choice for early diagnosis and CSF evaluation with culture and immunological tests for confirmation of the diagnosis.
AIMS AND OBJECTIVES: 1. Diagnosing tuberculosis using CT and MRI as the modality of choice. 2. To evaluate different presentation of tuberculosis on CT and MRI.
MATERIALS AND METHODS: The study included 65 cases of neurotuberculosis who visited the department of Radiodiagnosis, GMCH, Udaipur. Out of them 42 underwent only MRI investigation, 12 underwent only CT scans whereas 11 patients were evaluated by CT and MRI. Histopathological correlation was performed as a follow-up in these patients in outside centers.
RESULTS: Most patients presented with a combination of clinical symptoms but the most common presentation was epilepsy in intracranial TB. Most common complaint was of back pain. Cases of intracranial tuberculosis were diagnosed on only CT scan and needed further investigation to confirm the diagnosis. MRI can be confirmative in the diagnosis of intracranial tuberculosis. Further confirmation however can be obtained from different pathological tests. CT and MRI both play an important role in follow-up cases.
CONCLUSION: Even though MRI is the investigation of choice in almost all the cases, CT is advantageous as it is easily available, more cost effective, less claustrophobic and less time consuming. Hence, while MRI is the preferred investigation for evaluation of intracranial and spinal tuberculosis, CT scan is the initial investigation of choice.

KEYWORDS

MRI, CT scan, Intracranial TB, TB of Brain, Spine.

INTRODUCTION

Tuberculosis remains a major global problem and a public health issue of considerable magnitude. In recent times, there has been a resurgence of tuberculosis in both developing and developed countries.[1]

Tuberculous involvement of the central nervous system (CNS) is an important and serious type of extra-pulmonary involvement. It has been estimated that approximately 10% of tuberculosis have CNS involvement.[2] In developing countries CNS tuberculosis is a disease of younger age group, usually childhood and poor socioeconomic status is often the pre-disposing factor.

Diagnosis is based on clinical features, cerebrospinal fluid changes, culture and immunological tissue tests and imaging characteristics. Clinical features usually depend on the area being involved. Intracranial tuberculosis may manifest as a headache, fever or even giddiness, seizures, unconsciousness. Spinal tuberculosis usually manifests as back pain, deformity of the spine and rarely para paresis.

The culture and immunological tests as well as evaluation of the cerebrospinal fluid are all time consuming methods of diagnosing neurotuberculosis, but they also give the confirmed diagnosis of the disease.

X-rays are usually the first investigation done for symptomatic patients, but they are helpful only in the late stages of the disease.

Recent advances in technology have allowed to utilize additional imaging modalities in the evaluation of CNS infections like PET, MR spectroscopy, however CT and MRI studies are generally the modalities of choice in the evaluation of the intracranial and spinal tuberculosis. Since the advent of CT scanning and MRI, a significant decrease has occurred in the morbidity and mortality of patients with intracranial.[3] However, MRI with gadolinium enhancement is more sensitive than CT scanning in determining the extent of meningeal and parenchymal abnormalities like tuberculomas, abscesses and infarctions in intracranial tuberculosis. It also depicts hydrocephalus readily.[4]

In spinal tuberculosis, CT scan is found to be very useful because of its ability to demonstrate bone destruction or focal osteopenia early in the course of the infection. Its ability to demonstrate soft tissue swelling and cellulitis, however, is disappointing. MRI has now become the study of choice for evaluating patients with spinal complaints. Its advantages include multiplanar capability, superior soft tissue contrast resolution, and a unique ability to detect end-plate, disc space and marrow changes. Moreover, it can demonstrate the subtle changes far earlier in the disease so that immediate management may be undertaken.[5]

Hence, even though CT imaging is helpful in the diagnosis of neurotuberculosis, MRI is the preferred choice for early diagnosis and CSF evaluation with culture and immunological tests for confirmation of the diagnosis.

Aims And Objectives

1. Diagnosing tuberculosis using CT and MRI as the modality of choice.
2. To evaluate different presentation of tuberculosis on CT and MRI.
3. To diagnose the vertebral and soft tissue (disc, spinal cord, nerves) lesions with high accuracy.

Materials And Methods

The study included 65 cases of neurotuberculosis who visited the department of Radiodiagnosis, GMCH, Udaipur. This study was performed using the CT and MRI scans.

Patients who met **inclusion criteria** were included in the study.
1. Patients referred to the radiology department for neurological symptoms, and found to have positive findings.
2. All cases needing a follow up.
3. All accidentally diagnosed cases of neurotuberculosis.
4. All patients suffering from neurotuberculosis already diagnosed, treated and needing follow up.

Exclusion Criteria:

1. Patients with claustrophobia.
2. Patients who are unwilling or unable to cooperate for the procedure.

Methods:

Detailed clinical history and examination noted as outlined in Proforma.

Investigations:
Routine blood investigations were documented in all patients: CBC, Renal function test, Random blood sugar estimation; fasting blood sugar and 2 hours post prandial if required.

Radiological Investigations:
Out of 65 patients, 42 underwent only MRI investigation, 12 underwent only CT scans whereas 11 patients were evaluated by CT and MRI.

Histopathological correlation was performed as a follow-up in these patients in outside centers.

Results

Table 1: Clinical Presentation Of Intracranial And Spinal Tuberculosis Patients

	Clinical Presentation	No. of Cases
Intracranial Tuberculosis	Headache	11
	Fever	22
	Confusion	5
	Epilepsy	29
Spinal Tuberculosis	Back Pain	31
	Weakness Of Limbs	10
	Kyphosis	9
	Sensory Disturbance	3
	Radiculopathies	6

Most patients presented with a combination of clinical symptoms but the most common presentation was that of epilepsy in intracranial TB. Most common complain was of back pain. Very rarely patients presented with radiculopathies or sensory disturbances in spinal tuberculosis.

Table 2: Ct Scan In Diagnosis Of Neurotuberculosis

LABORATORY CONFIRMED	CT SCAN DIAGNOSIS		MRI DIAGNOSIS	
	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE
TB MENINGITIS	7	2	2	0
TB ABSCESS	0	1	2	1
TUBERCULOMAS	2	0	6	0
FOCAL CEREBRITIS	1	0	2	0

Cases of intracranial tuberculosis diagnosed on only CT scan and need further investigation to confirm the diagnosis. MRI can be confirmative in the diagnosis of intracranial tuberculosis. Further confirmation however can be obtained from different pathological tests.

Table 3: Sensitivity Of Ct Scan And Mri In Diagnosis Of Neurotuberculosis

TYPE OF LESION	CT SCAN	MRI
INTRACRANIAL TUBERCULOSIS	76%	99%
SPINAL TUBERCULOSIS	-	99%

MRI is more sensitive than CT scan in the diagnosis of intracranial tuberculosis. MRI is also very sensitive in the diagnosis of spinal tuberculosis. However, CT plays no role in the diagnosis of spinal tuberculosis.

Table 4: Role Of Ct And Mri In Follow Up Patients

S. NO.	INITIAL EXAM	MODALITY USED	FOLLOWUP EXAM	MODALITY USED
1.	Pott's spine with paradiscal inv and pre-paravert abscess	MRI	Decrease in the lesion with the pre-paravert abscess	MRI
2.	Left cerebellar abscess	MRI	Decrease in the size of the lesion	MRI
3.	Multiple tuberculomas inv cerebrum and cerebellum	MRI	Resolution of the tuberculomas with development of hydrocephalus	CT
4.	Right cerebellar tubercular abscess	MRI	Reduction in the size of the lesion	MRI
5.	Pott's spine with central inv	MRI	Resolution in the marrow changes	MRI

Here, as observed above CT and MRI both play an important role in follow-up cases.

Table 5: Comparision Between Ct And Mri In Diagnosis Of Intracranial Tuberculosis

SR. NO	CT SCAN			MRI				LAB FINDS
	STUDY	OTH	DIAG	T1,T2	DWI	OTH	DIAG	
1.	Hypo with thick wall enh	-	p/o granulo lesion	Iso on T1,Hyper on T2	Restric.	Peri-Focal Edema, Peri enh	TB abscess	CSF +ve for NTB
2.	Enh and thick meninges	Hycp	TB Menin.	Meninges hypo on T1, Hyper on T2	-	Enh of meninges	TB Menin.	Mantoux +ve
3.	Multi hypo lesions with peri enh	-	p/o multi granulo lesions	Iso on T1,Hypo on T2	-	Peri-focal edema, peri enh	Multi tubercu-lomas	CSF +ve for NTB
4.	Hypo with thick wall enh	-	p/o granulo lesion	Iso on T1,Hyper on T2	Restric.	Peri-focal edema, Peri enh	TB abscess	CSF +ve for NTB
5.	Enh and thick meninges	-	p/o TB Menin	Meninges hypo on T1, Hyper on T2	-	Enh of meninges	p/o TB menin	Mantoux +ve
6.	Hypo with adj gyral enh	Soft calc in b/l BG	p/o inf lesion	Few conglomerated lesions hypo on T1, hypo on T2	-	Perifocal edema, Peri enh, BG hyper-intensities	Multi tubercu-lomas	Mantoux +ve

Table 6: Comparision Between Ct And Mri In Diagnosis Of Spinal Tuberculosis

SR. NO.	CT SCAN			MRI				LAB FINDS
	STUDY	OTH	DIAG	T1, T2	ART DISC	PRE-PARA ABSC	DIAG	
1.	Erosion of C4	Retro-pharyngeal fullness	p/o spinal TB	C4 hypo on T1, Hyper on T2, cord compr	Not inv	Present	Pott's spine with central inv, pre-para vert abscess, Cord compression	CSF +ve for NTB
2.	Erosion of D9-D10 endplates	-	p/o spinal infection	D9-D10 hypo on T1, Hyper on T2, cord compr	Inv	Present	Pott's spine with paradiscal inv, pre-para vert abscess, Cord compression	Mantoux +ve

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3.	Erosion of D10-D11	Calc in pre-para vert region	p/o spinal TB	D10-D11 hypo on T1, Hyper on T2, Cord comp	Inv	Present	Pott's spine with paradiscal inv,pre-para vert abscess, cord compression	Biopsy +ve for TB
4.	Erosion of L4-L5	Calc in pre-para vert region	p/o spinal infection	L4-L5 hypo on T1, Hyper on T2, Cord comp	Inv	Present	Pott's spine with paradiscal inv, pre-para vert abscess, cord compression	CSF +ve for NTB

DISCUSSION

Most of the patients presented with epileptic episodes. The other common presentation was that of fever. Most studies mention non-specific clinical features of patients suffering from intracranial tuberculosis ranging from headaches to fever, seizures and confusion. In a study carried out by Sandip Chatterjee, mentioned that most children have fever like symptoms 2-8 weeks before the development of clinical features of meningeal irritation. He also mentioned that seizures may be the presenting feature of patients suffering from tuberculomas and tuberculous abscesses.[6]

Back pain was the most common complain the patients presented in our study. Other features like weakness of the limbs and kyphosis were infrequent presentation whereas radiculopathis and sensory disturbances were rare complains. Ferrer et al observed that clinical manifestations of patients with Pott's spine depend upon the site and the duration of the infection. They concluded that back pain is the earliest and most common symptom of Pott disease, with patients usually experiencing this problem for weeks before seeking treatment. They also observed that neurologic abnormalities occur in 50% of cases and can include spinal cord compression with paraplegia, paresis, impaired sensation, nerve root pain, and/or cauda equina syndrome.[7] Similar findings were reported by Hidalgo and et al[8] and B.Dass and et al[9].

Thirteen patients in our study underwent CT scans, out of which 9 patients were diagnosed to have tuberculous meningitis, 2 tuberculomas, 1 case of tuberculous abscess and 1 case of focal cerebritis. The outcomes were compared with the pathological findings in the same patients. It was proved that CT scan alone carries a sensitivity of about 76% in the diagnosis of intracranial tuberculosis.

Selmali et al reported that CT scan findings are typical of granulomatous meningitis with parenchymal involvement. Fungal infections and neurosarcoidosis may appear similar to CNS TB. At times, bacterial infections and metastatic disease also may mimic CNS TB. CSF analysis often helps in establishing the diagnosis.[10]

Rajajee et al studied the predictive value of CT scans in diagnosis of intracranial tuberculosis. Predictive value of CT scan in the diagnosis of intracranial tuberculomas have shown sensitivity at 100%, specificity at 85.7%, the PPV was only 33% (CI 24-42%). The NPV 100%. The low PPV for diagnosis of intracranial tuberculoma on CT alone indicates the need for confirming histological diagnosis.[11]

In an attempt to establish CT criteria for the diagnosis of CNS tuberculosis, Kumar et al identified basal meningeal enhancement, ventriculomegally, tuberculoma and infarcts as characteristics to distinguish CNS tuberculosis from pyogenic meningitis and proposed that basal meningeal enhancement, tuberculoma, or both were 89% sensitive and 100% specific for TBM.[12]

Thirteen patients underwent MRI, out of which 2 cases were diagnosed as having tuberculous meningitis, 7 tuberculomas, 2 tuberculous abscesses and 2 focal cerebritis. All of the results of these patients were compared with the results of their pathological results and it was found that MRI has about 99% sensitivity in making accurate diagnosis of intracranial tuberculosis. Gupta et al described the different patterns of intracranial tuberculosis and proved that MRI is better in detecting the different features.[13] Jinkins et al observed that contrast-enhanced MRI is generally considered to be superior to CT in detecting and assessing CNS tuberculosis.[14]

27 patients underwent MRI for spinal evaluation, out of these 24 patients were diagnosed to have Pott's spine, 2 patients had intramedullary tuberculomas and 1 had spinal meningitis. All of these results were compared to the pathological findings in these patients, and it was observed that MRI had a sensitivity of about 99% in the evaluation of the spinal tuberculosis. Valk et al observed that MRI was preferred in the diagnosis of spinal tuberculosis as this technique allowed describing lesions of the spinal cord, meninges and epidural space more precisely.[15]

Five follow-up patients were studied and it was found that the clinical and the imaging findings were compatible in all of them. Bernaerts et al also observed the importance of follow up neuroimaging in cases of neurotuberculosis. They found that while new or enlarging tuberculoma may occur in some patients despite adequate antituberculosis therapy, the activity of tuberculoma can generally be assessed by the degree of contrast enhancement on follow-up CT or MRI studies.[16]

Comparison Of Ct And Mri In Neurotuberculosis

Ten patients underwent both CT scan and MRI. There findings were than compared with the pathological findings. It was observed that MRI was superior in diagnosing both intracranial tubercular lesions as well as the spinal lesions. CT however is more cost effective as well as more available and it also provides more information about the bone destruction and the calcification. Other studies too show the superiority of MRI in the diagnosing neurotuberculosis. Savas Andronikou observed that while MRI is arguably superior to CT in identifying meningeal and parenchymal abnormalities, its limited availability worldwide and the requirement for general anesthesia in children suggest that it may have a limited impact on TBM diagnosis globally.[17]

Sinan et al observed that while MRI offers excellent visualization of the bone and soft tissue components of spinal tuberculosis and helps to identify disease at distant asymptomatic sites, CT is useful in assessing bone destruction, but is less accurate in defining the epidural extension of the disease and therefore its effect on neural structures. MR imaging clearly demonstrated the extent of soft tissue disease and its effect on the theca/cord and foramen in cases with doubtful CT findings.[18]

CONCLUSION

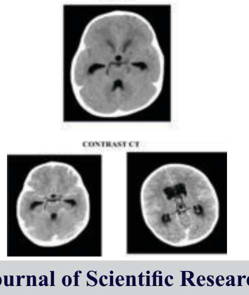
CT Scan and MRI scans have proved to be successful modalities in evaluating tuberculosis of the brain and the spine, but MRI results increased the physician's confidence in the diagnosis. The sensitivity of MRI was more in the diagnosis of spinal tuberculosis also as CT scan is not able to evaluate the extension of the lesion, the involvement of the articular discs and the compression of the spinal cord. However, calcifications and bone destructions were evaluated better on CT scan. Contrast studies were important in confirming the diagnosis in all the different manifestations of neurotuberculosis.

Even though MRI is the investigation of choice in almost all the cases, CT is advantageous as it is easily available, more cost effective, less claustrophobic and less time consuming. Hence, while MRI is the preferred investigation for evaluation of intracranial and spinal tuberculosis, CT scan is the initial investigation of choice.

Cranial Manifestations Of Tuberculosis

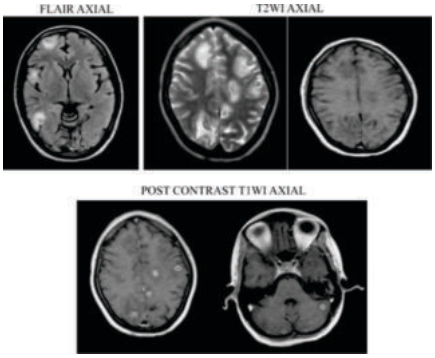
Ct Brain

Plain studies show effacement of the sulci and gyri with haziness of the meninges. Contrast studies show the enhancement of the meninges suggestive of meningitis. All the ventricles appear to be dilated suggestive of hydrocephalus. The underlying etiology appears to be tuberculosis.



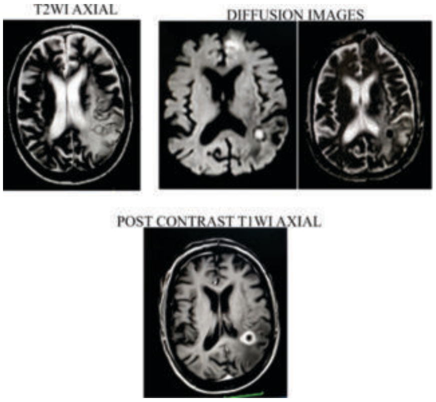
B] TUBERCULOMAS:

Mri Brain



C] Tuberculous Abscess:

Case 4: Mri Brain



This study showed an altered signal intensity lesion in the left periventricular occipital region which appears to hypointense on T1WI and hyperintense with preifocal edema on T2WI. Diffusion weighted images show restriction. Post contrast studies show thick peripheral enhancement. All these findings are in favour of tubercular abscess.

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