



VALIDATION OF SCREENING MODEL FOR MENINGITIS: A REVIEW

Ankita Tripathi *, Utsav Gupta, Pooja Chaurasiya, Priya Pandey, Sristi Raj

IIMT College of Pharmacy, Greater Noida, India

*Corresponding Author Email: ankita.surendra@gmail.com

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ABSTRACT

Meningitis is a condition caused by the inflammation of the meninges. Meningitis can be caused by bacteria, viruses, fungi, parasites, and amebic. Interestingly some meningitis is infectious, while other is non-infectious. The non-infectious causes of meningitis are autoimmune illnesses, cancer/paraneoplastic syndromes, and medication responses. There are several risk factors associated with meningitis, like a defect in the dural, alcoholism, age, medical condition, some kind of exposure, and so on. Since meningitis is a serious and delicate condition, the need of several screening models is required to validate meningitis. These models depend on mathematical calculations like regression models, multiple regression models, and logistic models, and some animal models are also there for meningitis. Hence, here we discussed meningitis and models briefly.

Keywords: Meningitis, Validation, Screening models

INTRODUCTION

The inflammation of the meninges is known as meningitis. The dura mater, arachnoid mater, and pia mater are the three membranes that surround the vertebral canal and skull, encapsulating the brain and spinal cord. Encephalitis, on the other hand, is a kind of brain inflammation.¹⁻²

The signs and symptoms of meningeal inflammation have been described in various historical books throughout history; nevertheless, it was not until surgeon John Abercrombie characterized it in 1828 that the term 'meningitis' became widely used. Despite advances in diagnosis, treatment, and immunization, 8.7 million cases of meningitis were recorded globally in 2015, with 379,000 fatalities.³⁻⁵

Infectious and non-infectious causes of meningitis include autoimmune illnesses, cancer/paraneoplastic syndromes, and medication responses. Bacteria, viruses, fungi, and, less typically, parasites are the infectious etiologic agents of meningitis.⁶ However, the bacterial meningitis is most commonly seen.

Meningitis can be caused by a variety of microorganisms. The most common bacteria are *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Neisseria meningitidis*. The one that may cause big epidemics is *N. meningitidis*, which causes meningococcal meningitis. *N. meningitidis* has been divided into 12 serogroups, six of which (A, B, C, W, X, and Y) can produce epidemics.⁷

N. meningitidis is capable of causing a wide range of illnesses. Septicemia, arthritis, and meningitis are among the invasive disorders induced by *N. meningitidis*, which are referred to as invasive meningococcal disease (IMD). Other invasive illnesses caused by *S. pneumoniae* include otitis and pneumonia.⁷

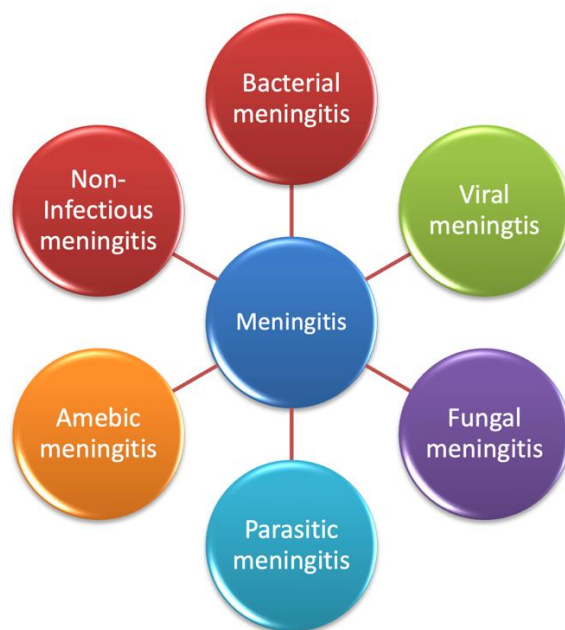
Hence, in this article we will discuss about the risk factors, types of meningitis, and also discuss about the validation of screening model for different types of meningitis.

Risk factors

1. Medical conditions that last a long time (renal failure, diabetes, adrenal insufficiency, cystic fibrosis)
2. Age's extremes
3. Under vaccination
4. Immunosuppression is a condition in which the immune system is inhibited (iatrogenic, transplant recipients, congenital immunodeficiencies, AIDS)
5. Living in cramped quarters
6. Exposures:
 - Excursions to endemic regions (Southwestern U.S. for cocci; Northeastern U.S. for Lyme disease)
 - Vectors are a kind of data that may be (mosquitoes, ticks)
7. Alcoholism is a mental illness caused by excessive use of
8. A ventriculoperitoneal (VP) shunt is present.
9. Endocarditis caused by bacteria
10. Malignancy
11. Defects in the dural
12. IV drug administration
13. Sickle cell disease is a kind of anemia that affects people.
14. Splenectomy.⁶

Different types of meningitis

There are different causes and types of meningitis present worldwide. They are widely classified as follows: -



Bacterial meningitis

Bacterial meningitis, an infectious condition characterized by infection and inflammation of the meninges, has a high morbidity and fatality rate across the world.⁸ If left untreated, bacterial meningitis can be deadly in 50% of cases. The etiologic agents that cause bacterial meningitis differ depending on the age group. Most instances of bacterial meningitis in newborns are caused by group B *Streptococcus agalactiae*, *Escherichia coli*, and *Listeria monocytogenes*, whereas *Streptococcus pneumoniae* and *Neisseria meningitidis* cause the majority of cases in children and adults.⁹⁻¹⁰ Although *Haemophilus influenzae* has been linked to bacterial meningitis in people of all ages; it is most common in children under the age of five.¹¹⁻¹² Given the wide variation in bacterial meningitis incidence and causative agents between areas, it's critical to distinguish between them while treating bacterial meningitis patients.⁹⁻¹⁰

Viral meningitis

Many cases of meningitis are caused by viruses every year, but they are generally missed since the consequences are not as severe as bacterial meningitis or viral encephalitis.¹³⁻¹⁴ However, viruses are now understood to be more significant as bacterial meningitis declines due to vaccination and molecular diagnostics usage rises.¹³⁻¹⁹ Meningitis is caused by a variety of viruses. However, the majority of infections are caused by enteroviruses, herpesviruses, or arthropod-borne viruses in specific regions of the world (arboviruses). Mumps virus is a serious disease in unprotected people.²⁰

Fungal meningitis

The increased proportion of immunocompromised individuals, such as those undergoing pharmacological immunosuppression and chemotherapies, and the high number of people living with HIV and AIDS, are all contributing to an increase in CNS fungal infections. Fungal meningitis (FM) is a challenging CNS illness to identify since it has vague symptoms and no evidence of meningeal irritation. Due to the difficulties in identifying FM, therapy is delayed, resulting in an increase in morbidity and death.²¹⁻²² Apart from the immunocompromised, even apparently immune-competent people can have FM, as seen in the cases of *Cryptococcus neoformans* and *Coccidioides immitis*.²³

Parasitic meningitis

Various parasites can induce meningitis or have various effects on the brain and nervous system. In comparison to viral and bacterial meningitis, parasite meningitis is far less prevalent. Eosinophilic meningitis, often known as eosinophilic meningoencephalitis or EM, is an uncommon type of meningitis caused by parasites.

In certain afflicted patients, the three primary parasites that cause EM are:

- Angiostrongylus cantonensis* (neurologic angiostrongyliasis)
- Baylisascaris procyonis* (baylisascariasis; neural larva migrans)
- Gnathostoma spinigerum* (neurognathostomiasis)²⁴

Amebic meningitis

Naegleria fowleri causes primary amebic meningoencephalitis (PAM), an uncommon brain infection that is typically deadly. *Naegleria fowleri* is an amoeba that lives in the wild (a single-celled living organism that is too small to be seen without a microscope.) From 1962 through 2019, the CDC received 148 reports of infections in the United States, with no more than 8 cases recorded per year.²⁴

Non-infectious meningitis

Infectious illnesses, which are caused by microorganisms that transmit from person to person, are not the sole causes of meningitis. Some causes of meningitis, however, are non-infectious and do not transmit from one person to another, such as cancer, lupus, certain drugs, head injury, and brain surgery.²⁴

Validation Models for Meningitis

Prediction models

Diagnostic prediction algorithms have been created to determine the likelihood of bacterial meningitis (BM) in individuals who have a suspected CNS infection. External validation in patients with suspected meningitis, on the other hand, is required to assess the diagnostic accuracy of these models. Patients who had a lumbar puncture for a suspected CNS infection were included in this procedure. Following a thorough assessment of the literature, the author tested selected BM models on our sample. And, if

findings in people after bacterial meningitis.⁴⁵ The most significant characteristics of this model are its ability to combine a modest inoculum dosage with a protracted illness development, providing a repeatable environment for examining clinical symptoms as well as enough time to develop the histological abnormalities found in a human environment.

Hence, it can be concluded that this mouse model's value comes from the fact that it offers a highly reproducible experimental setting for pneumococcal meningitis and offers some of the most important outcome parameters, including bacterial titers, meningeal and parenchymal infiltration, cytokine profiles, microglial activation, neuronal apoptosis in the hippocampus, perivascular infiltration, and (micro) hemorrhages. The author believes that combining these diseased characteristics, which are typical of what is seen in human autopsy investigations into a single model, is a useful tool in the analysis of pathophysiological and therapeutic intervention studies.⁴⁶

CONCLUSION

The meningitis is a serious and delicate medical condition and if left untreated and undetected for long time can be life threatening. Even, though a lot of advancement in medical science has occurred to treat the meningitis successfully. The need of screening models becomes the need of the hour, as the screening models not only predicted the possibility of the occurrence of meningitis but also give us more insight of the conditions and how the drugs and other treatment option work in that condition. In present time these screening models indeed help us and give deep knowledge about the condition but more work are still required to get more better understanding from the screening models.

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