Original Research

Observation of Clinical Profile of Different Types of Meningitis in a Tertiary Care Hospital

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Abstract

Background: *Meningitis, an inflammation of the membranes surrounding the brain and spinal cord, presents significant diagnostic challenges due to its varied etiologies and overlapping clinical symptoms. This study aims to observe and document the clinical and laboratory characteristics of viral, bacterial, and tubercular meningitis in a tertiary care hospital setting.*

Methods: *This descriptive observational study was conducted at the Department of Neuromedicine, Cumilla Medical College Hospital, Bangladesh, from January 2020 to December 2020. We enrolled 159 patients diagnosed with meningitis based on clinical, biochemical, and investigative criteria. Detailed demographic data, clinical examination findings, and relevant investigations, including cerebrospinal fluid (CSF) studies, were recorded. Data analysis was performed using SPSS software version 20 and MS-Excel 2016.*

Results: *Among the 159 participants, 36.7% were diagnosed with bacterial meningitis, 32.5% with viral meningitis, and 24.9% with tubercular meningitis. Fever was a universal symptom, while headache was reported by 87.3% of viral, 87.1% of bacterial, and 95.2% of tubercular meningitis patients. Vomiting was more prevalent in tubercular (57.1%) and bacterial (50%) meningitis. Laboratory findings showed the highest mean white blood cell count in bacterial meningitis (11803.18±2905.55 cells/cmm). C-reactive protein levels were also highest in bacterial meningitis (21.23±16.20 mg/dl). Elevated adenosine deaminase levels were a distinguishing feature of tubercular meningitis (14.18±10.60 Unit/L).*

Conclusion: *This study highlights the distinct clinical and laboratory profiles associated with different types of meningitis. The findings emphasize the importance of comprehensive evaluations for accurate diagnosis and effective management of meningitis. Further research should aim to refine diagnostic criteria and explore advanced diagnostic tools to improve patient outcomes.*

Introduction

Meningitis refers to the inflammation of the membranes (meninges) surrounding the brain and spinal cord [1]. Despite being a notifiable disease in many countries, the exact incidence rate of meningitis remains unknown. However, between 1990 and 2010, an estimated global figure of approximately 420,000 deaths were associated with the disease[2]. The most common types of meningitis are pyogenic (bacterial) meningitis, viral meningitis, and tuberculous meningitis (TBM). Among these, viral meningitis is the most common, while bacterial meningitis is the most severe. The severity of meningitis largely depends on its cause. Each type of meningitis has distinct etiological agents but ultimately follows a similar pathogenic process. A bacterium, fungus, virus, or parasite can spread through the bloodstream to the brain or spinal cord, where it infects the meninges or

surrounding fluids, leading to inflammation and infection. Non-infectious meningitis, on the other hand, results from physical injury or other conditions and does not involve an infectious agent[3]. The most common bacterial pathogens responsible for meningitis include Streptococcus pneumoniae, Neisseria meningitidis (meningococcus), Haemophilus influenzae, Listeria monocytogenes, and Staphylococcus aureus. Tuberculous meningitis is specifically caused by Mycobacterium tuberculosis. In viral meningitis, common causative organisms include enteroviruses (particularly Coxsackie virus) and the herpes simplex virus[4]. The incidence of bacterial meningitis varies globally, with an estimated occurrence of about 1–2 cases per 100,000 people per year[5]. Clinically, meningitis is often diagnosed using the classic triad of neck stiffness, fever, and altered consciousness. However, in practice, any two of these three symptoms are more commonly observed and are exhibited by up to 95% of meningitis patients[6]. Complications related to meningitis can include hydrocephalus, subdural collections, infarction, cerebritis, ventriculitis, and brain abscesses[7]. While there are numerous studies on meningitis, most have focused primarily on the pediatric population, leaving studies on the adult population relatively scarce. Additionally, much of the existing research has concentrated on bacterial and tuberculous meningitis. Therefore, it is particularly important to study the various types of meningitis occurring in a tertiary care setting to fill these gaps in the literature. This study aims to observe and document the clinical profiles of different types of meningitis in a tertiary care hospital, thereby contributing to a better understanding of the disease in both pediatric and adult populations.

Method

This descriptive observational study was conducted at the Department of Neuromedicine, Cumilla Medical College Hospital, Cumilla, Bangladesh, from January 2020 to December 2020. The study focused on the microbiological data of cerebrospinal fluid (CSF), blood cultures, laboratory examinations, and medical records of patients with meningitis admitted to the neuromedicine department. A total of 159 patients were enrolled in the study, having been diagnosed based on clinical, biochemical, and other investigative criteria, and meeting the specified inclusion and exclusion criteria. The inclusion criteria were patients admitted to the medical wards with symptoms of fever, headache, vomiting, and meningeal irritation, and adult patients of both genders. The exclusion criteria included patients who refused lumbar puncture or died before undergoing the procedure, patients with encephalopathy due to metabolic and endocrine causes, recent head trauma, immunocompromised conditions, known malignant lesions, or central nervous system neoplasms. Critically ill patients, those unable to undergo a CT scan, or those who withdrew informed consent were also excluded from the study. Patients presenting with features of meningitis were enrolled after obtaining informed written consent from the patient or their guardian. Detailed demographic data were collected from the informants and recorded in structured case report forms. Clinical examinations and relevant investigations, including CSF studies, were performed. Routine follow-up of the patients was conducted. Data analysis was carried out using SPSS software version 20.

Result

Table 1: Baseline characteristics distribution among the participants (N=159)

Baseline Characteristics	n	%
Age		
≤20	38	22.5%
21-30	42	24.9%
31-40	18	10.7%
41-50	16	9.5%
>50	45	26.6%
Gender		
Male	69	40.8%
Female	90	53.3%

The age distribution showed that 22.5% of the participants were 20 years old or younger, 24.9% were between 21 and 30 years old, 10.7% were between 31 and 40 years old, 9.5% were between 41 and 50 years old, and 26.6% were older than 50 years. Regarding gender distribution, 40.8% of

the participants were male, while 53.3% were female.

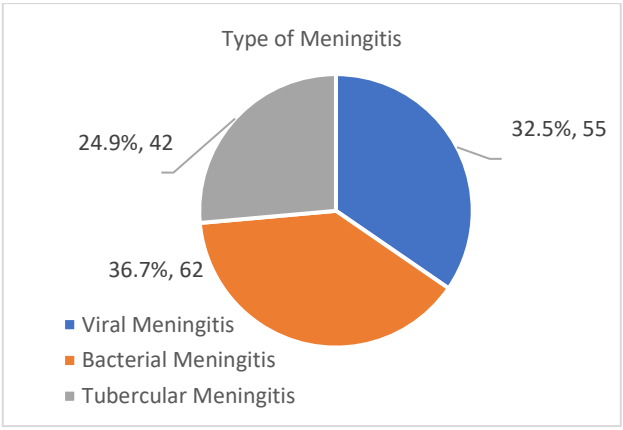

Figure 1: Distribution of different types of meningitis among the participants (N=159)

Among the 159 participants diagnosed with meningitis, the distribution of the types of meningitis was as follows: 36.7% (62 participants) were diagnosed with bacterial meningitis, 32.5% (55 participants) had viral meningitis, and 24.9% (42 participants) were diagnosed with tubercular meningitis, as illustrated in Figure 1.

Table 2: Distribution of symptoms by different types of meningitis (N=159)

Symptoms	Viral Meningitis (n=55)		Bacterial Meningitis (n=62)		Tubercular Meningitis (n=42)	
	n	%	n	%	n	%
Headache	48	87.3%	54	87.1%	40	95.2%
Fever	55	100.0%	62	100.0%	42	100.0%
Vomiting	20	36.4%	31	50.0%	24	57.1%
Convulsion	3	5.5%	4	6.5%	6	14.3%

Headache was prevalent among 87.3% of participants with viral meningitis, 87.1% with bacterial meningitis, and 95.2% with tubercular meningitis. Fever was a universal symptom, reported by 100% of participants across all types of meningitis. Vomiting was observed in 36.4% of participants with viral meningitis, 50% with bacterial meningitis, and 57.1% with tubercular meningitis. Convulsions were noted in 5.5% of participants with viral meningitis, 6.5% with bacterial meningitis, and 14.3% with tubercular meningitis.

Table 3: Distribution of signs by different types of eningitis (N=159)

Signs	Viral Meningitis (n=55)		Bacterial Meningitis (n=62)		Tubercular Meningitis (n=42)	
	n	%	n	%	n	%
Irritation	29	52.7%	37	59.7%	24	57.1%
Papilledema	4	7.3%	3	4.8%	16	38.1%
Cranial nerve palsy	2	3.6%	0	0.0%	8	19.0%
Planter extensor	6	10.9%	12	19.4%	11	26.2%

In terms of clinical signs, irritation was present in 52.7% of participants with viral meningitis, 59.7% with bacterial meningitis, and 57.1% with tubercular meningitis. Papilledema was observed in 7.3% of participants with viral meningitis, 4.8% with bacterial meningitis, and 38.1% with tubercular meningitis. Cranial nerve palsy was identified in 3.6% of participants with viral meningitis and 19% with tubercular meningitis, but was absent in bacterial meningitis cases. Lastly, plantar extensor responses were noted in 10.9% of participants with viral meningitis, 19.4% with bacterial meningitis, and 26.2% with tubercular meningitis.

Table 4: Comparison of laboratory characteristics in different types of meningitis (n=159)

Characteristic	Viral Meningitis (n=55)	Bacterial Meningitis (n=62)	Tubercular Meningitis (n=42)
Blood (WBC/cmm)	11041.43 ±4713.23	11803.18 ±2905.55	10302.44 ±2323.30
ESR (mm/1st hr)	33.84±23.94	33.86±20.64	39.78±19.99
CRP (mg/dl)	14.35±16.11	21.23±16.20	19.50±21.24
RBS (mmole/l)	7.03±2.19	6.83±2.48	6.89±1.58
Blood Na+(mmol/lit)	134.05±4.06	137±5.42	136.9±8.32
S creatinine (mg/dl)	1.07±0.37	1.14±0.60	0.98±0.24
Sugar (mg/dl)	68.67±24.95	59.12±16.17	62.66±16.10
Total cells/cmm	135.18±150.59	399.48±417.82	226.40±178.33
Polymorph (%)	29.08±72.78	179.11±296.02	39.51±97.93
Lymphocyte (%)	106.65±116.19	217.76±267.35	185.31±142.00
ADA (Unit/L)	4.83±3.40	6.72±6.72	14.18±10.60

The laboratory characteristics of different types of meningitis were compared among the 159 participants. The mean white blood cell (WBC)

count was highest in bacterial meningitis (11803.18±2905.55 cells/cmm), followed by viral meningitis (11041.43±4713.23 cells/cmm) and tubercular meningitis (10302.44±2323.30 cells/cmm). The erythrocyte sedimentation rate (ESR) was relatively similar between viral (33.84±23.94 mm/1st hr) and bacterial meningitis (33.86±20.64 mm/1st hr), but slightly higher in tubercular meningitis (39.78±19.99 mm/1st hr). C-reactive protein (CRP) levels were highest in bacterial meningitis (21.23±16.20 mg/dl), followed by tubercular meningitis (19.50±21.24 mg/dl) and viral meningitis (14.35±16.11 mg/dl). Random blood sugar (RBS) levels were similar across all types: viral meningitis (7.03±2.19 mmole/l), bacterial meningitis (6.83±2.48 mmole/l), and tubercular meningitis (6.89±1.58 mmole/l). Blood sodium (Na+) levels were lowest in viral meningitis (134.05±4.06 mmol/lit) and highest in bacterial meningitis (137±5.42 mmol/lit), with tubercular meningitis at 136.9±8.32 mmol/lit. Serum creatinine levels were highest in bacterial meningitis (1.14±0.60 mg/dl), followed by viral meningitis (1.07±0.37 mg/dl) and tubercular meningitis (0.98±0.24 mg/dl). Blood sugar levels in the CSF were lowest in bacterial meningitis (59.12±16.17 mg/dl), followed by tubercular meningitis (62.66±16.10 mg/dl) and viral meningitis (68.67±24.95 mg/dl). Total cell counts in the CSF were highest in bacterial meningitis (399.48±417.82 cells/cmm), followed by tubercular meningitis (226.40±178.33 cells/cmm) and viral meningitis (135.18±150.59 cells/cmm). The percentage of polymorphonuclear cells (polymorphs) was highest in bacterial meningitis (179.11±296.02%), followed by tubercular meningitis (39.51±97.93%) and viral meningitis (29.08±72.78%). Lymphocyte percentages were highest in bacterial meningitis (217.76±267.35%), followed by tubercular meningitis (185.31±142.00%) and viral meningitis (106.65±116.19%). Adenosine deaminase (ADA) levels were highest in tubercular meningitis (14.18±10.60 Unit/L), followed by bacterial meningitis (6.72±6.72 Unit/L) and viral meningitis (4.83±3.40 Unit/L).

Discussion

The findings of this study on the clinical and laboratory characteristics of viral, bacterial, and tubercular meningitis provide valuable insights into the distinct profiles of these conditions, which are critical for accurate diagnosis and effective management. In our study, fever was a universal symptom across all types of meningitis, reported by 100% of participants regardless of the type. Headache was also highly prevalent, with 87.3% of participants with viral meningitis, 87.1% with bacterial meningitis, and an even higher rate of 95.2% among those with tubercular meningitis. These findings underscore the commonality of fever and headache as primary symptoms of meningitis, which aligns with the results reported by Thwaites et al. (2002). Their study also highlighted the difficulty in distinguishing tubercular meningitis from bacterial meningitis based solely on clinical symptoms due to overlapping presentations such as fever and headache [8]. Vomiting was observed in 36.4% of participants with viral meningitis, 50% with bacterial meningitis, and 57.1% with tubercular meningitis. Convulsions were less common, seen in 5.5% of participants with viral meningitis, 6.5% with bacterial meningitis, and 14.3% with tubercular meningitis. The variability in these symptoms reflects the differences in the pathophysiology of the various types of meningitis. Our findings on the prevalence of vomiting and convulsions are consistent with the literature, which indicates these symptoms are more frequently associated with severe forms of meningitis, such as tubercular and bacterial meningitis. Laboratory findings in our study revealed significant differences between the types of meningitis. The mean white blood cell (WBC) count was highest in bacterial meningitis (11803.18±2905.55 cells/cmm), followed by viral meningitis (11041.43±4713.23 cells/cmm) and tubercular meningitis (10302.44±2323.30 cells/cmm). This elevated WBC count in bacterial meningitis is indicative of a more intense immune response, which is a well-documented phenomenon. Yang et al. (2020) also reported that higher WBC counts and neutrophil percentages are significant predictors of bacterial meningitis[9]. The erythrocyte sedimentation rate (ESR) was

relatively similar between viral (33.84±23.94 mm/1st hr) and bacterial meningitis (33.86±20.64 mm/1st hr), but slightly higher in tubercular meningitis (39.78±19.99 mm/1st hr). C-reactive protein (CRP) levels were highest in bacterial meningitis (21.23±16.20 mg/dl), followed by tubercular meningitis (19.50±21.24 mg/dl) and viral meningitis (14.35±16.11 mg/dl). The elevated CRP levels in bacterial meningitis further support the use of inflammatory markers to distinguish bacterial from other types of meningitis[10]. Our study also found significant differences in cerebrospinal fluid (CSF) analysis. The total cell count in the CSF was highest in bacterial meningitis (399.48±417.82 cells/cmm), followed by tubercular meningitis (226.40±178.33 cells/cmm) and viral meningitis (135.18±150.59 cells/cmm). Polymorphonuclear cell percentages were highest in bacterial meningitis (179.11±296.02%), while lymphocyte percentages were highest in tubercular meningitis (185.31±142.00%). These findings align with those of He et al. (2021), who noted that lower CSF glucose levels and higher protein content are indicative of tubercular meningitis [11]. Adenosine deaminase (ADA) levels were notably higher in tubercular meningitis (14.18±10.60 Unit/L), compared to bacterial (6.72±6.72 Unit/L) and viral meningitis (4.83±3.40 Unit/L). ADA is increasingly recognized as a useful biomarker for the diagnosis of tubercular meningitis, particularly in resource-limited settings where advanced diagnostic tools may not be available[12]. The diagnostic challenges in differentiating bacterial from viral meningitis are well documented. Cunha (2006) emphasized the critical importance of CSF lactic acid levels in distinguishing bacterial meningitis from viral meningitis, particularly when traditional markers like CSF glucose and pleocytosis are inconclusive [13]. Similarly, the rapid identification of pathogens using modern diagnostic tools, such as the FilmArray Meningitis/Encephalitis panel, has been shown to significantly improve the differentiation between bacterial and viral meningitis[10]. Furthermore, studies by Hristea et al. (2012) and Yang et al. (2020) have developed clinical prediction rules and diagnostic formulas to aid in the differentiation of tubercular meningitis from bacterial meningitis, highlighting factors such as duration of symptoms, presence of neurological impairment, CSF/blood glucose ratio, and CSF protein levels[9,14]. In summary, our study highlights the distinct clinical and laboratory profiles associated with viral, bacterial, and tubercular meningitis. These findings are consistent with existing literature and emphasize the importance of comprehensive clinical and laboratory evaluations in the accurate diagnosis and management of meningitis. The differentiation between the types of meningitis based on clinical and laboratory findings can significantly enhance diagnostic accuracy and patient outcomes.

Conclusion

This study provides comprehensive insights into the clinical and laboratory characteristics of viral, bacterial, and tubercular meningitis in a tertiary care hospital setting. Our findings highlight significant differences in the presentation and laboratory profiles of these types of meningitis, which are crucial for accurate diagnosis and effective management. Fever and headache were universally prevalent symptoms, while laboratory markers such as elevated white blood cell counts and C-reactive protein levels were more indicative of bacterial meningitis. Elevated adenosine deaminase levels were a distinguishing feature of tubercular meningitis. These distinct profiles underscore the importance of thorough clinical and laboratory evaluations in differentiating between types of meningitis. Future research should focus on further refining diagnostic criteria and exploring advanced diagnostic tools to improve patient outcomes. Overall, our study contributes to the existing body of knowledge and provides a foundation for better diagnostic and therapeutic strategies in the management of meningitis.

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