Tuberculosis Meningitis

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Key points:

- Introduction to Tuberculosis Meningitis
- Causes and Symptoms
- Diagnosis
- Prevention and Control
- Future Pathway

Introduction

TB is caused by a bacterium called the Mycobacterium tuberculosis. This disease remains a huge problem in the world of health even today especially in Pakistan. TBM is a serious form of disease. Despite its low incidence, it still carries a high risk of critical impact on the central nervous system, or in worst cases, death. Diagnosing the disease is challenging in itself due to its fast course of progression and symptoms being nonspecific, and it's hard to find M. tuberculosis in cerebrospinal fluid (CSF). TBM was responsible for approximately 78200 adults around the world in 2019.

Causes and Symptoms

TBM comes about when the Mycobacterium tuberculosis microbe gets into the nervous system, infecting the meninges. The meninges are a protective layer around the brain and the spinal cord.

This usually occurs when there is a spread of infection through the bloodstream from the original site, which happens to be the lungs, and then gradually spreads through other parts of the body.

When the bacterium get into the meninges, it triggers a powerful inflammatory response, which leads to inflammation of meningitis and, hence, neurological complications.

People with diabetes mellitus are more prone to TBM since their nervous system is weak, and their metabolic process has undergone alterations, hence making it twice as hard to fight infections. It is due to this reason that TBM is so common in Pakistan due to the rapidly increasing numbers of people of all ages having diabetes mellitus. This weak opening makes TBM easily reach the central nervous system. [3]

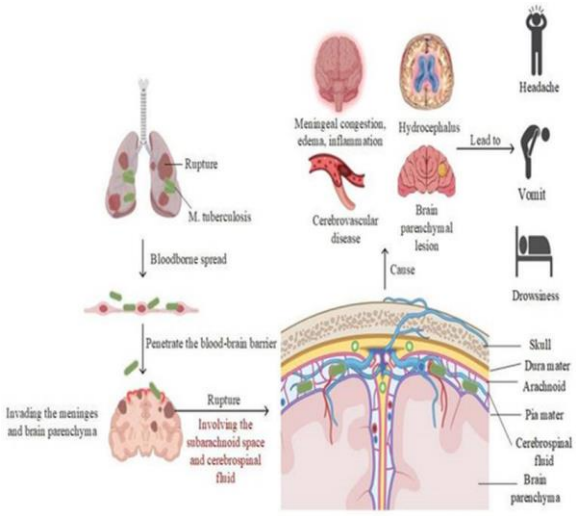


Figure 1*: Mechanism of tuberculous meningitis.* [2]

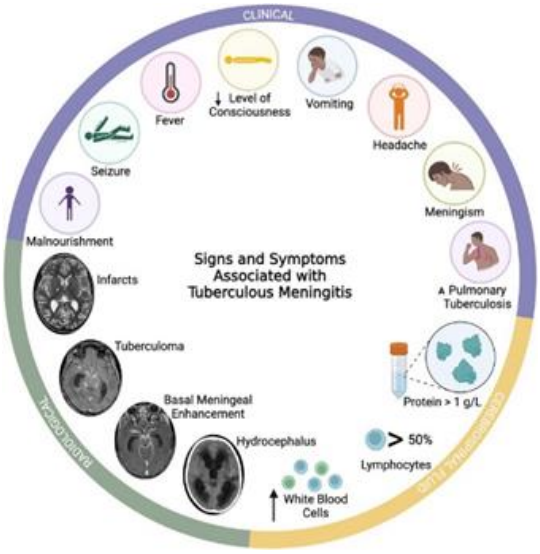


Figure 2*: Symptoms of TBM.* [4]

There are two kinds of TBMs that doctors look for when examining:

1. which progresses gradually, starting with a continuous headache followed by a mild fever, stiff neck, and cranial nerve involvement.
2. This type is a much more severe case; it can cause a coma. This type is known as meningoencephalitis. This can cause people's brain pressure to get very high, chances of seizures and specific neurological complications can take place. [5]

Diagnosis

Diagnosis in early stages is to be difficult, since there are no clear-cut signs of any symptoms, and there are no reliable means to perform an appropriate diagnosis during the early stages of TBM. [6]

It is challenging to make an accurate and precise diagnosis because existing lab tests lack sufficient accuracy and sensitivity, but metabolomics is really helpful when it comes to diseases such as TBM, as it looks at small molecules produced by the host (human body) and pathogens.

Metabolomics helps us understand how diseases actually progress in the body, assists in the identification of potential biomarkers for various conditions, and supports the development of better diagnostic and treatment methods.

One of the most core strategies used in metabolomics is mass spectrometry (MS), this technique allows a meticulous analysis of a broad range of metabolites.

MS-based metabolomics has already shown its potential for diagnosing TBM. However, this is quite difficult to perform since it involves many complications and has multi-step procedures. Even the smallest of changes can heavily alter the result. [7]

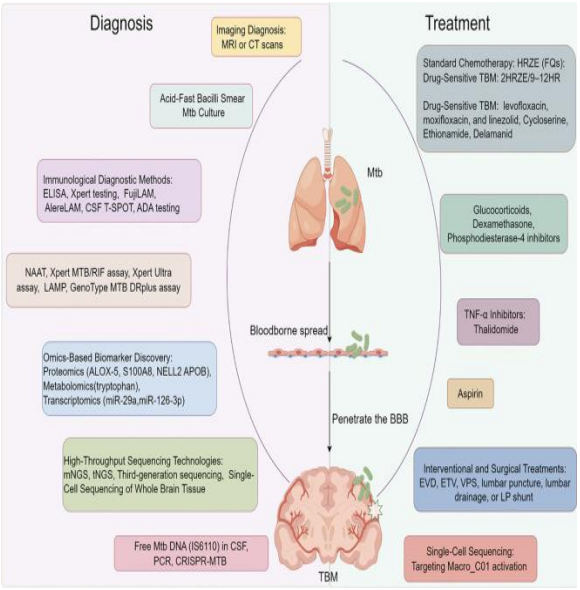


Figure 3*: Diagnosis and Treatment.* [8]

Prevention and Control

The treatment of hydrocephalus resulting from TBM depends largely on the extent of and location of the cerebrospinal fluid obstruction caused by the infection.

Corticosteroids are effective in attenuating the risk of neurological complications and death in HIV-negative children suffering from TBM.

Thalidomide is a drug used in children with TBM complications, such as tuberculous abscesses and optochiasmatic arachnoiditis.

Due to limited resources in hospitals, patients' treatment is carried out in their homes for carefully selected patients who were initially treated in the hospital.

In summary, the outcome of TBM largely depends on the early diagnosis and starting treatment immediately. [9]

Further Pathway

The new generation of diagnostics, includes targeted gene sequencing, real-time polymerase chain reaction (RT-PCR), miRNA profiling, and metagenomic next-generation sequencing (mNGS), shows a lot of promise in detecting TBM in its early stages.

These cutting-edge diagnostic techniques are significantly enhanced when put together with mass spectrometry, metabolomics, and proteomics, broadening the spectrum of disease-specific biomarkers.

A technique frequently used is machine learning, which analyzes complicated data, for example, medical imaging, genomic information, and clinical histories, revealing disease patterns, improving diagnostic meticulousness, and personalizing treatment.

Despite these advanced techniques, there are still problems ahead in using them in clinical areas, as it is expensive and quite complicated to use.

Further research says that it should be focused on authenticating these tools through proactive analysis, addressing their use, and initiating the use of these tools in medical centre.

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