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A Review on Bovine Tuberculosis

*Uduak A.*

* Department of Veterinary Public Health and Preventive Medicine, College of Veterinary Medicine, Michael Okpara University of Agriculture, Umudike, Nigeria.

**Abstract**

Zoonotic tuberculosis caused by *Mycobacterium bovis* is common in most developing countries like Nigeria. Bovine tuberculosis is a chronic infectious zoonotic disease of domestic animals and humans. It is characterized by formation of granulomas in tissue especially the lungs, lymph nodes, liver, intestines and the kidneys. In Nigeria bovine tuberculosis is endemic and mostly transmitted to humans through ingestion of unpasteurized contaminated milk and contact with infected animals. It is important to pasteurize milk before human consumption. The Fulani herders that are predominantly rural dwellers should also be educated on the need to boil milk before consumption since they lack infrastructures for pasteurization. Tuberculosis causes great economic losses on farmers and is of public health importance. The meat inspection system should also be strengthened and designed to prevent the consumption of contaminated products. This review advocates that developed countries should provide educational and technical assistance to developing countries like Nigeria to promote the control of tuberculosis. In Africa heads of government, agricultural and health sector should create the infrastructures necessary for this to be achieved. Personnel at all levels of the control program should be properly trained.

**Keywords:** *Mycobacterium bovis*, bovine, public health, Nigeria.
A REVIEW ON BOVINE TUBERCULOSIS

Introduction

Tuberculosis is an important bacterial disease in humans and animals worldwide. It infects over 2 billion people or one third of the world’s population and it is also estimated that 1.5 to 2 million people die from tuberculosis each year (Tiruviluamala and Reichman 2002). A total of 95% of cases occur in humans in developing countries. Worldwide it is said to be the leading cause of death by infectious disease (Theon et al., 2009). It is a known fact that humans and animals have had close interactions. This human-animal interaction is increasing due to the advancement from extensive rural production system into the combined urban and peri-urban intensified livestock husbandry to satisfy the rise in demand for animal products. This largely contributes to the transmission of infectious zoonotic diseases from cattle to man (Mbugi et al., 2012). Previously it was understood that tuberculosis began as a zoonosis when man domesticated and started living with cattle but molecular genetic studies by Brosch et al., 2002 suggested that human tuberculosis existed before tuberculosis in animals. However, the infection currently poses a major concern in the human population in developing countries, as humans and animals are sharing the same environment and dwelling premises, especially in rural areas (Shitaye et al., 2007) and as seen in nomadic Fulani settlements in Nigeria. Bovine tuberculosis is among the principal bacterial zoonotic diseases (Buncic, 2006) caused by Mycobacterium bovis a member of the Mycobacterium tuberculosis complex which affects many vertebrate animals and humans characterized by progressive development of granulomas in tissues and organs (Brosch et al., 2002; Amanfu, 2006; Smith et al., 2006; OIE 2010). The characteristic granulomas are mostly in the thoracic cavity (Shitaye et al., 2006) and other parts of the body including the genitalia. The pathology of M. bovis is similar to M. tuberculosis in humans, causing chronic debilitation, coughing, and further spread to other organs (Taylor et al., 2007). Infected cows produce mycobacterial mastitis causing the shedding of the bacteria into milk leading to transmission to humans if the milk is ingested without pasteurization (Garnier et al., 2003). Bovine tuberculosis is a disease of economic and zoonotic importance which is distributed worldwide, with Africa and Asian countries ranking highest in terms of disease burden (WHO, 2009; Ejeh et al., 2014).

Tuberculosis has emerged as a significant disease with the tendency for inter-species spread. Bovine tuberculosis has been significantly widely distributed throughout the world and has been a cause for great economic loss in animal production and the most frequent cause of tuberculosis in man (Tenguria et al., 2011). In developed countries, mandatory pasteurization of milk combined with tuberculin testing and slaughter of infected cattle resulted in dramatic decline in the incidence of human tuberculosis due to Mycobacterium bovis (Palmer et al., 2012). In developing countries where bovine tuberculosis is common and milk is usually not pasteurized an estimated 10 to 15% of human tuberculosis cases is caused by M. bovis (Ashford et al., 2001). Previous studies have reported Mycobacterium tuberculosis (Cadmus et al., 2006) as well as other members of the MTbC (Cadmus et al., 2010; Jenkins et al., 2011) as a cause of tuberculosis in cattle in Nigeria. In developed countries bovine tuberculosis had been controlled through test and slaughter method (Cosivi et al., 1998; Ayele et al., 2004; Amanfu et al., 2006; Smith et al., 2006; Theon et al., 2006); in Africa, especially Nigeria bovine tuberculosis is still a major concern (Cadmus et al., 2010). There has been a strong link between animal and human tuberculosis as shown by the works of Vilmeein in 1865 (Davies, 2006) and Koch in 1882 (Calmette, 1923), which demonstrated the cross- adaptability of the tubercle bacilli from one species to another to cause disease and pointing out that tuberculosis could be transmitted from animals to humans (Davies, 2006). This was corroborated in 1902 by Ravenel (1902), who demonstrated Mycobacterium bovis in a child with tuberculous meningitis. Bovine tuberculosis is becoming increasingly important due to the susceptibility of humans to the disease caused by M. bovis (Kleeberg, 1984) and there is increasing evidence that M. bovis infections may be much more significant than generally considered (Shitaye et al., 2007). There is an increasing
incidence of tuberculosis in humans especially the immune-compromised which has given rise to the zoonotic importance of *M. bovis*, especially in developing countries (Radostits et al., 2000). The correlation between *M. bovis* infection in cattle and the disease in the human population has been well documented in developed countries; there is paucity of information in developing countries (Cosivi et al., 1995). It is estimated that approximately 85% of the cattle population and 82% of the human population of Africa are in areas where bovine tuberculosis surveillance and control activities are often inadequate or unavailable, therefore, many epidemiologic and public health aspects of the infection remain largely unknown (Cosivi et al., 1998). The emergence of drug-resistant strains of Mycobacterium species, the rise and synergism of HIV/AIDS infection with tuberculosis, poverty, and neglect of tuberculosis control programmes have further complicated the situation of the disease in Africa (Ofukwu, 2008). Reports have shown that tuberculosis is a major health problem with over eight million new cases and three million deaths reported annually in the world (WHO, 1994). Tuberculosis in cattle is a public health issue. The knowledge about the implication of bovine tuberculosis in the human cases has to be developed and disseminated for effective control. The role of the different commodity chains (milk and meat) has to be evaluated. Wildlife, farm animals, pets, food and milk all pose a potential threat to our health. The economic loss caused by this disease is enormous and great in animal production. Infected animal loses 10 to 25% of their productive efficiency. Direct losses due to the infection become evident by decrease in 10 to 18% milk and 15% reduction in meat production (Radostits and Blood, 1994). Apart from effect on animal production, it is also of public health importance (O’Reilly and Daborn, 1995). Agricultural workers may acquire the disease by inhaling cough spray from infected cattle and develop typical pulmonary tuberculosis (Cosivi et al., 1998). In developing countries the socio-economic situation and low standard of living area for both animals and humans are contributory factors in tuberculosis transmission between human to human and human to cattle or vice versa. When the number of infected human individual increases, the possibility of transmission to cattle could also increase (Tamiru et al., 2013).

**Epidemiology**

Bovine tuberculosis is transmitted from cattle to humans directly by aerosol (WHO, 1994) and also through direct contact with contaminated materials from an infected herd of cattle (Beals, 2007). There are reports that individuals at risks are those in contact with potentially infected animals such as veterinarians, abattoir workers, meat inspectors, farmers, milkers, animal keepers, animal dealers, laboratory personnel and owners of potential tuberculous pets (e.g. monkeys) (O’Donahue et al., 1985; Ofukwu, 2006; Yumi et al., 2007). Kirk (2003) and Ofukwu (2006) in their report stated that children are the most affected. On the contrary Davies (2006) reported that the disease is more in the elderly and infection might have occurred in the past. In the United Kingdom from 1990-2003 an average of 7,000 cases of human tuberculosis were reported per annum and between 0.5 - 1.5% of the cases which were confirmed by culture were caused by *M. bovis*. In this 13-year study, only one case of human *M. bovis* was determined to be acquired from an animal source in the United Kingdom (Del la Rua- Domenech, 2006). Diseases in humans from *M. bovis* have occurred in no more than 25 cases a year for the last 5 years (Davies, 2006) in the United Kingdom. Cosivi et al., (1998) reported a preliminary study conducted in Africa with an average of 5 - 7% of human tuberculosis cases is caused by *M. bovis*. A study in Egypt showed that nine of twenty randomly selected patients with tuberculous peritonitis were infected with *M. bovis* and the rest with *M. tuberculosis* (Nafeh et al., 1992). In Tanzania 16% of the cases of tuberculosis was extra pulmonary tuberculosis (WHO, 2006). In Ethiopia *M. bovis* was found to be the cause of tuberculous lymphadenitis in 17.1% of 29 human tuberculosis cases (Kidane et al., 2002). Also in Ethiopia, Shitaye et al., (2007) reported that 16.7% of human isolates were identified as *M. bovis*. In a study in Nigeria, it was reported that one of the ten mycobacteria isolated from sputum-positive cultures was *M. bovis* (Idrisu and Schnurrenberger 1977). In Nigeria, zoonotic tuberculosis due to *M.
bovis accounts for 5% of all cases of tuberculosis in humans and up to 3% of cases in children less than 5 years of age (Ofukwu, 2006). Alhaji (1976) found the presence of M. bovis in the sputum of raw milk sellers in Zaria. Kolo (1991) in his study at the Ahmadu Bello University Teaching Hospital, Zaria, revealed that out of 300 samples of urine, pus, peritoneal and pleural fluid, bone marrow and lymph nodes collected from patients, 75% of the isolates were M. tuberculosis while 3% was M. bovis. A reported case of tuberculosis in 1999 of the sternum caused by M. bovis in a 3-year old child (Fadiran et al., 1999) supported the earlier findings of other authors. Ofukwu (2006) in his study reported that 2.4% of 124 samples of pus, urine and sputum collected from patients were characterized as M. bovis while M. tuberculosis accounted for 82.3%. Another study by Ofukwu et al., (2008) revealed the presence of M. bovis in raw milk samples in Benue State. These findings evoke serious public health concern taking into consideration the large proportion of the Nigerian population exposed to beef, milk and their products. There is every likelihood that many out there are infected with M. bovis (Nwanta et al., 2010). The existing eating culture (eating of raw meat and drinking of raw milk), the very common close contact of animals with humans in rural areas, inadequate meat inspection and the prevailing low standard of hygienic practices are potential risk factors that favours the spread of zoonotic tuberculosis (Shitaye et al., 2007). People with HIV/AIDS, other forms of immuno- suppression and debilitating disorders such as chronic renal disease, cancer, diabetes are reported to be at risk of being infected on exposure to tuberculosis (Harries, 1990; Hamburg and Frieden, 1994).

**Public Health Significance**

The human form of M. bovis infection has similar clinical forms as that caused by M. tuberculosis (Kirk, 2003; Ofukwu, 2006). Following ingestion of the organism, the primary infection in the intestine may heal, it may progress in the intestines, or it may disseminate to other organs (Grange and Collins, 1987). Cervical lymphadenopathy (which primarily affects the tonsilar and pre-auricular lymph nodes), intestinal lesions, chronic skin tuberculosis (lupus vulgaris), and other non-pulmonary forms are particularly common (Cosivi et al., 1998). Cervical lymphadenopathy which primarily affects the tonsillar and pre-auricular lymph node was once a very common form of tuberculosis in children that took infected milk (Pullock et al., 2006). In some cases, these lymph nodes rupture and drain to the skin, chronic skin disease lupus vulgaris may occasionally develop. Human infected through the skin can develop localized skin disease a form usually thought to be benign and self limiting. Pulmonary disease is more common in people with reactivated infections, the symptoms may include fever, cough, chest pain cavitation and hemoptysis (Shitaye et al., 2006; Ali et al., 2009) and this would occur only when some of the animals had active tuberculosis (Beals, 2007). The pulmonary form of tuberculosis occurs less frequently and is usually occupationally related (Kirk, 2003). Bovine tuberculosis can be treated successfully with antimicrobial drugs, but untreated infections may be fatal (Grange, 2001).

**Prevention and Control**

Tuberculosis needs to be prevented and controlled because it causes loss of productivity in animals infected, there is risk of infection to humans (Cousins, 2001). However, because of financial constraints, scarcity of trained professionals, lack of political will, as well as the underestimation of the importance of zoonotic tuberculosis in both the animal and public health sectors by national governments and donor agencies, control measures are not applied or are applied inadequately in most developing countries (Cosivi et al., 1998). Standard public health measures used to manage patients with contagious M. tuberculosis should be applied to contagious patients with M. bovis to stop person-person transmission (Theon et al., 2009). Cattle should not be treated at all and as such farm animals with tuberculosis must be slaughtered (culled) (Krauss et al., 2003). This is due to the fact that M. bovis is resistant to pyrazinamide, which is widely used in the treatment of infections caused by M. tuberculosis Complex in humans (Krauss et al., 2003). In developed countries, regular testing and
removal of infected animals under mandatory national bovine tuberculosis programs have successfully carried out control and eradication of bovine tuberculosis, the program have been successful in many European union member states and in seven central European countries between 1953 and 1980 (Pavlik et al., 2002). In order to reduce the risk associated with consumption of contaminated milk and meat, it is necessary that specific hygiene rules for food of animal origin be laid down to prevent infected animals from entering the food chain. Meat inspection system should be strengthened and designed to prevent the consumption of contaminated products by people. All animals entering the food chain should be subjected to ante-mortem and post-mortem inspection (Nwanta et al., 2010). Tuberculin test is valuable in the control of zoonotic tuberculosis because early recognition of preclinical infection in animals intended for food production and early removal of infected animals from the herd eliminates a future source of infection for other animals and for humans. In the case of cattle, a tuberculin test should be performed in the course of the twelve months prior to presentation for slaughter (FSAI, 2008). There is also need for medical and veterinary professionals should cooperate in cases of disease outbreak (Kahn et al., 2007).

Conclusion

The spread of tuberculosis from animals to humans in developing countries mostly from infected milk is a serious means of transmission that is being ignored (Davies, 2006). Milk pasteurization before human consumption is very important, rural dwellers should be educated on the need to boil milk before consumption since they lack infrastructures for pasteurization. Educational and technical assistance should be provided by developed countries to promote control of tuberculosis. In Africa heads of government, agricultural and health sector should create the infrastructures necessary for this to be achieved. WHO (1994) in its memorandum on zoonotic tuberculosis made the following recommendations: training of personnel at all levels of control programmes and the urgent need for further research on the diagnosis and control, immunological, epidemiological and socioeconomic aspects of the disease.

References


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