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A Comprehensive Review of the Assessment of Diagnostic Techniques for Drug-Resistant Tuberculosis

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Abstract

MDR-TB is a type of tuberculosis that is resistant to at least two of the most effective first-line anti-TB medications: rifampicin and isoniazid. It occurs when the TB-causing bacteria acquire mutations that render them drug-resistant. Because it is more challenging to treat and control than drug-susceptible TB, MDR-TB is a serious global health issue. Effective patient management, the introduction of appropriate treatment, and the prevention of further transmission all depend on a diagnosis of MDR-TB that is both prompt and accurate. To identify MDR-TB strains, various diagnostic methods have been developed and implemented over time. The various diagnostic methods used to detect MDR-TB are discussed in detail in this article, along with their advantages, disadvantages, and advancements.

Keywords: Multidrug-resistant tuberculosis • Drug-susceptible testing • Polymerase chain reaction

Introduction

Multidrug-Resistant Tuberculosis, or MDR-TB, is a serious threat to global public health and makes it hard to control tuberculosis around the world. Inadequate or improper treatment of drug-susceptible TB is the primary cause of MDR-TB. The TB bacteria can survive and develop resistance to the drugs that are used if patients do not complete their treatment in its entirety or are given the wrong drug regimens. MDR-TB can also be passed on directly from a person who is already infected with a drug-resistant strain. As a disease that can be passed from person to person, MDR-TB can be spread through coughing, sneezing, or speaking. Overcrowding, poor ventilation, and inadequate infection control measures in healthcare settings all contribute to the spread of MDR-TB. MDR-TB shares many of the same symptoms as drug-susceptible TB [1].

Literature Review

Specialized testing in the lab is required to make the diagnosis of MDR-TB. Drug susceptibility testing (DST) and conventional culture are used to identify patterns of drug resistance. However, these approaches take a lot of time and may not yield results for several weeks. Polymerase Chain Reaction (PCR) and Line Probe Assays (LPAs) are two examples of rapid molecular diagnostic methods that have been developed to detect drug resistance-associated genetic mutations more quickly. Second-line anti-TB medications, which are less effective, more toxic, and frequently more expensive, are required for the treatment of MDR-TB, which is a complex condition. In order to stop MDR-TB from spreading throughout the community and healthcare facilities, infection control measures are also part of the treatment process. Utilizing personal protective equipment, effective respiratory hygiene practices, and ensuring adequate ventilation are all part of this. A comprehensive strategy is required to stop MDR-TB from appearing and spreading. Adherence to treatment regimens, improved infection control measures, and monitoring of drug resistance patterns are all part of this strategy for drug-susceptible tuberculosis. In addition, MDR-TB can only be defeated if new, more potent anti-TB drugs and vaccines are developed [2,3].

Discussion

Sputum culture and DST, two conventional methods, have long been the gold standard for diagnosing TB. However, these methods take a lot of time and can take several weeks to produce results. We talk about the problems with traditional DST and why faster and more effective diagnostic methods are needed. The diagnosis of tuberculosis has been revolutionized by PCR-based assays like gene pert MTB/RIF and line probe assays. Specific genetic markers, such as rifampicin resistance-associated mutations in the rpoB gene, can be identified using these methods. When diagnosing MDR-TB, we investigate the benefits and drawbacks of PCR-based approaches. In terms of strain characterization and drug-resistant mutation detection, Next-Generation Sequencing (NGS) technologies provide unprecedented resolution. As potential alternatives to conventional DST, new phenotypic assays like the nitrate reductase assay and colorimetric techniques have emerged. The usefulness and dependability of these quick phenotypic methods for MDR-TB diagnosis are examined. We go into greater detail about line probe assays like Genotype MTBDRplus and Genotype MTBDRsl, which can simultaneously detect resistance to multiple anti-TB medications. Whole genome sequencing gives a complete picture of the genetics of MDR-TB strains, making it easier to find mutations that cause drug resistance [4-6].

Conclusion

Global TB control efforts are significantly hindered by MDR-TB. Improved laboratory diagnostics, effective drug regimens, infection control measures, and public health interventions are all necessary for its diagnosis, treatment, and prevention. To reduce its impact and prevent its further spread, MDR-TB must be addressed with ongoing commitment, resources, and collaboration from healthcare providers, policymakers, researchers and communities. For patient care and controlling the spread of drug-resistant strains, accurate and timely diagnosis of MDR-TB is essential. From conventional culture methods to advanced molecular and phenotypic assays, we have highlighted various diagnostic methods used to detect MDR-TB in this comprehensive review. The landscape of MDR-TB diagnostics continues to be shaped by ongoing research and technological advancements, despite the fact that each method has its advantages and disadvantages.

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Conflict of Interest

None.

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