

Tuberculosis :

It is a **chronic granulomatous infectious disease of man and animals caused by certain organisms within the genus Mycobacterium, and characterized by the development of tubercles nodules in different organs.**

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.

Causes:Is caused by **an aerobic, acid-fast, rod-shaped organism, the organism can multiply only if plentiful oxygen is available.** So in closed caseous lesions, the bacilli do not proliferate. But if the lesions were to open up into a bronchus, the organism proliferates rapidly.

There are several strains of M. tuberculosis are found that can be distinguished culturally, and by their pathogenicity to animals. These are:

1-The human strain (*Myco. Tuberculosis*) infective to humans and animals.

2-The bovine strain (*Myco.bovis*) infective to man and animals.

3-The avian strain(*Myco. Avium*) infective to fowls and some animals. Tuberculosis in cattle is mostly caused by the bovine strain, the human strain though infective caused only non-progressive lesion in the pharyngeal, thoracic and mesenteric lymph nodes. The disease is caused by many species of genus Mycobacterium. Mycobacterium is a slender, curved rods acid fast bacilli

The cell wall contains complex waxes and glycolipids. They are Gram. positive, but alstainable by simple bacteriological stains because of their high content of lipids. In nature several strains of Mycobacterium can be distinguished culturally and by their pathogenicity to animals.

Mycobacterium bovis is the main cause of tuberculosis in animals such as cattle, buffalo, camels, sheep, goats, horses, pigs and dogs.

.Route of infection: source of infection is an affected animals the common routes of infection are:

a-Aerogenous or inhalation(droplet infection, dust inhalation)

b-Enterogenous or ingestion(by contaminated materials may be milk or pasture by sputum, urine, or feces from infected animals)

Pathogenesis

Mycobacterium infection occurs by airborne transmission or ingestion of droplet contains viable organisms produced by sputum of infected animals. The bacilli adhere to the lining epithelium, where they induce local infiltration of neutrophils. The neutrophils are able to engulf the bacilli but are not able to kill them. The neutrophils rapidly totally disappear from the infected area due to their destruction and can not be seen in the lesion.

The macrophages arrive to the site of infection and phagocytize the bacilli. The intracellular organisms resist destruction by macrophages. The mechanism by which intracellular survival may be due to prevention of phagosome, lysosome fusion, or direct cytotoxic effect of some cell wall component to macrophages or prevent acidification of phagolysosome. Accumulation of mycobacterium stimulates an inflammatory response, which mature into a granulomatous lesion.

Following the formation of the primary lesion at the site of entry in organs, the bacilli carried to regional lymph node either freely or in macrophages through the lymph where tubercles are formed. The lesions in organ and regional lymph node called primary complex.

Infection spread to next lymph node and lymphatic until reach the circulation, localized in an organ or various organs in large numbers. Postprimary infection can occur in animal under stress, the resistance of the body is lowered activation of infection from old encapsulated lesions resulting in formation of daughter tubercle or get entry to general circulation and localized in various organs.

Gross lesion

Tubercle bacilli produce characteristic lesions no matter where they localize in tissue.

Lesions in tuberculosis are either proliferative (focal or diffuse) or with exudation. The proliferative is more common forming microscopic tubercles, which later diffuse to be seen by naked eye.

A. The proliferative form seen either as tubercles, miliary form or caseous form

1. Tubercle or nodular form is the classical form of lesions. The tubercle is 1. 2 cm in diameter, first gray and translucent but soon becomes yellowish. Large tubercles are dry, grayish. white and contain caseous masses calcified foci

2. Miliary tuberculosis is generalized form of tubercle. The lesions are characterized by the presence of numerous number of recent tubercle 2. 3 mm in diameter, approximately of the same age and shape
3. Caseous form is characterize by a small or large areas of tissue necrosis.

Microscopically, The tuberculous lesions are basically proliferative except in serous membrane is exudative.

The tissue reactions to mycobacterium bacilli start as a small aggregates of neutrophils that phagocytize the bacilli. The neutrophils die and totally disappear from the area.

After that the macrophages arrive and phagocytize the bacteria. The bacilli kill macrophage. Numerous monocytes and histocytes are attracted to the area under the effect of cytokines, metabolic products and disintegration of bacilli. The mononuclear cells become enlarged and pale with large vesicular nuclei and foamy cytoplasm (epithelioid cells).

Fusion of more than one epithelioid cell or by mitotic division of the nucleus of one cell without division of the cytoplasm resulted in formation of Langhan's giant cells. Lymphocytes, migrating from the adjacent blood vessels, form a dense zone around epithelioid cells. Under the effect of bacterial toxin, unsaturated fatty acids and perhaps also a vascular condition of the tubercle the tubercle undergoes degenerative changes and caseous necrosis

Old tubercles are encircled with fibrous tissue. Encapsulated. The necrotic portion may calcify or liquefy old tubercles. Calcification is a characteristic in some species of animals (cattle, sheep, and goats) while it is rarely or not observed (buffalo, pig, dog, and fowl).

The difference of tubercle structure in different animal species.

Cattle, sheep, and goat tubercles is characterized by the presence of a few number of lymphocytes, giant cells besides abundant connective tissue network and capsule. Calcification occurs frequently.

The disease mainly occurs in thoracic cavity, particularly lungs and related lymph nodes.

Lungs

The lungs involved in about 75% of the tuberculous cases. The pulmonary lesions take three forms.

A. tuberculous bronchopneumonia:The infection takes place through the air passage. The inflammatory process starts as terminal bronchiolitis with expansion into the alveoli. Macroscopically, catarrhal inflammation of one or more lobules followed

by pneumonia, caseation alternated with congestion and edema. Lesions rarely form cavities (vomica) due to liquefactive necrosis

B. Miliary tuberculosis: It results from entry of Mycobacterium into general circulation and arrest of the organisms in pulmonary vessels. The lungs show numerous discrete gray translucent firm nodules of same size and age.

C. Chronic nodular tuberculosis: It results from arrest of bacilli in lymphatic or capillaries. The tuberculous lesions formed from yellow caseous or calcified foci surrounded by varying degree of fibrosis.

Tuberculous pleurisy and peritonitis: It is tuberculous forms characterized by the presence localize or diffuse area of soft grayish velvety granulation tissue on serous membrane. The tubercle may aggregate extensive clusters similar to pearls or grapes (Pearl disease). The center of the nodules is caseated.

The spleen is involved in about 15% and the lesions is confined to the capsule. The lymph nodes involved in about 90% of the affected cases. The mammary gland involved in 1% of tuberculous cases. Three forms are seen according to anatomical distribution. Miliary tuberculous mastitis, diffuse lobular tuberculous mastitis and caseous tuberculous mastitis are seen.

Alimentary tract lesions

It is always secondary except in calf. They show tubercles lesion ileum and colon or in Payer's patch.

Central nervous system

Lesions are frequent in calves and young cattle and present in cerebrum, cereblum and meninges

In equine the tubercle is more cellular having many lymphocytes but little connective tissue ground substance besides softening of the center with rarely calcification.

In swine infected with Mycobacterium bovis the tubercle characterize by abundant lymphocytes with less connective tissue and caseation and calcification. Meanwhile, the avian strain causes much less caseation and calcification and highly cellular (neoplastic like appearance).

The dog's tubercles characterized by liquefactive necrosis.

The fowl tubercle shows extensive caseation without calcification besides deficient cellular elements and connective tissue framework.

Diagnosis

1-Clinical

Tuberculosis can be difficult to diagnose based only on the clinical signs. In developed countries, few infections become symptomatic; most are diagnosed by routine testing or found at the slaughterhouse.

2-Laboratory tests

In live cattle, tuberculosis is usually diagnosed in the field with the tuberculin skin test. In this test, tuberculin is injected intradermally; a positive test is indicated by a delayed hypersensitivity reaction (swelling). The tuberculin test can be performed using bovine tuberculin alone, or as a comparative test that distinguishes reactions to *M. bovis* from reactions to environmental mycobacteria. False negative responses are sometimes seen soon after infection, in the late stages of the disease, in animals with poor immune responses and in those that have recently calved.

Differential diagnosis

The differential diagnosis includes contagious bovine pleuropneumonia, *Pasteurella* or *Corynebacterium pyogenes* pneumonia, aspiration pneumonia (which is often secondary to chronic wasting disease in cervids), traumatic pericarditis, caseous lymphadenitis or melioidosis in small ruminants, and chronic aberrant liver fluke infestation.