Zoonotic importance of tuberculosis

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Abstract

Diseases and infections like tuberculosis, brucellosis, lyptospirosis etc., which are naturally transmitted between animals and man are included in zoonotic diseases. Human disease due to *M. bovis* is indistinguishable with regard to pathogenesis, lesions and clinical findings to that caused by *M. tuberculosis.* Immuno-suppressed persons are more likely to develop active TB after infection with *M. bovis* irrespective of its origin. Reports indicate that malnourished and alcoholics could develop pulmonary TB after exposure to *M.bovis.*

Many zoonotic diseases could occur in zoological settings due to close contact between man and animal. In an interesting case of zoonotic TB in Mysore, INH-resistant strain of *M. tuberculosis* was isolated from a Rhinoceros. As such, possibility of transmission of tubercle bacilli from a worker attending zoo mammals and vice-versa cannot be ruled out. Such settings require periodical screening of animal attendants for symptoms suggestive of pulmonary TB and necessary action needs to be taken to ensure timely diagnosis and proper treatment under DOTS based on their sputum examination and chest X-ray if necessary, besides preventing transmission to precious zoo mammals.

Key Words: Zoonosis, *M. bovis, M. tuberculosis,* infection, DOTS.

Introduction

The word 'zoonosis' (Plural: Zoonoses) was introduced by Rudolf Virchow in 1880 to include collectively the diseases shared in nature by man and animals. In 1959, WHO defined that zoonoses are "those diseases and infections which are naturally transmitted between animals and man". Zoonoses include those infections where there is either a proof or strong circumstantial evidence for transmission between animal and man like Rabies, Leptospirosis, Cysticercosis, Brucellosis, Tuberculosis etc., Historically, zoonotic diseases had a tremendous impact on the evolution of man, especially those cultures and societies where animals have been domesticated and bred for food and clothing. Zoonoses are among the most frequent and dreaded risk to which mankind is exposed. Zoonosis occurs throughout the world, transcending the natural boundaries. Zoonosis is no longer a national problem since their effect on global economy and health is well known. Its effect extends from the movement of animals and importation of diseases to restriction on trade practices internationally.

Most often zoonotic aspects of tuberculosis in human beings revolve around isolation of *M. bovis* from their sputum specimen. It has been observed that not only *M. bovis* causes TB in animals but *M. tuberculosis* too can cause disease in animals (especially zoo animals). The infection can get transmitted from animals to human beings and vice versa.

Another perception is about transmission of infection through consumption of milk from animals with tuberculosis, which no doubt is less frequent in India due to boiling of milk before consumption. But the inhalation of airborne droplets containing mycobacteria from animals with pulmonary TB especially in crowded and less ventilated settings can be the most potential route of transmission from animal to man and vice versa. Therefore, isolation of *M. tuberculosis* strain instead of *M. bovis* in such settings where there is a close contact between animal and man under same shelter may often mask the true source of infection.

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Bovine Tuberculosis

Over 50 million cattle are estimated to be infected with *M. bovis* worldwide resulting in economic loss of about $3 billion[1]. Although the primary host of *M. bovis* is cattle, it infects many other animal species (both domestic and wild) besides humans. Maintenance host have been found in a Possum, Deer, Red fox, Mink, Feral ferret, Mole, Brown rat and Feral cat besides seals in Australian coastal waters[2]. Such maintenance hosts are capable of maintaining infection within its own population. They can spread infection to other animal species, which in turn are capable of passing infection back to cattle. Surveys conducted in United Kingdom and New Zealand have identified *M. bovis* infection in Badger[3].

Indian situation of Bovine TB

Till 1916 Tuberculosis in cattle was considered very rare because:

- Indigenous cattle are naturally resistant.
- Low virulent tubercle bacilli isolated from indigenous cattle.
- Open air system where animals were housed.

During 1980s, Indian Council of Agriculture Research (ICAR) started a scheme where state governments had to screen susceptible herds for ascertaining the prevalence of chronic disease like tuberculosis, Para-tuberculosis and brucellosis. True pictures of disease could not be reflected due to selective nature and varying sizes of bovine pockets taken up for screening. Prevalence of bovine TB in India varies from 1.6 to 16% in cattle and 3 to 25% in buffaloes[4].

Zoonotic aspect of *M.bovis*

Proportion of human disease caused by *M. bovis* shows regional variation depending on the presence and extent of disease in cattle population, the social and economic situation, standard of food hygiene besides application of preventive measures. Human disease due to *M. bovis* is indistinguishable with regard to pathogenesis, lesions and clinical findings to that caused by *M. tuberculosis.* Studies in United Kingdom and United states of America confirm that by 1937, upto 25% of TB cases in humans were due to *M. bovis.* The majority of these cases were non-pulmonary TB with only 2.5% pulmonary TB. A high rate of *M. bovis* infection is commonly associated with occupational exposure. Clinically *M. bovis* shows a high degree of virulence for both human and cattle in contrast to *M. tuberculosis* which is virulent for human but presumably not for cattle. Cattle with TB, excrete bacilli intermittently and about 50% of the bacilli survive for 36 days at zero degree centigrade[1]. At 16°C, 50% survive for less than a day. Moisture also helps them to survive. Investigation of Veterinarians working with infected herds show high rates of tuberculin positivity (45.4%) and overt TB (4.1%) although it is not established that such infection and disease is only due to *M. bovis*[5,6].

Transmission of M.bovis

Animal to human

- Consumption of milk and meat products containing tubercle bacilli, from cattle including goat, deer, buffalo, sheep and camel.
- Inhalation of infectious aerosols in dried bovine sputum on walls and windows of cow sheds and also aerosol generated during the handling of tuberculosis carcass in slaughter houses.
- Rarely by contact of infected material through cuts and abrasions.

Human to animal

- Farm workers with open TB due to *M. bovis* can infect cattle leading to active disease.
- Reports show that infection is principally by respiratory route but farmers with genito-urinary TB due to *M. bovis* could infect cattle by urinating in cow sheds. A study revealed that a farmer infected 48 cattle in four herds in somewhat bizarre manner by urinating in cow shed[2].

Impact of HIV on transmission of *M. bovis*

Immuno-suppressed persons are more likely to develop active TB after infection with *M. bovis* irrespective of its origin. Reports indicate that malnourished and alcoholics could develop pulmonary TB after exposure to *M. bovis*. In a study of multi-drug resistant strain of *M. bovis* was isolated from AIDS patients who developed TB within 10 months of brief exposure in a hospital in Paris[3]. Disease due to *M. bovis* has also been reported in young HIV positive TB cases in France and England[3]. Many cases of TB with *M. bovis* were found among HIV positive hispanic patients in USA near the border with Mexico[2].

Zoonotic aspect of *M. tuberculosis*

Many zoonotic diseases could occur in zoological settings due to close contact between man and animal. Mammalian TB caused by *M. bovis* is a well documented problem with long history in zoological settings throughout the world. Tuberculosis in Rhinoceros caused by *M. bovis* has been reported from the National Zoological Park, Smithsanian Institute, Washington, USA in 1978 and 1979[7]. In India, there are many zoological gardens where precious and rare species of wild animals are housed. In rhinoceros, TB occurs mainly due to *M. bovis,* but in an interesting case at National Zoological Garden, Mysore, one rhinoceros died of pulmonary TB in 1992. Earlier, another rhinoceros from the same zoo was suspected to have died of TB. The purpose of this case report has been to highlight the unusual findings when a lung tissue of the diseased rhinoceros was sent to NTI, for bacteriological investigations including culture and drug sensitivity tests.

Lung tissue from rhinoceros - a case report[8]

Isolation and identification - Tests Undertaken:-

- Smear microscopy for Acid Fast Bacilli (AFB)
- Inoculation on Loweinstein Jenson (LJ) Media at 37°C.
- Inoculation on Pyruvate (Stone brinks) media at 32°C.
- Identification tests included Rate of Growth (RG), incubation at 37°C and 42°C.
- Bio-chemical tests like Niacin Test, Nitrate Reduction Test (NRT) and Para-Nitro Benzoic Acid (PNB) Tests.

Results of Bacteriological Investigations:-

Microscopy	: Positive for AFB (++)		
Culture	: Positive on LJ Media (+++)		
	Negative on Stone Brinks Media		
Identification	: *Mycobacterium tuberculosis*		
	: Niacin	=	Positive
	: RG	=	More than 9 days
	: NRT	=	Positive (51)
	: PNB	=	Negative

Drug Sensitivity Profile:-

Isonicotinic Acid Hydrazide (INH)	=	Resistant*
Streptomycin (SM)	=	Sensitive
Rifampicin (RIF)	=	Sensitive

*INH - Resistant *M.tuberculosis* (MIC >50)

Recommendations:

Based on the above observations following public health measures in zoological settings and places where frequent contact among man and animal exists following actions have been suggested[8].

- In view of isolating INH-resistant strain of *M.tuberculosis* from a Rhinoceros, perhaps for the first time, possibility of transmission of tubercle bacilli from a worker attending zoo mammals and vice-versa cannot be ruled out.
- Animal attendants need to be screened periodically for symptoms suggestive of pulmonary TB and necessary action taken immediately to ensure timely diagnosis and proper treatment based on their sputum examination and chest X-ray, if necessary.

- Tuberculin testing of zoo mammals should be carried out periodically besides maintaining proper hygiene and good ventilation in the shelters of zoo animals.
- Drug-resistant TB can be prevented by adopting Directly Observed Treatment Short Course (DOTS) under Revised National Tuberculosis Control Programme (RNTCP).

Veterinary Public Health Measures for zoonotic TB

- Routine testing and inspection of all cattle even at slaughter houses.
- Detecting infected herds and removing them to reduce the spread of TB within herds.
- Adopting control strategies to reduce transmission by: (i) Effective ventilation; (ii) Reduction of group size; (iii) Minimizing contamination of feed, grazing and water with respiratory secretions or faeces by attention to hygienic practices, buildings and equipments.
- Promoting research on accurate diagnostic tests and the potential role of other domestic and wild animal species as disease reservoir.
- Creating awareness in the community especially farmers and those involved in slaughtering and meat trading.
- Public health precautions like pasteurization/ heat treatment of milk that can reduce the danger of TB particularly to infants.
- Efficient surveillance system and co-ordination between medical and veterinary professionals through effective communication for contact tracing and joint epidemiological investigations.
- Regular health checks for occupational groups at risk including examination for non-pulmonary forms of TB such as Lymphadenitis beside sputum microscopy and chest radiology, if required.
- A co-ordinated strategy for developing and testing of new vaccines for tuberculosis in man and animal.
- Funding agencies need to be encouraged to sponsor regular workshops to facilitate collaborations and achieve scientific consensus on research priorities besides developing an E-mail discussion groups and video conference.

The above recommendations have been reproduced from Indian Council of Agriculture Research (ICAR) Publication[4].

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