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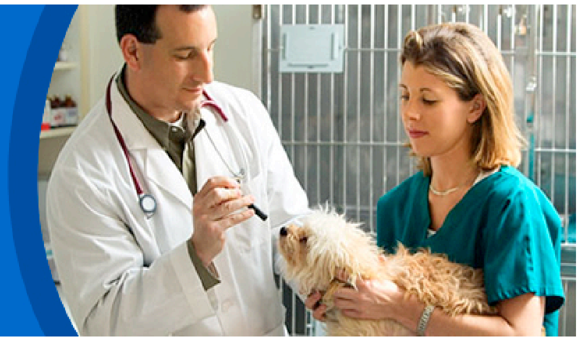

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A review on bovine tuberculosis and its zoonotic important

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Abstract

Bovine tuberculosis is a chronic and contagious disease of cattle and other domestic and wild animals including human, Mycobacterium bovis (M. bovis) is a causative agent which is a member of the Mycobacterium tuberculosis complex. A disease is Characterized by tuberculous lesions occur most frequently in the lungs and the retropharyngeal, bronchial and mediastenal lymph nodes and can be transmitted from animals to humans and vice versa with the most common means of transmission is through the respiratory system. Nowadays human tuberculosis of animal origin (zoonotic TB) is an important public health concern in developing countries, the highest incidence of bTB is generally found in areas where intensive dairy systems are practiced and Currently the BTB in humans is becoming increasingly important in developing countries, as humans and animals are sharing the same micro-environment and dwelling premises, especially in rural areas. As well as causing a high morbidity, bovine tuberculosis (BTB) can also be a financial burden to farmers owning infected cattle; it has been suggested that cattle with BTB have a reduced productivity affecting milk yield and carcass value as well as through reduced pulling power in traditional farming system. Because of economic and the public health hazards inherent in the retention of the tuberculous animals, antituberculous chemotherapy of animals is discouraged so slaughter or test- and-segregation methods is the best controlled methods of the disease and in the globe especially in developing countries there is a habit of milk consumption on raw form so that there should be milk pasteurization plant in the locality to secure milk origin of tuberculosis infected animals.

Keywords: Bovine tuberculosis, Zoonotic importance and risk factors

Introduction

Ethiopia has the largest livestock population in Africa, including an estimated, 53.99 million cattle that contribute to the livelihoods of 60–70% of the population (Halderman, 2004; Central Stastical Agency (CSA), 2013) [17, 12]. The vast majority of the cattle are indigenous zebu (Bos indicus) managed under traditional husbandry systems (grazing in the field) in rural areas. However, in recent years the number of dairy cattle of highly productive exotic (Bos taurus, mainly Holstein-Friesian) and cross breeds has been on the rise, particularly in urban and peri-urban areas in response to the increasing demand for milk products and the Ethiopian government's effort to improve productivity in the livestock sector. The population of dairy cows accounts for 6.3 million animals (around 12% of the total cattle population) and the estimated total national milk production per year is 2.6 billion liters of which the urban and peri- urban dairy farmers produce 2% (CSA, 2007) [11].

In a country such as Ethiopia, where livestock are extremely important for people's livelihood, animal diseases can be a real threat to animal productivity and thus negatively impact on the agricultural sector and economic development. From those diseases bovine tuberculosis (BTB) is one of the major important diseases that causes devastating economic loss in once country (Ayele *et al*., 2004) [6].

Bovine tuberculosis is a chronic and contagious disease of cattle and other domestic and wild animals including human (Radostits *et al*., 2007) [38]. Mycobacterium bovis (M. bovis) is a causative agent which is a member of the Mycobacterium tuberculosis complex, a group of mycobacterial species that includes M. tuberculosis, M. bovis, M. africanum and M. microti. From those, M. bovis is the most universal pathogen for the disease bovine tuberculosis among mycobacterium species and affects many vertebrate animals of all age groups including humans although, cattle, goats and pigs are found to be most susceptible, while sheep and horses are showing a high natural resistance and the disease is characterized by progressive development of tubercles in any tissue/organ of the body (Romha *et al*. 2013; Laval and Ameni, 2004) [42, 26]. Characteristic tuberculous lesions occur most frequently in the lungs and the retropharyngeal, bronchial and mediastenal lymph nodes. Lesions can also be found in the mesenteric lymph nodes, liver, spleen, on serous membranes, and in other organs (Office International des Epizootics (OIE), 2010) [22].

Bovine TB can be transmitted from animals to humans and vice versa. The most common means of transmission is through the respiratory system. Invisible droplets (aerosols) containing TB bacteria may be exhaled or coughed out by infected animals and then inhaled by susceptible animals or humans. The risk of exposure is greatest in enclosed areas, such as barns. Inhalation of aerosols is the most common route of infection for farm and ranch workers and veterinarians who work with diseased livestock. Livestock also are more likely to infect each other when they share a common watering place contaminated with saliva and other discharges from infected animals. Calves and humans can contract bovine TB when they drink unpasteurized milk from infected cows (Radostits *et al*., 2000; Ayele *et al*., 2004) [37, 6].

According to Carla *et al*. (2013) [8] currently intradermal test is the most common test for the diagnosis in the live animal on the basis of delayed hypersensitivity reaction to bovine tuberculin. Interpretation of intradermal test can be done 72 hours after injection. Delayed type hypersensitivity or type IV reaction is usually occurred 24-48 hours after antigen get into the body which is the reaction of specifically sensitized T-cell lymphocytes to antigen and resulting in the release of lymphokines. There after there is inflammation and accumulation of mononuclear cells at the injection site.

As well as causing a high morbidity, bovine tuberculosis (BTB) can also be a financial burden to farmers owning infected cattle; it has been suggested that cattle with BTB have a reduced productivity affecting milk yield and carcass value as well as through reduced pulling power in traditional farming system (Gumi *et al*., 2011) [16]. Is also an economically important disease with zoonotic potential, particularly in countries with emerging economies, mainly through consumption of unpasteurized milk products and its prevalence in Ethiopian cattle can therefore be a contributing factor to the human burden of TB in the country that currently is ranked as the 7th highest in the world (world health organization (WHO), 2011; Vordermeier *et al*., 2012) [50, 49].

Currently, the BTB in humans is becoming increasingly important in developing countries, as humans and animals are sharing the same micro- environment and dwelling premises, especially in rural areas. At present, due to the association of mycobacterial agent with the human immune virus (HIV/AIDS) pandemic and in view of the high prevalence of HIV/AIDS in the developing world and susceptibility of AIDS patients to tuberculosis in general, the situation changing is most likely (Raghvendra *et al*., 2010) [39].

Nowadays human tuberculosis of animal origin (zoonotic TB) is an important public health concern in developing countries. More than 94% of the world population lives in countries in which the control of bovine tuberculosis in cattle is limited or absent. Rural inhabitants and some urban dwellers in Africa still consume unpasteurized and soured milk potentially infected with M. bovis. Therefore M. bovis can infect humans, primarily by the ingestion of unpasteurized dairy products but also in aerosols and through breaks in the skin. Raw or undercooked meat can also be a source of the organism. Person-to- person transmission is rare in immunocompetent individuals, but M. bovis has occasionally been transmitted within small clusters of people, particularly alcoholics or HIV-infected individuals. Rarely, humans have infected cattle via aerosols or in urine (Tsegaye *et al*., 2010) [48].

The disease is prevalent worldwide but prevalence data is scarce in most developing countries due to lack of active control programmes. Although bovine tuberculosis was once found worldwide, control programmes have eliminated or nearly eliminated this disease from domesticated animals in many countries. But still in a large number of countries bovine tuberculosis is a major infectious disease among cattle, other domesticated animals, and certain wildlife populations (OIE, 2009) [21].

In sub-Saharan Africa, animal production is facing new challenges since demographic growth, urbanization, and economic development are all contributing to the increasing demand for milk, meat, eggs and other animal products. The indigenous cattle and the prevailing extensive rural production system are unlikely to be able to satisfy the rise in demand for animal products; therefore intensification of animal husbandry is required. The combination of intensified animal husbandry and the development of peri-urban systems for livestock production have resulted in increased incidence of bTB.

Several studies conducted since 2006 have confirmed that BTB is endemic in Ethiopia with prevalence rates varying from 0.8% to around 10% in extensive rural farming systems (Gumi *et al*., 2011) [16], while higher prevalence rates have been reported from regions in Ethiopia where intensive husbandry systems are more common (Tsegaye *et al*., 2010) [48] and also more prevalent in intensive dairy farms than in smallholder dairy farm regions with a prevalence ranging from 3.4% in small holder production system to 50% in intensive production system (Bogale *et al*., 2001; Ameni *et al*., 2006) [7, 3]. However, there is no data on the nation-wide distribution of the disease as there are still areas where such studies have not yet been conducted.

Therefore, the general objective of this review will to determine the review of bovine tuberculosis and its zoonotic importance. The specific objectives of this study will be:

- To overview bovine tuberculosis and its zoonotic implications
- To identify related risk factors for bovine tuberculosis

Bovine Tuberculosis

Etiological agent, Taxonomy and characteristics

The causative organism of bovine tuberculosis is Mycobacterium bovis, a member of the M. tuberculosis complex (MTBC), which includes M. tuberculosis, M. bovis, Mycobacterium africanum, Mycobacterium microti, Mycobacterium Canetti, Mycobacterium caprae and Mycobacterium pinnipedii, and many of the species and subspecies of MTBC show specific host association (Center for Food Security and Public Health (CFSPH), 2007) [10]. The most notable member of the complex is M. tuberculosis, the most important bacterial pathogen of human. In contrast to M. tuberculosis which is largely host restricted to humans, M. bovis is primarily maintained in bovine, in particular, domesticated cattle, although the pathogen can frequently be recovered from other mammals, including humans. But all members of the M. tuberculosis complex have been reported to cause infection in animals (Smith *et al*., 2006) [46].

Thereby bovine tuberculosis results from infection by Mycobacterium bovis, a Gram positive, acid-fast bacterium in the Mycobacterium tuberculosis complex of the family Mycobacteriaceae. The thick cell wall of mycobacterial agent is rich in mycolic acid and other complex lipid making hydrophobic and impermeable to aqueous stains without heat (Quinn *et al*., 2002) [35]. Mycobacteria are predominantly rod shaped, about 0.5µm wide, and variable in length. Spores, flagellas, and capsules are absent. Though cytochemically gram-positive, it often resist staining with the gram stain. The most method staining property is their acid fastness. They are strictly aerobes that grow best on complex organic media such as lowenstein-jensen's, which contains, among other ingredients, whole eggs and potato flour. Mycobacterium bovis is a slow-growing (16 to 20 hour generation time) (Hirsh, 2004) [18]. Related to M. tuberculosis—the bacteria which causes tuberculosis in humans—M. bovis can also jump the species barrier and cause tuberculosis in humans (Raghvendra *et al*., 2010) [39].

Epidemiology and transmission

Bovine Tuberculosis has no geographical boundaries and infection occurs in diverse group of animals, which infection occurs in diverse group of animals, which includes farm animals of economic importance, wildlife and humans (Pavlik, 2002) [32]. It is usually maintained in cattle populations, but a few other species can become reservoir hosts. Most species are considered to be spillover hosts. Populations of spillover hosts do not maintain M. bovis in definitely in the absence of maintenance hosts, but may transmit the infection between their members (or to other species) for a time. Some spillover hosts can become maintenance hosts if their population density is high. Bovine TB is predominantly a respiratory infection. Hence, any situation of close cattle contact with an infectious case may facilitate transmission (Quinn *et al*., 2002) [35].

According to Amanfu (2006) [1] Direct routes of transmission require close and mostly sustained contact with an infectious case, whereas 'indirect' routes would include transmission via, for example, a contaminated external or internal environment, contaminated feed, water and equipment. On balance, direct contact would seem to be far more significant than transmission potentially supported by 'indirect' routes. Direct infection from dam to calf (s) is clearly demonstrated in several recent studies (Skuce *et al*., 2011) [45].

The most common route of transmission between cattle is aerosol inhalation. Transmission may also occur by ingestion of water or feed contaminated by feces, or as a result of calves nursing infected dams. Under natural conditions, stagnant drinking water may cause infection up to 18 days after its last use by a TB-carrier animal, but a running stream does not represent an important source of infection to cattle in downstream fields (Ameni *et al*., 2006) [3].

Viable organisms can be isolated from the feces of infected cattle and from the ground in contact with the feces for 6 to 8 weeks after the feces are dropped. The period may be as short as 1 week if the weather is dry and pastures are harrowed but will be much longer in wet weather. Separating infected and susceptible animals with a fence provides practical protection against the spread of the disease. Less common routes of infection include intrauterine infection, at coitus or through the use of infected semen or contaminated insemination or uterine pipettes, and intramammary infection, by the use of contaminated teat cannulas or contaminated cups of milking machines. Unusual sources of infection are infected cats, goats, or even farm attendants (Floron *et al*., 2000) [15].

In humans from animal the major factors among which contribute to the acquisition of the infection in both urban and rural population is family ownership of cattle, previous livestock ownership, sharing of the house with animals, consumption of non-pasteurized milk (raw milk) or poorly cooked meat. All these causalities and/or habits are the daily practices most notably of rural communities in Ethiopia. In particular, milk borne infection is the main cause of non-pulmonary tuberculosis in areas where BTB is common and uncontrolled (Shitaye *et al*., 2011) [43]. In developing countries, the conditions for M. bovis transmission to humans not only exist unchanged, but also the human population has a greater vulnerability due to poverty, human immune virus (HIV) and reduced access to health care (Ayele *et al*., 2004) [6].

Sources of infection

Infected cattle are the main source of infection for other cattle. Organisms are found in exhaled air, in sputum, faces, milk, and urine, vaginal and uterine discharge. Cattle in the early stages of the disease, before any lesions are visible, may also excrete viable mycobacteria in nasal and tracheal mucus. In experimentally infected cattle, excretion of the organism commences about 90 days after infection (Radostits *et al*., 2000) [38].

Not only infected cattle are the source of infection for other cattle, but also certain wild species appear to be significant maintenance host and reservoir for infection. In human ingestion of unpasteurized milk and milk products pose a great risk than ingestion of infected meat products because badly infected carcass are condemned; parts of carcass that are processed as meat products are inspected and thoroughly cooked (Anaelem *et al*., 2010; Radostits *et al*., 2007) [5, 38].

Risk factors

Risk factors at the animal level

One of the main individual risk factors identified by numerous studies in both developed and developing countries is the age of animals. The duration of exposure increases with age; older animals are more likely to have been exposed than younger ones, as shown by several cross-sectional studies. Susceptibility to M. bovis may be as well enhanced in cattle infected with immunosuppressive viruses such as bovine viral diarrhea or immunodeficiency viruses (De la Rua-Domenech *et al*., 2006) [14, 46]. According to Inangolet *et al*. (2008) [19] study significantly more females positive to the skin test than males. Sex linked factors are probably related to management practices or behavioral habits; males and females are managed differently, both in developed and developing countries.

Risk factors at the herd-level

Studies carried out in several parts of the world, both in developed and developing countries, identified herd size as one of the major bTB herd-level risk factors (Porphyre *et al*., 2012) [34]. The more cattle there are on a farm, the greater the probability that one of them will acquire the infection. Large herds generally pasture on a larger area, with a higher probability to have more contiguous herds, thus increasing the risk of cattle-to-cattle spread (Reilly and Courtenary, 2013) [41].

The highest incidence of bTB is generally found in areas where intensive dairy systems are practiced. Dairy production in developed countries follows a trend towards increased intensification on a smaller number of larger production units, which implies increased contact between animals and thus an enhanced risk of bTB transmission. In these intensive systems, aerogenic transmission of bTB seems to dominate (Kaneene *et al*., 2012) [25]. Studies in Ethiopia, in a 2006-study comparing the effects of zero grazing versus free grazing among cattle, it was reported that the severity of bTB was significantly higher in cattle kept indoors at a higher population density than in cattle kept on pasture. In addition to close contact, stress caused by overcrowding or nutritional differences between housed and pastured animals was mentioned as contributing to the spread of the disease (Ameni *et al*, 2006) [3].

Risk factors at the region/country level

The importation of living cattle, especially from the endemic country to the free one, is likely to be responsible for the introduction of bTB (Olaya *et al*., 2007) [30]. Animals purchased from a high bTB incidence area and introduced in a low bTB incidence region increase the risk of a herd breakdown (Carrique- mess, 2011) [9]. According to Aranaz *et al*. (2010) and Amanfu (2006) [1] Migration and people's travelling habits are additional risk factors for the spread of M. bovis, since bTB is present in most developing countries where surveillance and controls are often inadequate or unavailable. In many developing countries, milk and dairy products are still consumed unpasteurized, and the risk of M. bovis transmission remains likely.

Thus, a foreign-born person, contaminated in his/her childhood and clinically expressing the disease, represents a risk if he comes in contact with a bTB- free herd. Finally, wildlife, a risk factor also considered at the region/country level too, since wild species movements include border crossing. These trans-border movements of wildlife can occur naturally or be human-induced, such as via legal importations to zoological parks or animal reintroduction for conservation programmes. Illegal importations of wild species can be considered as a risk factor on an international scale as well (Marie- France, 2009) [28].

Pathogenesis

The infectious process begins with deposition of tubercle, bacilli in the lung or pharyngeal or intestinal mucus membranes. In previously unexposed animals, local multiplication occurs within; resistant to phagocytic killing allows continued intracellular and extracellular multiplication. Once cell mediated reactivity is established, subsequent re infection follows a different course: antigen specific T-lymphocytes and activated macrophages promptly converge on the site, contain the infection, and prevent lymphocytic spread.

Antigen specific T-lymphocyte responses, however, also mediate cytotoxic reactions and cause extensive tissue destruction, which are characteristics of progressive tuberculosis. While the lymphocytic dissemination is limited by the immune response, tissue damage facilitates bacterial spread by contiguous extension, or erosion of bronchi, blood vessels, or viscera, introducing infection to new areas. Wherever microorganisms lodge; this reaction will be repeated with cumulative consequences. Hematogenous dissemination may produce military tuberculosis: multifocal tubercle formation throughout an organ (Hirsh *et al*., 2004) [18].

Clinical and pathological findings

Early infections are often asymptomatic. In the late stages, common symptoms include progressive emaciation, a low–grade fluctuating fever, weakness and inappetence. Animals with pulmonary involvement usually have a moist cough that is worse in the morning, during cold weather or exercise, and may have dyspnea or tachypnea. In the terminal stages, animals may become extremely emaciated and develop acute respiratory distress. In some animals, the retropharyngeal or other lymph nodes enlarge and may rupture and drain (Jolley *et al*., 2007; Raghvendra *et al*., 2010) [20, 39].

Greatly enlarged lymph nodes can also obstruct blood vessels, airways, or the digestive tract. If the digestive tract is involved, intermittent diarrhea and constipation may be seen. In cervids, bovine tuberculosis may be a subacute or chronic disease, and the rate of progression is variable. In some animals, the only symptom may be abscesses of unknown origin in isolated lymph nodes, and symptoms may not develop for several years. In other cases, the disease may be disseminated, with a rapid, fulminating course (Radostits *et al*., 2007) [38].

During postmortem examination bovine tuberculosis is characterized by the formation of granulomas (tubercles) where bacteria have localized. These granulomas are usually yellowish and caseous, caseo- calcareous or calcified, they are often encapsulated. Meat inspection officers are trained to check for miliary tubercles in the head, spleen, kidney, mammary glands, fore and hind-limbs, lungs, liver, heart, and associated lymph nodes (Opara *et al*., 2012) [31]. According to Regassa *et al*. (2001) [4] the distribution of the lesions in different body systems showed that, from the higher to the lower were found in respiratory, digestive and biliary systems respectively.

Diagnosis

Clinical examination

Bovine tuberculosis can be clinically characterized, by progressive emaciation, a low–grade fluctuating fever, weakness and inappetence. TB lesions may be found in any organ or body cavity of diseased animals. In early stages of the disease, these lesions are difficult to find, even during post mortem examination. But in later stages, the nodules or lumps caused by bovine TB become very evident in the lungs and associated lymph nodes and in the lymph nodes of the head and intestinal tract. Lesions may also appear in the abdominal organs, reproductive organs, nervous system, superficial body lymph nodes, and bones. Humans and animals with TB develop an immune response, which can be detected by the tuberculin skin test (Raghvendra *et al*., 2010) [39].

Tuberculin test

Tuberculin is a sterile laboratory product made by growing TB bacteria, killing them with heat, removing them from the substance on which they were grown, and properly diluting and preserving the remaining mixture. About 72 hours after tuberculin is injected into animals affected with TB, a characteristic swelling reaction appears at the point of injection. This reaction is a positive test result, indicating exposure to one type of mycobacteria. Further diagnostic methods are necessary to confirm the presence of bovine TB. In humans, these tests include chest x-rays and sputum cultures. For animals, the comparative cervical tuberculin test, serological tests, post mortem examinations, and other laboratory procedures are used (Cousins and Florisson, 2005) [13].

Intradermal test is the standard method for the diagnosis of tuberculosis in live bovine. In the past, heat-concentrated synthetic medium tuberculin was preferred to use as a diagnostic reagent; however, nowadays it has been replaced by purified protein derivative (PPD) tuberculin because it is more specific and widely used as well as commercially available. For the diagnosis of bovine tuberculosis, single intradermal test using bovine tuberculin or intradermal comparative test using avian tuberculin combined with bovine tuberculin can be used for the test. The preferred position for intradermal test is mid-neck as it is more sensitive than the caudal fold of tail. However, the caudal fold of tail can be applied by increasing the amount of the reagent (Skuce *et al*., 2011) [45].

Currently, the most widely employed diagnostic method is based on intradermal tests but they have limitations in both sensitivity and specificity. These tests are based on a measurable cellular immune response against M. bovis. They are performed as a single intradermal tuberculin test, based on the intradermal inoculation of M. bovis purified protein derivative (PPDB), or a comparative intradermal tuberculin test (CIDT), utilizing PPDB and Mycobacterium avium PPD (PPDA). The CIDT has 68 to 95% sensitivity and a higher specificity by recognizing cross-reactive responses against environmental mycobacteria, and allows adjustment for final interpretation (Carla *et al*., 2013; Managhan *et al*., 2000) [8, 27].

The Gamma Interferon assay (IFN) is also based on the cell-immune response and measures IFN released into whole-blood culture *in vitro*, in response to specific antigen stimula¬tion. This assay has been evaluated as a primary diagnostic method in many countries. Since lymphocyte stimulation is done *in vitro*, and conse¬quently does not alter the immune status of the animal, it is not necessary to wait 60-90 days to repeat the test when the initial test is inconclusive, a distinct limitation of the skin tests (Jolley *et al*., 2007) [20].

Culture media

The gold standard for BTB diagnosis is considered to be the isolation and identification of the microorganism (or its DNA) by bacteriological culture or polymerase chain reaction (PCR) using samples collected from suspect cases (Medeiros *et al*., 2010) [29]. Although both methods achieve high specificity, they can only be performed post-mortem and cultures may require incuba¬tion for four months. Milk samples can also be analyzed by bacteriological culture or PCR; however, microbial spread to the mammary glands is not necessarily reliable (Pollock *et al*., 2005) [33]. In addition, negative test results do not exclude the possibility of infection, especially in an area with low disease incidence and low bacteriological load, a complica¬ting factor for accurate diagnosis (Jolley *et al*., 2007) [20].

Isolates can be identified by determining traditional cultural and biochemical properties. On a suitable pyruvate-based solid medium, colonies of M. bovis are smooth and off-white (buff) in color. The organism grows slowly at 37°C, but does not grow at 22°C or 45°C. Mycobacterium bovis is sensitive to thiophen-2-carboxylic acid hydrazide (TCH) and to isonicotinic acid hydrazide (INH). This can be tested for by growth on 7H10/7H11 Middle brook agar medium or on egg-containing media. The egg medium should be prepared without pyruvate because it inhibits INH and could have a similar effect on TCH (which is an analogue of INH) and thus give false-positive (resistant) results (OIE, 2009) [21].

Differential staining

Mycobacterium bovis can be demonstrated microscopically on direct smears from clinical samples and on prepared tissue materials. The acid fastness of M. bovis is normally demonstrated with the classic Ziehl–Neelsen stain, but a fluorescent acid-fast stain may also be used (OIE, 2009) [21].

Serological examination

Serological assays are considered to be useful tools for the diagnosis of bovine tuberculosis although limited to those periods when antibodies are a feature of the disease. There is a switch in the nature of the immune response against M. bovis as the infection progresses. It is known that during the later stages of infection, there is a strong humeral response and assays based on the cell-im¬mune response can be either negative or inconclusive. In addition, serological assays are relatively easy to perform and can be used to rapidly test a large number of samples (Surujbali *et al*. 2002, Medeiros *et al*., 2010) [20, 29].

Treatment, control and prevention

Because of economic and the public health hazards inherent in the retention of the tuberculous animals, antituberculous chemotherapy of animals is discouraged. In countries with eradication programmes treatment is generally discouraged or illegal (Radostits *et al*., 2007) [38]. The course of treatment for humans with bovine TB takes 6 to 9 months, and the success rate following treatment is more than 95 percent (Cousins and Florisson, 2005) [13].

Bovine tuberculosis can be controlled by test-and- slaughter or test-and-segregation methods. Affected herds are re-tested periodically to eliminate cattle that may shed the organism; the tuberculin test is generally used. Infected herds are usually quarantined, and animals that have been in contact with reactors are traced. Only test-and-slaughter techniques are guaranteed to eradicate tuberculosis from domesticated animals. However, some countries use test-and-segregation programs during the early stages of eradication, and switch to test-and-slaughter methods in the final stage. Once eradication is nearly complete, slaughter surveillance, with tracing of infected animals, may be a more efficient use of resources. Sanitation and disinfection may reduce the spread of the agent within the herd. M. bovis is relatively resistant to disinfectants and requires long contact times for inactivation (Medeiros *et al*. 2010; OIE, 2010) [29, 22].

Effective disinfectants include 5% phenol, iodine solutions with a high concentration of available iodine, glutaraldehyde and formaldehyde. In environments with low concentrations of organic material, 1% sodium hypochlorite with a long contact time is also effective. M. bovis is also susceptible to moist heat of 121°C for a minimum of 15 minutes (Quinn *et al*., 2002) [35].

In livestock, bovine TB can be controlled within an affected herd through regular testing and slaughter of any single animal that tests positive until the entire herd tests negative for this disease. However, because there is no method available to ensure that bovine TB has been eliminated from an affected herd; Animal and Plant Health Inspection Service (APHIS) recommends herd depopulation (as cited by Raghvendra *et al*., 2010) [39]. Bovine TB has been reduced/eliminated from domestic cattle in many developed countries by the application of a test-and- cull policy that moves (Amanfu, 2006; Thoen *et al*., 2006) [1, 47]. In Africa, although bovine TB is known to be common in both cattle and wildlife, control policies have not been enforced in many countries due to cost implications, lack of capacity, and infrastructure limitations (Amanfu, 2006) [1].

Before embarking on any control programme as prevention it is essential that all dairy farms should be registered and that all dairy cattle older than six months of age are identified with permanent marks, at least tagged with ear tags. At present, tagging is practiced in intensive dairy farms, but it does not yet cover all dairy farms, small holders in particular (Raghvendra *et al*., 2010) [39].

In most parts of Ethiopia like country where there are maximum cases of bovine tuberculosis, animals are kept near dwellings and maintained under very poor management and hygienic status, thus increasing the risk of acquiring infection for animals and humans as well. Therefore, creating awareness among the people, to meet the standard hygienic requirement and to improve husbandry practices is of paramount importance. In intensive dairy farms, building of the new premises needs to be done according to designs appropriate to dairy farms taking into account space per-cow, proper manure disposal, and good ventilation and lighting systems. Pasteurization of milk and milk products should be done as routine practice most notably in rural communities (Amanfu, 2006) [1].

Economic and Zoonotic Importance of Bovine Tuberculosis

Bovine tuberculosis occurs in every country of the world and is of major importance in dairy cattle. It is under control in most developed countries but is still a major cause of loss in many less well developed countries. Apart from actual deaths, infected animals' loss 10-25% of their productive efficiency (Kahn, 2005). Nowadays increasing incidence of tuberculosis in humans particularly in immune compromised humans, has given are newer interest in the zoonotic importance of M. bovis, especially in developing countries and the ease and frequency of the spread of tuberculosis from animal to humans in an uncontrolled environment makes this an important zoonoses (Radostits *et al*., 2007) [38].

Status of Bovine tuberculosis in Ethiopia

Ethiopia is among those countries with epidemiological and public health aspects of the infection remain unknown. But same data on bovine tuberculosis in cattle and humans in different sites of country indicate that the rate of reactors cattle was higher in large-scale government owned dairy farm than in private owned small dairy farms.

The disease is considered as one of the major livestock diseases that results in high morbidity and mortality in Ethiopia. Furthermore, Ethiopia has reported the occurrence of BTB in the year 2007 (as cited by Ayele *et al*., 2004; Zinsstag *et al*., 2006) [6, 51]. However, still there is lack of knowledge about the actual prevalence and distribution of the disease at a national level.

Despite this, the economic impacts and zoonotic importance of the BTB infection are either not well studied or documented. A study undertaken in previous years has shown the prevalence rate of 16.7% of BTB based on tuberculin skin tests on the government state farms and other private dairy farms. Among various undertaken studies, the prevalence rate of BTB ranges from 3.4% in a small holder production system to 50% in intensive dairy productions has been reported in various places of the country (Ameni *et al*. 2003; Regassa, 2005) [2, 40].

In Ethiopia, exotic breeds were found to be more susceptible than cross and local breeds to M. bovis with manifestation of high incidence and prevalence rates (Regassa, 2005; Ameni *et al*., 2006) [40, 3]. In addition, a herd prevalence rate of 42.6% to 48.6% was found to be higher than the prevalence rate of individual animals (7.9% to 18.7%), that indicates the herd size can favor the transmission of BTB in intensive dairy farms in particular (Ameni *et al*., 2003; Shitaye *et al*., 2006) [2, 44].

Conclussion and Recommendations

It is concluded that Bovine tuberculosis is a chronic and contagious disease of cattle and other domestic and wild animals including human and which is caused by Mycobacterium bovis, a member of the M. tuberculosis complex. Can be transmitted both Direct routes and 'indirect' routes which include transmission via a contaminated external or internal environment, contaminated feed, water and equipment. The disease can be controlled by test- and-slaughter or test-and-segregation methods. Most developed countries where BTB is a problem have introduced a test-and-slaughter policy to control/eradicate the disease. The CIDT, although not 100% sensitive, is the standard test widely used in developed countries for this purpose. As such policy is considered costly it has no compensation scheme for elimination of infected animals currently in practice in the developing countries. In light with the above facts, the following recommendations are forwarded:-

- Since no compensation scheme for elimination of infected animals is currently in place in in developing countries particularly in Ethiopia and due to financial constraints such policy might not be feasible in the near future. So, a test-and-segregation policy of tuberculin positive animals should be pursued.
- In the globe area particularly in under developing countries there is a habit of milk consumption on raw form so that there should be milk pasteurization plant in the locality to secure milk origin of tuberculosis infected animals.
- As the dairy industry in the country has expanded in recent years and is expected to continue doing so, significant number of high productive exotic and cross breed animals are likely to be traded from the urban areas around the capital to the rural areas. So there should be spread of knowledge about BTB and its risks to farmers and people involved in the smallholder dairy farms.
- In Ethiopia; since this review could not established the prevalence and distribution of the disease in the country, the source of the infection whether it was from the human to cattle or vice versa, further study in the form of research, establishment of collaboration between physician and veterinarians to trace back positive patient to get profile of their cattle should be in mind.

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