INTRACRANIAL MANIFESTATIONS OF TUBERCULOSIS – AN IMAGING STUDY

YASSER AMIN, ASIM SHAUKAT, BILAL A. MIAN
Departments of Radiology, Mayo Hospital and Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore

In this paper we report various intracranial manifestations of tuberculosis in 48 patients who presented at our hospitals. The object of this study was to see different patterns of intracranial tuberculosis seen on cross sectional imaging in the city of Lahore and its suburbs. In a total of 48 patients, 21 had meningitis. 16 patients were found to have tuberculomas which also included 6 who had accompanying meningitis. Vasculitis resulting in lacunar infarcts was seen in 3 patients. Hydrocephalus was seen in 5 patients and choroid plexus tuberculosis (choroid plexitis) was seen in 3. Intracranial tuberculosis, therefore can have many presentations such as meningitis, tuberculomas or rare varieties such as abscess, cerebritis or choroid plexus involvement. It can also lead to devastating complications such as hydrocephalus and infarcts.

INTRODUCTION
Tuberculosis can virtually affect any organ system of the body\(^1\). Initially, thought to be at a decline, it has had a resurgence in recent years with increasing number of cases seen in both immunocompromised and immunocompetent populations\(^2\). Brain involvement is perhaps one of the common manifestations of tuberculosis. A high index of clinical suspicion and familiarity with CT and MRI features of various intracranial appearances is important for the timely diagnosis and treatment of this disease\(^3\).\(^4\).\(^5\). Tuberculosis spreads to the brain mainly through the haematogenous route, however direct spread from contiguous regions such as middle ear cavity and spine has been reported\(^5\).\(^6\). The disease, if left untreated can have devastating sequelae\(^5\).

The purpose of this study is to observe various intracranial manifestations of tuberculosis which can vary and can be confused with other disease entities and to explain different signs of intracranial tuberculosis seen on Computerized Tomography and Magnetic Resonance Imaging.

PATIENTS AND METHODS
This was a descriptive study of 48 cases of proven intracranial tuberculosis, conducted between January 1, 2002 to June 30, 2002 in the Departments of Radiology, Mayo Hospital and Shaukat Khanum Hospital. The age group of the patients ranged from 9 years to 56 years, 29 of them were males and 19 were females. The symptoms of patients ranged from simple headache to neck stiffness, mild disorientation to unconsciousness. The diagnosis of tuberculosis was made by CSF analysis of all the patients. Only those patients were included whose CSF picture support the diagnosis of tuberculosis and were admitted only for followup purposes. The critically ill patients and those who were below 5 years of age and above 60 years, were excluded from the study. Consent was obtained from every patient included in this study. As this was a descriptive study, the data was analysed using proportions/percentages. The CT and MRI were performed after the CSF supported diagnosis.

RESULTS
In a total of 48 patients, 21(43%) had meningitis. 16 (33%) were found to have tuberculomas which also included 6 patients who had accompanying meningitis. Vasculitis resulting in lacunar infarcts was seen in 3(6%) patients. (6%). Hydrocephalus was seen in 5(10%) patients and choroid plexus tuberculosis (choroid plexitis) was seen in 3 (6%).
## Table 1: Division of the patients into subgroups.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Finding</th>
<th>No. of Patients</th>
<th>% age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Meningitis alone</td>
<td>21</td>
<td>43%</td>
</tr>
<tr>
<td>2.</td>
<td>Meningitis with hydrocephalus</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>3.</td>
<td>Meningitis with tuberculomas</td>
<td>6</td>
<td>12%</td>
</tr>
<tr>
<td>4.</td>
<td>Tuberculomas alone</td>
<td>10</td>
<td>21%</td>
</tr>
<tr>
<td>5.</td>
<td>Vasculitis</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>6.</td>
<td>Choroid plexus involvement</td>
<td>3</td>
<td>6%</td>
</tr>
</tbody>
</table>

In 43% of patients of tuberculous meningitis, the CT scan and MRI T1-weighted images showed intense meningeal enhancement after intravenous contrast predominantly in the basal cisterns area, in the fissures and cerebral cortex. (fig 1). The tuberculomas appeared as rounded or lobulated multiple masses of low or high attenuation on CT and isointense to hyperintense on T2 weighted MRI images in 21% of tuberculoma cases. (fig 2). The three patients (6%) of choroid plexitis showed enlarged choroid plexus with enhancement after intravenous contrast administration and were hyperintense on T1 MRI images with associated hydrocephalus in one case. (fig 3). Obstructive hydrocephalus was demonstrated by CT scans in some of the patients. (fig 4) The 6% cases had vasculitis resulting in infarcts in cerebral hemisphere (fig 5). Global ischaemia was seen in a child due to vasculitis as a result of tuberculous infection (fig 6).
Fig 3: Tuberculous choroids plexitis; Post contrast CT scan demonstrating enhancing enlarged right choroids plexus in (A) and (B). Similar findings demonstrated on MRI examination of a different patient (C) and (D). T1WI demonstrating enlarged enhancing choroid.

Fig 4: Communicating hydrocephalus; Non contrast CT scan demonstrating massively dilated ventricular system. Note dilated third and fourth ventricles in (A) and lateral ventricles in (B).

Fig 5: Infarcts resultant from vasculitis; CT scan demonstrating infarct in the distribution of right middle cerebral artery and its perforator branches in sylvian fissure (A). A corresponding proton density weighted MR image (B).

Fig 6: Diffuse anoxic injury: Post contrast CT scan demonstrating diffuse atrophy of the brain with prominent CSF spaces in a 7 year old with history of tuberculosis.

DISCUSSION
The intracranial involvement of tuberculosis can be divided into meningeal and parenchymal involvement. All the data of patients was compared with other studies performed on tuberculosis and the signs seen on CT and MRI properly compared with known international standards.

Tuberculous meningitis is the largest group in this study. Meningeal involvement is isodense or hyperdense relative to the basal cisterns at non contrast CT and demonstrates intense, often homogeneous enhancement after contrast administration\(^7\). This enhancement extends into hemispheric fissures and over the cortical surfaces of the brain. MR imaging findings vary depending on the stage of the disease. In the early stages, findings at unenhanced imaging tend to be normal. Gadolinium-enhanced T1-weighted imaging demonstrates abnormal meningeal enhancement that is more pronounced in the basal cisterns\(^7\). There is also the involvement of the meninges within the sulci over the cerebral convexities and in the sylvian fissures\(^8,9\). This enhancement of the basal cisterns corresponds to the gelatinous exudates\(^8,10\). The tuberculomas most of the time are multiple. The frontal and parietal lobes are the most commonly affected regions\(^11\). At CT, tuberculomas appear as rounded or lobulated masses with low or high attenuation\(^12,13\). The MR imaging features of a tuberculoma depended on whether it is noncaseating or caseating. Noncaseating tuberculomas are often hyperintense on T2-weighted images with homogeneous (nodular) enhancement. Caseating tuberculomas are
isointense to markedly hypointense on T2-weighted images and exhibited rim enhancement\textsuperscript{11,14}. Choroid plexus tuberculosis, although a rare presentation of tuberculosis, has been reported previously\textsuperscript{(15)}. We found three patients with choroid plexus involvement. Choroid plexus tuberculosis is hyperdense on plain CT, hyperintense on T1 MRI and increases in size after contrast. They show intense homogenous enhancement after IV contrast\textsuperscript{16,17}. Associated hydrocephalus is seen in the affected ventricle along with ventriculitis in one case. Other complications of intracranial tuberculosis manifest in the shape of vasculitis mostly of the major arteries and also small perforating vessels which are laden with thick exudates resulting in ischaemic infarcts and communicating hydrocephalus. Obstructive hydrocephalus results from obstruction of the cerebrospinal fluid pathway by a focal parenchymal lesion\textsuperscript{(18)} and thick intraventricular exudates also obstruct the CSF flow by plugging the cerebral aqueduct. Diffuse cerebral atrophy has been reported as a consequence of global ischaemia, commonly seen in children.

Other, rare forms of intracranial tuberculosis have been reported, they include intracranial abscess, cerebritis and miliary central nervous system tuberculosis. Miliary tubercles appear as numerous round, homogeneously enhancing lesions less than 2 mm in diameter.

**CONCLUSION**

In conclusion tuberculosis, can have many presentations such as meningitis, tuberculomas or rare varieties such as abscess, cerebritis or choroid plexus involvement. It also can lead to devastating complications such as hydrocephalus and infarcts. The differential diagnosis of cranial and spinal tuberculosis includes other infectious or noninfectious diseases (eg, sarcoidosis, toxoplasmosis, lymphoma, pyogenic and fungal infections), multicentric primary neoplasms (eg, haemangio blastsoma, gliomas,etc), and metastases. A high index of clinical suspicion is also warranted to combat this disease. So look out for tuberculosis, it can be anywhere in the brain and can show atypical findings.

**REFERENCES**