# CORYNEBACTERIUM INFECTIONS

Corynebacteria are Gram-positive, non acid-fast, and sometimes "**beaded**" in stained tissue sections. They share features with Mycobacteria and Nocardia, but can be easily differentiated.

Corynebacteria are involved in a wide variety of lesions in many domestic animals, as well as in humans. The best known organism in this genus is *Corynebacterium diphtheriae,* cause of human diphtheria.

Other members of this group are referred to as "**diphtheroid bacteria".** Most are of low pathogenicity & exist as commensals in animals. Predisposing factors play an important role in the induction of disease. The lesions are variable AND Tissue reaction is either necrotizing, suppurative and/or Granulomatous.

| S. No | Corynebacterium | Diseases |
|---|---|---|
| 1. | C. *diphtheria* | Diphtheria in Humans |
| 2. | C. *renale* | "**bacillary Pyelonephritis**", Chronic **Purulent Cystitis** and **Urethritis** in Cattle;<br>Mainly seen in Cows; it is rare in bulls |
| 3. | C. *cystitidis* | Haemorrhagic Cystitis and Pyelonephritis in Cows |
| 4. | *C. pilosum* | Severe Cystitis and Pyelonephritis in Cows |
| **5.** | **C. *pseudotuberculosis***<br>*(C. ovis)* | **Caseous Lymphadenitis** (pseudotuberculosis) in Sheep and Goats<br>**Ulcerative Lymphangitis** and **Pectoral Abscesses** and **Folliculitis** (*inflammation of hair follicle)* in Horses |
| 6. | C. *bovis* | Mastitis in Cattle |
| **7.** | C. *suis*<br>*(now as Eubacterium suis)* | Pyelonephritis and Cystitis in Pigs |
| 8. | C. pyogenes<br>*(Actinomyces pyogenes)* | Suppurative Infections in Cattle, Sheep, Goats & Pigs |
| 9. | C. *equi*<br>(now as *Rhodococcus equi)* | Pneumonia in Foals (Horses) |

***Corynebacterium pyogenes****,* now called ***Actinomyces pyogenes****,* is a common and important organism in *pyogenic / suppurative infections* in cattle, pigs, sheep, and goats. In cattle, the organisms are found in encapsulated abscesses, and in necrotic and suppurative pneumonias AND also in suppurative arthritis and umbilical infections in calves, and from purulent metritis & mastitis in cows.

# CASEOUS LYMPHADENITIS in Sheep and Goats

**Synonym/ Common Name:** Pseudotuberculosis of Sheep and Goats

**Definition:** Caseous lymphadenitis is a chronic, contagious, suppurative disease of sheep & goats, caused by *Corynebacterium pseudotuberculosis* [C. *ovis],* a *Gram-positive 'diphtheroid bacillus'* that most frequently infects the lymph nodes and lymphatic system and is characterized by the formation of Abscesses in Lymph nodes. It may also involve respiratory tract with abscess formation in the lungs and/or mediastinal or retropharyngeal lymph nodes.

**Etiology**: It is caused by soil-borne *Corynebacterium pseudotuberculosis* [C. *ovis]*, which is Gram-positive, non acid-fast, intracellular coccobacillus which appear "**beaded**" in stained tissue sections.

There are 2 serotypes, with *type I* in sheep/goats and *type II* in buffalo/cattle. An *exotoxin* that consists of a phospholipase D is an important aspect of its virulence that enhances dissemination of the bacteria by damaging endothelial cells and increasing vascular permeability.

**Spread**

The organism gains entry by way of abrasions in the skin or oral mucous membranes, and less commonly, through inhalation. It increases in prevalence with age and reaches a peak incidence in adults. Disease in **goats** can be more severe than in sheep. Caseous lymphadenitis (CLA) in **sheep** almost always follows a wound infection, usually a shearing wound or through contaminated hair clippers. Infection is rare in cattle. The disease is **considered Zoonotic** and is an occupational disease of shearers (persons who cut sheep's wool).

**Pathogenesis**

After penetrating into the host, which generally occurs through the oral, nasal and ocular mucosa, or through skin wounds, the agent disseminates freely or within macrophages, mainly through the afferent lymphatic system, to local lymph nodes and internal organs. C. *pseudotuberculosis* is an intracellular organism and lives inside cells.

The lipid cell layer of the bacteria (containing Mycolic Acid) is pyogenic, but not immunogenic. This same layer makes phagocytosis of the bacteria difficult, increasing its virulence (cytoxicity), and survival inside macrophages; abscesses form through the release of lysosomal enzymes. C. *pseudotuberculosis* also produces an Exotoxin - **Phospholipase D** (PLD) increases vascular permeability, bacterial survival within

macrophages and aids in dissemination of the bacteria from the location of the primary infection (local lymph node) to other organs (lungs, regional lymph nodes, mesenteric limph nodes, etc.), **where it forms abcesses**, because it lyses mammal cell membranes, causing micro-hemorrhages and vascular lesions. These abcesses can be found in either peripheral or internal lymph nodes.

The location of the affected lymph nodes affects the clinical presentation. With involvement of the thoracic lymph nodes, the affected animal may display clinical signs of respiratory disease such as dyspnea, tachypnea, and chronic cough, in addition to chronic weight loss. With haematogenous spread, organism may spread with abscess formation in many organs, including lungs, liver, kidney, brain, and spinal cord.

**Signs**

Caseous lymphadenitis in its SUPERFICIAL / PERIPHERAL FORM is characterized by infection of external lymph nodes, such as the submandibular, parotid, pre-scapular lymph nodes, while the INTERNAL / VISCERAL FORM is characterized by abscessing of internal organs, such as lungs, liver, kidneys, uterus, spleen and internal lymph nodes, such as the mediastinal and bronchial lymph nodes. Internal abscesses are normally associated with weight loss and weakness, known in sheep as thin-ewe syndrome. The Visceral form is more common in Sheep, while the Superficial form is among goats.

There is palpable enlargement of one or more of the superficial lymph nodes. Those most commonly affected are the submandibular, parotid, pre-scapular, submaxillary, prefemoral, supramammary, and popliteal nodes. The mature abscesses easily leak through fistulas and green pus is discharged into the environment or into the affected organ. Abscesses usually recur, months or years later, in the same animal, due to the failure to eliminate the infection.

In cases in which systemic involvement occurs, chronic pneumonia, pyelonephritis, ataxia (incoordination) and paraplegia (paralysis of hind portion of the body and of both legs) may be present.

**Lesions**

Although both the **External (Peripheral)** and **Internal forms** of CL occur in sheep and goats, the external form is more common in goats, and the internal form is more common in sheep. In sheep these abscesses initially contain pale green material that eventually forms a classical laminated **"onion-ring" appearance** in cross section, with concentric fibrous layers separated by inspissated caseous exudate and matures into a calcified mass. Abscesses in goats are less organized, remain greenish-cream colored and the exudate may be soft and paste-like texture.

The initial lesion in lymphoid tissues is *diffuse lymphadenitis* that is probably the result of the soluble exotoxin. When the organism reaches the nodes, multiple microscopic abscesses form in the cortex. Eosinophils are prominent in the reaction and cause the pus to be green.

Microscopically, the lesion starts as a small nidus (focus) of epithelioid cells but is soon transformed into caseous necrosis, which becomes the main feature. The central caseous mass is soon surrounded by a thin layer of epithelioid cells mixed with lymphocytes, to which an external layer of fibrous connective tissue is added. As the lesion grows, the epithelioid and fibrous reactive layers undergo necrosis; the epitheloid layer dies first. While the fibrous layer still remains visible, new reactive layers form outside it, one after another become necrotic. The abscesses are rapidly encapsulated, and when this occurs, the acute reaction in the surrounding tissues subsides, but the abscesses continue to enlarge. With enlargement, there is progressive necrosis and re-formation of the capsule, which gives the lesion a very characteristic structure of onion-like *concentric lamellations*. These lamellations are more prominent when calcified granules are deposited in successive layers at the margin of the expanding lesion. Although Calcification is seen, but giant cells are not seen. The larger lesions in superficial nodes cause pressure atrophy and depilation of the overlying skin; they frequently rupture to discharge chronically through a narrow fistula. As a general rule, once the infection gains the nodes, it is persistent.

Lesions are usually restricted to lymph nodes, particularly prescapular, prefemoral, and mediastinal nodes, and less often, lungs, kidneys, and other viscera. The gross appearance of lymph nodes is characteristic. The entire node is greatly enlarged and almost replaced by a single spherical lesion. In cross section, it is concentrically laminated, mostly in sheep. Layers of fibrous capsule alternate with caseous, friable material which is greenish, and sometimes gritty: In the lungs, the lesions may resemble an abscess, with a central, semifluid mass of yellowish or greenish pus.

**Diagnosis**

i. The gross and microscopic lesions, if typical, are practically diagnostic.
ii. Culture & Identification from active lesions for *Corynebacterium pseudotuberculosis* is diagnostically definitive. Examination of pus taken by needle biopsy for the presence of C. *pseudotuberculosis* is the usual laboratory technique. Isolation of the causative organism depends On demonstrating its diphtheroid morphology and cultural characteristics.

iii. The serological tests which have been examined detect antibodies to the exotoxin of C. *pseudotuberculosis* and include Indirect haemagglutination, haemolysis inhibition, and immunodiffusion.
iv. ELISA tests to detect antibody to cell wall antigens & exotoxin, and PCR Test have also been developed and used.

**Differential Diagnosis:**

1. Pyogranulomatous lesions of Actinobacillosis
2. Superficial Abcesses caused by Staphylococccus aureus and Actinomyces bovis
3. Pneumonia associated with Tuberculosis.
4. Submandibular Oedema due to parasites (Fashiola hepatica; Haemonchus spp.)
5. Salivary Cysts, Lymphosarcoma etc.

## ULCERATIVE LYMPHANGITIS of Horses and Cattle

Ulcerative Lymphangitis is a mild contagious disease mainly of horses and sometimes cattle; characterized by lymphangitis of the lower limbs. It is caused by *Corynebacterium*. *pseudotuberculosis.*

**Signs and Lesions**

In horses, initial wound infection is followed by swelling and pain of the pastern, sufficient to cause severe lameness. Nodules develop in the subcutaneous tissue around the fetlock, but can then spread to subcutaneous sites on all parts of the body.

These may enlarge 5 -7 cm in diameter and rupture to discharge a creamy green pus. The resulting ulcer has irregular edges and a necrotic base. Lymphatics draining the area become enlarged and hard, and secondary ulcers may develop along them. Lesions heal in 1 -2 weeks but fresh crops may occur, and cause persistence of the disease for up to 12 months.

The lesions in cattle are similar to those in horses, except that there may be lymph node enlargement and the ulcers discharge a gelatinous clear exudate.