

Neurological Complications and Clinical Outcomes of Bacterial Meningitis: A Cross-Sectional Study from Dhi-Qar, Iraq

Hazim Ali Marah

Neurological
Complications
and Clinical
Outcomes of
Bacterial
Meningitis

ABSTRACT

Objective: To evaluate the prevalence and the type of neurological complications in patients who had bacterial meningitis.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Al-Turky hospital in Dhi-Qar, Iraq from 15th March 2025 31st August 2025.

Methods: Fifty three patients who diagnosed with bacterial meningitis were enrolled. The demographic characteristics, clinical presentation and neurological complications were gathered and analyzed.

Results: The males (54.7%) were more numerous than females (45.3%). The largest age group was 10–20 years (41.5%). Forty-two (79.3%) patients had neurological sequel; while 11 (20.7%) patients were neurologically normal. Seizures, altered mental status, hearing impairment, focal neurological deficits, and cerebrovascular complications were the most common complications observed. The elderly age was the least represented and neurological complications occurred in all age groups.

Conclusion: Neurological complications are very common in patients with bacterial meningitis and play an important role in the poor outcome. Rapid diagnosis and early initiation of antimicrobial treatment and close neurological monitoring is crucial to limit morbidity and optimize prognosis.

Key Words: Bacterial meningitis, Neurological complications, Seizures, Cerebrovascular complications, Hearing loss

Citation of article: Marah HA. Neurological Complications and Clinical Outcomes of Bacterial Meningitis: A Cross-Sectional Study from Dhi-Qar, Iraq. Med Forum 2026;37(7):130-134. doi:10.60110/medforum.370726.

INTRODUCTION

Bacterial meningitis is a potentially severe infection of the central nervous system (CNS) involving the inflammation of the meninges and cerebrospinal fluid (CSF). Despite recent advances in antibiotic therapy, intensive care unit (ICU) management and vaccination programmes, bacterial meningitis continues to be a major cause of morbidity and mortality globally, and a major contributor to long-term neurological disability.^{1,2} Poor clinical outcome could also be linked to delayed diagnosis and poor health care in developing countries, adding to the significance of the disease burden.

Internal Medicine Department, College of Medicine, University of Thi-qar, Iraq

Correspondence: Hazim Ali Marah, Internal Medicine Department, College of Medicine, University of Thi-qar, Iraq. Contact No: +964 781 265 0387 Email: hazem-ali@utq.edu.iq

Received: February, 2026

Reviewed: March-April, 2026

Accepted: May, 2026

Pathogenic microorganisms enter the subarachnoid space by hematogenous dissemination or from contiguous spread from other infectious processes, like sinusitis, otitis media, mastoiditis or head trauma.⁴

In the CSF, bacterial proliferation causes a high inflammatory response that involves infiltration of leukocytes, production of cytokines, disruption of the blood brain barrier, cerebral oedema and changes in cerebral blood flow.⁶ These pathological events directly involve in causing neuronal damage and neurological dysfunction. The most common community-acquired bacterial meningitis pathogens are *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Haemophilus influenzae* and *Listeria monocytogenes*.^{1,3} Pneumococcal meningitis is the most likely to cause complications and poor outcomes in adults, because of its inflammatory reaction and ability to cause vascular damage.⁸ Neurological involvement can happen in the acute stages of the infection or may be delayed following resolution of clinical illness. Neurological sequelae have been linked to a number of clinical parameters, such as hypoalbuminemia, severe systemic inflammation, seizures, hypotension, advanced age and delayed antibiotic treatment.⁵ Ischemic stroke, cerebral infarction, vasculitis, vasospasm, and thrombosis are among the most serious complications, referred to as

cerebrovascular complications.^{5,7} In some cases, delayed cerebral thrombosis has also occurred after apparent recovery, and is linked to poor prognosis.^{9,10} Another frequent complication is hearing loss, especially in those who have pneumococcal meningitis. The inflammatory process can extend into the cochlea and vestibulocochlear nerve causing permanent sensorineural hearing loss.¹⁴⁻¹⁷ It has been shown in previous studies that starting adjunctive corticosteroid therapy early (before 12 years of age) will decrease the occurrence of hearing loss and neurological complications.¹⁸

Other important neurological features include hydrocephalus, seizures, altered mental status, elevated ICP and focal neurological deficits.¹⁹⁻²⁴ Moreover, survivors can suffer from long-term cognitive dysfunction, memory loss, decreased attention span, and diminished quality of life.²⁵

Prompt diagnosis and treatment are still critical to minimizing neurological damage due to bacterial meningitis. Thus, the present study was designed to evaluate the prevalence and spectrum of neurological complications of bacterial meningitis patients admitted to Al-Turky hospital, Dhi-Qar Province, Iraq in addition to determining their clinical effect.

METHODS

This cross-sectional study was conducted in Al-Turky hospital in Dhi-Qar, Iraq from 15th March 2025 31st August 2025 vide letter No.335/QM/Approval/SFHP Dated March 1, 2025. Fifty three patients who diagnosed with bacterial meningitis were enrolled. The patients with bacterial meningitis if they had one or more neurological signs or symptoms (seizures, decreased hearing, mental status changes, visual abnormalities, weakness of the limbs, or psychiatric abnormalities) were included. If the patient was diagnosed with viral meningitis, fungal meningitis, parasitic meningitis or if medical records were incomplete were excluded. The data were collected as age, sex, clinical presentation and neurological sequelae of bacterial meningitis. Neurological complications were diagnosed based on clinical assessment, neurological examination and available radiological and laboratory investigations. The data was entered and analyzed with the SPSS-26.

RESULTS

There were 24 (45.3%) female and 29 (54.7%) male patients with an absolute predominance of female patients. The maximum number of patients were found to be in the age group of 10-20 years, which made up 22 cases (41.5%). This was followed by the age group 21-30 which had a 10 patients (18.9%) distribution. Eight cases (15.2%) were in the age group 31 to 40 and 51 years and above (Table 1). The least proportion of cases was seen in age group 41-50 years (5 patients,

9.4%). These results show that in the current study population, younger patients were more likely to have bacterial meningitis (Table 1).

Concerning the clinical outcomes, neurological complications were seen in 42 (79.3%) patients of the cases. Alternatively, of those patients who recovered, there were no neurological complications in 11 (20.7%) patients. In comparison, there were slightly more females than males among patients with no neurological complications [6 (11.3%) females vs. 5 (9.4%) males). On the other hand, males had 24 (45.3%) patients of neurological complications, while females had 18 (34%) patients. The neurologic complications were very common in bacterial meningitis and had a higher incidence in male patients than female patients (Table 2).

Table No. 1: Demographic information of the patients (n = 53)

Variable	No.	%
Gender		
Male	29	54.7
Female	24	45.3
Age (Years)		
10-20	22	41.5
21-30	10	18.7
31-40	8	15.2
41-50	5	9.4
≥51	8	15.2

Table No. 2: Gender of the patients with bacterial meningitis distribution of neurological complications (n = 53)

Clinical outcome	Male	Female	Total
Without neurological complications	5 (9.4%)	6 (11.3%)	11 (20.7%)
With neurological complications	24 (45.3%)	18 (34.0%)	42 (79.3%)
Total	29 (54.7%)	24 (45.3%)	53 (100%)

The age distribution of the neurological complications showed that a significant number of patients were aged <15 years. The largest group of 11 patients with no complications had ages between 31 and 40 years, followed by the 10-20-year age group, with 3 patients and 2 patients, respectively, recovering without complications, and only 1 patient aged 41-50 years recovering. No patient in the non-complication group was 51 years or older. Among the 42 patients who experienced neurological complications, the 10-20 year age group had the largest number of patients (n=16), followed by the 21-30 year age group (n=9), 51 years and older age group (n=8), and the 31-40 year age group (n=7). In 41-50-year-old patients, only two cases with neurological complications were found. The present results show that neurological complications

were reported in all age groups, but were most often in younger patients and older people (Table 3). Further evaluation of the kind of neurological complications showed that seizures were the most common complication, occurring in 19 (45.2%) patients. Seizures were seen more often in patients aged 10-20 years, and most of the seizures were recorded in this group of patients. Altered mental status was the second most frequent complication, with 11 (26.2%) patients experiencing. Five (12.0%) patients experienced cerebrovascular accidents (CVA) with the majority of cases being in patients age 41 years or older. 4 (9.5%) patients had unilateral weakness, mostly older patients (51 years and older). Two (4.7%) patients having hearing loss was documented, and hallucinations least common neurological complication with only 1 (2.4%) patient. The incidence of neurological complications was analysed by age and

sex group, and males were more likely to have seizures, especially in the younger groups. Altered mental status was seen in males and females and of different age groups. The occurrence of cerebral vascular accidents was mainly seen in the elderly and older female patients, while hearing loss was seen only in younger and middle aged adults. Unilateral weakness was most commonly found in the elderly patients, intimating a possible relationship with cerebrovascular involvement. Hallucinations did not occur in the majority of patients and were only reported in one man aged 31-40 years. In all, seizures and altered mental status were common neurological complications and more than two-third of all the neurological complications were observed in this study, which is why they are very important neurological complications of bacterial meningitis (Table 4).

Table No. 3: The distribution of patients with and without neurological complications by age group and gender (n = 53)

Clinical Outcome	10–20 Years	21–30 Years	31–40 Years	41–50 Years	≥51 Years	Total
Without neurological complications	M=1, F=2	M=1, F=1	M=3, F=2	M=0, F=1	M=0, F=0	11 (20.7%)
With neurological complications	M=9, F=7	M=6, F=3	M=5, F=2	M=0, F=2	M=4, F=4	42 (79.3%)
Total	19	11	12	3	8	53 (100%)

Table No.4: Distribution of neurological complications among patients with bacterial meningitis by age group and gender (n = 42)

Neurological complication	10–20 Years	21–30 Years	31–40 Years	41–50 Years	≥51 Years	Total
Seizures	M = 8	M = 4	M = 1	M = 0	M = 1	19 (45.2%)
	F = 4	F = 1	F = 0	F = 0	F = 0	
Altered mental status	M = 1	M = 1	M = 3	M = 0	M = 0	11 (26.2%)
	F = 2	F = 2	F = 1	F = 0	F = 1	
Cerebrovascular accident	M = 0	M = 0	M = 0	M = 0	M = 1	5 (12.0%)
	F = 0	F = 0	F = 0	F = 2	F = 2	
Hearing loss	M = 0	M = 1	M = 0	M = 0	M = 0	2 (4.7%)
	F = 0	F = 0	F = 1	F = 0	F = 0	
Weakness	M = 0	M = 0	M = 0	M = 0	M = 2	4 (9.5%)
	F = 1	F = 0	F = 0	F = 0	F = 1	
Hallucinations	M = 0	M = 0	M = 1	M = 0	M = 0	1 (2.4%)
	F = 0	F = 0	F = 0	F = 0	F = 0	

DISCUSSION

Although there have been major strides in antimicrobial treatment and supportive care, bacterial meningitis remains a disease of high neurological morbidity. In the current study, neurological complications were found in 79.3% of the patients, which meant that there was a high burden of disease among the patients with neurological complications. This is similar to other

studies which have documented high rates of neurologic sequelae after bacterial meningitis.^{1,8}

In the present study, male patients were slightly predominant. This has been reported in other epidemiological studies^{1,3} which indicate that both biological susceptibility and environmental factors may play a role in the higher rates in males.

Younger age groups had the highest percentage of patients. This finding is in line with previous research showing that adolescents and young adults continue to

be at risk of bacterial meningitis, especially serogroup *Neisseria meningitidis* and *Streptococcus pneumoniae*.^{1,3} Part of this age distribution may be due to regional demographic characteristics.

The high incidence of neurological symptoms reported in this study is typical of bacterial meningitis, which is a very inflammatory condition. Local inflammatory mediators have been shown to play a role in causing cerebral edema, vascular damage, decreased cerebral blood flow and neuronal injury, all of which have been shown to worsen the chances of neurological dysfunction.^{4,6}

One of the most severe complications of bacterial meningitis is cerebrovascular. The relationship between cerebral infarction and poor neurological outcomes and a high mortality rate has already been demonstrated in previous studies.^{5,7,11} Mechanisms include vasculitis, thrombosis, vasospasm, endothelial damage and disturbances in cerebral autoregulation.^{12,13} It is important to maintain neurological monitoring throughout the acute phase of infection and post-clinical recovery, due to these complications.

Hearing loss is also one of the most frequent chronic complications of survival. Inflammatory injury to the cochlea and auditory pathways as such is shown in several studies to cause permanent sensorineural hearing loss.¹⁴⁻¹⁷ This positive impact of adjunctive corticosteroid treatment that has been previously reported further highlights the need for early treatment strategies to limit neurological injury.¹⁸

Another significant neurological symptom is seizures and these are usually indicative of a more serious disease. They have been linked to higher death rate and worse functional outcomes.²³ Furthermore, those who have seizures in the acute stage may be at higher risk for developing chronic epilepsy after recovery.

Impaired circulation of CSF (secondary to meningeal inflammation) is a known complication of hydrocephalus. Hydrocephalus has been previously reported to be associated with prolonged hospital stays, higher mortality, and poor neurological outcomes, especially in those who undergo neurosurgical treatment.²⁰⁻²²

Another important long-term concern among bacterial meningitis survivors is with cognitive impairment. Several studies have reported persistent memory, attention, psychomotor and executive functioning deficits that might impact educational, occupational, and social functioning.²⁴

The results of the present study show the persistent burden of bacterial meningitis and its neurological effects in Iraq. Early diagnosis, early initiation of antimicrobial treatment and careful neurological assessment continue to be key to minimising morbidity and patient outcomes. More multicenter studies with larger numbers of patients are suggested to define risk

factors and long-term neurological consequences of bacterial meningitis in Iraqi patients.

CONCLUSION

Neurological complications are common and are an important source of morbidity in patients with bacterial meningitis. In this article, around 79.3% of patients suffered from one or more neurologic complications. Patients in the younger age groups were the most numerous, and males were affected slightly more frequently than females. A timely diagnosis, early and timely antimicrobial treatment, and ongoing neurological evaluation are vital in order to prevent complications and optimize patient outcomes.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Hazim Ali Marah
Drafting or Revising Critically:	Hazim Ali Marah
Final Approval of version:	The above author
Agreement to accountable for all aspects of work:	The above author

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No.335/QM/Approval/SFHP Dated 01.03.2025

REFERENCES

1. van de Beek D, de Gans J, Tunkel AR, Wijdicks EF. Community-acquired bacterial meningitis in adults. *NEJM* 2006;354(1): 44-53.
2. van de Beek D. Progress and challenges in bacterial meningitis. *Lancet* 2021;380(9854): 1623-4.
3. Kim JS, Jang YT, Kim JD, Park TH, Park JM, Kilgore PE, et al. Incidence of *Haemophilus influenzae* type b and other invasive diseases in South Korean children. *Vaccine* 2004;22(29-30):3952-62.
4. Bodilsen J, Dalager-Pedersen M, Schønheyder HC, Nielsen H. Stroke in community-acquired bacterial meningitis: A Danish population-based study. *Int J Infect Dis* 2014; 20: 18-22.
5. Schut ES, Lucas MJ, Brouwer MC, Vergouwen MDI, van der Ende A, van de Beek D. Cerebral infarction in adults with bacterial meningitis. *Neurocritical Care* 2012;16(3):421-7.
6. Deliran SS, Brouwer MC, van de Beek D. Cerebrovascular Complications in Bacterial Meningitis. *Stroke Vasc Interv Neurol* 2024; 5(1):e001435.

7. Katchanov J, Heuschmann PU, Endres M, Weber JR. Cerebral infarction in bacterial meningitis: Predictive factors and outcome. *J Neurol* 2010; 257(5): 716-20.
8. Kastenbauer S, Pfister HW. Pneumococcal meningitis in adults: spectrum of complications and prognostic factors in a series of 87 cases. *Brain* 2003;126(5):1015-25.
9. Lucas MJ, Brouwer MC, van de Beek D. Delayed cerebral thrombosis in bacterial meningitis: A prospective cohort study. *Intensive Care Med* 2013;39(5):866-71.
10. Schut ES, Brouwer MC, de Gans J, Florquin S, Troost D, van de Beek D. Delayed cerebral thrombosis after initial good recovery from pneumococcal meningitis. *Neurol* 2009;73(23): 1988-95.
11. Klein M, Koedel U, Pfefferkorn T, et al. Arterial cerebrovascular complications in 94 adults with acute bacterial meningitis. *Crit Care* 2011;15(6): R281.
12. Saberi A, Roudbary SA, Ghayeghran A, Kazemi S, Hosseini-zhad M. Diagnosis of Meningitis Caused by Pathogenic Microorganisms Using Magnetic Resonance Imaging: A Systematic Review. *Basic Clin Neurosci* 2018;9(2):73-86.
13. Vergouwen MDI, Schut ES, Troost D, van de Beek D. Diffuse cerebral intravascular coagulation and cerebral infarction in pneumococcal meningitis. *Neurocrit Care* 2010; 13(2): 217-20.
14. Heckenberg SGB, Brouwer MC, van der Ende A, Hensen EF, van de Beek D. Hearing loss in adults surviving pneumococcal meningitis. *Clin Microbiol Infect* 2012; 18(9): 849-55.
15. Worsøe L, Cayé-Thomasen P, Brandt CT, Thomsen J, Østergaard C. Factors associated with hearing loss after pneumococcal meningitis. *Clin Infect Dis* 2010;51(8): 917-24.
16. Pauna HF, Knoll RM, Lubner RJ, et al. Histopathological changes to the peripheral vestibular system following meningitic labyrinthitis. *Laryngoscope Investigative Otolaryngol* 2020;5:256-66.
17. Caye-Thomasen P, Dam MS, Omland SH, Mantoni M. Cochlear ossification in patients with profound hearing loss following bacterial meningitis. *Acta Oto-Laryngologica* 2012;132(7): 720-25.
18. Brouwer MC, McIntyre P, Prasad K, van de Beek D. Corticosteroids for acute bacterial meningitis. *Cochrane Database Syst Rev* 2013; 6: CD004405.
19. Abulhasan YB, Al-Jehani H, Valiquette MA, et al. Lumbar drainage for the treatment of severe bacterial meningitis. *Neurocrit Care* 2013;19(2): 199-205.
20. Kasanmoentalib ES, Brouwer MC, van der Ende A, van de Beek D. Hydrocephalus in adults with community-acquired bacterial meningitis. *Neurol* 2010; 75(10): 918-23.
21. Bodilsen J, Schønheyder HC, Nielsen H. Hydrocephalus is a rare outcome in community-acquired bacterial meningitis in adults. *BMC Infect Dis* 2013; 13: 321.
22. Wang KW, Chang WN, Chang HW, Wang HC, Lu CH. Clinical relevance of hydrocephalus in bacterial meningitis in adults. *Surg Neurol* 2005; 64(1): 61-5.
23. Zoons E, Weisfelt M, de Gans J, Spanjaard L, Koelman JHTM, Reitsma JB, et al. Seizures in adults with bacterial meningitis. *Neurol* 2008; 70(22): 2109-15.
24. Hoogman M, van de Beek D, Weisfelt M, de Gans J, Schmand B. Cognitive outcome in adults after bacterial meningitis. *J Neurol Neurosurg Psychiatr* 2007; 78(10): 1092-6.