Tuberculosis is one of the three classical zoonoses communicated easily between animals and man, the other two being Rabies and Brucellosis.

**Classification**

**OIE List B disease**

Of the three species of Mycobacterium (M. tuberculosis, M. bovis & M. avium) that are commonly concerned with causing the disease in domestic animals and man, only M. bovis is known to produce progressive disease in cattle and buffaloes. The human and avian types of tubercle bacilli are responsible only for retrogressive lesions in the bovine species and are important for the nuisance they create in the pursuit of control program, by bringing about tuberculin conversion of healthy individuals. This interferes with the detection of actual disease and the tracing of source of infection in a herd. Bovine tuberculosis is a strain of TB that infects cows and other animals, but it can also give people TB. The bacteria that cause bovine TB, called Mycobacterium bovis, are closely related to M. tuberculosis, the bacteria that usually cause TB in humans. Before the introduction of the pasteurization process of milk, bovine TB was a serious problem in all over India.

In order to appreciate the public health significance of bovine TB, it is to be remembered that M. bovis has a much wider range of host susceptibility than M. tuberculosis and that it has been known to afflict the man and to produce a fulminating disease in him as the one caused by the human type of tubercle bacillus. The paucity of literature on the subject in a developing country should
not lead to undue complacency, which has to be scrupulously guarded against and prevented from gaining a foothold in the minds of professional people.

Until about the middle of the second decade of the current century, it was widely accepted that TB did not afflict our cattle to anything like the extent to which it affected those in the western hemisphere. We also know that animal husbandry work too was then only at its infancy in India; and the conditions of herding together did not exist. With the institution of the intensive cattle development programs at the import of the highly susceptible exotic animals for upgrading our livestock, the picture has changed fast. Today, there is a hardly a herd of respectable size in the country that can be termed as free from TB. It would thus be height of indiscretion to adopt a complacent attitude of continuing to ignore the problem of control of TB among cattle & buffaloes that has been knocking at our door, quite a time now. Our international livestock trade interest have already suffered much on this score.

**THE BACTERIUM**

The organism does not grow on blood agar plates and requires 6-8 weeks of incubation time to see visible growth on Lowenstein-Jensen media. Acid fast staining would yield acid fast positive rod shaped organisms on sputum smears.

The tubercle bacillus is about as susceptible to the action of heat and light as any other vegetative organism; but is highly
resistant to the action of chemical substances, a fact made use of in obtaining pure cultures from contaminated pathological material. Though drying kills a fair proportion of tubercle bacilli, many may escape this effect. The organism can also survive for long periods in cool shady places, particularly if protected from light by crust formation on infective discharges or dung.

The **PRE-DISPOSING causes** that might come into play are serially listed below:

I. Disease of civilization / domestication:- herding together facilitates spread.

II. Age: young animals are more susceptible than older ones.


IV. Housing: Dark, ill ventilated, damp dwellings are favourable for the spread.

V. Heredity: Zebu cattle are somewhat more resistant than exotic or crossbred.

VI. Climate: Cold and humid weather is favourable for spread.

**ROUTES OF INFECTION**

1) **Respiratory route:**- is the most common (about 90%). It is brought about by inhalation of droplets expelled by a patient during coughing, sneezing etc. Larger droplets usually settle down in the vicinity of the patient but those of 10 microns and below can be carried over long distances by wind.

   Also, the larger infective particles which settle in the upper respiratory tract of the host are normally expelled by the action of the ciliated epithelium and coughed out. It is the smaller particles that establish the disease after directly reaching a pulmonary alveolus, usually in the peripheral lung parenchyma, close to the pleura.

2) **Alimentary route:**- this route comes into play in case of suckling calves or in young stock fed on raw milk. A much higher dose of viable tubercle bacilli is necessary for establishing infection by this route, as compared to the pulmonary invasion.

3) **Congenital:**- infection is rare and occurs if generalization of the
disease in mother, involving the uterus, takes place during latter stage of pregnancy.

4) **Genital** transmission is known to occur at the time of service if the female is suffering from tuberculous metritis or vaginitis the male has lesions of orchitis or epididymitis.

5) Entry of infection through teat canal.

6) Infection through the skin is also possible, though not common.

**SPREAD IN THE BODY:**

- Lymphatic spread
- Hematogenous spread
- Spread through continuity

**Clinical signs**

In the early stages, there are no clinical signs. In advanced stages cattle have:

- Fluctuating temperature
- Anorexia and loss of body condition
- Enlarged lymph nodes
- Persistent cough progressing to dyspnoea and increases respiratory rate if pulmonary tuberculosis

**Induration of the udder**

**Post-mortem findings**

*M. bovis* mainly enters the body via the respiratory tract or the alimentary tract, with the former being the most common. In the lungs localised bronchiolitis is followed by 'tubercle', formation — an abscess with necrotic focus and caseation and sometimes calcification surrounded by a fibrous capsule. Tubercles have a yellowish appearance, and a caseous, caseo-calcareous or calcified consistency.

Findings at post-mortem vary from single small focus usually in the lung to numerous, sometimes confluent lesions in several organs. Tubercles may be found in bronchial, mediastinal, retropharyngeal and portal lymph nodes. Lesions in the lungs, liver, spleen, body cavities and female genitalia can be found in advanced cases.
Differential diagnosis

- Contagious bovine pleuropneumonia
- Bacterial pneumonia caused by pasteurellae or Corynebacterium pyogenes
- Inhalation pneumonia
- Traumatic pericarditis
  Chronic aberrant liver fluke infestation

Specimens required for diagnosis

Diagnosis in the live animal is based on skin testing — intradermal tuberculin testing — and clinical examination. The latter is of value in advanced cases, which often do not react to the tuberculin test. In area where *Mycobacterium avium* is frequent, comparative tuberculin testing can be used to differentiate false positive Serological methods like the gamma interferon test or ELISA are also available.

Diagnosis at slaughter is based on identifying typical lesions. It may not always be possible to distinguish tuberculosis lesions from other granulomas and neoplasms grossly. Histological examination in the laboratory, special staining of smears, and culturing of the organism can be undertaken.

Transmission

Tuberculosis is primarily spread between herds by the movement of infected animals. But as *Mycobacterium* spp. are very resistant in the environment (surviving more than 2 months in pasture, and several months in sheds, resurgence from has to be considered. The role of wildlife reservoir has been stressed in some countries (possum in New Zealand, badgers in United Kingdoms, deer in United States of America,...)

Infection most commonly occurs *via* the respiratory tract and the alimentary tract with cattle considered to be much more susceptible to infection by inhalation. Pigs on the other hand are more likely to be infected by ingestion of contaminated foodstuffs. Less commonly are infections in utero, *via* the genital tract, or through skin abrasions. In Australia, under range conditions infection in cattle
nearly always occurred by the respiratory route, while under intensive stocking infection by ingestion was just as common as by inhalation.

In respiratory cases bacilli are shed into the air by coughing. They are also shed in the faeces in advanced respiratory cases, in generalised cases and in alimentary cases. When the kidneys or udder are involved, bacilli may also be shed in the urine and milk. Ingestion of infected milk can be an important source of infection for calves.

Humans usually become infected by ingestion of infected milk, handling or consumption of meat from tuberculous animals, or inhalation where infection levels are high in cattle.

**Risk of introduction**

Bovine tuberculosis is most likely to be introduced with imports of live cattle, embryo and semen. Such imports should come from free countries or certified tuberculosis-free herds, supplemented by tuberculin testing during quarantine.

The disease could also be introduced through the importation of contaminated meat and dairy products.

**LESIONS**

The recognition of granulomatous lesions, called tubercles, is important from the view point of diagnosis; but the subject does not need any detailed discussion, as the veterinarians are quite familiar with them. Every caseous or calcified lesion should not however, be
regarded as the one of tubercle origin; and it is necessary to examine it for the presence of the tubercle bacillus before making a conclusive diagnosis.

**DIAGNOSIS**

Early and accurate diagnosis is a necessary pre-requisite for dealing with the ravages and limiting its spread. Relative merits of different lines of approach are briefly discussed here.

A. **History** of the herd or area with regard to its previous disease status is of some advantage, though not of any great consequence.

B. **Clinical examination** by palpation of superficial lymphnodes, observation of symptoms, auscultation or radiography may have very limited application in a control program, where early detection of infection, in its pre-clinical stage is the desired objective. This procedure is however, profitably employed at the ante-mortem examination of the animals brought to abattoir.

C. **Serological examination** is not considered of much value; because humoral antibody response of the infected individual reaches significant levels only after generalization of the infection has taken place.

D. **Allergic tests** for the diagnosis of TB were developed in the wake of the observation of Koch’s phenomenon in 1891, during the study of experimental TB in guinea pigs. Of the various techniques employed for determining hypersensitivity to tuberculin (viz. subcutaneous, intravenous, intradermal, cutaneous,
ophthalmic etc.) the intradermal method has been the most widely used; and is recommended for general adoption. This comprises of careful introduction of 0.1 ml of tuberculin into the deeper layers of dermis and studying the reaction 72 hrs. later. In uninfected animals, there is hardly any discernible swelling. A diffuse, edematous, warm, painful swelling at the site of injection is considered an indication of the presence of infection.

In the interpretation of results, greater stress is placed on the character of the reaction than on the resultant degree of swelling.

E. **Post-mortem** examination does not, as a method of diagnosis, offer the same strategy in the control of chronic infections as it does in acute diseases. Its use is, therefore, limited to meat inspection.

F. **Bacteriological examination** of discharges, secretions or tissues is of considerable aid to the diagnosis. It comprises microscopic examination of smears or tissue sections and isolation of the causative organism in cultures.

G. **Laboratory animal transmission experiments** provide a very reliable, though slow, method of diagnosing TB. Even one viable organism of the mammalian types (M.tuberculosis or M. bovis) contained in the inoculate administered to a healthy adult guinea pig, i/m or s/c, will produce progressive disease in the animal.

**CONTROL**

Once the Tuberculosis enters an organized herd or a composite cattle raising area, it continues to spread like smoldering fire, unless special and sustained efforts are made to contain its ravage. The incidence continues to rise until the whole population is engulfed. The advantage of the slow progress of the disease is lost in the prolonged persistence of the sources of the infection within the population at risk.

Apart from lowering the performance of the affected individual and making it a source of alignment among its kin, the disease in animals has public health aspect.
Unfortunately, investigation of the human health hazard posed by the disease among animals has not received in our country, the attention that it deserves. The paucity of literature might not, however constitute a proof of non-existence of the problem or to be taken as an evidence against the possibility of its emergency in due course.

Among the methods of control for TB in Cattle & buffaloes, curative and prophylactic measures are not eligible for sound and solid reasons. The application of hygienic measures is therefore the only method of control that has to be depended upon.

The salient feature, advantage and shortcomings of these different lines of the approach are briefly discussed below;

1. **TREATMENT** is not advocated because

   (i) there is no chemotherapeutic agent, yet known that will rid the system of all the tubercle bacilli. The treated individual has to be vigilant against the exacerbation of the disease for the rest of his life.

   (ii) It is highly uneconomic, inordinately protracted and extremely cumbersome.

   (iii) Its adoption as a measure of control would involve close individual veterinary supervision for every animal that has been brought to the stage of being termed as ‘arrested case’ for the entire period of his life.

   (iv) The avoidance of strenuous work as a safeguard against recrudescence of the disease will leave the treated individual incapacitated.

   (v) Ineffective attempts at chemotherapy may result in the emergence of drug fastness.

2. **VACCINATION** with BCG, in the evolution and initial evaluation of which the veterinarians had a great hand, has not found acceptance as a method of controlling TB among animals; firstly, because it confers an extremely low grade of immunity and secondly, because it converts the vaccinated individual into a tuberculin reactor. The latter happening deprives the veterinarian of a useful tool for diagnosis, thereby rendering it impossible to
detect the infected individuals or to trace the source of infection. This would constitute gross interference in the pursuit of an effective control program. Vaccination with BCG confers poor protection in animal and interferes with tuberculin test and therefore is not practiced.

3 The adoption of HYGIENIC MEASURES is thus the method of choice recommended universally for the control of TB among cattle. To assist and augment the management effort for minimizing the changes of the contact of the susceptible host with the causative agent, the infected individual which have a potential of turning into a source of infection are located through periodical application of intradermal tuberculin test and removed from the herd by destruction or by segregation. Consideration of the available resources on the one hand and of the incidence of the tuberculin reactions on the other are taken into account for deciding upon the policy between the two alternatives, test and destruction or test and segregation.

If the incidence is low and the resources ample, test and destruction procedure is a quick and effective method of control. In the case of higher incidence of infection, coupled with borderline level of economic security, the adoption of this technique would be disastrous and resource is then had to the test and segregation procedure. The animal that react at successive tuberculin tests are maintained as a separate herd and their produce rendered safe by pasteurization before sale. The calves born in the reactor herd are weaned at birth, reared on disease free premises, subjected to tuberculin test at 6 months of age and if found non-reacting, mixed with the healthy (non-reactor) animals. Clinical and open cases are all destroyed as soon as detected.

It should not be difficult to visualize the opposition of the cattle owner to the institution and pursuit of TB control program at some considerable additional expenditure to him, without any
visible or ready return. It is so easy a lesson of simple economics that an illiterate farmer understands as intensely as his enlightened counterpart in any advanced country. Incentives have, therefore, to be provided in the form of subsidy or bonus on the production of TB-free milk and animals. This governmental liability can gradually be reduced and finally be abolished as the control program catches up and the farming community and the general public start realizing the worth of disease free animals and their produce. The higher value offered for these would ultimately provide the required incentive.

A major bottleneck in the execution of TB control program among cattle and buffaloes in India is the religious sentiment of our people against cow-slaughter. It might perhaps be impossible to bring round the masses through concerted efforts at educating the public opinion.

Another consideration that has to be accommodated in the scheme of control is the scattered distribution of our cattle population, the consolidated holdings being only a few and far between. This situation can perhaps be tackled by resorting to insurance of cattle against the disease and running central or regional farms for segregation of reactors, where hygienic control can be practiced.

For obtaining tangible results on a state / country-wide basis, some compulsion is necessary to be imposed on unwilling minds to bring them in line with the spirit and the tenets of TB control. To be successful in a democratic set-up, this process has to be gradual. Programs are therefore instituted initially on a voluntary basis and when large proportion of population has caught with then legislation is enacted.

Some treatments (e.g. isoniazid, streptomycin) have been shown to have some efficacy, however it is limited and include risks of zoonotic transmission (by non removal of infective animals) and drug resistance. Consequently treatment of infected animals is not recommended and is illegal in a number of countries.
The preferred option is to eradicate the disease by test and slaughter. This involves, on a herd basis, repeat tuberculin testing and removal of reactors until the whole herd has passed 'clean' at two successive tests. Tests in infected herds should be conducted every 3 months. Herds should be considered free of TB after two negative tests distant from 6 months. Hygienic measures on the farm (cleaning and disinfecting) and control of movement of infected cattle are very important.

From the public health perspective, pasteurisation of milk is essential to inactivate tubercle bacilli. Meat inspection to remove tuberculous animals from the food chain is also required. Infected carcases detected at abattoirs should be traced back to identify infected herds.

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