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CLINICAL ASPECTS OF BOVINE TUBERCULOSIS- A CHRONIC BACTERIAL DISEASE OF CATTLE: AN OVERVIEW

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ABSTRACT

Bovine tuberculosis is a chronic bacterial disease of cattle that occasionally affects other species of mammals. This disease is a significant zoonosis that can spread to humans, typically by the inhalation of aerosols or the ingestion of unpasteurized milk. In developed countries, eradication programs have reduced or eliminated tuberculosis in cattle, and human disease is now rare; however, reservoirs in wildlife can make complete eradication difficult. Bovine tuberculosis is still common in less developed countries, and severe economic losses can occur from livestock deaths, chronic disease and trade restrictions. In some situations, this disease may also be a serious threat to endangered species. Bovine tuberculosis results from infection by *Mycobacterium bovis*, a Gram positive, acid-fast bacterium in the *Mycobacterium tuberculosis* complex of the family Mycobacteriaceae. This article presents a brief review of bovine tuberculosis with an emphasis on its various clinical aspects; the article also reveals the various aspects related to bovine tuberculosis viz introduction, concept of bovine tuberculosis, concept of *Mycobacterium bovis* , sign and symptoms in various sources for *Mycobacterium bovis*, species affected, geographical distribution as well as diagnosis.

Keywords: Tuberculosis, Bovine tuberculosis, BTB, Mycobacterium bovis, Mycobacterium tuberculosis, Mycobacteriaceae, Mycobacteriosis, Zoonotic Disease.

INTRODUCTON

Tuberculosis as we all know that it is any of the infectious diseases of humans and other animals due to species of *Mycobacterium* and marked by formation of tubercles and caseous necrosis in tissues of any organ; in humans the lung is the major seat of infection and the usual portal through which infection reaches other organs. Tuberculosis usually attacks the lungs but can also affect other parts of the body.

It is spread through the air, when people who have the disease cough, sneeze, or spit (Konstantinos, 2010). Most infections in humans result in anasymptomatic, latent infection, and about one in ten latent infections eventually progresses to active disease, which, if left untreated, kills more than 50% of its victims. The classic symptoms are a chronic cough with blood-tinged sputum, fever, night sweats, and weight loss. Infection of other organs causes a wide range of symptoms. Diagnosis relies on radiology (commonly chest X-rays), a tuberculin skin test, blood tests, as well as microscopic examination and microbiological culture of bodily fluids. Treatment is difficult and requires long courses of multiple antibiotics. Contacts are also screened and treated if necessary. Antibiotic resistance is a growing problem in (extensively) multi-drug-resistant tuberculosis. Prevention relies on screening programs and vaccination, usually with Bacillus Calmette-Guérin vaccine.A third of the world's population are thought to be infected with *M.*

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tuberculosis (Jasmer *et al.,* 2005). and new infections occur at a rate of about one per second. The proportion of people who become sick with tuberculosis each year is stable or falling worldwide but, because of population growth, the absolute number of new cases is still increasing. In 2007 there were an estimated 13.7 million chronic active cases, 9.3 million new cases, and 1.8 million deaths, mostly in developing countries. In addition, more people in the developed world are contracting tuberculosis because their immune systems are compromised by immunosuppressive drugs, substance abuse, or AIDS. The distribution of tuberculosis is not uniform across the globe; about 80% of the population in many Asian and African countries test positive in tuberculin tests, while only 5-10% of the US population test positive.

CONCEPT OF BOVINE TUBERCULOSIS

Bovine Tuberculosis is a federal reportable disease with serious implications for agricultural economics and human health. Infection can occur in some wild life species, primarily as spillover from infected cattle. However, under specific conditions, the bacterium can maintain a population in wildlife alone. Bovine tuberculosis (BTB) is a chronic infectious disease of animals characterised by the formation of granulomas in tissues and organs, more significantly in the lungs, lymph nodes, intestine and kidney including others. BTB is caused by slowly growing non-photochromogenic bacilli members of the *Mycobacterium tuberculosis* complex: *M. bovis* and *M. caprae* species. However, *M. bovis* is the most universal pathogen among mycobacteria and affects many vertebrate animals of all age groups including humans although, cattle, goats and pigs are found. BTB has been significantly widely distributed throughout the world and it has been a cause for great economic loss in animal production. In developed countries, BTB in animals is a rarity with occasional severe occurrences in small groups of herds. In developing countries, however, such as in 46% of African, 44% of Asian and 35% of the South American and the Caribbean countries, sporadic occurrences and (particularly in Africa 11%) enzootic occurrences of BTB have been reported (Cosivi *et al.,* 1998). BTB, apart from being the most important disease of intensification with a serious effect on animal production, also has a significant public health importance (O'Reilly and Daborn, 1995).

Although, the direct correlation between *M. bovis* infection in cattle and human populations is not well known (Collins and Grange, 1983; Cosivi *et al.,* 1995), however, zoonotic BTB is present in most developing countries where surveillance and control activities are often inadequate or unavailable.

The actual impact of animal BTB on human health is generally considered low in developed and developing countries, which may be based on the rare identification of *M. bovis* isolates from human patients (Amanfu, 2006). In addition, the occurrence of BTB due to *M. bovis* in humans is difficult to determine accurately because of technical problems in isolating the micro-organism. 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 mycobacteria with the *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. Prevalence data on BTB infection in Africa is scarce. There is, however, sufficient evidence to indicate that it is widely distributed in almost all African countries and even is found at high prevalence in some animal populations (Ayele *et al.,* 2004). Bovine TB can be transmitted from animals to humans and vice versa. Although young animals, and humans, can contract the disease by drinking raw milk from infected dams (mothers), 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, hogs, and humans can contract bovine TB when they drink unpasteurised milk from infected cows.

Both beef and dairy cattle are susceptible to bovine TB. However, confinement dairies and feedlots are the primary areas of concern. Frequent herd additions increase the opportunity for introduction of the disease, and high animal densities increase the likelihood of the disease spreading among herdmates. Like most mycobacterium, *M. bovis* multiplies slowly, so animals exposed in a terminal feedlot are usually sent to slaughter during the early stages of the disease. However, because dairy cattle remain in the herd longer and are maintained in relatively dense populations, dairies are at higher risk for heavy herd infection rates.

CONCEPT OF *MYCOBACTERIUM BOVIS*

Mycobacterium bovis is a slow-growing (16 to 20 hour generation time), aerobic bacterium and the

causative agent of tuberculosis in cattle which is known as bovine. Related to *M. tuberculosis*—the bacteria which causes tuberculosis in humans—*M. bovis* can also jump the species barrier and cause tuberculosis in humans.

It has been estimated that, during the first half of the 20th century, *M. bovis* was responsible for more losses among farm animals than all other infectious diseases combined. Infection occurs if the bacterium is ingested. The primary cause of Mycobacterium bovis is the result of transmission of an infectious agent by another person by one or more of the following: saliva, air, cough, fecal-oral route, surfaces, blood, needles, blood transfusions, sexual contact, mother to fetus etc. *M. bovis* is usually transmitted to humans via infected milk, although it can also spread via aerosol droplets. Actual infections in humans are rare, mostly due to pasteurisation killing any bacteria in infected milk; as well, cattle are randomly tested for the disease and immediately destroyed if infected. However, in areas of the developing world where pasteurisation is not routine, *M. bovis* is a relatively common cause of human tuberculosis (O'Reilly and Daborn, 1995). *Mycobacterium bovis* can be transmitted from human to human; there was an outbreak in Birmingham, England in 2004, and from human to cattle (Griffith and Munro, 1944; Tice, 1944), but such occurrences are rare.

SIGNS AND SYMPTOMS IN VARIOUS SOURCES FOR *M. BOVIS*

The list of signs and symptoms in various sources for Mycobacterium bovis includes the 10 symptoms listed below:

- Asymptomatic in some cases
- Symptoms may take months or years to manifest
- Fever
- Night sweats
- Unintentional weight loss
- Cough
- Enlarged neck lymph nodes
- Abdominal pain
- Abdominal swelling
- Diarrhoea

SPECIES AFFECTED APART FROM CATTLES FROM BOVINE TB

Cattle are the primary hosts for *M. bovis*, but other domesticated and wild mammals can also be infected. Known maintenance hosts include brush–tailed opossums (and possibly ferrets) in New Zealand, badgers in the United Kingdom and Ireland, bison and elk in Canada, and kudu and African buffalo in southern Africa. White-tailed deer in the United States (Michigan) have been classified as maintenance hosts; however, some authors now believe this species may be a spillover host that maintains the organism only when its population density is high. Species reported to be spillover hosts include sheep, goats, horses, pigs, dogs, cats, ferrets, camels, llamas, many species of wild ruminants including deer and elk;elephants, rhinoceroses, foxes, coyotes, mink, primates, opossums, otters, seals, sea lions, hares, raccoons, bears, warthogs, large cats (including lions, tigers, leopards, cheetahs and lynx) and several species of rodents. Most mammals may be susceptible.

Little is known about the susceptibility of birds to *M. bovis*, although they are generally thought to be resistant. Experimental infections have recently been reported in pigeons after oral or intratracheal inoculation and in crows after intraperitoneal inoculation. Some avian species, including mallard ducks, appear to be resistant to experimental infection (Butler *et al.,* 2001; Classidy, 2006).

GEOGRAPHIC DISTRIBUTION OF BOVINE TUBERCULOSIS

Although bovine tuberculosis was once found worldwide, control programs have eliminated or nearly eliminated this disease from domesticated animals in many countries. Nations currently classified as tuberculosis-free include Australia, Iceland, Denmark, Sweden, Norway, Finland, Austria, Switzerland, Luxembourg, Latvia, Slovakia, Lithuania, Estonia, the Czech Republic, Canada, Singapore, Jamaica, Barbados and Israel. Eradication programs are in progress in other European countries, Japan, New Zealand, the United States, Mexico, and some countries of Central and South America. Although bovine tuberculosis has been eradicated from the majority of U.S. states, a few infected herds continue to be reported, and a few states may periodically lose their disease-free status. In particular, a focus of infection in wild white-tailed deer has complicated eradication efforts in Michigan. Similar problems exist with infected badgers in the U.K. and Ireland, and infected brush-tailed opossums in New Zealand. Bovine tuberculosis is still widespread in Africa, parts of Asia and some Middle Eastern countries.

DIAGNOSIS OF BOVINE TUBERCULOSIS

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. 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. 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).

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, APHIS recommends herd depopulation.

DISCUSSION AND CONCLUSION

It may be concluded that Tuberculosis is caused by a group of closely related acid fast bacilli forming the *Mycobacterium tuberculosis* complex. Among these organisms, *M. bovis* is most important in causing bovine tuberculosis (BTB) and has great tendency to infect human and other animals due to its wide host range (Khan and Khan, 2007). The BTB is a chronic debilitating disease with cosmopolitan distribution. The Office International des Epizooties classifies BTB as a list B transmissible disease which is considered to be of socio-economic or public health importance and is of high significance to the international trade of animals and animal products (Cousins, 2001). The BTB is still a health problem in developed countries (Rastogi and Barrow, 1994) but is a problem of serious concern in underdeveloped countries like Pakistan, where milk is not pasteurized on large scale and disease reporting and management systems are inadequate. *Mycobacterium bovis* causes TB in cattle. An effort to eradicate bovine tuberculosis from the cattle and deer herds of New Zealand is underway. It has been found that herd infection is more likely in areas where infected natural reservoir such as Australian brush-tailed possums come into contact with domestic livestock at farm/bush borders (Tweddle and Livingstone, 1994). Controlling the vectors through possum eradication and monitoring the level of disease in livestock herds through regular surveillance are seen as a "two-pronged" approach to ridding New Zealand of the disease. Current control options for bovine TB are extremely limited. Around the world where bovine TB exists in wildlife species, there are two basic options: live with the disease and associated agricultural and human health risks or eradicate it. There are no suitable or effective medicines/vaccinations available for wild life. In addition the logistics of treating free ranging wild life are prohibitive. Thus eradication programs are faced with the reality of using depopulation as the only practical and effective means of limiting the bacterial populations. Bovine TB is a chronic disease, seldom becoming apparent until it has reached an advanced stage in cattle, captive deer, and swine. Some infected livestock seem to be in prime condition, showing no evidence of infection until they are slaughtered, yet they may be found so seriously infected during slaughter inspection that their carcasses must be condemned.

For the effective control of BTB, it is worthwhile to apply the following measures as fundamental practice:

(i) **Identification of animals**: Before embarking on any control programme it is essential that all dairy farms (because of high prevalence) 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.

(ii) **Improvement of management and hygienic practices:** 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, good ventilation and lighting systems. Pasteurisation of milk and milk products should be done as routine practice most notably in rural communities.

(iii) **Legislation**: For enabling enforcement of control measures, there is a need for legislation that makes it obligatory to register dairy farms and to notify the veterinary personnel about any animal purchase, sales or transfer of farms. These measures can be gradually expanded to the traditional integrated extensive farm systems. Test-ands laughter policy should be designed and started as a major control measure to avert the spreading of the BTB infection.

(iv) **Insurance of dairy farms**: Although this principle is not yet familiarised; however, insuring dairy farms may encourage owners to cull their infected cattle after testing for BTB and other economically important contagious diseases.

(v) **Sound testing and meat inspection**: Based on a proper strategy, regular tuberculin skin testing should be continued in large with significant efforts in all animal production systems nationwide. Similarly, routine abattoir meat inspection procedures have to be made for the detection of tuberculous lesions and special attention has to be given while a large number of animals are examined in particular. The result can be upgraded when Ziehl-Neelsen staining is simultaneously used. There is also the need to have the qualified veterinary staff at the slaughterhouses so that quality data can be generated for effective control measures. It is equally important to take strict control and quarantine measures during the importation of animals and animal products.

(vi) **Establishment of areas and/or farms free of Bovine tuberculosis:** A bi-annual testing programme could be introduced to establish a "provisional disease free status in some herds/farms or areas". Under this scheme a herd with a negative result is started, it should then be strengthened with a frequent follow up to make sure that these farms are not re-infected.

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