Section: Neurosurgery

Original Research Article

INCIDENCE AND STUDY OF HYDROCEPHALUS IN TUBERCULOUS MENINGITIS PATIENTS OF BIHAR AND NEPAL

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Abstract

Background: Tuberculous meningitis (TBM) is associated with high mortality. Hydrocephalus is one of the most common complications of TBM. It is often difficult to differentiate between communicating and obstructing hydrocephalus on the basis of an MRI study. **Materials and Methods:** 95 patients with TBM were studied. All patients underwent clinical and CSF evaluations and an MRI study. Patients were treated with anti-tuberculosis drugs and steroids. A follow-up MRI was done after six months. Hydrocephalus was assessed using Evan's index. **Result:** Out of 95 patients with TBM, 65 (68%) had hydrocephalus presentations. The baseline characters of TBM were compared with those of No Baseline (33) patients, and the level of significance of the p value was highly significant ($p<0.001$). A comparison of baseline characteristics predicting complete resolution after six months was studied in 35 patients, and 15 had complete resolution and 20 had partial or no resolution with a significant p value. **Conclusion:** Hydrocephalus was observed in two-third of patients with TBM and has a poor prognosis in later stages but early stages of TBM may resolve completely.

INTRODUCTION

Tuberculous Meningitis (TBM) is a devastating infective disorder of the central nervous system. Approximately one-third of patients die despite of treatment.[1] TBM is associated with a variety of complications, like hydrocephalus, peri-ventricular infarcts, optochiasmatic and spinal arachnoidtis, and Tuberculous mass lesions in the brain.[2]

Hydrocephalus is easily diagnosed by both a CT scan and an MRI scan. However, an MRI scan is considered superior to diagnose hydrocephalus and to identify associated tuberculomas, basal exudates, and infarcts.[3] Hydrocephalus is well managed with medical management. In a minority of patients, it requires surgical intervention; ventriculoperitoneal shunt, endoscopic third ventriculostomy, and external ventricular drainage are surgical procedures that are used to treat TBM.[4] Hydrocephalus is generally a poor prognostic marker. Hence, an attempt is made to evaluate the severity of hydrocephalus in Tuberculous meningitis.

MATERIALS AND METHODS

95 (ninety-five) patients with Tuberculous meningitis, 62 (65%) of whom had hydrocephalus at presentation, were admitted to Shri Krishna Medical College, Uma Nagar, Muzaffarpur, Bihar-842004 were studied.

Inclusive Criteria

Patients with a history suggestive of sub acute or chronic meningitis were clinically assessed. The diagnostic score of 6–9 points (when cerebral imaging is not available) or 6–11 points (when cerebral imaging is available) was selected for study.

Exclusion Criteria

The patients who did not fulfill the diagnostic criteria of tubercular meningitis, age<18 years, or an alternative diagnosis to TBM (i.e., cryptococcal meningitis) were excluded from the study.

Method: Severity of disease was as per the British Medical Research Council (BMRC) staging system. Patients with stage-I disease had a Glasgow coma scale score of 15 with no focal neurological signs. Patients with stage-II had signs of meningeal irritation with slight or no alteration of sensorium and minor neurological deficiency (like cranial nerve palsies) or no deficit (Glasgow scale score 11–14), and patients with stage-III had severe alteration of sensorium, convulsion, focal neurological deficit and involuntary movements (Glasgow coma scale score <10).

Every patient underwent a complete blood count (CBC), peripheral blood smear examination, ESR (erythrocyte rate), blood sugar, blood urea, Nitrogen serum creatinine liver function test (LFT), serum

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electrolytes, chest x-ray, Enzyme-Linked Immuno Sorbent Assay for Human immunodeficiency virus (HIV), CSF biochemical, and microscopic examination, including India-Ink preparation were performed.CSF sediments were stained and cultured (Löwenstein Jensen) by standard methods. CSF specimens were also tested for mycobacterial polymerase chain reaction (PCR). All patients were also subjected to MR imaging of the brain using the Sigma Excite 1.5 Tesla instrument (General Electric Medical Systems, Milwaukee, WI, USA).

Every patient was treated with an anti-tuberculosis regimen as recommended by the World Health Organization.

Follow-up and outcome assessment:

Disability assessment was done using the Modified Barthel Index (MBI), which is a 20- point scoring system. Assessments of disability of bowel and bladder grooming, toilet use, transfer mobility, dressing, feeding, use of stairs, and bathing. For each activity, a score of 0 (zero) indicated complete dependence, and a score of 2 or 3 indicated that the patient was able to perform activities independently. A score of <12 indicated poor functional status, and a score of >12 indicated good functional status.

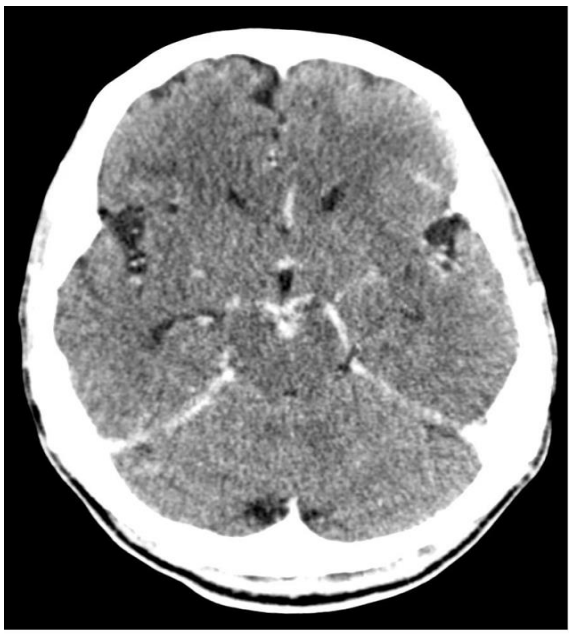
Assessment of disability as per MBI was done at baseline and at the end of 1st, 3rd and 6th months of follow-up; an MBI > 12 at the end of 6th month was considered a good outcome. The follow-up MR study was done after 6 months.

Incidence of hydrocephalus:

Out of 62 patients with hydrocephalus, 35 (60.3%) had moderate or severe hydrocephalus (Evans ratio equal to or more than 0.34), and peri-ventricular ooze was present in 37 (38.9%).

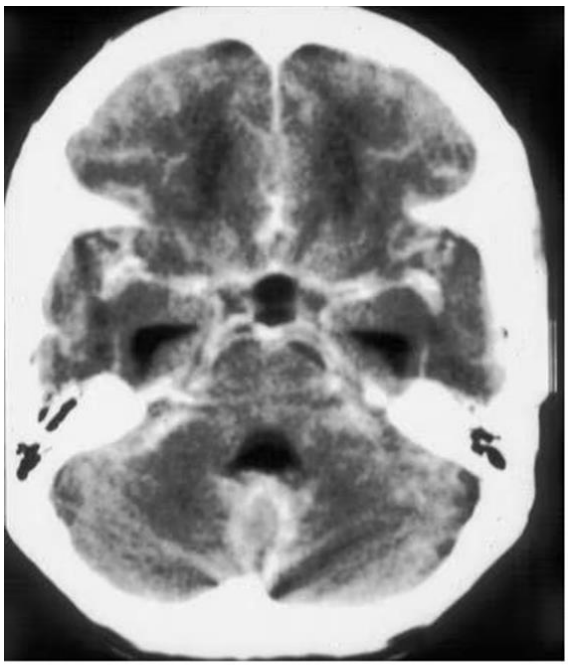
In the study of baseline characteristics predicting complete resolution of baseline hydrocephalus after six months in 35 patients, 15 had complete resolution and 20 had partial or no resolution.

The duration of the study was from January 2023 to May 2024.



(Figure-1) Axial contrast-enhanced CT scan in a patient with tuberculous meningitis demonstrating marked enhancement and basilar exudate in the interpeduncular cisterns and meninges.

Statistical analysis: Comparison of cases with hydrocephalus were done with those without hydrocephalus and outcome categorized as complete resolution after 6 Months or partial or no resolution at all by ANOVA test. The statistical analysis was carried out in SPSS software. The ratio of male and females was 2:1.



(Figure-2) Axial contrast enhanced axial CT shows marked enhancement in the basal cistern and meninges, with dilatation of the ventricles.

RESULTS

[Table 1] Comparison of Baseline characteristics in patients of tuberculous meningitis with hydrocephalus or without hydrocephalus

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Duration of illness > 2 months 67 (67.7%) in baseline hydrocephalus and 9 (27.7%) in No baseline patients and p<0.001 (p value is highly significant).

- Pulmonary TB: Total number 21 (22.1%) Baseline case with hydro caphalus were 16 (25.8%) and No baseline hydrocephalus were 5 (15.1%) and p<0.001 (p value was highly significant)
- MRC Stage-I: 29 (30.5%) were total, 14 (22.5%) with baseline hydrocephalus, 16 (48.4%) No baseline patients and p<0.001.
- MRC Stage-II: 29 (30.5%) were total, 14 (22.5%) with baseline hydrocephalus, 16 (48.4%) No baseline patients and p<0.001 (p value was highly significant)
- MRC Stage-III: 25 (26.3%) were total, 24 (38.7%) with baseline hydrocephalus, 15 (45.4%) No baseline hydrocephalus and p<0.001 (p value was highly significant).
- Fever: 90 (94.7%) were total number, 61 (98.3%) with baseline hydrocephalus, 29 (87.8%) No baseline hydrocephalus and p<0.001 (p value was highly significant).
- Headache: 87 (91.5%) were total number patients, 57 (91.9%) with baseline hydrocephalus, 29 (87.8%) No baseline hydrocephalus and p<0.001 (p value was highly significant).
- Vomiting: 70 (73.6%) were total number, 49 (70.7%) with baseline hydrocephalus, 21 (63.6%) No baseline hydrocephalus and p<0.001 (p value was highly significant).
- Seizures: 36 (38.9%) were total number, 31 (50%) with baseline hydrocephalus, 5 (15.1%) No baseline hydrocephalus and p<0.001
- Altered sensorium: 37 (38.9%) were total number, 28 (45.1%) with baseline hydrocephalus, 9 (27.2%) No baseline hydrocephalus and p<0.001 (p value was highly significant).
- Meningeal signs: 84 (88.4%) were total number of patients, 58 (93.5%) were with baseline hydrocephalus, 26 (81.8%) No baseline hydrocephalus and p<0.001 (p value was highly significant).
- Diplopia: 60 (63.1%) were with baseline hydrocephalus, 11 (36.3%) were no baseline hydrocephalus and p<0.001.
- Cranial nerve involvement: 74 (77.8%) were total number of patients, 55 (88.7%) patients were baseline hydrocephalus, 19 (57.4%) with no baseline hydrocephalus and p<0.001 (p value was highly significant).
- 59 (62.1%) were total number of papilloedema, 49 (79.03%) with baseline hydrocephalus and 10 (33.3%) were no baseline hydrocephalus and p<0.001 (p value was highly significant).
- 12 (12.6%) were total number of optic atrophy, 9 (14.5%) were with baseline hydrocephalus and 3 (6.06%) were no baseline hydrocephalus and p<0.001 (p value was highly significant).
- 53 (55.7%) were with normal Vision, 25 (40%) with baseline hydrocephalus and 28 (84.8%) had no baseline hydrocephalus and p<0.001.
- 43 (45%) had low vision, 37 (59.6%) with baseline hydrocephalus, 6 (18.8%) had no baseline hydrocephalus and p<0.001.
- 25 (26.3%) had CSF AFB stain, 22 (35.4%) had baseline hydrocephalus, 3 (9.09%) No baseline hydrocephalus and p<0.001.
- Initial CGS: Out of 20 patients, 17 (85%) had complete resolution, 8 (40%) had partial or no resolution and p<0.001.
- Out of 23 Normal vision, 19 (82.6%) had complete resolution, 11 (55%) had partial or no resolution and p<0.001.
- Out of 19 hydrocephalus, 11 (11.1%) had complete resolution, 8 (40%) had partial or no resolution and p<0.001.
- Out of 21 Baseline MBI >12, 19 (90.4%) had complete resolution, 8 (40%) had partial or no resolution and p<0.001.
- Out of 19 CSF TLC <100 cumm, 16 (84.2%), 7 (35%) had partial or no resolution and p<0.001.
- In 19 CSF protein <2.5 g/mg, 16 (84.2%) had complete resolution and p<0.001.
- In 18 Mild hydrocephalus patients, 17 (94.2%) had complete resolution, 5 (25%) had partial or no resolution and p<0.001.
- In 14 Basal exudates, 3 (21.4%) had complete resolution, 10 (50%) had partial or no resolution and p<0.001.
- In 14 Infarction patients, 3 (21.4%) had complete resolution and 10 (50%) had partial or no resolution and p<0.001.
- In 11 tuberculoma, 2 (18%) had complete resolution and 8 had partial or no resolution.
- 33 (35.7%) had CSF AFB culture, 25 (40.3%) had baseline hydrocephalus and 8 (24.4%) had partial or no resolution and p<0.001.
- 42 (45.2%) had CSF TB PCR, 33 (53.2%) had baseline and 9 (27.7%) had or no resolution and p<0.001.
- 42 (45.2%) had definite TBM, 33 (53.2%) had baseline hydrocephalus, 9 (27.7%) had no resolution and p<0.001.
- 87 (92.6%) had meningeal enhancement, 59 (95.1%) had baseline hydrocephalus, 28 (84.5%) had no resolution and p<0.001.
- 37 (38.9%) had tuberculoma, 32 (51.6%) had baseline hydrocephalus, 5 (15.5%) had no resolution and p<0.001.
- 31 (32.6%) had infarction, 26 (41.9%) had baseline hydrocephalus, 5 (15.5%) had no resolution and p<0.001.
- 69 (72.6%) had good outcome >12, 38 (59.6%) had baseline hydrocephalus and 31 (93.9%) had no resolution and p<0.001.
- 27 (28.3%) had poor outcome, 25 (48%) had baseline hydrocephalus 2 (6%) had no resolution and p<0.001.

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Table 1: Comparison of Baseline characteristics in patients of Tuberculous meningitis with or without hydrocephalus. (No. of patients: 90).

Characters	Total No 95		Baseline hydrocephalus (62)		No Baseline (33)		Level of significant (p value)
	No	%	No	%	No	%	
Duration of illness>2 months	51	53.6	67	67.7	9	27.7	P<0.001
Pulmonary TB	21	22.1	16	25.8	5	15.1	P<0.001
MRC Stage-I	29	30.5	14	22.5	16	48.4	P<0.001
MRC Stage-II	39	41.0	25	40.3	15	45.4	P<0.001
MRC Stage-III	25	26.3	24	36.7	1	3.03	P<0.001
Fever	90	94.7	63	98.3	29	87.8	P<0.001
Headache	87	91.5	57	90.9	29	87.8	P<0.001
Vomiting	70	73.6	49	79.0	21	63.6	P<0.001
Seizures	36	37.8	31	50.0	5	15.1	P<0.001
Altered sensorium	37	38.9	28	45.1	9	27.2	P<0.001
Meningeal signs	84	88.4	58	73.5	27	81.8	P<0.001
Diplopia	60	63.1	49	79.3	11	36.3	P<0.001
Cranial Nerve involvement	74	77.8	55	87.7	19	57.4	P<0.001
Papilledema	59	62.1	49	79.3	10	33.3	P<0.001
Optic atrophy	12	12.6	9	14.5	3	6.06	P<0.001
Normal vision	53	55.7	25	40	28	84.2	P<0.001
Low vision	43	45	37	59.6	6	18.8	P<0.001
CSF AFB stain	25	26.3	22	35.4	3	9.09	P<0.001
CSF AFB culture	33	35.7	25	40.3	8	24.7	P<0.001
CSF TB PCR	42	45.2	33	53.2	9	27.7	P<0.001
Definite TBM	42	45.2	33	53.2	9	27.7	P<0.001
Meningeal Enhancement	87	92.6	59	95.1	28	84.8	P<0.001
Tuberculoma	37	38.9	32	51.6	5	15.5	P<0.001
Infarct	31	32.6	26	41.9	5	15.5	p<0.001
Good outcome >12	69	72.6	38	59.6	31	93.9	p<0.001
Poor outcome <12	27	38.3	25	40.0	2	6.0	p<0.001

AFB = Acid fast Bacilli, MRC = Medical Research council, CSF=Cerebral spinal fluid, PCT = polymerase chain reaction, TB=Tuberculosis, TBM = Tuberculous Meningitis, MBI = Modified Barthel Index

Table 2: Comparison of Baseline characteristic predicting complete resolution of baseline hydrocephalus after six months (35) with partial resolution

Duration illness	Complete Resolution (15)			Partial or No resolution (20)		p value
	Total	No	%	No	%	
< 2 months	15	8	53.3	07	35	p<0.001
MRC stage I & II	21	18	85.7	09	45	p<0.001
Seizures	15	6	40	09	45	p<0.001
Initial GCS	20	17	85	08	40	p<0.001
Normal Vision	23	19	82.6	11	55	p<0.001
Hemiparesis	19	11	11	08	40	p<0.001
Baseline MRI >12	21	19	90.4	02	10	p<0.001
CSF TLC <100/cumm	19	16	84.2	07	35	p<0.001
CSF protein <2.5	19	16	84.2	07	35	p<0.001
Mild Hydrocephalus	18	17	94.2	05	25	p<0.001
Basal exudates	14	3	21.4	10	50	p<0.001
Infarction	14	3	21.4	10	50	p<0.001
Tuberculoma	11	2	18	08	40	p<0.001

CSF= Cerebrospinal fluid, GCS=Glasgow coma scale, TLC=Total leucocytes count, MRC=Medical Research Council.

[Table 2] Study of Hydrocephalus at baseline comparison between predicting complete resolution and partial resolution after six months

- Duration of illness >2 Months out of 15, 8 (53.3%) had complete resolution and 7 (35%) had partial or no resolution and p<0.001
- MRC stage I and II out of 21, 18 (85.7%) had resolution and 9 (45%) had partial or no resolution and p<0.001.
- In 15 seizure patients, 6 (40%) had complete resolution and 9 (45%) had partial or no resolution and p<0.001

DISCUSSION

Present study comprises of hydrocephalus in Tuberculous meningitis patients in Bihar and Nepal. In this comparative study of baseline characteristics of hydrocephalus (62 patients) and no baseline characteristic (33 patients), Duration of illness:>2 months pulmonary TB MRC stage-I, II, and III: fever, headache, vomiting, seizures, altered sensorium, meningeal signs, diplopia, cranial nerve involvement, papilloedema, and optic atrophy Normal vision, low vision, CSF AFB stain, CSF AFB culture TB PCR, definitive TBM, meningeal enhancement, tuberculoma, infarction. Good outcome marked by score >12 and poor outcome by

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score <12 had a significant level of p value (p<0.001) (Table 1). In the comparison of baseline characteristics, predicting complete resolution of baseline hydrocephalus after six months (complete resolution and partial or no resolution) was studied. Duration of illness: >2 months MRC stages I and II, seizures Initial GCS, normal vision, hemiparesis, baseline MBI > 12, CSF TLC<100% cumm, CSF protein <2.5, 9% Mild hydrocephalus Basal exudates, infarction, and tuberculoma had a significant level of p value (p<0.001) [Table 2]. [Figure 1 and 2]. These findings are more or less in agreement with previous studies.[5-7]

Hydrocephalus was significantly more in male as compared to female. Hydrocephalus is classified as communicating hydrocephalus and non-communicating type; (there is an obstruction to the flow of CSF either at the level of the cerebral aqueduct or at the outflow tract of the fourth ventricle) Communicating hydrocephalus is a commoner variety seen in 80% of patients.[8] It is also reported that cranial CT is equally efficient in diagnosing hydrocephalus in TBM as MRI.[9]

In the post-mortem studies of hydrocephalus patients, it is observed that Mycobacterium Tuberculosis that infects lungs via airborne transmission, later same Mycobacterium Tuberculosis via hematogenous route spread to meninges and subpial regions of the brain, forming a small Tuberculous granuloma called Rich Focus.[10] Alternatively, Mycobacterium can reach directly to the brain and other parts in Miliary tuberculosis.

Rarely, hydrocephalus can be asymmetric. It is due to ependymitis and thick exudates in the ventricles of the brain.

Hydrocephalus is recognized with the help of Evan's ratio. The Evans ratio is a ratio of the maximum width of the frontal horns to the maximum width of the inner skull. Evans angle was originally calculated in sagittal sections; on encephalograms, a normal Evans angle is less than 0.30 degree. Evans angles of <0.34, 0.34 to 0.4, and >0.4 degrees classify hydrocephalus as mild, moderate, and severe hydrocephalus respectively.[11]

Prompt initiation of anti-tubercular treatment is the cornerstone of treatment for TBM. Corticosteroids are given to minimize the host's inflammatory damage, but deterrent patients may need surgical interventions. surgical Interventions include ventriculo-peritoneal shunt, endoscopic third ventriculostomy, and External Ventricular Drainage.

CONCLUSION

Hydrocephalus is seen in up to 80% of patients with Tuberculous meningitis and is much more commonly observed in children with TBM. Patients with communicating hydrocephalus respond to medical management, but for non- communicating hydrocephalus surgical interventions are required. The present significant findings require clinical trials with a large number of patients in hi-tech hospitals to combat any emergencies. As chronic hydrocephalus is life-threatening cases as reported with increased intracranial pressure with subsequently deteriorating vision and consciousness. Moreover, in the surgical method, the long-term benefits of CSF diversion are still unknown.

Limitation of study: Owing to the tertiary location of the research centre, funding the small number of patients, and the lack of the latest techniques, we have limited funding and results follow ups.

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