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Survey of bovine tuberculosis and its zoonotic transfer around Kanti block of Muzaffarpur district, Bihar

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Abstract

Tuberculosis (TB), primarily caused by *Mycobacterium tuberculosis* (MTB), is a serious infectious disease in humans. Each year, it affects over 9 million people globally and is responsible for approximately 1.4 million deaths worldwide. In cattle, *Bovine Tuberculosis* (BTB), a dreaded disease, is caused by *Mycobacterium Bovis*. *M. bovis* is transferred to humans through different routes and induces *M. tuberculosis*. In the current survey, we selected our Kanti Block in Muzaffarpur district to estimate the prevalence of suspected Bovine TB. A total of 857 cattle heads have been surveyed as yet, out of which 43 are highly suspected of Bovine TB. The predisposing factors, such as inadequate nutrition, unhygienic conditions, poor housing, poor management practices, the genetic breeds, lack of precaution, etc., are also responsible for the spread of Bovine TB.

Keywords: Bovine tuberculosis, disease, cattle, survey, predisposing factors

Introduction

Tuberculosis, caused primarily by *Mycobacterium Tuberculosis* in humans, is a dreaded disease affecting more than 9 million people every year, causing 1.4 million deaths per year worldwide (ICMR, Olea-Popelka, *et al.* 2008, Waters, *et al.* 2018) [8, 15]. In the agriculture-dominated rural economy, cattle rearing constitutes an important source of income for farmers and the marginalized sections of society. Healthy cattle are a valuable asset, but many diseases have ravaged the cattle of rural folk. One of the most debilitating of them is Bovine TB caused by *Mycobacterium bovis*, a member of the *Mycobacterium Tuberculosis Complex* (MTBC) (Cosivi O *et al.* 1998) [4]. The primary reservoirs of *M. bovis* are cattle and buffalo (Bapat, P.R. *et al.*, 2017; Borna, M. *et al.*, 2013) [2, 3].

The populations of cattle and buffaloes are 425801 and 296568, respectively (total 7.2 lakhs), according to the livestock census of 2019 (Duffy S.C. *et al.*, 2020) [6]. The total milk production in the period 2013-2014 was 243.23 million liters, but given the district's area and geographical conditions, it should exceed this amount.

The *M. bovis* infestation leads to a sharp decline in the yield of cattle heads and, if left untreated, ultimately to their death. It not only causes the loss of cattle but may also infect their rearers through zoonotic transmission via different routes (Bapat, P.R. *et al.*, 2017) [2]. The more common transmissions are 'cattle to cattle' and 'cattle to human'. About 10% caused by *M. bovis* in developing countries (Olea-Popelka, F.J., E. Costello, P. White, G. McGrath, J.D. Collins, J. O'Keeffe, D.F. Kelton, O. Berke, S. More, and S.W. Martin, 2008; Pedro *et al.*, 2013) [10, 13]. In the Indian pastoral and now urban economy, livestock is essential for our health and wealth, and it significantly contributes to government revenue and the local economy. India is ranked first worldwide in milk production. Of about 300 million domesticated cattle, 21.8 million are afflicted with *M. Bovis* (Duffy S.C. *et al.*, 2020) [6].

In 2024, 10925 people were notified with Tuberculosis infection in Muzaffarpur district, of which 273 cases were from Kanti Block (DTC, Muzaffarpur). The main transmission routes to humans are using unpasteurized milk, inhaling infected droplets, etc. The caretakers and their families living close to infected cattle have a significant risk of infection (Bapat, P.R. *et al.*, 2017; M.J. Clinton, Diana, M. Cardwell, M.B. Robert, Jr., and G.C. Gregory, 2014) [2, 9].

In addition to signs and symptoms, predisposing factors are essential for surveying suspected cases of Bovine TB. This survey aimed to provide initial information on suspected cases of Bovine TB and their diagnosis by Tuberculin Skin Test (TST) in Kanti block of Muzaffarpur district, Bihar, India.

Methodology

It is a case-control, cross-sectional study conducted entirely in the rural areas of Kanti block, Muzaffarpur district, among small and marginal farmers. Most of these farmers were illiterate, and almost all were unaware of BTB. At the beginning of the survey, there were two major challenges. The first was to create a thorough survey form to collect and organize all the needed data. A detailed questionnaire on cattle health was provided to cattle rearers, and their responses were collected. The second challenge was to obtain an antigen so testing could be done on suspected cattle to identify the Index cases. The antigen for testing was obtained from IAHP, the Institute of Animal Health and Production, Patna, Bihar. This institute was previously known as the "Livestock Research Station" (LRS). It is a state government organization affiliated with the Bihar Animal Sciences University (BASU), which manages veterinary education and research in the state.

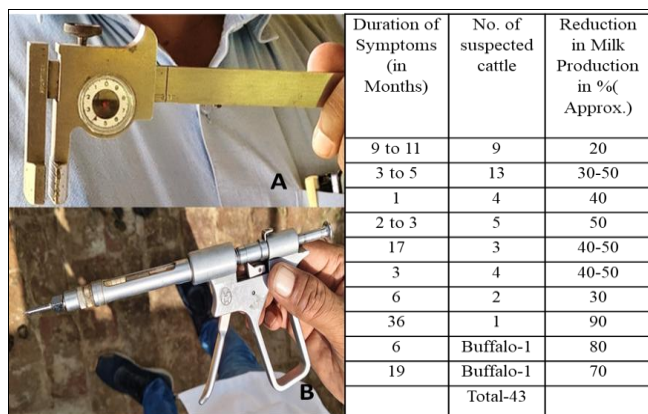


Fig 1: (A) Caliper, (B) TB Gun or Antigen Gun & Table: average milk reduction

In this survey, approximately 857 cattle and buffalo were included, covering around 250 households, and some small cowsheds were also included. The survey ensured there were no prior cases of Human Tuberculosis (MTB) in those locations, allowing zoonotic transmission to be assessed. The ongoing BTB survey in Kanti Block of Muzaffarpur District highlights several critical animals and nearby public health concerns, and at present, diagnosis is done only by one method: TST.

Tuberculin Skin Test

The Tuberculin Skin Test (TST) was performed by administering a 0.1 mL intradermal dose of the antigen in the upper neck area. Before this, the site was shaved to remove hair, and thickness was measured with a caliper. Skin

thickness varied from 0.47 mm to 0.70 mm, with an average of 0.59 mm. The antigen was administered using a device known as the Antigen Gun or TB Gun. This method is the same as the Mantoux test used for human pediatric TB. After 72 hours, experts reassessed skin thickness with a caliper to check if the patient had the disease.

At the start of the survey, many thin animals showed reduced milk production. Their milk yield was already down by 20% to 90%. The farm was unhygienic, traditional in style, and poorly managed. After a lengthy treatment period, some animals died, while others were quietly sold to butchers. We also received reports of such cases from paramedics and farm workers. Later, we included cases of Latent Bovine TB Infection (LTBI) in the study. The number of index cases continued to increase. Screening for BTB had not yet occurred in Bihar. Government bodies or NGOs either managed open areas. Until now, screening has been done only in Gaushalas or in a few selected cowsheds. A consent form has been created, stating that written consent will be obtained from the owners of cows and buffalo to be tested. This consent form is attached to the survey form and will be signed by both the researcher and the farmer or owner. No abattoirs were included in this survey.

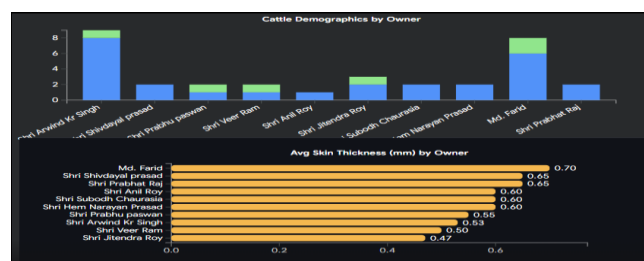


Fig 2: Cattle Demography and Average Skin Thickness in mm.

However, in the next block, we decided to use a double-layered diagnosis. We will definitely use TST and also use IGRA to identify index cases.

Results and Discussion

Kanti block is heavily populated and situated near the Burhi Gandak River, 15 km from the district headquarters of Muzaffarpur in North Bihar. It is rich in agricultural products and cattle farming. During the initial survey, it emerged that people, especially farmers, were not aware of BTB. They did not know that TB can occur in cows, buffaloes, and other domestic animals. Because of this, farmers paid no attention to this disease at all. BTB, primarily caused by *M. bovis*, is a Significant zoonotic disease that affects cattle, buffaloes, and several domestic animals and can also be transmitted to humans (Bapat *et al.*, 2017) [2]. In the current survey, 857 animals were examined, of which 43 suspected animals were traced and found to exhibit symptoms; some showed fewer symptoms, while others showed more. Out of these 43 cattle heads, two were buffalo, and the rest were cows and their calves.

Table 1: Distribution of suspected heads

Particulars	Total	Suspected	Sold out	Died	Case turned to LSD	Tested	positive	Negative
Cows	453	34	6	0	1	27	0	27
C's calf (Heifer)	227	7	0	0	1	6	0	6
Buffaloes	124	0	0	0	0	0	0	0
B's calf	53	0	0	0	0	0	0	0
Total	857	43	6	2	2	33	0	33

As for the buffalo, two were strongly suspected of BTB, but unfortunately, both had died before the test during the survey. The second buffalo was found in a household with a human TB case; the case was drug-resistant and involved an adult female. This suggests a potential zoonotic transmission, but since the buffalo was dead, no conclusive evidence was available. One cow was highly suspected of having tuberculosis and had been previously declared as such by a practitioner. In this case, a pediatric human TB case was also found in the same household, indicating a possible zoonotic transmission. Although the cow was alive, further confirmatory tests could not be performed because it developed highly infectious and lethal Lumpy Skin Disease (LSD) by the time of testing. Some suspected cows were sold before testing could take place. Once the survey was finished

and the information was sent to IAHP, the organization formed a team of five specialists to investigate. The team included two Assistant Research Officers, one Deputed Officer, one Livestock Officer, and one Livestock Assistant. Out of 43 cattle, only 33 could be tested. Testing could not be done on 10 because two buffalo had already died during the survey. One cow and its calf had developed Lumpy Skin Disease (LSD) just before testing at the end of the survey, which made it risky to test them, according to the research officer of the test team. Therefore, they were not tested. The remaining cow and her six calves were sold because the farmers could not sustain their work for long, and the cost of treatment was becoming too high. As a result, only 33 cows and calves were tested.

	Total	Suspected	Sold out	Died	Case turned to LSD	Tested	positive	Negative
N	4	4	4	4	4	4	4	4
Missing	0	0	0	0	0	0	0	0
Mean	214	10.3	1.50	0.00	0.500	8.25	0.00	8.25
Median	176	3.50	0.00	0.00	0.500	3.00	0.00	3.00
Standard deviation	174	16.2	3.00	0.00	0.577	12.8	0.00	12.8
Minimum	53	0	0	0	0	0	0	0
Maximum	453	34	6	0	1	27	0	27

Finally, no active cases were found among the 33 suspected cases reported by IAHP, Patna, Bihar

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Conflicts Of Interest: No conflict of interest.

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