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Mini Review

Bovine Tuberculosis Remains a Major Public Health Concern: A Review

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Abstract

The bacterium *Mycobacterium bovis*, which is closely related to the human bacteria and avian tuberculosis, causes bovine tuberculosis, a chronic disease of animals. Tuberculosis in cattle is usually a chronic, debilitating disease, but it can also be acute and rapidly progressing. In less developed countries, bovine tuberculosis is still prevalent, and cattle fatalities, chronic disease, and trade restrictions can result in significant economic losses. Test-and-slaughter or test-and-segregation strategies can be used to control bovine tuberculosis. The tuberculin test is commonly used to re-test affected herds in order to exclude animals that may shed the pathogen. The disease is extremely important in terms of both economics and public health, and it requires immediate attention from all parties. As a result, a concerted effort is being made to manage the disease in animals and to raise public awareness about the importance of improving people's eating habits when it comes to animal products.

Keywords: Bovine tuberculosis; *Mycobacterium bovis*; Domestic animals; Public health

Abbreviations

BCG: Bacille Calmette-Guerin; BTB: Bovine Tuberculosis; FAO: Food and Agriculture Organization; *M. bovis*: *Mycobacterium bovis;* MTBC: Mycobacterium Tuberculosis Complex; OIE: International Organization for Animal Health; PPD: Purified Protein Derivative; TB: Tuberculosis; WHO: World Health Organization

Introduction

Mycobacterium bovis (*M. bovis*) infection poses a concern to wildlife and humans. Bovine tuberculosis (bTB) is a chronic disease of livestock caused mostly by *Mycobacterium bovis* (*M. bovis*). bTB has significant economic consequences, affecting both animal productivity and international trade [1.2]. Zoonotic tuberculosis is also a socioeconomic illness, as it reduces cattle production efficiency, causes carcass or organ condemnation, and restricts international trade in developing nations [3].

Bovine tuberculosis (BTB) is present all throughout the world, although it is especially prevalent in Africa, Asia, and the Americas [4]. *M. bovis* is the most common cause of tuberculosis in humans, but *M. bovis* is the most common cause of TB in cattle. It is the cause of Zoonotic TB in humans, which can be transmitted to people from infected vertebrate animals [5].

Despite the fact that milk is thought to be the main route for BTB transmission from cattle to humans, non-pasteurized milk is by far the more likely vehicle for pathogenic mycobacteria transmission [6]. *M. bovis* was responsible for 143,000 new human tuberculosis infections and 12,300 fatalities in 2019, according to the World Health Organization [8]. The African and Asian countries, which have the highest prevalence of bTB, accounted for more than 91.0 % of the deaths [8].

Bovine tuberculosis is a reemerging illness that affects both humans and animals and is caused by a bacterial group known as Mycobacterium tuberculosis complex (MTBC) [5]. It can refer to a variety of bacteria, such as Mycobacterium tuberculosis and *Mycobacterium bovis* [9]. M. tuberculosis (MTB) is the most common cause of tuberculosis in humans, but *M. bovis* is the most common cause of bovine tuberculosis (Pal et al., 2014).

The purpose of this review is to highlight the potential danger of bovine TB for animal and to emphasise the emerging public health threat of this disease for humans.

Literature Review on Bovine Tuberculosis

Etiology

Bovine tuberculosis is caused by *Mycobacterium bovis*, which is the etiological agent. *M. bovis* thrives in frozen tissue, whereas tissue preservatives such sodium tetraborate are adverse to survival [10]. Non-motile, non-spore forming, obligate aerobic, thin rod with 1-10 m length and 0.2-0.6 m width facultative intracellular microorganism with a slow generation time of 15-20 hours [5,11]. *M. bovis* is has a 3-week incubation period [10]. *M. bovis* may persist in the environment for several months, especially in cold, dark, and wet circumstances. The survival time varies from 18 to 332 days at 12°C-24°C (54°F-75°F) depending on sunshine exposure [10].

Transmission

Bovine tuberculosis is transmitted from animals to humans through the consumption of raw animal products and uncooked meat, which can affect the gastrointestine and spread to other organs. It is also transmitted from contaminated animals to others through the air or contaminated feed, as well as when the animals' materials are contaminated [12]. *M. bovis* is transmitted from cattle to humans primarily through the intake of raw milk and very rarely through direct contact (via aerosols). Furthermore, transmission can occur through inhalation of infective droplets or through ingestion

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of sputum, mucous or nasal discharges, feces, or urine containing infective bacilli [13,14]. Ingesting raw milk from sick cows can also infect calves and people [5].

Infected females can also transmit the bacteria vertically. The uterus can act as a route for infection in the fetus, and surviving calves often suffer liver and spleen diseases. People who engage in animal husbandry, slaughterhouse employees, veterinarians, and anyone who come into close contact with potentially infected animals are more likely to contract *M. bovis* [15].

High density and confinement increase the frequency of nose-to-nose encounters, as well as the number of animals exposed to contaminated excrement, exudate, feed, or water. Housing may aid disease transmission by increasing animal density and polluting the air and environment [12].

Pathogenesis

The bacteria usually enter the respiratory system of a cow and settles in the lungs. After then, the organism is phagocytized by lung macrophages. The bacterium becomes entrenched when it enters a herd of cattle via aerosolized droplets or ingestion. Depending on the severity of the infection and the immune system of the individual animal, the incubation period could last months or years [16].

The organism replicates intracellular after being taken over by macrophages. Granuloma or tubercle is formed as the body tries to draw on infected macrophages through the tissue. Granuloma is usually 1 - 3 cm wide, yellow or gray, round and solid. In the cut section, the root of the granuloma consists of dry, yellow, or necrotic dry matter. The infection can spread excessively to the lymph nodes and other parts of the body and cause 2 - 3 mm wide, tubercles. The formation of these tiny tubercles is known as miliarytuberculosis [16].

Clinical sign

Early clinical features of BTB include chronic cough, sputum production, decreased appetite, weight loss, fever, night sweats and hemoptysis [17]. Common clinical symptoms include persistent irritability, weakness, anorexia and flu-like fever. Local diseases can affect the lymph nodes, skin, bones and joints, the genitourinary system, the definitions or the respiratory system [18]. Animals infected with *M. bovis* have a low-grade fever, persistent cough with occasional pneumonia, difficulty breathing, weakness and loss of appetite, stiffness and inflammation of the upper lymph node (adenitis) [19].

Diagnosis

To identify cattle infected with *M. bovis*, an intradermal tuberculin test is usually performed, based on the incorporation of *M. bovis* antigen is called a purified protein derivative (PPD). Although tuberculin skin tests are very sensitive and specific it requires 48-72h processing and veterinarians should be specially trained to make an assay [20] .This test is a standard way to detect bovine tuberculosis. It includes measuring skin thickness, injecting cow tuberculin inside the measured area and measuring any subsequent swelling at the injection site 72 hours later [4]. A comparative study of intradermal tuberculin and bovine and bird tuberculin is widely used to distinguish between animals with bovine tuberculinar related genera [16]. A definitive diagnosis is made by culturing bacteria in the laboratory, a process that lasts at least eight weeks [4,21].

M. bovis it is difficult to obtain directly from a clinical sample from live animals or by growing it in a boxcar. Therefore, techniques that directly target organisms or their DNA, such as culture or polymerase chain reaction are not sensitive. Thus, key diagnostic examples were taken from suspected individuals and were raised in the Lowenstein-Jensen media. These media are made up of thick egg, potato meal, bone marrow transplantation, citrate, glycerol and malachite green. The addition of glycerol suppresses the growth of *M. Bovis* however promotes another mycobacteria [21].

Culture is still considered the gold standard in the study of mycobacterial illnesses. However, because of the symptoms of dysgenic development and delayed movement, *M. Bovis* can be identified in cultures and chemical procedures, although it takes time. Furthermore, using molecular methods is expensive because it necessitates the availability of suitable laboratory resources and qualified personnel [20].

Treatment

Bovine tuberculosis treatment is not a popular or cost-effective alternative in countries committed to tuberculosis eradication. Isoniazid, streptomycin-para-aminosalicylic acid, and other acids are commonly used in the treatment of human tuberculosis. The need for long-term therapy for the condition can lead to the development of multidrug resistant bacteria [10]. In several countries, including Ethiopia, test and slaughter-based control measures based on tuberculin skin testing were preferred over Bacille Calmette-Guerin (BCG) vaccination [18].

Public health importance

Tuberculosis is still a major public health issue in many parts of the world, including Ethiopia. Several of these risk factors may have contributed to the reported increase in human tuberculosis incidence in Sub-Saharan African countries, including Ethiopia. Most societies have been severely impacted by tough elements that have led to such problems. Although, *M. bovis* is not the most common cause of human tuberculosis, humans are nevertheless susceptible to BTB [22].

Humans can be infected in two ways: first, by swallowing the agent by consuming raw milk containing the infective bacilli, and second, by inhaling infective droplets when the owner and his or her cow are in close proximity, especially at night as some owners share shelters with their animals. BTB is thought to be responsible for up to 10% of human tuberculosis in some countries [4,23]. BTB is known to be a public health concern since it is transferred from infected animals to humans through close contact and the intake of raw animal products [5].

Economic importance of bovine tuberculosis

The costs of disease control (testing and compensation fees, losses from animal movement and sale restrictions), as well as lower milk and meat output, all result in financial losses [24,25]. The disease is a barrier to socioeconomic development; 75% of TB patients are between the ages of 15 and 54, when they are most economically active. The national economy may suffer as a result [26].

Control and preventions

Many affluent countries have successfully controlled BTB through the use of a test slaughter method in conjunction with milk pasteurization. Animal culling, on the other hand, is a budgetary challenge for developing countries such as Ethiopia. As a result, the second option, pasteurization of milk, should be pursued because it effectively stops the transmission channel of *M. bovis* from animal to human at a low cost [27]. BTB is prevented through early diagnosis and appropriate treatment of infectious cases, good infection control, and other variables such as better housing and nutrition [24]. It is critical that herd replacement calves be fed tuberculosis-free milk, either from known tuberculosis-free animals or pasteurized milk [24].

Food safety precautions such as drinking pasteurized milk and cooking meat thoroughly will also help to prevent transmission at the animal-human interface. Pasteurization of milk should be made mandatory because it is the most effective way to reduce bTB's public health impact. Sanitary inspection of carcasses at abattoirs should be performed on a regular basis to so that possibly contaminated animal products are removed and their origins tracked back to potentially infected herds so that management methods can be implemented [28].

Conclusion and Recommendations

Bovine TB is a bacterial disease that affects both animals and humans and causes granulomatous lesions in many organs. Surveillance initiatives for both humans and animals should be prioritized, particularly in endemic areas. To quantify and determine the size of the problem involved in disease transmission at the human-animal interface, a strong multi-disciplinary relationship between medical and veterinary professionals is required. Vaccine research and development programs should be conducted, and all TB vaccines now in development could be used in the cattle herd. The government should adopt a One Health approach that includes training all stakeholders in best practices in screening, detection, and developing interventional techniques for cross-species transmission. Transparency in data collection and sharing between animal and human public health professionals will aid in the monitoring of the human-cattle transmission cycle and vice versa.

The following recommendations were made based on the above conclusion:

- Efforts should be made to manage the disease in animals.
- Creating and raising awareness in society to improve their feeding habits of animal products diet.
- Insuring dairy farms to incentivize owners to cull diseased cattle when BTB and other economically important infectious illnesses have been tested.

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