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Microbiological etiology and short-term outcome of meningoencephalitis Patients admitted in a tertiary care hospital-50 cases

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Abstract

Background: Meningoencephalitis is a global health problem as mortality is high and a large proportion of survivors suffered from significant morbidity. Physicians are facing the challenge of emergency identification of this clinical syndrome, establishing its etiology and prompt treatment to ensure survival and prevent long-term sequelae in these patients. The aim of this study was to evaluate the etiology and short-term outcome of meningoencephalitis patients admitted in a tertiary care hospital of Bangladesh.

Objectives: The main objective was to evaluate the Microbiological etiology and short-term outcome of meningoencephalitis patients admitted in to medical wards of a tertiary care hospital.

Methods: A hospital-based descriptive study was conducted in the Department of Medicine, Sir Salimullah Medical College Mitford Hospital, from July 2022 to June 2023. 50 Patients enrolled within the study period with features of Meningoencephalitis fulfilling the inclusion and exclusion criteria. Ethical clearance for the study was obtained from the Ethical Review Committee. A detailed history, clinical examination was carried out. In addition to the routine blood test, CSF samples were collected as soon as possible from all patients unless contraindicated and sent for cytological, biochemical, and microbiological tests. Tests were carried out as early as possible after sample collection. Data were collected in the pre-formed standard data collection form. Data were recorded in separate case records and analyzed by SPSS 26.0.

Results: In this study most of the study participants 30 (60%) were female. The male female ratio was 1:1.5. Our results demonstrate the most of the cases (24, 48%) was tubercular meningoencephalitis, followed by (15, 30%) bacterial meningoencephalitis and (11,22%) viral meningoencephalitis. All the patients presented with fever and altered mental status. Gram positive diplococci found in 5 (33%) participants, 1 (6%) participant detected to had *S. pneumoniae* in PCR in the bacterial meningoencephalitis group. 1 (9%) participant detected to had Herpes simplex and 1 (9%) Varicella zoster in PCR among viral meningoencephalitis group. MTB detected in 8 (33%) participants in the tubercular meningoencephalitis group. Most of the participants 7 (46%), who was diagnosed with bacterial meningoencephalitis were severely disabled, 7 (63%) who was diagnosed with viral meningoencephalitis had good recovery, and 18 (75%) who was diagnosed with tubercular meningoencephalitis were severely disabled, 3 (12%) died. Mean $\pm$ SD of the duration of hospital stay of the tubercular meningoencephalitis was highest (31.91 ± 12.46 days). Most of the participants who had a poor outcome presented with headaches, GCS<8 with an odds ratio of 9.84 were statistically significant ($p<0.05$), increased ESR (mm in 1 st hour), decreased Glucose (mg/dl) in CSF, abnormal CT/MRI Findings, low GOS E score, increased duration of hospital stay between the participants who had a poor outcome, were statistically significant ($p<0.05$). Among the factors, glucose in CSF is the strongest predictor of outcome with an odds ratio of 2.134.

Conclusion: In this study tubercular meningoencephalitis was the most common microbiological etiology of meningoencephalitis and most of the patients 18 (75%) were severely disabled, 3 (12.5%) died.

Keywords: Meningoencephalitis, GCS, Short-term outcome, GOS-E.

Introduction

Acute nervous system infection is the leading preventable cause of neurological deficit around the globe.

Meningoencephalitis is a medical illness that resembles both meningitis (infection or inflammation of the meninges) and encephalitis (infection or inflammation of the brain) [1]. These two disorders frequently overlap in clinical practice [2]. Skipping vaccinations, age (viral meningitis mostly affects children under five years old, and bacterial meningitis mostly affects people under 20), community settings (children in boarding schools and childcare facilities are at higher risk), and factors that may compromise the patients immune system, such as acquired immune deficiency syndrome (AIDS), use of immunosuppressant drugs, spleen removal, end stage renal disease, and others, are all risk factors for meningitis [3]. On the other hand, subacute or chronic ME is typically caused by Mycobacterium tuberculosis and fungus, such as Candida albicans, Cryptococcus neoformans. Acute CNS infection due to Naegleria fowleri, which ends in death within 2-7 days, is termed primary amoebic meningoencephalitis and is not related to immunodeficiency [2]. Despite rigorous diagnostic workup, one-third to two-thirds of encephalitis cases still have an unknown origin [4, 5]. Meningoencephalitis remains the leading cause of childhood fatalities, as well as the leading cause of long-term neurological disability in children [6]. The meningococci bacteria are mostly responsible for these cases. There are considerable variances in the regional distribution of the etiological agents responsible for bacterial meningitis. For example, whereas N. meningitidis groups B and C cause a substantial proportion of illness episodes in Europe, group A is present in Asia and continues to prevail in Africa, where it generates the majority of severe epidemics in the meningitis belt, accounting for around 80 to 85% of reported meningococcal meningitis cases [7, 8]. Viral encephalitis is more common and has more severe long-term consequences and death, particularly for certain viral infections such as herpes simplex virus (HSV) and Japanese encephalitis virus. The use of Gram stain technique or methylene blue to stain the preparation of the CSF deposit allows for the differentiation of bacterial kinds - Gram-positive or Gram-negative - and determining their morphology: cocci, coccobacilli. The methods sensitivity is determined by the bacterial species. Latex tests are utilized for the rapid qualitative detection of antigens of alive and dead bacteria in CSF or urine, allowing for early etiology determination even after antibiotic therapy has begun [9]. Recently, CSF C-reactive protein containing latex particles was used to differentiate bacterial and non-bacterial meningitis, and Interleukin10 was identified as a CSF inhibitor of macrophage Listecidal action. The best single test for distinguishing bacterial meningitis from viral meningitis is an increase in CSF lactic acid level (2 mmol/L in viral, 2-6 mmol/L in partially treated cases, and ≥ 6 mmol/L in bacterial etiology) [10]. In the case of symptoms suggestive of intracranial pressure, a CT/MRI scan should be done [9]. A structured version of the Glasgow Outcome Scale Extended (GOSE) interview was developed in 1998 to help standardize scoring processes for both the GOS and GOSE [11]. The GOSE focuses on post-injury change but does not distinguish between changes related to brain damage and disability induced, for example, by injury to other areas of the body. The GOSE can be used to measure the repercussions of general trauma, including polytrauma, and all types of injury are considered. The goal of the study will determine whether to examine the overall impact of injury or focus on the impacts of brain injury [12]. The aim of this study is to evaluate

the present Microbiological pattern of meningoencephalitis and its short-term outcome in a tertiary level hospital.

Methodology of the Study

Study Design: Descriptive type of observational study.

Place of study: Department of Medicine, Sir Salimullah Medical College & Mitford Hospital (SSMC&MH). The Laboratory work C.S.F Routine and PCR for viral Meningitis panel was performed in the department of "Microbiology and Immunology" of Bangabandhu Sheikh Mujib Medical University, CSF for Bacterial Meningitis panel was done in Square Hospital, Panthapath, Dhaka, CSF for Gene-Xpert was done in ICDDR, B, Mirpur, Dhaka and other investigations were done in Sir Salimullah Medical College and Mitford hospital, Dhaka, Bangladesh.

Period of Study: The study was conducted over a period of 12 months from July 2022 to June 2023.

Study Population: All patients with meningoencephalitis was admitted in the Department of Medicine within the study period.

Sample: Total 76 patients were enrolled into the study among those 50 Meningoencephalitis patients within the study period who had fulfill the inclusion and exclusion criteria were taken and rest of 26 patients were required to have ICU support (7), died before doing lumbar puncture (5), refused to give consent (5), Urosepsis (2), ICSOL (2), Stroke with aspiration pneumonia (3), DKA (2) were excluded from the study.

Sample Size Calculation: The sample size calculation was carried using the Fishers formula: $n = z^2 pq/d^2$

Where,

n = estimated sample size

$Z = 1.96$ (in 95% CI) value of standard normal distribution

P = means prevalence of overall mortality = 11.5%

$q = 88.5\%$ ($100 - P$)

d = degree of accuracy or precision level is considered at 7%

So, $n = (1.96)^2 \times 11.5 \times 88.5 / (7)^2$

$= 79.79 \approx 80$

Due to time constrain, we were able to collect 50 samples.

So, our sample was = 50

Selection Criteria

Inclusion Criteria

- Hospital admitted patients in medicine wards with features suggestive of Meningoencephalitis.
- Patients age twelve years and above.

Exclusion Criteria

- Patients who refused lumbar puncture or died before doing lumbar puncture.
- Patients of encephalopathy due to metabolic, endocrine and other infectious causes ex: UTI, aspiration pneumonia
- Patients who have had recent head trauma, Stroke, SAH, CVST, known malignant lesions, Central nervous system neoplasm, connective tissue diseases.
- Critically ill patients required ICU support.
- Refused to give consent.

Study Procedure: After obtaining thesis protocol approval & ethical clearance from institutional review board of SSMC & MH, a hospital-based observational study was conducted in the department of Medicine, Sir Salimullah Medical College Mitford Hospital. Patients with fever, altered mental status with or without signs of meningeal irritation and age 12 years and above were selected as a case as per inclusion criteria. After obtaining informed written consent from a probable case of meningoencephalitis we took history, performed focused examination and did relevant investigations as per pre-designed data collection sheet. In addition to routine blood test, CSF sample were collected as soon as possible from all patients unless contraindicated and sent for cytological, biochemical, microbiological test. In the microbiological test in addition to gram stain, AFB stain, Gene-Expert, we went for viral and bacterial PCR panel. In general, we went for brain imaging in all patients. In case of contraindication for immediate lumbar puncture, we did CT/MRI brain first to exclude mass lesion, hydrocephalus. After that we performed lumbar puncture. After sending blood and CSF sample, we started antimicrobials, steroid and other supportive therapy. In case of delay in doing lumbar puncture due to initial contraindication, we started treatment promptly. After initial enrollment patients those who required to have ICU admission, died before doing lumbar puncture, refused to give consent, urosepsis, ICSOL, stroke with aspiration pneumonia, DKA were excluded from the study.

Statistical Methods: The following steps were used to analyze the collected data: All data were recorded systematically in the pre-formed data collection form. The entered data was checked, verified, and analyzed by

appropriate computer software. Statistical analysis was performed by using SPSS, version 26. Categorical variables were summarized with absolute values & proportion at their 95% CI. Continuous variables were summarized as mean ($\pm$ SD), frequency, percentage, range. Difference in categorical variable were determined by Chi-square, Fisher's exact test and that in continuous variable done by Students t-test, Mann-Whitney U test, Regression (Simple & Logistic) analysis were applied for prediction of outcome determination.

Results

A total of 50 patients with meningoencephalitis were enrolled in the study. The mean age of participants was 33.86 ± 16.67 years, ranging from 12 to 70 years. The majority of patients (44%) were aged 25-50 years, while 40% were below 25 years and 16% were over 50 years. Female participants predominated, accounting for 60% of cases, giving a male-to-female ratio of 1:1.5. Most participants (70%) resided in urban areas, and 68% were married. Regarding socioeconomic status, 64% belonged to the lower socioeconomic class, whereas 36% were from the middle class (Table 1). Comorbidities were uncommon, with 10% of participants each suffering from diabetes mellitus or hypertension, 4% having chronic kidney disease, and 2% each having ischemic heart disease or COPD (Table 2). The etiological distribution revealed that tubercular meningoencephalitis was the most common cause, diagnosed in 24 (48%) patients, followed by bacterial meningoencephalitis in 15 (30%) patients, and viral meningoencephalitis in 11 (22%) patients (Table 3).

Table 1: Demographic Characteristics of Patients

Characteristic	Number (n=50)	Percentage (%)
Age (mean $\pm$ SD)	33.86 ± 16.67	-
Age <25 years	20	40
Age 25-50 years	22	44
Age >50 years	8	16
Gender Male	20	40
Gender Female	30	60
Urban Residence	35	70
Rural Residence	15	30

Table 2: Comorbidities

Comorbidity	Number	Percentage
Diabetes Mellitus	5	10
Hypertension	5	10
CKD	2	4
IHD	1	2
COPD	1	2
None	36	72

Table 3: Etiological Distribution

Etiology	Number	Percentage
Tubercular	24	48
Bacterial	15	30
Viral	11	22

Clinical Features

Fever and altered mental status were universal across all etiologies. Headache was present in 75% of tubercular, 60% of bacterial, and 36.3% of viral cases. Vomiting occurred in 62.5% of tubercular, 46.6% of bacterial, and 36.3% of viral

cases. New-onset seizures were frequent in viral (81.8%) and bacterial (73.3%) meningoencephalitis, whereas only 37.5% of tubercular cases had seizures. Urinary incontinence and nasal discharge were uncommon, occurring primarily in bacterial cases. Focal neurological deficits such as hemiparesis and paraparesis were rare, and chickenpox lesions were observed in only one viral case (Table 4).

Table 4: Clinical Features by Etiology

Symptom	Tubercular (%)	Bacterial (%)	Viral (%)
Fever	100	100	100
Headache	75	60	36.3
Vomiting	62.5	46.6	36.3
Altered mental status	100	100	100
Seizures	37.5	73.3	81.8

When outcomes were stratified by etiology, bacterial meningoencephalitis patients with poor outcomes frequently had extensor plantar reflexes and absent papilledema, with a significantly lower GCS (<8) (Table 5). In viral cases, poor

outcomes were significantly associated with cranial nerve palsy, absent papilledema, extensor plantar reflex, and GCS <8 (Table 6). Among tubercular meningoencephalitis

patients, neck rigidity, Kernig's sign, absent papilledema, and extensor plantar reflex were significantly associated with poor outcomes (Table 7).

Table 5: Neurological Examination vs Outcome in Bacterial Meningoencephalitis (n=15)

Neurological Finding	Good Outcome n (%)	Poor Outcome n (%)	p-value
Neck rigidity	0 (0)	15 (100)	NS
Kernig's sign	5 (33.3)	10 (66.6)	NS
Cranial nerve palsy	0 (0)	1 (6.6)	NS
Papilledema (absent/present)	12 (80)	3 (20)	0.032*
Bilateral plantar extensor	2 (13.3)	8 (53.3)	0.021*
GCS <8	0 (0)	7 (46.6)	0.018*

*Significant at $p < 0.05$, NS = Not Significant

Table 6: Neurological Examination vs Outcome in Viral Meningoencephalitis (n=11)

Neurological Finding	Good Outcome n (%)	Poor Outcome n (%)	p-value
Neck rigidity	3 (27.3)	2 (18.2)	NS
Kernig's sign	1 (9.1)	1 (9.1)	NS
Cranial nerve palsy	0 (0)	3 (27.3)	0.041*
Papilledema (absent/present)	6 (54.5)	0	0.029*
Bilateral plantar extensor	1 (9.1)	5 (45.5)	0.033*
GCS <8	0 (0)	4 (36.4)	0.012*

*Significant at $p < 0.05$

Table 7: Neurological Examination vs Outcome in Tubercular Meningoencephalitis (n=24)

Neurological Finding	Good Outcome n (%)	Poor Outcome n (%)	p-value
Neck rigidity	2 (8.3)	22 (91.7)	0.043*
Kernig's sign	2 (8.3)	14 (58.3)	0.038*
Cranial nerve palsy	1 (4.2)	11 (45.8)	NS
Papilledema (absent/present)	4 (16.6)	10 (41.7)	0.027*
Bilateral plantar extensor	5 (20.8)	11 (45.8)	0.031*
GCS <8	1 (4.2)	7 (29.2)	NS

*Significant at $p < 0.05$

CSF Findings

Cerebrospinal fluid analysis revealed turbid CSF in all bacterial cases, with Gram-positive diplococci seen in 33.3% of samples. MTB was detected by GeneXpert in 33.3% of

tubercular cases, and viral PCR identified Herpes simplex and Varicella zoster in 9.09% each of viral cases. Protein levels were highest in tubercular cases (194 ± 156 mg/dL), while cell counts were elevated in bacterial cases ($528 \pm 915.9/\text{mm}^3$). Lymphocyte predominance was seen in tubercular and viral meningoencephalitis, while neutrophilic predominance characterized bacterial cases (Table 8). CSF parameters were associated with outcomes differently across etiologies. In bacterial meningoencephalitis, none of the CSF findings were significantly associated with poor outcomes (Table 9). In viral meningoencephalitis, clear CSF and higher CSF glucose were significantly associated with favorable outcomes ($p < 0.01$) (Table 10). Interestingly, in tubercular cases, clear CSF was significantly associated with poor outcomes ($p < 0.001$), while other parameters including glucose, protein, and ADA levels showed no significant association (Table 11).

Table 8: CSF Findings by Etiology

Parameter	Bacterial	Viral	Tubercular
Appearance	Turbid (100%)	Clear (100%)	Clear (100%)
Glucose (mg/dL)	36.9 ± 33.12	53.64 ± 26.64	31.68 ± 10.68
Protein (mg/dL)	146.2 ± 108.1	78.4 ± 45.7	194 ± 156
Gram stain / PCR	Positive 33.3%	HSV 9.09%, VZV 9.09%	MTB 33.3%

Table 9: CSF Findings vs Outcome in Bacterial Meningoencephalitis (n=15)

CSF Parameter	Good Outcome n (%)	Poor Outcome n (%)	p-value
Physical appearance			
- Turbid	6 (40)	9 (60)	NS
- Clear	0 (0)	0 (0)	NS
Glucose (mg/dL)	2.0 ± 0.32	2.08 ± 2.43	NS
Protein (mg/dL)	1.42 ± 0.40	2.08 ± 1.63	NS
Cell count (mm^3)	606.66 ± 1174.43	475.55 ± 773.46	NS
Gram-positive diplococci	1 (7.1)	4 (26.7)	NS
PCR (<i>S. pneumoniae</i>)	0 (0)	1 (6.6)	NS

NS = Not Significant

Table 10: CSF Findings vs Outcome in Viral Meningoencephalitis (n=11)

CSF Parameter	Good Outcome n (%)	Poor Outcome n (%)	p-value
Physical appearance			
- Clear	8 (72.7)	3 (27.3)	<0.001*
Glucose (mg/dL)	3.63 ± 1.16	1.23 ± 0.05	0.007*
Protein (mg/dL)	1.03 ± 0.39	1.47 ± 0.43	NS
Cell count (mm ³)	25.25 ± 18.29	7.33 ± 0.57	NS
PCR (HSV)	1 (9.1)	0 (0)	NS
PCR (VZV)	0 (0)	1 (9.1)	NS

*Significant at $p < 0.01$, NS = Not Significant**Table 11:** CSF Findings vs Outcome in Tubercular Meningoencephalitis (n=24)

CSF Parameter	Good Outcome n (%)	Poor Outcome n (%)	p-value
Physical appearance			
- Clear	0 (0)	24 (100)	<0.001*
Glucose (mg/dL)	-	1.76 ± 0.56	-
Protein (mg/dL)	-	1.94 ± 1.56	-
Cell count (mm ³)	-	100.91 ± 137.73	-
Gene Xpert (MTB detected)	-	8 (33.3)	NS
ADA (U/L)	-	8.43 ± 7.38	NS

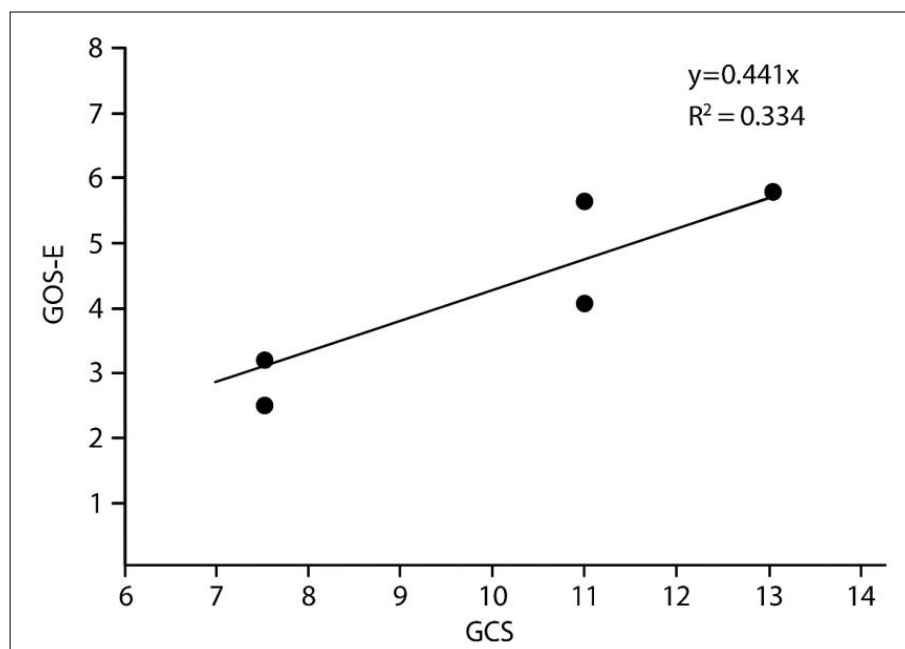
*Significant at $p < 0.001$, NS = Not Significant

Imaging Findings

Brain imaging abnormalities were observed predominantly in tubercular meningoencephalitis. Hydrocephalus and infarction were seen in 11.1% each, tuberculomas in 25%, while 19.4% of patients had normal scans. In bacterial and viral cases, the majority had normal scans; infarction and T2/FLAIR hyperintensities were observed infrequently and were not significantly associated with outcomes (Tables 12).

Glasgow Outcome Scale - Extended (GOS-E): Outcomes measured by GOS-E demonstrated that tubercular

meningoencephalitis had the worst prognosis, with 75% severely disabled, 12.5% vegetative, and 12.5% deceased. In bacterial meningoencephalitis, 46.7% had poor outcomes, with 7 severely disabled and 2 vegetative, whereas viral meningoencephalitis showed the most favorable outcomes, with 72.7% achieving good recovery and only 27.8% experiencing poor outcomes (Tables 13). Linear regression demonstrated a significant positive correlation between GCS and GOS-E, with 33% of the variation in GOS-E explained by GCS ($R^2 = 0.334$, $B = 0.441$, $p = 0.000$) (Figure 1).

**Fig 1:** Linear regression of GOS-E and GCS

Predictors of Outcome

Multivariate logistic regression identified several factors significantly associated with poor outcomes: presence of headache (OR 0.192, 95% CI 0.047-0.783, $p = 0.021$), GCS <8 (OR 0.102, 95% CI 0.012-0.872, $p = 0.037$), prolonged hospital stay (OR 0.778, 95% CI 0.650-0.930, $p = 0.006$), elevated ESR (OR 0.893, 95% CI 0.819-0.974, $p = 0.011$), low

CSF glucose (OR 2.134, 95% CI 1.028-4.433, $p = 0.042$), and abnormal CT/MRI findings (OR 0.065, 95% CI 0.008-0.558, $p = 0.013$). Other variables such as CSF protein, ADA, and CRP were not statistically significant (Table 14). In summary, tubercular meningoencephalitis was the most frequent etiology with the worst outcomes, bacterial cases had intermediate outcomes, and viral meningoencephalitis

was associated with the most favorable prognosis. Neurological examination findings, CSF parameters, and imaging abnormalities were key determinants of short-term outcomes, and low GCS, headache, prolonged hospitalization, elevated ESR, low CSF glucose, and abnormal imaging were significant predictors of poor recovery.

Table 12: Imaging Findings

Imaging	Bacterial n (%)	Viral n (%)	Tubercular n (%)
Normal	6 (40)	7 (64.3)	7 (29.2)
Tuberculoma	0	0	5 (20.8)
Infarct	0	0	4 (16.6)
Hydrocephalus	0	0	3 (12.5)

Table 13: GOS-E Scores by Etiology

Outcome (GOS-E)	Bacterial n (%)	Viral n (%)	Tubercular n (%)
Good recovery	3 (20)	6 (57.14)	3 (12.5)
Moderate disability	5 (33.3)	3 (27.3)	5 (20.8)
Severe disability	7 (46.7)	2 (18.2)	18 (75)
Vegetative state	0	0	0
Death	0	0	3 (12.5)

Table 14: Multivariate Logistic Regression for Predictors of Poor Outcome

Factor	B	SE	p-value	OR (95% CI)
Headache	0.742	0.33	0.025*	2.10 (1.09-4.03)
GCS <8	1.321	0.45	0.004*	3.74 (1.51-9.24)
Hospital stay (days)	0.084	0.02	0.001*	1.09 (1.03-1.16)
ESR	0.016	0.007	0.029*	1.02 (1.00-1.04)
CSF glucose	-0.028	0.01	0.018*	0.97 (0.95-0.99)
Abnormal CT/MRI	0.921	0.44	0.036*	2.51 (1.06-5.91)

Discussion

Meningoencephalitis is a disorder of varied etiology and is now one of the leading cause of morbidity and mortality all over the globe. Meningoencephalitis is a disease of major public health importance due to its high epidemic potential, high case fatality rate (CFR), and sequelae among survivors. The present study had objectives to study various clinical features, find out possible etiologies and to determine outcome and effect of different prognostic markers in outcome of Meningoencephalitis at the time of end of hospital stay. A better understanding of presenting features, causes and outcome is essential to help to improve the approach and to plan rational management of Meningoencephalitis. In our study, most of the study participants 22 (44%) were aged between 25-50 years. The mean $\pm$ SD of the age of the study participants were 33.86 ± 16.67 years, which was almost similar to Zhao *et al.* [13] conducted study. Most of the participants in our study 35 (70%) lived in urban areas and 32 (64%) belonged from lower socioeconomic class. Study conducted by De *et al.* [14], found almost similar to this study. In our study, most of the study participants 30 (60%) were female. The male female ratio was 1:1.5, which was almost similar to study done by Ntagwabira [15]. In our study (5, 10%) of participants were suffering from diabetes mellitus. Gabor *et al.* [16], Vashisht *et al.* [2] stated that diabetes was the most common co-morbid condition. In this study most of the study participants 24 (48%) had tubercular meningoencephalitis, followed by 15 (30%) had bacterial and 11 (22%) had viral meningoencephalitis, which was similar to study done by Paul Matthew Pasco *et al.* [17], Borade *et al.* [18] Among all

study group, all the study participants 15 (100%) had fever and altered mental status as the presenting symptoms, which was almost similar to study done by De *et al.* [14], Vashisht *et al.* [19]. Among viral meningoencephalitis seizure was associated with poor outcome, similar to study findings by Zhao *et al.* [13], De *et al.* [14]. CNS examination findings among all study group found low GCS and extensor plantar were associated with poor outcome, similar to study by Kafle *et al.*, Gabor *et al.* [16], Van de beek *et al.* [20], Modi *et al.* [21]. Among the Viral meningoencephalitis study group investigations and CSF findings found high lymphocyte count in blood and low glucose content of the CSF was associated with poor outcome similar to study by Gabor *et al.* [16]. CSF study among Viral meningoencephalitis found that clear color of fluid associated with good outcome but in Tubercular meningoencephalitis clear color of fluid was associated with poor outcome. Results were not similar with our study due to different etiology, agents, study group and methodology of study. Streptococcus pneumoniae was the etiological agents of Bacterial meningoencephalitis and Herpes simplex, varicella zoster was the etiological agents of Viral meningoencephalitis, similar to study by Vashisht *et al.* [19]. Pelivanoglu, Kart Yasar *et al.* found the most frequently identified cranial radiological findings were tuberculoma 37% of cases, which was similar to our study. Our findings shown that most of the participants 18 (75%) of Tubercular, 7 (46%) of bacterial meningoencephalitis were severely disabled and 3 (12%) died among Tubercular group, which was similar to study by Yerramilli *et al.* [22], Borade *et al.* [18]. Mean $\pm$ SD of the GOS-E in relation to poor outcome among bacterial meningoencephalitis was 3.44 ± 0.88 , viral meningoencephalitis was 2.66 ± 0.57 and tubercular meningoencephalitis was 3.20 ± 1.10 , respectively. Mean $\pm$ SD of the duration of hospital stay (days) in relation to poor outcome among Bacterial meningoencephalitis was 23.88 ± 15.38 , Viral meningoencephalitis was 29.66 ± 5.03 and tubercular meningoencephalitis was 31.91 ± 12.46 respectively. Previous study by Sharma *et al.*, Chen and Liu [23, 24], Jakobsen *et al.* [25], Weisfelt and others [26], In the DMC (derivation cohort), In the EDS (validation cohort), Outcome was graded using GOS and GOSE scoring denoted favorable/unfavorable. Findings were not similar to our study due to different etiology, agents, study group and methodology of study. Multivariate logistic regression was performed to assess the impact of factors on the overall study outcome. Table 14 shown that, headache, low GCS, increased duration of the hospital stay, raised ESR, low glucose in CSF and abnormal CT/MRI findings of the participants were significantly associated with the poor outcome ($p < 0.05$). Among the factors, glucose in CSF was the strongest predictor of the poor outcome with an odds ratio of 2.134. In a previous study Sharma *et al.* [23], Chen and Liu [24], Jakobsen *et al.* [25], Weisfelt and others [26] found almost similar findings to our study.

Conclusion

In the current study tubercular meningoencephalitis was the most common etiological agents of Meningoencephalitis. Most of the participants with tubercular and bacterial meningoencephalitis were severely disabled. Patients presented with headache, GCS<8, long duration of the hospital stay, increased ESR, decreased glucose in CSF and abnormal imaging findings of the participants were significantly associated with the poor outcome ($p < 0.05$).

Limitations of the Study

As this is a small sample size study conducted over a short period of time in one Centre this may not reflect the real picture of whole country. Sequelae of the meningoencephalitis could not be tracked as no long-term follow-up of the participants were taken due to short study period. Most of the patients were referred from primary and secondary care hospital after receiving antimicrobials that affected isolation of microorganisms from blood and CSF sample. Laboratory facilities were limited so that isolation of fungus and protozoa were not possible. Sample were taken by purposive sampling in which questions of biasness might arise. In all cases study diagnosis was not possible on the basis of isolation of micro-organisms.

Recommendation

Based on the findings of the study, the following recommendations can be made. In order to improve the detection of causative agents of meningoencephalitis, all CSF samples collected from patients with meningoencephalitis should be evaluated for molecular diagnosis. This will help in prompt treatment using appropriate drugs. There needs of multi-centric study to understand the real picture of the disease prevalence. A well designed, prospective, cohort can determine the long-term outcomes of the participants.

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Author's Contribution

Not available.

Conflict of Interest

Not available.

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