



RESEARCH ARTICLE

EVALUATION OF NEUROIMAGING STUDIES IN CNS INFECTIONS AND ITS CORRELATION WITH CLINICAL PRESENTATION IN CHILDREN IN BIHAR

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Abstract:

Introduction:

CNS infections are an important cause of morbidity among children. They may have similar clinical presentation and hence pose a difficulty in diagnosis of TBM, pyogenic meningitis, encephalitis and brain abscess. Material and Methods: This prospective study was carried out in pediatrics department, Patna medical college and hospital, Patna from June 2012 - September 2014. Seventy five children were selected between 2 months to 15 years age groups for neuroimaging study having clinical feature of CNS infections.

Results: Out of 75 cases 33% TBM, 27% Pyogenic meningitis, 22% encephalitis, 13% NCC, and 5% cases were brain abscess. Fever was present in all cases of brain abscess, 75% of encephalitis, 66.6% of pyogenic meningitis and in 45.83% of TBM. Seizure was present in 90% cases of NCC, 71.84% cases of pyogenic meningitis, 50% cases of encephalitis and 45.83% cases of TBM. Eighty one percent cases of encephalitis and 65% cases of pyogenic meningitis were presented with altered sensorium. CT scan finding of TB were basal exudates (83.33%), hydrocephalus (79%), tuberculoma (25%), infarction (20.8%) and that of meningitis were ventriculomegaly (40%) and subdural effusion (20%). Hypodense lesion in medial portion of temporal lobe on CT scan was present in 81.2% cases of encephalitis. Ring enhancement was found in brain abscess (75%) and NCC (50%).

Conclusion: Neuroimaging techniques like CT scan or MRI are non invasive with high degree of sensitivity in differentiating CNS infection.

Key words- CNS infections, Neuroimaging, TBM, CT scan,

INTRODUCTION

CNS infections are life threatening condition and prognosis depends on early identification and site of involvement and pathogen to start effective therapy as early as possible. Blood investigation and CSF examination are gold standard to identify pathogen but neuroimaging is crucial for identification of inflammatory lesion of brain, leads to rapid diagnosis and appropriate treatment.¹

Partially treated bacterial meningitis may reduce the incidence of Gram positivity and renders the culture sterile. Pleocytosis with lymphocytic predominance may present in early stage of bacterial meningitis lead to search for newer investigation and tests.² **Neurotuberculosis** is one



of the most serious complications of primary tuberculous infection.³ This may be tuberculous meningitis and tuberculoma.

Brain abscess are collection of infectious material within [brain](#) tissue. [Lumbar puncture](#) procedure, which is performed in many infectious disorders of the central nervous system is contraindicated in this condition. The diagnosis is established by neuroimaging (CT) (with contrast) which gives [ring-enhancing lesion](#) appearance.^{4,5}

Encephalitis is defined as inflammatory process of the CNS with dysfunction of brain. The cause of encephalitis are mostly viral, most common is Herpes Simplex Type1. Encephalitis, localizing sign(focal seizure, focal paralysis, focal EEG changes) presence of RBC in CSF and involvement of temporal lobe is diagnostic clue.^{6,7} When cysticercosis involves the central nervous system, it is called **neurocysticercosis(NCC)**.The diagnosis of NCC is still a dilemma. But with the advent of modern neuroimaging technique it has given us a milestone in correct diagnosis of many similar presenting diseases.

This study is being undertaken to evaluate neuroimaging finding in intracranial infections so as to resolve the diagnostic dilemma. Early diagnosis and institution of appropriate therapy is crucially important for a favourable outcome.

Patna medical college and hospital caters a wide population-patients coming from different corners of state and adjacent states like UP and Bengal etc. Patients also come from other countries like Nepal. So the study done in OPD & inpatient reflects a wide population.

MATERIAL AND METHODS:

This study "Evaluation of Neuroimaging studies in CNS infection and its correlation with clinical presentation in children in Bihar" was prospective study done in department of pediatrics, Patna Medical College and Hospital, Patna during period of June 2012 to September 2014.

The aim of study was 1) to determine the changes occurring in neuroimaging in cases of TBM, pyogenic meningitis, herpes encephalitis, neurocysticercosis and brain abscess. 2) Evaluate the utility of neuroimaging to resolve the diagnostic dilemma between intracranial infections. 3) Study the sensitivity and specificity of neuroimaging finding in intracranial infections.

Children between two months to fifteen years of age of either sex admitted from OPD and emergency with clinical feature suggestive of intracranial infections were selected for the study. After clinical examinations, blood investigations and CSF examination, neuroimaging was done in seventy five patients. Critically ill children was excluded from this study.

CT scan of brain was done in department of radiology PMCH, Patna as well as in private centers. Radiologist was blinded to clinical diagnosis and CSF finding. CT scan finding were compared in patients of pyogenic, tubercular meningitis and herpes encephalitis to see which feature were common in any one group. The sensitivity and specificity of these finding were calculated.

**RESULTS:**

Incidence of pyogenic meningitis was higher than tuberculous meningitis and encephalitis in infants but 70.8% TBM and 66.66% encephalitis were of 3-9 years of age group. Neurocysticercosis(66.6%) was present in 9-15 years age group, while 50% of brain abscess found in 6-8 years age group(table1). Out of 75 patients 47 belonged to lower socio economic group and only 7 patients from upper socioeconomic group (Table2).

Tuberculous infection (TBM) was most common infection (33%) followed by pyogenic meningitis(27%), encephalitis(22%) NCC(13%) and brain abscess(5%)(Table3).

Fever was presenting complain in hundred percent cases of brain abscess,75% of encephalitis, 66.6% cases of pyogenic meningitis and 45.83% cases of TBM. Headache was present in 70% cases of NCC, in 50% of encephalitis. Ninety percent of NCC patients was presented with convulsion, while in 71.4% pyogenic meningitis, 50% encephalitis and 45.83% TBM convulsion was present. Out of 75 patients 13 of encephalitis, 14 of pyogenic meningitis and 9 of TBM patients were presented with altered sensorium. Vomiting was mainly present in TBM(82.3%), pyogenic meningitis(61.9%), encephalitis. Four patients of TBM and 3 patients of pyogenic meningitis had presented with cranial nerve palsy (Table4).

Out of 24 patients of TBM 22 had CT abnormalities. Basal enhancement were present in 20 cases(83.3%), hydrocephalous in 19 cases(79.1%) , cerebral infarction 5(20.8%),in tuberculoma in(29.1%) cases. The principal changes in CT scan of brain in pyogenic meningitis were ventriculomegaly(40%) and subdural effusion (20%) , in encephalitis were hypodense lesion in medial portion of temporal lobe(81.2%), in NCC were ring enhancement(50%) and calcification(30%) and in brain abscess were ring enhancement(75%) and cerebral edema. Normal CT scan was found in 35% cases of pyogenic meningitis, 30.7% cases of encephalitis and 2% cases of TBM(Table5).

In TBM sensitivity of basal enhancement and tuberculoma were 84.4% and 39.1% respectively while specificity of both were found to 100% and positive predictive value 100%. In pyogenic meningitis the specificity of subdural effusion was 96.9% but sensitivity was only 14.2%.In herpes simplex encephalitis hypodense lesion in medial portion of temporal lobe has high specificity(88.8%) and negative predictive values(78.4%) (Table6).

Table 1: Age distribution of cases CNS infections

Age	TBM	PM	Encephalitis	NCC	Brain abscess
2 month-1years	1	2	1	1	0
1-3years	4	4	2	1	1
3-6years	12	9	4	2	1
6-9years	5	3	6	2	2
9-15 years	2	2	2	4	0

Table 2: Socio economic status wise distribution



Status	No. of cases	Percentage
Lower	47	63.33
Middle	21	28.33
Upper	7	8.33

Table 3: Distribution of cases of CNS infections

Type of CNS infection	No. of cases	Percentage
Tuberculous	24	33
Pyogenic	20	27
Encephalitis	16	22
NCC	10	13
Brain abscess	04	05

Table 4: Clinical feature in CNS infections

Clinical feature	TBM no. of caese(%)	PM no. of cases(%)	Encephalitis no. of cases(%)	NCC no. of cases(%)	Brain abscess no of cases(%)
Fever	11(45.83)	14(66.66)	12(75)	0	4(100)
Convulsion	11(45.83)	15(71.4)	8(50)	9(90)	2
Headache	9	9	8(50)	7(70)	3(75)
Altered sensorium	9	14	13(81.25)	0	0
Vomiting	18(82.3)	13(61.9)	6	0	0
Hemiplegia	6	4	0	3(30)	2
Cranial nerve palsy	4	3	0	0	0

Table 5: Diagnostic indices of CT finding in CNS infection



CT finding	TBM	PM	Encephalitis	NCC	Brain abscess
Basal enhancement	88.33%				
Hydrocephalus	79%				
Tuberculoma	25%				
Infarction	20.8%				
Subdural effusion		20%			
Ring enhancement				50%	75%
Ventriculomegaly		40%			
Hypodense in temporal lobe			81.25%		
NoCT changes	8.3%	35%	30%		

Table 6: Diagnostic indices of CT finding in CNS infections

	TBM		PM		E		PPV	NPV
CT finding	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity		
Subdural effusion			14.2%	96.9%			80%	56.4%
Basal enhancement	84.4%	100%					100%	84.4%
Tuberculoma	39.1%	100%					100%	54.9%
Hypodense in temporal lobe					26.6%	88.8%		

DISCUSSION:

The present study comprised of 75 children of 2 months to 15 years age group. The major differential diagnosis of intracranial infections in children TBM, pyogenic meningitis, viral encephalitis, NCC and brain abscess. Incidence of pyogenic meningitis is higher than TBM, viral encephalitis, brain abscess in infancy^{8,9}. Immune system was not well developed to fight against the capsulated organism. In this study children from lower socio economic group have higher incidence of CNS infections and this is because of under nutrition, impaired immunity, lack of awareness about vaccination, poor sanitation and overcrowding.

Pyogenic and tubercular meningitis have similar presentation specially if prior antibiotic was given^{10,11}. Antibiotic therapy renders the CSF sterile and often change cellular reaction to lymphocytic.



Increased mortality and morbidity are important complications of CNS infections so CT scan is widely used investigation modality in these cases to resolve diagnostic dilemma. Early diagnosis and management are associated with favourable outcomes.

Our result indicate that CT scan finding in TBM, brain abscess and NCC are much more distinct and specific than in pyogenic meningitis & H.simplex encephalitis.¹²⁻¹⁴

Seventy five patients studied in this case is a small number. Many patients could not included in this study because of low socioeconomic status and critically ill condition due to late referral of cases from periphery. There is need to increase awareness about vaccination, improve primary health centers and maintain sanitation.

REFERENCES:

- 1.Oliver Kastrup, Isabel Wanke, Matthias Maschke, Neuroimaging of infection , NeuroRx v.2(2), 2005 Apr PMC1064994.
2. Dubos F, Korczowski B, Aygun DA, et al: Distinguishing between bacterial and aseptic meningitis in children: European comparison of two clinical decision rules. *Arch Dis Child* 2010; 95:963-967.
3. Andronikou, S , Smith B, Matherhill, M,Douis H, Definitive neurological diagnostic feature of T⁺TBM in children:April 2006
4. Fanning NF, Laffan EE, Shroff MM. Serial diffusion-weighted MRI correlates with clinical course and treatment response in children with intracranial pus collections. *Pediatr Radiol* 2006;36:26-37.
5. Han KT, Choi DS, Ryoo JW, et al. Diffusion-weighted MR imaging of pyogenic intraventricular empyema. *Neuroradiology* 2007;49: 813-818.
6. Pelligra G, Lynch N, Miller SP, et al. Brainstem involvement in neonatal herpes simplex virus type 2 encephalitis. *Pediatrics* 2007;120:e442-e44.
7. Engman ML, Adolfsson I, Lewensohn-Fuchs I, et al. Neuropsychologic outcomes in children with neonatal herpes encephalitis. *Pediatr Neurol* 2008;38:398-405.
8. Schneider JF. Neonatal brain infections. *Pediatr Radiol*2005;26:1115-1121.
9. Schneider JF. Neonatal brain infections. *Pediatr Radiol* 2011;41(Suppl 1):S143-S148.
- 10.Vimlesh Seth, S K kobra : Essential of TB in children 3rd edition 2006.
- 11.Cruz AT, Starke JR. Clinical manifestations of tuberculosis in children. *Paediatr Respir Rev* 2007;8:107-117
- 12.Luther G,Parihar A,Nath K,et al. Comparative evaluation of fungal,tubercular and pyogenic intracranial infection with convention neuroimaging studies.*AJNR AM j neuroradial* 2007.28:1332-1338.
- 13.Barkovich AJ. *Pediatric Neuroimaging* . Philadelphia, PA: Lippincott Williams & Wilkins; 2005;801-868.
- 14.Foerster BR, Thurnher MM, Malani PN, et al. Intracranial infections: clinical and imaging characteristics. *Acta Radiol*.