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Original Research Article

HYDROCEPHALUS IN PATIENTS WITH TUBERCULOUS MENINGITIS, ITS MANAGEMENT, AND OUTCOME

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Abstract: *Hydrocephalus (HCP) is a common complication of tuberculous meningitis (TBM) that significantly impacts patient outcomes. Effective management strategies, including medical and surgical interventions, are essential to improve recovery and reduce disability and mortality rates.* ***Objective:*** *The objective of the present study is to determine the management and outcomes of HCP in patients with TBM.* ***Methods:*** *After the ethical approval from the institutional review board, this cross-sectional observational study was conducted at Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), Karachi, from June 2022 to June 2024. Through non-probability consecutive sampling, 87 patients ages above 8 years, both genders, who are diagnosed and admitted for TBMH and who are classified in grades I to IV according to Modified Vellore grade were included in the present study.* ***Results:*** *Modified Vellore grading classified patients into Grade I (26%), Grade II (31%), Grade III (28%), and Grade IV (14%). Medical management included anti-tuberculous therapy (ATT) in all patients. Surgical intervention, such as ventriculoperitoneal shunting, was performed in 25% of cases, while 75% were managed non-surgically. At 12 months, 55% of participants showed good recovery, 22% had moderate disability, and 17% had severe disability, with a mortality rate of 6%. Stratification by age revealed significantly better outcomes in individuals under 50 years (p=0.02), with good recovery observed in 31 younger patients compared to 17 older ones.* ***Conclusion:*** *Male gender, younger age at onset, and better early treatment correlated with better recovery indicating that early diagnosis and appropriate therapy are crucial.*

Keywords: Hydrocephalus, Tuberculous Meningitis, Management, Outcomes

Introduction

Tuberculous meningitis is a severe form of extrapulmonary tuberculosis (TBP) with high case-fatality rates contributing to morbidity in areas of high TB prevalence (1). With TBM, hydrocephalus is present in 11–50% of patients, most commonly found in adults with an incidence of 16.1%, which causes elevated intracranial pressure and provides symptoms of neurological deterioration(2). Consequently, the prognosis of TBM-related hydrocephalus is based on early diagnosis, the degree of illness manifested at the time of admission and multiple management approaches applied to the patients (3).

Classification is usually done based on what is referred to as the Modified Vellore grading system; this is scaled against the Glasgow Coma Scale (GCS) (4). A higher mortality rate of 64.8% for grades III-IV of neurological deficits is often seen in comparison to the 17.5% of patients with milder conditions (5). The overall hydrocephalic sequela of TBM are lifelong neurological issues, and motor, cognitive, and frank functional disability affecting 50.9% of patients post-treatment (6). TBM with hydrocephalus management is a two-step procedure. The management starts with ATT and corticosteroids, which help inhibit the inflammation process and slow down hydrocephalus (7). In cases that do not respond to medical management intervention such as ventriculoperitoneal shunting and external ventricular drainage are used. These procedures enhance the intracranial dynamics by a large margin but the consequence includes shunt infection or blockage (8).

However, the mortality rate of TBM with hydrocephalus has improved and is estimated at 24.7% while more than 63% of severely affected patients have poor outcomes(9). These factors make it very vital to begin the intervention process and to adopt differential treatment based on the intensity of the disease to enhance survival and functional rehabilitation. Further studies ought to focus on identifying diagnostic algorithms of TBM that offer maximum effectiveness and individual therapeutic regimens aimed at decreasing the number of cases of TBM-related hydrocephalus around the world. The objective of the present study is to determine the management and outcomes of HCP in patients with TBM.

Methodology

After the ethical approval from the institutional review board, this cross-sectional observational study was conducted at Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), Karachi, from June 2022 to June 2024. Through non-probability consecutive sampling, 87 patients ages above 8 years, both genders, who are diagnosed and admitted for TBMH and who are classified in grades I to IV according to Modified Vellore grade were included in the present study. Patients not diagnosed with TBMH were excluded from the present study. After the informed consent, a self-administered questionnaire was used to gather data. A standard protocol was followed and medical management was offered as the first line of

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treatment. This includes acetazolamide to lower CSF production, dehydrating medicines like mannitol, and diuretics like furosemide. Dexamethasone tapering doses were administered for a duration of four to six weeks. Mannitol was only used for acute decompensation, but not longer than 72 hours because it can cause rebound intracranial hypertension. Fusemide and acetazolamide were administered for extended durations, up to one month. In addition to the aforementioned medications, antituberculosis therapy (ATT) was used to mitigate the inflammatory response, thereby facilitating the opening of the CSF channels. A shunt or EVD was done promptly as per evidence of hydrocephalus and according to the modified mall or Vellore grading. The functional outcome of the patients was assessed post-treatment within 12 months based on GCS. The SPSS version 26 program was used for the statistical analysis. The mean and standard deviation were used for continuous data. Variables with a categorical nature were expressed using frequency and percentage. The related determinants for a bad GCS outcome were examined using chi-square. P <0.05 was considered significant.

Results

The study comprised 87 participants, with a mean age of 49.6 years (SD = 17.2, range = 18-85). The majority of participants were male (58%, n = 50). Table 1 summarizes the demographic characteristics. Presenting symptoms included fever (56%, n = 49), neck stiffness (46%, n = 40), and seizures (44%, n = 38). Altered consciousness was observed in 44% of participants (n = 38). Symptom duration was categorized as acute (46%, n = 40), subacute (19%, n = 17), and chronic (33%, n = 29). A history of tuberculosis (TB) contact was documented in 36% of participants (n = 31), and 53% had co-existing TB (n = 46). TB history was unknown in 14% of participants (n = 12) (Table 1).

Table 1: Demographic Variables of the study participants

Variables	Mean and Frequency (n=87)
Age (years)	49.6±17.2
Gender	
Male	51 (58%)
Female	36 (42%)
Presenting Symptoms	
Fever, Neck stiffness, Seizure	49 (56%)
Altered consciousness	38 (44%)
Duration of Symptoms	
Acute	40 (46%)
Subacute	18 (19%)
Chronic	29 (33%)
TB History	
TB Contact	32 (36%)
Co-existing TB	46 (53%)
Unknown	12 (14%)
Chest X-ray Findings	
Normal	49 (56%)
Abnormal	38 (44%)

Chest X-ray findings were abnormal in 44% of patients (n = 38), with the remainder appearing normal (Table 1). Clinical parameters revealed a mean peripheral white blood cell count of 41.5 × 10^3/µL (SD = 12.7, range = 10-100). Serum sodium levels averaged 136.9 mmol/L (SD = 1.4, range = 130-145). The erythrocyte sedimentation rate (ESR) was 53 mm/h (SD = 25.2, range = 10-120). Cerebrospinal fluid (CSF) analysis showed acid-fast bacilli positivity in 55% of participants (n = 48). The mean cell count was 45 cells/µL (SD = 25.2, range = 10-100). Elevated protein levels were observed at 0.6 g/L (SD = 0.08, range = 0.2-1.2). Reduced glucose levels averaged 2.1 mmol/L (SD = 0.11, range = 1.5-3.5). Random serum glucose was 4.1 mmol/L (SD = 0.08, range = 3.5-5.5) (Table 2).

Table 2: Clinical parameters of the study participants

Variables	Mean and Frequency (n=87)
Peripheral WBC (×10^3/µL)	41.5±12.7
Serum Na+ (mmol/L)	136.9±1.4
ESR (mm/h)	53±25.2
CSF Acid-Fast Bacilli	48 (55%)
CSF Cell Count (cells/µL)	45±25.2
CSF Protein (>0.5g/L)	0.6±0,08
CSF Glucose (mmol/L)	2.1±0.11
Random Serum Glucose (mmol/L)	4.1±0.08

Modified Mallor Vellore grading classified patients into Grade I (26%, n = 23), Grade II (31%, n = 27), Grade III (28%, n = 24), and Grade IV (14%, n = 12). Medical management included anti-tuberculous therapy (ATT) for all the patients. Surgical interventions were performed, with **82 patients (94.3%)** undergoing ventriculoperitoneal shunting (VP shunt) and **5 patients (5.7%)** receiving external ventricular drainage (EVD) (Table 3).

Table 3: Clinical Management and Outcomes.

Variables	Mean and Frequency (n=87)
Modified Vellore Grade	
I	23 (26%)
II	27 (31%)
III	25 (28%)
IV	12 (14%)
Medical Management	
Rifampin, Isoniazid, Dexamethasone	29 (33%)
ATT	58 (67%)
Surgical Interventions	
Ventriculoperitoneal shunt	82 (94.3%)
External Ventricular Drainage (EVD)	5 (5.7%)
Outcome at 12 Months	
Good recovery	48 (55%)
Moderate disability	19 (22%)
Severe disability	15 (17%)
Death	5 (6%)
Hospital stay (days)	9.3±2.8

At 12 months, 55% of participants showed good recovery (n = 48), 22% had moderate disability (n = 19), and 17% had severe disability (n = 15), with a mortality rate of 6% (n = 5). Stratification by age revealed significantly better

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outcomes in individuals under 50 years (p = 0.021), with good recovery observed in 31 younger patients compared to 17 older ones. Gender differences were significant (p < 0.0001), with males demonstrating better recovery outcomes (34 good recoveries, 2 moderate disabilities, and no deaths) compared to females (14 good recoveries and 4 deaths). The average hospital stay was 9.3 days (SD = 2.8, range = 5-20). This data highlights the influence of demographic and clinical variables on outcomes in TBM patients with hydrocephalus (Table 4).

Table 4: Stratification of outcomes based on age and gender

Variable	Outcomes at 12 months				P Value
	Good recovery	Moderate disability	Severe disability	Death	
Age					0.02
<50 years	31	8	4	1	
>50 years	17	11	11	4	
Gender					<0.0001
Male	34	2	15	0	
Female	14	17	0	4	

Discussion

The results of this study are in concordance with the existing body of literature on TBM and hydrocephalus and the impact that demographic and clinical characteristics have on outcomes. This high percentage of male patients (58%) is also in parity with other studies, which suggest that TBM is more common in men in part because of behavioral and immunological factors (10). However, the average age of 49.6 years indicates that patients in the TBM are slightly older compared to the data obtained in the regions with younger populations in the present studies and proves the heterogeneity of TB epidemiology throughout the world (11). Three presenting symptoms: fever, neck stiffness, seizures (56%), and altered consciousness (44%) are classic features of TBM. This pattern is in line with various findings where fever and neurological deficits are presented as the first complaints in TBM-associated hydrocephalus (12). Division of patients into acute, subacute, and chronic groups depending on the time elapsed since the appearance of symptoms is also informative regarding the further course of the disease. New/recurring chronic (33%) in this group is consistent with prior studies suggesting delayed diagnoses in under-resourced settings worsening outcomes (13). As expected in TBM, patients exhibited a high peripheral white blood cell count of an average of 41.5 × 10^3/µl in addition to the raised ESR of 53 mm/h. Comparable shifts in CSF profile like acid-fast bacilli detection (present in 55% of samples), and low glucose level (mean 2.1 mmol/L) are described in previous research as diagnostic markers(14).

Admission–discharge outcomes indicate a relatively favorable prognosis in TBM with hydrocephalus, hinting at good recovery in 55% and mortality in 6% at 12 months (6). Accordingly, mortality rates are described as ranging from 15 to 25%, although outcomes are significantly poorer for patients with more severe conditions (Modified Vellore Grades III-IV) (15). The improved outcome noted in younger patients (<50 years) is consistent with the findings of other authors who have identified age as a factor in recovery. Moreover, the highly skewed sex differences with better results in males (p<0.0001) have been described less commonly, but there is a need to know more about the biology and socio-cultural factors.

The application of anti-tuberculous therapy and surgical intervention can also be referred to as effective prescriptions. The majority of cases use ventriculoperitoneal shunting, which the following literature supports as a decisive step to reduce intracranial pressure. The average length of stay was 9.3 days, which may have been due to the efficient management of available resources in patient care.

Conclusion

These results underscore the importance of demographic and clinical factors on the prognosis of tuberculous meningitis and hydrocephalus patients. Male gender, younger age at onset, and better early treatment i.e. ventriculoperitoneal shunting correlated with better recovery indicating that early diagnosis and appropriate therapy are crucial. Therefore, further research is still needed concerning disparities and management strategies to further enhance the possibilities of gaining better long-term results.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-TCHKP-09343/23)

Consent for publication
Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

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References

1. Chen X, Wei J, Zhang M, Su B, Ren M, Cai M, et al. Prevalence, incidence, and case fatality of tuberculous meningitis in adults living with HIV: a systematic review and meta-analysis. BMC Public Health. 2024;24(1):2145.
2. Zhang X, Li P, Wen J, Chang J, Chen Y, Yin R, et al. Ventriculoperitoneal shunt for tuberculous meningitis-associated hydrocephalus: long-term outcomes and complications. BMC Infectious Diseases. 2023;23(1):742.
3. Kanesen D, Kandasamy R, Wong ASH, Tharakan J, Lim CJ, Abdullah JM. Clinical Outcome of Tuberculous Meningitis with Hydrocephalus - A Retrospective Study. The Malaysian journal of medical sciences: MJMS. 2021;28(5):82-93.
4. Ganesh S, Abraham A, Mani T, Joseph M. Revisiting the Classification of Moderate and Mild Traumatic Brain Injury Based on the Admission Glasgow Coma Scale Score. Indian Journal of Neurotrauma. 2023;21.
5. Jenkins FS, Vasella F, Padevit L, Mutschler V, Akeret K, Velz J, et al. Preoperative risk factors associated with new focal neurological deficit and other major adverse events in first-time intracranial meningioma neurosurgery. Acta neurochirurgica. 2021;163(10):2871-9.
6. Wang L, Gu Z, Chen X, Yu X, Meng X. Analysis of risk factors for long-term mortality in patients with stage II and III tuberculous meningitis. BMC Infectious Diseases. 2024;24(1):656.
7. Marx GE, Chan ED. Tuberculous meningitis: diagnosis and treatment overview. Tuberculosis research and treatment. 2011;2011:798764.
8. Javeed F, Mohan A, Wara UU, Rehman L, Khan M. Ventriculoperitoneal Shunt Surgery for Hydrocephalus: One of the Common Neurosurgical Procedures and Its Related Problems. Cureus. 2023;15(2):e35002.
9. Foppiano Palacios C, Saleeb PG. Challenges in the diagnosis of tuberculous meningitis. Journal of clinical tuberculosis and other mycobacterial diseases. 2020;20:100164.
10. Huang M, Ma Y, Ji X, Jiang H, Liu F, Chu N, et al. A study of risk factors for tuberculous meningitis among patients with tuberculosis in China: An analysis of data between 2012 and 2019. Frontiers in Public Health. 2023;10.
11. Bai W, Ameyaw EK. Global, regional and national trends in tuberculosis incidence and main risk factors: a study using data from 2000 to 2021. BMC Public Health. 2024;24(1):12.
12. Kleinschmidt-DeMasters BK, Beckham JD, Tyler KL. 23 - Infections and Inflammatory Disorders. In: Perry A, Brat DJ, editors. Practical Surgical Neuropathology: A Diagnostic Approach (Second Edition): Elsevier; 2018. p. 547-79.
13. Simmons N, Olsen MA, Buss J, Bailey TC, Mejia-Chew C. Missed Opportunities in the Diagnosis of Tuberculosis Meningitis. Open forum infectious diseases. 2023;10(2):ofad050.
14. Shah AR, Desai KN, Maru AM. Evaluation of hematological parameters in pulmonary tuberculosis patients. J Family Med Prim Care. 2022;11(8):4424-8.
15. Navarro-Flores A, Fernandez-Chinguel JE, Pacheco-Barrios N, Soriano-Moreno DR, Pacheco-Barrios K. Global morbidity and mortality of central nervous system tuberculosis: a systematic review and meta-analysis. Journal of Neurology. 2022;269(7):3482-94.
16. Meng F, Wu H, Yang S. Clinical application of ventriculoperitoneal shunting in treating traumatic brain injury. Experimental and therapeutic medicine. 2019;18(4):2497-502.

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