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Role of Magnetic Resonance Imaging and Spinal Tap in Early Diagnosis of Tuberculous Meningitis

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ABSTRACT

Background: Tuberculous meningitis (TBM) is difficult to diagnose in early stages due to nonspecific symptoms. There should be high index of suspicion to diagnose TBM at an early stage. The objective of the study was to find out the role of magnetic resonance imaging (MRI) and spinal tap in early diagnosis of tuberculous meningitis.

Material and Methods: A cross sectional study was conducted from July 2015 till July 2018 at Neuromedicine ward, Jinnah Postgraduate Medical Centre (JPMC), Karachi. All patients above 12 year of age, both male and female with nonspecific symptoms like headache, malaise and drowsiness or suspicion of TBM (stage I, II, and III according to British Medical Research Council TBM staging criteria) were included in the study. Patients diagnosed with other CNS disease like encephalitis, malaria and acute bacterial meningitis were excluded. Magnetic Resonance Imaging (MRI) of the brain and early spinal tap for cerebrospinal fluid (CSF) analysis were used to diagnose TBM and findings were noted. Results of MRI and CSF analysis were analyzed by SPSS version 24.

Results: A total of 110 patients of TBM, with 60 (54.5%) male and 50 (45.5%) female patients were included in the study. Most of the patients belonged to a younger age group of 12-40 years (81.8%), while 18.2% were above 40 years of age. About 90% patients were diagnosed in stage I TBM and 10% in stage II and III. MRI brain findings included meningeal enhancement (60%), hydrocephalus (41.81%) cerebral edema (82.73%), tuberculoma (19%) and infarct (14.5%), respectively. CSF analysis showed low protein in 80%, low glucose in 91.8% and lymphocytic pleocytosis in 97.2%, respectively.

Conclusion: Both MRI brain and spinal tap with CSF analysis played a role in the early diagnosis of TBM, which is important to prevent the lethal complications associated with late diagnosis of this disease.

Key words: Brain, Cerebrospinal fluid, Magnetic Resonance Imaging, Tuberculous meningitis

Authors' Contribution:
Conception, synthesis, planning of research and manuscript writing Interpretation, discussion, Active participation in data collection
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Introduction

Tuberculous meningitis (TBM) is difficult to diagnose in early stages due to nonspecific symptoms. There should be a high index of suspicion to diagnose TBM at an early stage. History of BCG vaccination does not rule out TBM. In stage I, TBM patients can usually present with nonspecific symptoms like fever, headache, drowsiness, confusion, malaise and fatigue.[1] Duration of symptoms may be from days to many months. Patients sometimes present with visual symptoms and wrong diagnosis can be made. TBM patients can also present with monoplegia, hemiplegia, aphasia, tetraplegia, cranial nerve palsies in stage II disease and with coma in stage III disease[1].Definitive diagnosis of TBM can be made by finding tubercle bacilli in CSF by culture.[1] Large volume (10ml) is required to find tubercle bacilli in culture especially in ventricular fluid. PCR is 98% specific for diagnosis of TBM performed on CSF.[1] Tuberculin skin test is not specific or sensitive for diagnosis of active TBM. Patients with TBM should be preferably evaluated with contrast enhanced CT imaging and it can diagnose early TBM and hydrocephalus due to TBM. Choroid

plexuses enhancement with ventricular enlargement is suggestive of diagnosis of TBM.[2]

MRI reveals diffuse thick meningeal enhancement. Cerebral infarct can also be seen in MRI brain. Basal enhancement hydrocephalus and infarction are diagnostic for TBM.[3] Contrast enhanced MRI is generally considered best diagnostic test for TBM. TBM is usually secondary to pulmonary TB so chest X-Ray is also important for diagnosis of TBM. Serial transcranial Doppler ultra-sonography with blood flow velocity and pulsatility index measurement can be used to find out the prognosis of TBM and to find out the infarct resulting in permanent neurological deficit or death.[4]

The rationale of this study was early diagnosis of tuberculous meningitis to prevent complications associated with late stage disease. By avoiding early use of MRI and spinal tap, we can delay the diagnosis of TBM which leads to increase in mortality and morbidity, when infarct and hydrocephalus develops. So even with mild symptoms, MRI and early spinal tap can detect the TBM in stage I. Therefore, the present study was conducted to find out the role of MRI and spinal tap in diagnosing early stage TBM

Material and Methods

This was a cross sectional observational study conducted at Neuromedicine ward, Jinnah Postgraduate Medical Center (JPMC) Karachi, from July 2015 to July 2018. Patients with a clinical suspicion of TBM, of both gender (male and female) and above 12 years of age were included. Patients presenting with fever, headache, drowsiness, confusion, malaise, myalgia, fatigue, visual loss, coma and atypical symptoms like monoplegia, tetraplegia, hemiplegia neck stiffness, afebrile fits or cranial nerve palsy were investigated for TBM.

Patients diagnosed with other diseases of CNS like encephalitis bacterial meningitis, viral meningitis, subarachnoid hemorrhage and cerebral malaria were excluded. TBM Patients with nonspecific symptoms like fever, headache and vomiting were classified as stage I TBM, those presenting with altered consciousness as stage II TBM and patients with coma were classified in stage III TBM, according to the criteria of TBM severity outlined by British Medical Research Councill.[2] BCG vaccination history was taken if family history of tuberculosis was found positive, and suspicion of TBM was made even with mild nonspecific symptoms. Laboratory investigation like CBC, urea, creatinine, random blood sugar, liver function tests and specific investigations like Mantoux test and X-Ray chest were carried out. Fundoscopy was also done. Spinal tap was done and CSF analysis with AFB staining and culture was performed. MRI brain was carried out in all equivocal patients to diagnose the TBM in stage I. MRI findings like meningeal enhancement, hydrocephalus, cerebral edema, tuberculoma and infarct were noted. CSF findings like raised proteins, low glucose and lymphocytic pleocytosis were also recorded. Data was analyzed using SPSS version 24.

Results

A total of 110 patients of TBM above 12 years of age with 60 (54.5%) males and 50 (45.5%) females were included in the study. Most of the patients (n=99; 90%) presented in stage I, while the remaining (n=11; 10%) were stage II and/or stage III patients. About 90 (81.86%) patients were between 12-40 years of age and 20 (19.19%) patients were above 40 years of age. Complications included death due to TBM in 11 patients (10%) and hydrocephalus, cranial nerve palsies, hyponatremia in 33 patients (30%). Other TBM patients (n=66; 60%) recovered uneventfully. About 33 patients (30%) were diagnosed with associated pulmonary tuberculosis, and 44 (40%) with associated TB abdomen and TB lymph node. MRI findings were significant even in patients with nonspecific symptoms like basilar meningeal enhancement. MRI and CSF findings are given in Tables I and II, respectively.

Table: I MRI findings in TBM patients

MRI brain findings	No. of patients (n=110)	Percentage
Meningeal enhancement	66	60
Hydrocephalus	46	41.8
Cerebral edema	91	82.7
Tuberculoma	21	19
Infarct	16	14.5

Table: II CSF findings in TBM patients		
CSF Findings	**No. of patients (n=110)**	**Percentage**
Raised protein	88	80
Low glucose	101	91.8
Lymphocytic pleocytosis	107	97.2

Almost all the patients except one (n=109; 99.09%) had MRI findings suggestive of TBM with further confirmation on CSF analysis.

Discussion

TBM patient can present with early or late symptoms. Early diagnosis of the condition is important to prevent death or disability. In stage I of TBM, patients usually presented with non-specific symptoms like headache, vomiting, fever, myalgia and lethargy. In stage II of TBM, patients presented with altered level of consciousness and focal deficits, while in stage III of TBM, patients with coma and focal neurological deficit were included. To prevent brain infarction or hydrocephalus which leads to death or disability, it is important that early MRI should be done to diagnose TBM, so that anti-tubercular treatment (ATT) can be started in initial stages of TBM. Early lumbar puncture for CSF analysis and MRI brain should be done for diagnosis of TBM.

MRI brain shows diffuse basilar meningeal enhancement and cerebral infarct can be seen in 30% of TBM patients.[5] A study conducted in South Africa reported that combination of basilar enhancement, hydrocephalus and infarction was 100% specific and 41% sensitive for diagnosis of TBM.[6] In this study, meningeal enhancement was present in 60%, tuberculomas in 19%, while infarct was found only in 14.5% of TBM patients. Tuberculoma and infarcts are usually present in stage II and stage III of TBM disease. Most of our patients were diagnosed in TBM stage I, so tuberculoma and infarcts were less common in this study. Brain edema was the most common finding because of the early presentation of majority of TBM patients in this study. Imaging studies, especially MRI has an important role in diagnosing TBM, because clinical diagnosis is often difficult.[7]

Spinal tap carries the risk of tonsillar herniation in patients with raised intracranial pressure. Tuberculin skin testing also has limited value because patients vaccinated with BCG also turn out to be positive. However, in spite of the associated risk, the procedure of spinal tap must be performed for diagnosis of TBM.[8] CSF finding in this study revealed raised protein in 80%, low glucose in 91.8% and lymphocytic pleocytosis in 97.27%. Almost similar values for CSF analysis have been reported in another study.[9]

Adenosine deaminase levels in CSF (CSF ADA) greater than 6 strongly suggest the diagnosis of TBM. Most guidelines for diagnosis of TBM agree on simple CSF analysis such as low glucose, low protein and presence of lymphocytic pleocytosis. But this investigation has limitation when antibiotic has been already given. Therefore, adjuvant MRI brain can diagnose the TBM earlier.[10] In this study we attempted to diagnose TBM in early stage to avoid lethal complications like hydrocephalus, hyponatremia, cranial nerve palsy, stroke and death from TBM, and to start disease eradication by ATT therapy.

MRI brain is not available in primary- and secondary-care centers, so physicians should refer the TBM patient to the tertiary-care center for CSF analysis and MRI scan for early diagnosis and to prevent lethal complications of the disease. In this study, we carried out MRI brain in all patients with clinical suspicion of TBM presenting with non-specific symptoms and were able to diagnose TBM in stage I in 90% of our patients. Computerized tomography (CT) findings in TBM do not corroborate the clinical presentation, while MRI has the potential to diagnose with more sensitivity than CT scan, especially in detecting basal enhancement and infarcts,[11] both in brain and spine.[12,13] Therefore MRI is superior to CT scan for diagnosing TBM.[11] Rapid diagnoses of TBM is crucial and delay in diagnosis is associated with poor prognosis. Laboratory diagnosis of TBM also has low sensitivity, so early MRI brain is mandatory because once the neurological symptoms are advanced and patient presents in coma or with neurological deficit, then diagnosis is obvious, but the prognosis is poor. According to WHO “End TB strategy” program, 80% reduction in TB incidence by 2030 and 90% reduction in TB-related deaths can be achieved through early diagnosis (e.g. CSF analysis, MRI etc.) and appropriate treatment (ATT).[14]

Meningitis is most common in children[15] and adolescent mainly due to hematogenous spread with the primary focus mostly present in the lungs. JPMC is a public sector hospital which caters to the treatment of adult population while children are referred to the nearby National Institute of Child Health (NICH). Therefore, we excluded children from our study, which was also a limitation. Another limitation was non-availability of diffusion weighted MRI, which can detect infarction in hyper acute stage.

Conclusion

Both MRI brain and spinal tap with CSF analysis played a role in the early diagnosis of TBM, which is important to prevent the lethal complications associated with late stage disease.

References

1. M.F Torok. Tuberculosis Meningitis: Advance in diagnosis and treatment of TBM; Br Med Bull. 2015; 113(1): 117-131. Doi: 10.1093/bmb/ldv003
2. Thwaites GE, Bang ND, Dung NH, Quy HT, Oanh DTT, Thoa NTC, et al. Dexamethasone for the treatment of tuberculous meningitis in adolescents and adults. N Engl J Med. 2004; 351: 1741-51. Doi: 10.1056/NEJMoa040573
3. Namani S, Dreshaj S, Berisha AZ. Tuberculous meningoencephalitis associated with brain tuberculomas during pregnancy: a case report. J Med Case Rep. 2017 11:175. Doi: 10.1186/s13256-017-1347-7
4. Trivedi R, Saksena S, Gupta RK. Magnetic resonance imaging in central nervous system tuberculosis. Indian J Radiol Imaging. 2009; 19(4): 256-65. Doi: 10.4103/0971-3026.57205
5. Ros K L. Pearl and Pitfall in Diagnosis and Management of Central Nervous System Infectious Disease. Semin Neurol. 1998; 18(2): 185-96. Doi: 10.1055/s-2008-1040872
6. AndroNikog S, Smith B, Hathushill M, Douis H, Wiliamhust J. Definite Neuroradiological Diagnostic Features of Tuberculosis Meningitis in children. Pediatr Radiol. 2004: 34(11): 876-85. Doi: 10.1007/s00247-004-1237-1
7. Medscape.https://emedicine.medscape.com/article/344862-overview
8. Tarakad S, Ramachandral. Tuberculosis Meningitis Workup; Neurology. 2017 Medscape. https://emedicine.medscape.com/article/1166190-workup
9. Qamar FN, Rahman AJ, Iqbal S, Humayun K. Comparison of clinical and CSF profiles in children with tuberculous and pyogenic meningitis; role of CSF protein: glucose ratio as diagnostic marker of tuberculous meningitis. J Pak Med Assoc. 2013; 63(2): 206-10. PMID: 23894896
10. Solari L, Soto A, Agapito JC, Acurio V, Vargas D, Battaglioli T.et al Validity of CSF Parameters for Diagnosis of TBM: Int J Infect Dis. 2013; 17(12): e1111-5. Doi: 10.1016/j.ijid.2013.06.003
11. Pienaar M, Andronikou S, van Toorn R. MRI to Demonstrate the Diagnostic Feature and Complication of TBM not seen with CT; Childs Nerve Syst. 2009; 25(8): 941-947.
12. Verdon R, Chevret S, Laissy JP, Wolff M. Tuberculosis Meningitis in Adult, a view of 48 cases: Clin Infect Dis. 1996; 22(6): 982-8. Doi: 10.1093/clinids/22.6.982
13. Hernaldiz, Albaujar S, Andres JR, Roya A, Gorzalez, Jarcia JJ, Panajal, Vazkuez. Tuberculosis Radiculomyelitis complicating Tuberculosis Meningitis; A Case Report: Clin Infect Dis. 2011; 53(9): 915–926. Doi: 10.1086/313821
14. World Health Organization. Global tuberculosis report 20th edition. World Health Organization, Geneva; 2015
15. Sanei Taheri M, Karimi MA, Haghighatkhah H, Pourghorban R, Samadian M, Delavar Kasmaei H. Central Nervous System Tuberculosis: An imaging focus review of reemerging disease: Radiol Res pract. 2015; 2015: 202806. Doi: 10.1155/2015/202806.