NEUROLOGICAL COMPLICATIONS AND OUTCOMES OF BACTERIAL MENINGITIS/MENINGOENCEPHALITIS IN ADULTS: A REVIEW

Dzhumaeva Nasiba Sobirovna
assistant of the Department of
Infectious Diseases and Epidemiology
of Samarkang State Medical University

Abstract. Bacterial meningitis and meningoencephalitis are severe infections of the central nervous system with high morbidity and mortality in adults. Neurological complications such as hearing loss, seizures, cognitive impairment, and hydrocephalus are common and often determine long-term outcomes. This review summarizes the spectrum of complications, predictors of poor prognosis, and modern approaches to reduce neurological sequelae in adult patients.

Keywords: bacterial meningitis, meningoencephalitis, neurological complications, outcomes, adults, CNS infections

Introduction. Bacterial meningitis and meningoencephalitis continue to pose serious health challenges globally, especially in adult and elderly populations. Despite the availability of antibiotics and adjunctive therapies, neurological complications are frequent and often irreversible [1]. The incidence of long-term deficits varies depending on the causative organism, time to treatment, and host factors such as age and comorbidities [2]. Neurological complications remain a significant cause of morbidity following bacterial meningitis and meningoencephalitis in adults. These complications can arise acutely during the infection or develop later as part of a post-infectious syndrome. The pathophysiology is multifactorial, involving inflammatory damage, vascular involvement, and direct neuronal toxicity [1, 4].

Etiological Factors and Pathogenesis. The most common pathogens in adults are *Streptococcus pneumoniae*, *Neisseria meningitidis*, and *Listeria monocytogenes* [3]. These bacteria invade the subarachnoid space, leading to intense inflammation, cytokine release, and breakdown of the blood-brain barrier. Resulting complications are often linked to cerebral edema, vascular thrombosis, and neuronal damage [4].

Neurological Complications. Neurological sequelae occur in up to 50% of survivors [5]. Common complications include:

- **Sensorineural hearing loss**: especially with *S. pneumoniae* meningitis [6]. One of the most common long-term complications is sensorineural hearing loss (SNHL), particularly associated with *Streptococcus pneumoniae*. It occurs in up to 30% of survivors and results from inflammation of the cochlea or auditory nerve, which may be irreversible [2]. Rapid initiation of dexamethasone has been shown to reduce this risk when given before or with the first dose of antibiotics [10].
- **Seizures and epilepsy**: due to cortical irritation and infarcts. Seizures occur in approximately 20–30% of adults during acute bacterial meningitis. They are typically generalized or focal and may be the first clinical sign of cortical involvement or cerebral infarction [3]. Post-infectious epilepsy can develop later, especially in patients with extensive cortical damage or brain abscesses [6].
- **Cognitive and memory impairment**: observed in 20–30% of cases after recovery [7]. Cognitive dysfunction, including memory loss, attention deficits, and decreased executive function, may persist for months or years after the infection. This is particularly seen in older adults and those with pneumococcal etiology [7]. Neuropsychological sequelae are often underdiagnosed but significantly impair quality of life and occupational reintegration.

- **Hydrocephalus**: more frequent in tuberculous and Listeria meningitis [8]. Hydrocephalus, especially the communicating form, is more frequently associated with *Listeria monocytogenes* and tuberculous meningitis. It results from obstruction of cerebrospinal fluid (CSF) flow due to inflammation and fibrosis in the arachnoid villi. CT or MRI imaging is essential for early diagnosis, and management may require external ventricular drainage or shunting [8].
- **Focal deficits and cranial nerve palsies**: due to inflammatory damage and increased intracranial pressure. Focal deficits, such as hemiparesis or aphasia, are often due to cerebral infarctions secondary to vasculitis or thrombosis. Cranial nerve palsies, particularly involving CN VI and CN VII, are observed in both acute and recovery phases and may be transient or permanent [4, 5].

These complications may persist or progress even after pathogen clearance.

Prognostic Indicators and Risk Factors. Predictors of poor outcome include advanced age, altered consciousness on admission, presence of seizures, hypotension, and pneumococcal etiology [9]. High CSF protein, low glucose levels, and delayed antibiotic administration are also associated with worse prognosis.

Treatment and prevention of sequelae

Early administration of antibiotics is crucial, often preceded by dexamethasone to reduce inflammation and prevent hearing loss [10]. Adjunctive therapies under investigation include neuroprotective agents and targeted anti-inflammatory drugs. Rehabilitation, hearing aids, and cognitive therapy are essential components of long-term care.

Conclusion. Bacterial meningitis and meningoencephalitis in adults remain life-threatening conditions with substantial neurological consequences. Early

recognition, timely therapy, and post-infection rehabilitation are critical to improving outcomes and minimizing long-term disability.

References

1. van de Beek D., de Gans J., Tunkel A.R., Wijdicks E.F.M. Community-acquired bacterial meningitis in adults. // N Engl J Med. – 2006. – Vol.354(1). – P.44–53.
2. Brouwer M.C., Tunkel A.R., van de Beek D. Epidemiology, diagnosis, and antimicrobial treatment of acute bacterial meningitis. // Clin Microbiol Rev. – 2010. – Vol.23(3). – P.467–492.
3. Thigpen M.C., Whitney C.G., Messonnier N.E. Bacterial meningitis in the United States, 1998–2007. // N Engl J Med. – 2011. – Vol.364(21). – P.2016–2025.
4. Mook-Kanamori B.B., Geldhoff M., van der Poll T., van de Beek D. Pathogenesis and pathophysiology of pneumococcal meningitis. // Clin Microbiol Rev. – 2011. – Vol.24(3). – P.557–591.
5. Koedel U., Scheld W.M., Pfister H.W. Pathogenesis and pathophysiology of pneumococcal meningitis. // Lancet Infect Dis. – 2002. – Vol.2(12). – P.721–736.
6. Schmutzhard J., Pfausler B. Central nervous system infections in adults. // Neurocrit Care. – 2010. – Vol.12(3). – P.369–384.
7. Weisfelt M., de Gans J., van der Poll T., van de Beek D. Pneumococcal meningitis in adults: new approaches to management and prevention. // Lancet Neurol. – 2006. – Vol.5(5). – P.332–342.
8. Sáez-Llorens X., McCracken G.H. Bacterial meningitis in children. // Lancet. – 2003. – Vol.361(9375). – P.2139–2148.
9. Durand M.L., Calderwood S.B., Weber D.J., Miller S.I., Southwick F.S., Caviness V.S., Swartz M.N. Acute bacterial meningitis in adults. A review of 493 episodes. // N Engl J Med. – 1993. – Vol.328(1). – P.21–28.

10.de Gans J., van de Beek D. Dexamethasone in adults with bacterial meningitis. // N Engl J Med. – 2002. – Vol.347(20). – P.1549–1556.