

Levels of Biohazard and Biosafety Protection for Mycobacterium Tuberculosis Strains with Varying Virulence

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Abstract

Tuberculosis (TB) could be a chronic infectious disease caused by mycobacteria (MTB) that seriously endangers human health. TB is transmitted through the tract and poses nice safety risks to laboratory technicians and employees, through direct or indirect contact with MTB. Therefore, the excellent application of normal laboratory operative procedures, safety instrumentation, contingency plans, and different laboratory safety measures not solely ensures the safe handling of doubtless infectious microorganisms by laboratory employees however conjointly strives to stop the accidental exposure of doubtless harmful pathogens to larger communities. During this article, we tend to will discuss topics as safety risk assessments appropriate for handling the biohazard levels of MTB strains, and also the development of corresponding safety protection measures necessary for the safety of MTB testing and connected analysis that may be enforced at totally different levels of laboratory and medical specialty scenario.

Keywords: Pathogenicity; Biohazard; Biomedical;

Introduction

Tuberculosis (TB) could be a chronic communicable disease that poses serious threats to health of the kinsmen. Globally, China is hierarchical the third, in terms of the quantity of patients with TB. Mycobacteria (MTB) are often found within the respiratory organ tissue, though the organism will invade all organs of the body. MTB strains area unit divided into human and bovine varieties, of that human MTB infections area unit additional ordinarily seen. Since the start of the twenty first century, there has been a rise within the incidence of TB in China. The increasing range of drug-resistant strains has brought Brobdingnagian challenges to the bar and treatment methods on TB [4]. Since TB is transmitted through the tract, it conjointly poses a heavy safety risk to tending and laboratory employees through direct or indirect contact with patients [1-3].

Currently in China, the biohazard levels of infective microorganisms are classified into four classes, with class IV representing the bottom and class I the best level. Classes I and II area unit put together stated as extremely infective microorganisms. Microorganisms that area unit undiscovered or declared as eradicated in China also are listed below class I. The biohazard classification of microorganisms by the Laboratories – General needs for safety (GB 19489–2008) standards is usually in agreement with the assessment criteria and classification of the globe Health Organization (WHO) Laboratory safety Manual – Third Edition. However, a number of the strains of identical microorganism or virus could have variations or altered drug sensitivity that presenting totally different virulence and pathogenicity. Understanding the virulence of various infective microorganisms is of nice importance in categorizing their biohazard potential and choosing acceptable strategies for safety and protection.

Discussion

There area unit substantial variations within the virulence of MTB strains, though all of them area unit classified as class II. for instance, the virulence-attenuated strain H37Ra has extraordinarily low pathogenicity toward humans or animals. H37Rv could be an ordinarily used virulent laboratory strain that considerably exhibits the reduced virulence when serial passage in vitro. Drug-susceptible (DS), drug-resistant (DR), multi-drug resistant (MDR), extensively drug-resistant (XDR), and very drug-resistant (XXDR) strains area unit all

powerfully infective toward animals and primarily exhibit identical virulence. Consequently, the clinical severities of infections caused by varied kinds of drug-resistant strains area unit typically totally different. Therefore, specific levels of safety protection ought to be fastidiously thought of and needed with relation to laboratory activities involving every MTB strain. During this article, we tend to attempt to comprehensively discuss the virulence and classification of biohazard levels on totally different MTB varieties, moreover because the safety needs for those laboratories that handling the MTB strains [4-6].

There area unit numerous genetic variations or drug sensitivities on TB strains that with totally different virulence and pathogenicity, and so, they gift variable levels of biohazard risks to the people or communities. particularly, DR TB strains, together with MDR, XDR, and XXDR TB, area unit related to higher biohazard levels thanks to restricted treatment strategies and fewer economical therapies. Given their potential hurt to patients, moreover as tending and laboratory employees, intensiveprotective measures area unit required for suspected DR strains. within the following subsections, we tend to attempt to in short discuss the virulence of various MTB varieties together with DS, DR, laboratory-adapted, and immunogenic strains.

WHO recommends a 6-month treatment strategy for drug-susceptible TB with Associate in Nursing initial of 2-month intensive part (daily dose of INH, rifampicin, pyrazinamide, and ethambutol), followed by twin medical care of INH and rifampicin for consequent four months. The treatment success in programmatic conditions has been rumored as close to eighty fifth. Drug resistance in patients may arise from the first transmission of DR-MTB strains and/or the acquisition of drug resistance throughout the anti-TB treatment.

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Within the latter state of affairs, MTB is at first sensitive to the drug used for treatment, however later develops resistance to identical drug throughout the course of treatment. A previous study rumored that in 334 patients United Nations agency were all sensitive at the time of initial treatment, the incidence of noninheritable drug resistance was as high as thirty seven.72% together with forty five.24% of them developed MDR. More will increase within the range of patients with MDR-TB have resulted in an exceedingly considerably increased risk of widespread DR-MTB.

Patients infected with strains that proof against a minimum of the 2 main first-line drugs-isoniazid and rifampicin area unit classified as MDR however much incurable by the quality first-line treatment. At present, the continuing unfold of MDR-TB is one in every of the foremost pressing and tough challenges to the world TB management program. Globally, 4.6% of the TB patient's area unit infected by MDR-TB, however in some areas like Kazakstan, Kyrgyzstan, Moldova, and state, this proportion could have exceeded twenty fifth. In 2012, the Chinese Centers for illness management and bar (CDC) rumored that 100% of all the one.4 million TB patients in China belong to MDR-TB, and a good majority of MDR-TB patients had ne'er been on any treatment programs for TB. Recently, 1950 MTB isolates from patients were enclosed in an exceedingly retrospective study. Of these, 208 (10.67%) were diagnosed as MDR-TB, in twenty nine regions of China.

XDR-TB, initial rumored in 2006, is MDR-TB that's proof against 3 or additional of the six categories of the second-line injectable medication as a result of access to testing for the status of second-line medication remains lacking in several areas of the globe, XDR-TB typically goes unidentified. Recently, four (2.6%) XDR-TB and eighteen (11.6%) pre-XDR-TB isolates were known among one hundred fifteen MDR-TB isolates from Morocco. it absolutely was calculable that nine.6% of the MDR-TB cases area unit XDR-TB connected, worldwide a replacement sort of nearly incurable drug-resistant isolate, referred to as XXDR-TB with resistance to all or any first- and second-line medication, was known supported Associate in Nursinging in vitro study performed in European country in 2007. Management of such strains is cherish the pre-antibiotic era and underlines the pressing wants that together with new medication development, finding different therapeutic choices, and applying acceptable policies and methods for TB management [7-9].

Although patients harboring MDR and XDR strains gift a formidable challenge for treatment, curative medical care is commonly doable, together with the first identification of resistance and also the use of a properly designed program. MDR-TB treatment is tough as a result of the second-line TB medication area unit principally weak inhibitors with toxicant aspect effects. Most of that medication was developed many years past however seldom used thanks to their aspect effects. The weak repressive activity of the second-line TB medication prolongs the MDR-TB treatment to 18–24 months.

Recently, the efficaciousness of treatments against MDR-TB has been reviewed, from fifty studies that involving twelve, 030 patients in twenty five countries from 2009 to 2019. Information showed that whereby the twelve, 030 cases, 7,346 (61%) were with treatment success, 1,017 (8%) unsuccessful and one, 729 (14%) died. Treatment success was absolutely related to the employment of medicine as linezolid, levofloxacin, carbapenems, moxifloxacin, bedaquiline, and clofazimine. a major association was conjointly found between reduced mortality and also the use of linezolid, levofloxacin, moxifloxacin, or bedaquiline. Yank body part Society (ATS), U.S. CDC, European metabolism Society (ERS), and Infectious Diseases Society of America

(IDSA) together sponsored a replacement follow guideline for the treatment of DR-TB in 2019. The document includes recommendations for the treatment of MDR-TB, moreover as single-resistant cases (e.g. isoniazid-resistant however rifampin-susceptible TB). The new recommendations enclosed the selection and range of medicine in an exceedingly sure program, the period of intensive and continuation phases, and also the role of injectable medication within the MDR-TB treatment programs. a good all-oral program for MDR-TB will so be assembled supported these recommendations. Recommendations conjointly give things together with necessary surgery for treating the treatment of MDR-TB and people once exposed to MDR-TB through personal contact.

Biohazard levels and safety measures ought to be determined in accordance with the character of organism and also the variety of laboratories. Risk assessment-based approach and assessment principles ought to be adopted to involve all the potential risks once operating with the target organism, below the particular laboratory condition and also the kinds of experimental procedures being conducted. Risk assessments ought to be acceptable and fitting. Estimation of potential risks could cause hurt to safety and result in doable accidental exposures. However, overestimation of potential risks will result in fixing additional tight protecting facilities than really required, putting excess burdens on laboratory employees and management, disbursal further monetary expenses and human resources.

Although the biohazard level classification of MTB is below class II, there area unit vital variations in virulence among varied MTB strains that highlight the importance of individual relevant biological risk assessments [16]. we propose that the biohazard level of MTB strains with totally different virulence capacities be divided into four varieties, in line with the degree of hurt they will do to humans or animals First, attenuated MTB immunogenic strains like BCG, that cause a coffee risk to people and community, renowned to be non-pathogenic to healthy adults and animals and used for protection within the healthy population, area unit below class IV infective microorganisms Second, virulent MTB like virulent laboratory MTB strain H37Ra, falls at intervals the counseled scope of class III infective microorganisms. intensive experimental findings have confirmed that the virulence of those virulent laboratory MTB strains has been sufficiently attenuated when several passages within the laboratory, and these strains now not sitting serious biohazard risks to humans, animals, or the setting. They even have restricted risks on transmission and barely inflicting serious health problem once accidental laboratory infection happens. Third, MDR-MTB strains, single DR-MTB strains, DS-MTB, and also the laboratory grownup virulent MTB strains (H37Rv) will cause serious human or animal diseases and area unit transmitted comparatively simply from humans to animals, among humans, or animals, directly or indirectly. These MTB strains ought to be handled in line with the safety Biohazard level of class II infective microorganisms. Finally, thanks to the acute drug resistance nature of XXDR and XDR-MTB strains, their biohazard levels area unit thought of like class I infective microorganisms [10].

Conclusion

Laboratory manager's area unit accountable for aggregation and reviewing the laboratory safety manual and appointing qualified or professionally trained personnel as safety officers. The implementation of safety procedures ought to be conducted and should embody safety management duties, sensible microbiological laboratory normal operative procedures, safety inspections, safety coaching, health watching, personal protection, risk assessment, fireplace

safety management, safety management of risky chemicals, waste management, and laboratory contingency plans, among different tasks. rules for private protection instrumentation (PPE), particularly, ought to clearly stipulate that everyone employees should wear laboratory protecting the least bit times whereas operating within the laboratory which laboratory and isolation clothing should be hold on singly from personal clothing. Gloves should be worn for all procedures involving direct or doable accidental contact with body fluid, blood, or different probably infectious materials. After use, gloves ought to be removed aseptically and hands should be washed in real time.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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