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Research Article

A Study of CT Findings in Children with Neurotuberculosis

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Abstract

Objectives: To study the computed tomography (CT) features of tuberculous meningitis in children.
Methods: A total of 45 patients diagnosed with neurotuberculosis were included. Cranial CT scans were done in these patients with and without IV contrast. The CT results were evaluated.
Results: CT findings were abnormal in 41 (91.11%) and normal in 4 (8.89%). Basal exudate was the most common finding, seen in 25 (55.55%) cases followed by hydrocephalus in 15 (33.33%) cases. Infarcts were seen in 8 (17.77%), tuberculoma in 6 (13.33%), cerebral oedema in 3 (6.66%) children, cerebral atrophy and cerebral abscess were 1 (2.22%) each.
Conclusion: CT is abnormal in the great majority of patients with neurotuberculosis and can aid in the diagnosis. Basal enhancement was the most common finding in our study.
Keywords: CT scan, meningitis, tuberculosis, children

1. Introduction

Tuberculosis is a major global health problem. Worldwide about 8.6 million people developed tuberculosis in 2012, among whom 1.3 million died of the disease.[1] Despite India having a robust antituberculosis programme, one fourth of the global incident tuberculosis cases occur in India annually.[2]

Central nervous system tuberculosis generally mirrors the incidence of tuberculosis in the community. Around 10% of patients who have tuberculosis elsewhere in the body develop neurotuberculosis.[3.] The most important complication of primary tuberculous infection that leads to high mortality and morbidity is neurotuberculosis.[4]

The diagnosis of neurotuberculosis frequently constitutes a difficult problem. Partially treated meningitis may give a similar cerebrospinal fluid (CSF) picture as that of tuberculous meningitis (TBM).[5,6] There is also a diagnostic dilemma between TBM and other meningoencephalitides.[6] As delay in diagnosis and treatment leads to greater morbidity and mortality, the emphasis should be on early diagnosis of neurotuberculosis.[7,8]

The role of CT in early diagnosis of TBM and its complications is well established.[8,9,10] It is valuable in identifying intracranial lesions which are characteristic of neurotuberculosis. Cranial CT scan within 1 week of initial symptoms may reveal basilar enhancement or infarction. When combined with CSF findings atypical for common bacterial infection, these radiologic findings support the prompt initiation of antitubercular therapy.[11] Magnetic resonance imaging (MRI) is in general more sensitive to the detection of neurotuberculosis,[12] but is more expensive, requires more time, not easily accessible in developing countries and there are technical considerations of life support equipment and need for sedation/anaesthesia in younger children. Hence CT is still the diagnostic imaging mainstay in many resource poor settings to demonstrate the various aspects of neurotuberculosis on initial presentation and monitor the evolution of the disease and response to therapy as it is easily accessible and rapid. There are few studies documenting the CT findings in children with neurotuberculosis. This study was undertaken to evaluate the profile of radiological features of neurotuberculosis in an exclusively pediatric population.

2. Materials and method

Children between 6 months to 18 years of age admitted to the teaching hospitals attached to a medical college, who were diagnosed as neurotuberculosis were included in the study. The diagnosis of neurotuberculosis was made according to a predesigned protocol, which included detailed history, physical examination and relevant investigations. Clinical grading at the time of presentation for all patients were done according to the British Medical Council staging.[13] All patients underwent Mantoux test, CSF examination, chest x-ray, and CT scan.

CT scans before and after IV administered contrast material was obtained on a Siemens Somotom ARC computed tomography system which is a modified third generation machine. The CT study was performed according to the departmental protocol specifying sequence and method. Reading of study was done by a consultant radiologist. The CT studies were reported as normal or abnormal. The abnormal CTs were further grouped as: basal enhancement (post contrast), hydrocephalus, granulomata, infarcts, abscess, atrophy and cerebral oedema.

3. Results

A total of 45 patients diagnosed as neurotuberculosis were included in the study. CT was abnormal in 41 (91.11%) out of 45 cases and was normal in 4 (8.89%) cases.

Table 1: CT features

Features	No. (n = 45)	Percentage (%)
Basal exudates	25	55.55
Hydrocephalus	15	33.33
Infarct	8	17.77
Tuberculoma	6	13.33
Cerebral Oedema	3	6.66
Cerebral atrophy	1	2.22
Cerebral abscess	1	2.22
Normal	4	8.88

Table 1 shows the various features seen on CT. The most common features were basal exudates, followed by hydrocephalus, infarcts and tuberculoma respectively. Majority (80%) of hydrocephalus was communicating type, only 20% had obstructive type. Most (87.5%) infarcts were seen in the middle cerebral artery(MCA) territory and very few(12.5%) in the anterior cerebral artery(ACA) territory. Tuberculomas were supratentorial in location and solitary in majority patients (83.3%), infratentorial in only one patient and they were multiple. Cerebral oedema was seen in a few children and other features like cerebral atrophy and cerebral abscess were seen in 1 each.

Table 2: TBM stages with CT features

	Be	Hc	In	Tu	C Oe	2f	3f	N	At	Total	%
Stage I	1	-	-	-	-	1	-	-	-	2	4.4
Stage II	7	1	1	5	1	2	-	2	1	20	44.44
Stage III	5	3	2	-	-	7	4	2	-	23	51.12
Total	13	4	3	5	1	10	4	4	1	45	100

Note: Be- basal exudates, Hc-hydrocephalus, In-infarcts, Tu-tuberculoma, C Oe-cerebral oedema, 2f-2 features 3f-3 features, N-normal, At-atrophy.

Table 2 shows the distribution of CT features found in the various stages of TBM. Most children presented with stage 3 disease. Basal exudates were the commonest feature in stage two diseases and almost 50% had multiple features in stage 3.

4. Discussion

The early diagnosis of TBM remains difficult especially in children, as they may present with insidious onset and non specific clinical findings.[14,15,16] CT helps in recognising features suggestive of CNS tuberculosis like basal enhancement, tuberculoma and identifying complications of TBM including infarction and hydrocephalus.[8,17,18,19] The common triad of CT findings in TBM are:

1. Basal meningeal enhancement
2. Hydrocephalus
3. Infarction

In our study CT was abnormal in majority of cases.

Table 3: Comparison of CT features in various studies.

CT features	Present study	Pienaar et al[12] N=30 (%)	Kingsley et al[20] n = 25 (%)	Bullock et al[5] (%)	Bhargava et al[21] n=60 (%)	Kumar et al[18] (%) n=94
Basal exudates	55.55	70	64	64.2	81.66	82.7
Hydrocephalus	33.33	76.66	84	76	83.05	80.6
Infarcts	17.77	70	32	20.5	28.33	19.3
Tuberculoma	13.33	16	28	-	10	23.6
Cerebral oedema	6.66	-	-	-	3.33	-
Cerebral atrophy	2.22	-	-	-	-	6.45
Cerebral abscess	2.22	-	-	-	-	-

Basal exudate is the most consistent feature of TBM. The highest sensitivity (83%) and specificity (100%) for the diagnosis of TBM has been found to be for basal enhancement.[18] It was the commonest finding on CT in the present study. Similar observation was made by Kumar et al.[18] Other studies had a higher occurrence of basal exudates than ours.[12,21]

Hydrocephalus is the most frequent complication of TBM and is generally more prominent in the pediatric age group.[9] Most studies had a high occurrence of hydrocephalus and it was also the commonest feature seen on CT,[5,12,20,21] whereas our study had a significantly low occurrence at 33.33%. However a study done in Pakistan found hydrocephalus in less than 10% of patients.[23]

Majority of the hydrocephalus in our study were of the communicating type as reported in literature.[3,9] Communicating hydrocephalus is due to blockage of the basal cisterns by tubercular exudates in the acute stage and adhesive leptomeningitis in chronic stages. Of the three obstructive hydrocephalus cases in our series, one was due to blockade of the aqueduct by multiple tuberculomas, one due to pressure by cerebral abscess and another may be due to entrapment of the ventricle by granulomatous ependymitis.

Infarcts are another common complication of basal meningitis which contributes to the morbidity and mortality. The reported frequency of infarcts demonstrated on CT varies from 20.5% to 38%[5,,13,18,21] which correlates with our series. However in the study by Piennar[12] 70% of the patients had infarcts on CT. Most infarcts in our series were in the MCA territory similar to that reported by Bhargava et al[21], however they also had involvement of the PCA territory. Infarcts in the PCA territory are picked up better by MRI.[12]

Compared to basal exudates and hydrocephalus, tuberculomas are infrequently seen. The occurrence of tuberculoma in our series correlated well with other studies.[13,18,21] The CSF analysis in about 70% patients with tuberculoma in our study was normal, which highlights the importance of CT in the diagnosis of TBM.

Other than the classical triad, associated features like cerebral oedema and atrophy have been reported by very few studies. A study done in Pakistan reported cerebral oedema in14% and cerebral atrophy in 4%.[24] Cerebral atrophy in neurotuberculosis can attributed to be secondary to the infection itself.

We also report the rare occurrence of tubercular abscess in one patient which has hardly been reported by other studies documenting CT features. Tubercular brain abscess is a rare complication seen in less than 10% of all patients with neurotuberculosis.[26]

Piennar demonstrated that MRI detected basal exudates, tuberculoma and infarcts missed on CT and that hydrocephalus is equally picked by both CT and MRI.[12] However as MRI was not available at our institute it was not done in any patient. Probably it would have revealed some abnormality in the 4 patients with normal CT in our study.

An early diagnosis of neurotuberculosis is crucial for treatment and prognosis. Approximately 95% of our patients presented in stage 2 or 3. Low socioeconomic status and educational level may have contributed to the patient's families seeking treatment at a later stage. Majority of our patients were in

stage 3 at the time of presentation followed by stage 2. This is different from the two series in Pakistan[3,25]; which had majority of patients in stage 2 followed by stage 3. This suggests that patients were sicker in our study group as also inferred by the occurrence of majority of multiple findings on CT in stage 3.

Interesting part of our study is reporting the number of occurrence of multiple features in the various stages of TBM which very few studies have done.

4. Conclusion

CT scanning demonstrates abnormalities in majority of patients with neurotuberculosis. Our study highlights the importance of CT in patients with tuberculoma who may have normal CSF and hence may lead to diagnostic confusion. In endemic areas like India, along with clinical and other laboratory features, CT scanning is an important adjunctive in the diagnosis and management of CNS tuberculosis.

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