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Review on Actinomycosis in Cattle

Ufaysa Gensa
Jimma University College of Agriculture and Veterinary Medicine, School of Veterinary Medicine. P.O. box 307, Jimma, Oromia, Ethiopia

SUMMARY
Actinomycosis (lumpy jaw) in cattle is a chronic infectious disease characterized by suppurative granulation of the skull, particularly the mandible and maxilla. *A bovis* are the etiologic agent of lumpy jaw in cattle. It has also been isolated from nodular abscesses in the lungs of cattle and infrequently from infections in sheep, pigs, dogs, and other mammals.). Although actinomycosis occurs only sporadically, it is of importance because of its widespread occurrence and poor response to treatment. It is recorded from most countries of the world. Predisposition to disease seems to occur through direct extension of the infection from the gums, apparently following injury or as a complication of periodontitis of other causes.).In the jawbones a rarefying osteomyelitis is produced. Actinomycosis lesion in the cows appeared as hard and immobile swellings in the mandibles. The disease is sporadic but common in cattle. Occasional cases occur in pigs and horses and rarely in goats. Rarefaction of the bone and the presence of loculi and sinuses containing thin, whey-like pus with small, gritty granules are usual. Treatment is with surgical debridement and antibacterial therapy, particularly iodides as used in case of actinobacillosis. For control, isolation or disposal of animals with discharging lesions is important, although the disease does not spread readily unless predisposing environmental factors cause a high incidence of oral lacerations. Therefore the objective of this paper is to review available information on actinomycosis in cattle and to highlight the basic clinical findings, diagnosis and prevention measures of the disease in cattle.
Keywords: *Actinomyces bovis*, sulfur granule, osteomyelitis, lumpy jaw

INTRODUCTION

Actinomycosis (lumpy jaw) in cattle is a chronic infectious disease characterized by suppurative granulation of the skull, particularly the mandible and maxilla. There are gross painful swellings; abscesses, fistulous tracts and extensive fibrosis that all contribute to the granulomatous lesion (Radostits *et al.,* 2007). *A bovis* are the etiologic agent of lumpy jaw in cattle. It has also been isolated from nodular abscesses in the lungs of cattle and infrequently from infections in sheep, pigs, dogs, and other mammals, including chronic fistulous withers and chronic poll evil in horses. Lumpy jaw is a localized, chronic, progressive, granulomatous abscess that most frequently involves the mandible, the maxillae, or other bony tissues in the head (http://www.msdvetmanual.com)**.**

Disease is seen when *A. bovis* is introduced to underlying soft tissue via penetrating wounds of the oral mucosa from wire or coarse hay or sticks. Involvement of adjacent bone frequently results in facial distortion, loose teeth (making chewing difficult), and dyspnea from swelling into the nasal cavity.Classically, *Actinomycis bovis* infection causes a rarefying osteomyelitis of the mandible or maxilla ('lumpy jaw'), and infection of the associated lymph nodes (Montgomery, 1998). The natural habitat of *A bovis* is the oral cavity and nasopharynx, and the bacteria are thought to enter through wounds in the buccal mucosa or through dental alveoli. Rarely, infection may involve soft tissues, such as the oesophageal groove, leading to a syndrome of impaired digestion.

The causative organism of lumpy jaw is *Actinomyces bovis*, a Gram-positive filamentous anaerobe. It is a normal inhabitant of the oral flora and upper respiratory and digestive tracts of most animals (Smith, 2002). The organism gains access to the soft tissues as a result of mucosal damage caused by sharp objects or erupting teeth. Following the infection, a proliferation of connective tissue, invasion with leucocytes and the resulting formation of a walled tumor-like mass can be seen. The granuloma then invades the bones of the mandible or occasionally the maxilla (Eddy, 2004). Actinomycosis is characterized by the presence of 'sulphur granules', which contain bacteria that are arranged in clubs or phagocytized (Pine & Overman 1963). The pathogenesis of the disease in cattle is traumatic and the route of entry is typically a break of the mucosa of the gingiva due to penetrating small and hard vegetable bodies. The infection causes periostitis and, in most cases, osteomyelitis arising from periodontitis (Palmer 1993).

Fine-needle aspiration biopsy (FNAB) is a less aggressive procedure than histological biopsy and might be of aid in recognizing microorganisms and sulphur granules, especially when bacteriological analyses are negative. FNAB is a safe, easy-to-use, fast, effective, inexpensive and minimally invasive diagnostic technique that can be performed before microbiological examination and anti-microbial therapy. FNAB might be useful for the differentiation of actinomycosis lesions and neoplastic disorders of bone (Militerno, 2008). Various treatment protocols have been documented in the literature for the lumpy jaw but with sub-satisfactory responses (Mettler *et al*., 2009).Therefore the objective of this paper is to review existing information on actinomycosis in cattle and to highlight the basic clinical findings, diagnosis and prevention measures of the disease in cattle.

2. LITRARURE REVIEW

Actinomycosis is an infrequent invasive bacterial disease that has been recognized for over a century. *Actinomyces* spp. are filamentous Gram-positive bacilli, mainly belonging to the human commensal flora of the oropharynx, gastrointestinal tract, and urogenital tract. To date, multiple different clinical features of actinomycosis have been described, as various anatomical sites (such as face, bone and joint, respiratory tract, genitourinary tract, digestive tract, central nervous system, skin, and soft tissue structures) can be affected. Of note, in any site, actinomycosis frequently mimics malignancy, tuberculosis, or nocardiosis, as it spreads continuously and progressively, and often forms a cold abscess

2.1 Etiology

Actinomyces bovis is the primary cause but other bacteria may be present in extensive lesions including non-bovis Actinomyces Spp (Rao *et al*., 2013). Actinomycosis may be considered when a patient has chronic progression of disease across tissue planes that are mass-like at times, sinus tract development that may heal and recur, and refractory infection after a typical course of antibiotics (Vishwanathan, 2013).

2.2 Epidemiology

The disease is sporadic but common in cattle. Occasional cases occur in pigs and horses and rarely in goats (Mohamed *et al*., 2011). Although actinomycosis occurs only sporadically, it is of importance because of its widespread occurrence and poor response to treatment. It is recorded from most countries of the world. Actinomyces bovis is a common inhabitant of the bovine (Rao *et al*., 2013). Actinomyosis is a subacute to chronic bacterial disease that is characterized by slowly progressing suppurative fibrosing inflammation, development of draining sinus tracts that may discharge characteristic "sulfur granules," and direct dissemination via contiguous tissues.

It most commonly involves the cervicofacial area, thorax or abdomen, including the pelvis, but rarely also the central nervous system (CNS), skin or bone (Schaal, 1984). The disease is worldwide in distribution and more common in males Tooth and infection is presumed to occur through wounds to the buccal mucosa caused by sharp pieces of feed or foreign material Infection may also occur through dental alveoli, and may account for the more common occurrence of the disease in young cattle when the teeth are erupting. Infection of the alimentary tract wall is probably related to laceration by sharp foreign bodies (Radostist *et al*., 2007).

2.3 Pathogenesis

The organism is an obligatory parasite on the mucous membranes of the oropharynx. Predisposition to disease seems to occur through direct extension of the infection from the gums, apparently following injury or as a complication of periodontitis of other causes (Jubb *et al.*, 1993).In the jawbones a rarefying osteomyelitis is produced. The lesion is characteristically granulomatous both in this site and where visceral involvement occurs. The effects on the animal are purely physical Involvement of the jaw causes interference with prehension and mastication, and when the alimentary tract is involved there is physical interference with ruminaI movement and digestion, both resulting in partial starvation. Rarely, localization occurs in other organs, caused apparently by hematogenous spread from these primary lesions (Radostits *et al.,* 2007).

2.4 Clinical Findings

Actinomycosis of the jaw commences as a painless, bony swelling which appears on the mandible or maxilla, usually at the level of the central molar teeth. The enlargement may be diffuse or discrete and in the case of the mandible may appear only as a thickening of the lower edge of the bone with most of the enlargement in the intermandibular space. Such lesions are often not detected until they are too extensive for treatment to be effective. The characteristic lesion is an indurated area of multiple, small, communicating abscesses surrounded by granulation tissue. Lesions tend to form sinus tracts that communicate to the skin and drain a purulent discharge containing “sulfur” granules (rounded or spherical, usually yellowish, and $\leq$ 1 mm in diameter). Infection spreads to contiguous tissues, but only rarely hematogenously (www.merckmanuals.com**)**.

The more common, discrete lesions on the lateral surfaces of the bones are more readily observed. Some lesions enlarge rapidly within a few weeks, others slowly over a period of months. The swellings are very hard, immovable and, in the later stages, painful to the touch. They usually break through the skin and discharge through one or more openings. The discharge of pus is small in amount and consists of sticky, honey-like fluid containing minute, hard, yellow white granules. There is a tendency for the sinuses to heal and for fresh ones to develop periodically (Radostist *et al*., 2007).

Teeth embedded in the affected bone become maligned and painful and cause difficult mastication with consequent loss of condition. In severe cases, spread to contiguous soft tissues may be extensive and involve the muscles and fascia of the throat. Excessive swelling of the maxilla may cause dyspnea. Actinomycosis is a chronic granulomatous disease of cattle and pigs and rarely in sheep and horses. It is caused by *Actinomyces*

bovis which is an obligatory parasite in the mucous membrane of the mouth and pharynx. Infection occurs following injury with a sharp object or hard feed pieces to the oral mucosa.Antemortem findings:Painful swelling of the maxilla and mandible (lumpy jaw); rarely in feet;Suppurative tracts in the granulation tissue breaking towards oral cavity or skin ulceration of cheeks and gums and wart like granulations outward on head; difficult breathing and salivationLoss of weight diarrhoea and bloat(www.en.wikipedia.org/wiki/Actinomycosis_in_animals).

Involvement of the local lymph nodes does not occur. Eventually the animal becomes so emaciated that destruction is necessary although the time required to reach this stage varies from several months to a year or more. The most common form of actinomycosis of soft tissues is involvement of the esophageal groove region, with spread to the lower esophagus and the anterior wall of the reticulum. The syndrome is one of impaired digestion. There is periodic diarrhea with the passage of undigested food material, chronic bloat, and allotriophagia. Less common lesions of soft tissue include orchitis in bulls, the trachea causing partial obstruction, and abscess in the brain or lungs (Bertone, 1984).

Fig. 1: Clinical presentations in a calf (A) and 3 cows (B, C, D) with actinomycosis. In the calf, the lesion was located bilaterally in the maxilla. Actinomycosis lesion in the cows appeared as hard and immobile swellings in the mandibles. In one cow (D), a severe form was observed where lesions involved the muscles and fascia.
Source**:** (Tharwat and Abdel-Rahim, 2011)

2.5 Diagnosis and Clinical Pathology

Gram staining of pus and pathology of infected tissue is of great interest for the diagnosis of actinomycosis, as it is usually more sensitive than culture, which remains sterile in more than 50% of cases. Once *Actinomyces* spp. has invaded tissues, they develop a chronic granulomatous infection characterized by the formation of tiny clumps, called sulfur granules because of their yellow color. These formations of 0.1–1 mm in diameter, composed of an internal tangle of mycelial fragments and a rosette of peripheral clubs, are stabilized by a protein–polysaccharide complex, which is supposed to provide a resistance mechanism to host defenses by inhibiting phagocytosis (Wong, 2011). Diagnosis is suspected clinically and confirmed by identification of *A. bovis* using microscopy and culture of sputum (ideally obtained endoscopically), pus, or a biopsy specimen. Imaging tests (eg, chest x-ray, abdominal or thoracic CT) are often done depending on findings.In pus or tissue, the microorganism appears as the distinctive sulfur granules or as tangled masses of branched and unbranched wavy bacterial filaments, pus cells, and debris, surrounded by an outer zone of radiating, club-shaped, hyaline, and refractive filaments that take hematoxylin-eosin stain in tissue but are positive on Gram stain (www.merckmanuals.com).

Actinomycotic lesions frequently involve other bacteria. Unfortunately, the presence of multiple bacterial organisms makes the primary isolation of Actinomyces more difficult (Huss, 1993). Smears of the discharging pus stained with Gram's stain provide an effective simple method of confirming the diagnosis. Gram-positive filaments of the organism are most readily found in the centers of the crushed granules (Radostist *et al*., 2007).

2.6 Differential Diagnosis

As is often the case, there are diseases/conditions with signs and symptoms that are similar to actinomycosis. As such, misdiagnoses can occur. Some examples include abscesses caused by grass seeds, woody tongue, bottle jaw, cancerous growths, and irritation caused by lodged objects (www.en.wikipedia.org/wiki/Actinomycosis_in_animals). Abscesses of the cheek muscles and throat region are quite common when spiny grass-awns occur in the diet. They are characterized by their movability and localization in soft tissues compared to the immovability of an actinomycotic lesion. Pus may be thin, fetid, or caseous depending on the duration of the abscess. Prompt recovery follows opening and drainage (Radostist *et al*., 2007).

2.7 Necropsy Findings

Rarefaction of the bone and the presence of loculi and sinuses containing thin, whey-like pus with small, gritty granules are usual. An extensive fibrous tissue reaction around the lesion is constant, and there may be contiguous spread to surrounding soft tissues. The presence of 'club' colonies containing the typical, thread-like bacteria is characteristic of the disease. These formations may be seen on microscopic examination of smears made from crushed granules in pus or on histological examination of section. Granulomatous lesions containing pockets of pus may be found in the esophageal groove, the lower esophagus and the anterior wall of the reticulum. Postmortem findings:(1)Lesions in the mandible (Lumpy jaw) or maxilla (2)Granulomatous lesions in lower part oesophagus or anterior part of the reticulum (3)Local peritonitis (4)Mild abomasitis and enteritis(http://www.fao.org/docrep/003/t0756e/T0756E03.htm)

Spread from these lesions may cause a chronic, local peritonitis. There may be evidence of deranged digestion with the rumen contents sloppier than usual, an empty abomasum and a mild abomasitis and enteritis. Involvement of local lymph nodes does not occur, irrespective of the site of the primary lesion. Abscesses of the cheek muscles and throat region are quite common when spiny grass-awns occur in the diet. They are characterized by their movability and localization in soft tissues compared to the immovability of an actinomycotic lesion. Pus may be thin, fetid, or caseous depending on the duration of the abscess. Prompt recovery follows opening and drainage (Radostist *et al*., 2007).

2.7 Treatment Control and Prevention

The affected areas are treated with iodine solutions. A common method to achieve this is to give the cattle sodium iodide orally on a regular treatment schedule. Antibiotics such as Tetracycline's are also used. These two treatment methods can be used alone or together; simultaneous use is considered more aggressive. Killing the bacteria that cause the infection is the ultimately purpose of these treatment methods. However, they are seldom effective unless treatment is started very early (Smith, 2013).

Treatment is with surgical debridement and antibacterial therapy, particularly iodides as used in case of actinobacillosis.

Additional treatment recorded as being effective includes isoniazid given orally at the rate of 10-20 mg/kg body weight daily for about 30 days. Cessation of the growth of the lesion should occur but response in advanced cases is poor (Maiti and Parai, 1959). Lesion cavity was then washed 3 times with normal saline and finally flushed twice with iodine solution 2% this procedure was repeated weekly for 4 weeks. After procedure, 5-day care included parenteral administration of antibiotic (10mg/kg IM, Oxytetracyclin, Terramycin), non-steroidal antiinflammatory drug (2.2 mg/kg IV, flunixin meglumine) and Glucose 10% (Tharwat and Abdel-Rahim, 2011). Repeat cryo therapy with liquid nitrogen is reported to be effective. For control, isolation or disposal of animals with discharging lesions is important, although the disease does not spread readily unless predisposing environmental factors cause a high incidence of oral lacerations (Radostist *et al*., 2007).

3 CONCLUSIONS AND RECOMMENDATIONS

Actinomycosis bovis or lump jaw of cattle is a bacterial disease caused by the growth in the tissues of bacteria called actinomyces bovis. It appears as a lump or large swelling particularly on maxilla and mandible of cattle and resulting rarefying osteomyelitis. The lesions are often not detected until they are too extensive for treatment to be effective. The disease characterizes in the presence of sulphur granules which contain bacteria inside by forming colony. Although actinomycosis occurs only sporadically, it is of importance because of its widespread occurrence and poor response to treatment. The disease can be diagnosed by FNAB which is a safe, easy-to-use, fast; effective, inexpensive and minimally invasive diagnostic technique that can be performed .The disease treatment consists of surgical debridement and antibacterial therapy, particularly iodides. Therefore from this conclusion the following recommendations are forwarded:

- Since the disease onset is not clearly seen, prompt and effective diagnosis and treatment should be considered before extensive and fibrous tissue reaction occurs.
- Detailed study on patho-mechanism of disease like involvements of other soft tissue should be

conducted to avoid misdiagnoses of disease.

- As the disease was predisposed by oral laceration preventing factors that lead to this condition should be minimized.
- Isolation of animals with discharging lesions was also important.

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