Dry Gangrene of the Extremities Associated with 
Salmonella dublin Infection in a Calf

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Abstract: An orphan disease was observed in a young calf presenting dry gangrene of the extremities with necrosis of the hind legs, ears and tail. Careful clinical examination and differential diagnosis with other causes of dry gangrene have been made including frostbite, bovine virus diarrhea and poisoning by fescue and ergotism. Deep investigation and laboratory research revealed the occurrence of Salmonella infection and further identification according to ISO 6579 method in calf feces and viscera led to isolation of Salmonella sp subsequently serotyped as Salmonella dublin. A relationship has been suggested between the occurrence of this disease and the cold agglutination associated with the autoimmune hemolytic anemia leading to ischemia of tissues of the terminal extremities.

Key words: Calf • Dry gangrene • Salmonella dublin

INTRODUCTION

Salmonella affects a wide range of hosts including humans and animals and is the most common cause of food poisoning in public health. The reservoir of salmonella is the digestive tract of vertebrates and many animal species harbor these bacteria and include chickens, cattle, swine, fish and reptiles and some others [1]. Salmonella, with its thousand species, may affect wild birds with outbreaks observed in passerines [2]. Some rare types of salmonellosis were observed in humans with erratic localization [3]. Whereas, Salmonella dublin causes salmonellosis and is well adapted to cattle. The charge of the environment with salmonella cells from infectious calves is crucial in transmitting Salmonella dublin between calves [4]. Carrier animals of Salmonella dublin play a central role in the transmission and shed bacteria periodically through feces or milk [5]. Salmonella enterica subspecies enterica undergoes hypermutation for best adaptation to the environments, including antimicrobial treatments and industrial processes [6]. Clinical symptoms observed in cattle include septicemia, acute and chronic enteritis. Septicemia is more often seen in young calves and occurs when the microorganism surpasses the natural barriers formed mainly by the gastrointestinal epithelia and reach the bloodstream resulting in septicemia. In the acute enteritis, death may occur within 1 to 2 days and surviving calves often grow poorly. Salmonella dublin may cause arthritis and affect the growth plates of long bones [7]. Many animals will become carriers and cannot readily be cleared up with antibiotics, since the bacteria refuge inside tissues where most antibiotics cannot reach them efficiently. Diseases that can be confused with salmonellosis in calves include septicemia caused by Escherichia coli, bovine virus diarrhea (BVD), coccidiosis and some types of poisoning plants [8].

MATERIALS AND METHODS

Case History: A farm with 10 Friesian cows for milk production and a 3 month - old calf suffering from an infection of feet that was unresponsive to antibiotics. This farm without vaccination program and bad hygiene conditions with reported cases of abortion and abscess formation. The farm located in Batna in the East of Algeria, a semi-arid region characterized by a cold winter with an average temperature of 10°C and hot summer where the temperature may reach 45°C. The calf is reared in an opened farm and was fed with hay of oat. The first
symptoms observed are colitis followed by hyperthermia and later by cutaneous lesions at the crown of the distal limbs, the skin covering all feet was dry and became black; this necrotic skin extended proximally to the fetlock. The hind fetlock joints were unstable while the extremities of ears and tail appeared to be affected also and the calf was feverish (39.4°C) (Figure 1 and 2).

**Clinical Findings:** In front of this unusual disease, several diseases have been suspected and previously enumerated; deep bibliographic research has been conducted and reported cases of dry gangrene have been found with almost the same clinical symptoms and for best confirmation laboratory research was enterprise. We suspected a dry gangrene of the extremities associated with salmonellosis especially *Salmonella dublin* or *Salmonella typhimurium* because the clinical signs are looking like those reported in other cases [9, 10]. This disease has also been described in other animals [11, 12].

**Blood Smears:** Blood was taken from the jugular vein without anticoagulant to prevent possible morphological changes of blood cells. Blood smears were immediately performed and stained with MayGrünwald Giemsa after air drying and minutely observed.

**Bacteriology:** Synovial fluid has been taken from different joints followed by Gram staining. Calf feces were collected for isolation of salmonella using ISO 6579 and 2002 modified methods.

**Necropsy:** Samples of spleen, liver and bowels as well as the stub of affected legs were taken for bacteriological detection of *Salmonella dublin*, reported to be associated with this type of gangrene, 25 g of solid samples were sowed on buffered peptone water (BPW) followed by spread over blood agar, then suspected colonies were restreaked on xylose lysine deoxycholate (XLD) and triple sugar iron (TSI) agars.

**RESULTS AND DISCUSSION**

There is no subsequent bacterial decomposition and signs include gradual shrinking of tissue which becomes brown and then turns black. Usually a line of demarcation is formed where the gangrene stops, owed to the fact that the tissue above this line continues to receive an adequate blood supply. Other causes of dry gangrene belonging to frostbite of legs are rapidly discarded; most cases of frostbite affect ears, tail, teats, scrotum and distal parts of the legs, especially digits, which is absolutely different from our case characterized by dry gangrene of the hind limbs. Poisoning with fescue is not probable due to the too young age of the calf which begins to feed hay of oat and the fescue genus is a plant which grows up only in temperate areas like European and Asiatic countries; fescue was never found in our country, thus its improbability to make a poisoning [13]. Ergotism is really eluded because ergot (Sclerotia) is well known by the farmers and is banned from all animal feed [14].

**Hematology:** The blood smears showing many reticulocytes evocated a regenerative hemolytic anemia accompanied by punctuated reticulocytes, leucocytosis was observed and was associated with bacterial infection.

**Bacteriology:** The synovial fluid showed different forms of bacteria with Gram positive staining. The use of previously cited methods for isolation of suspected *Salmonella* from calf feces were unsuccessful and the available data [15] states that up to 50% of infected calves may be negative in fecal swabs while some researchers stated that only modified semi-solid Rappaport-Vassiliadis Agar (MSRV) seems to have the most reliable detection capability of *Salmonella dublin* in cattle feces [16]. In front of this hopeless case and the rapid increase of the lesions, the calf was euthanized.
Necropsy: Careful examination showed hypertrophied mesenteric lymph nodes with no lesions on the spleen; neither typhlitis nor intestinal lesions were observed. All colonies showing a Salmonella profile were identified using API 20 E strips to finally obtain *Salmonella spp* isolated from the spleen and this species was serotyped as *Salmonella dublin*.

Dry gangrene is caused by reduced blood flow and differs from gas and wet gangrene; this later is usually caused by *Clostridium spp.* [17]. The dry gangrene observed on the extremities is probably a relationship between the cold agglutinin and the ischemia of extremities caused by blood vessels sealing, this ischemia causes foot necrosis and loss of ears and tail extremities. Cold agglutinin disease is a rare type of immune mediated hemolytic anemia, which is associated with autoantibodies that bind to the red cell surface at lower temperatures. Cold agglutinins are usually of the IgM class and are often idiopathic in origin [18]. Clinical signs of this disease are usually associated with cold exposure; therefore, calves with cold agglutinins are observed during cold weather and in colder regions.

Two types of disease signs may occur: hemolytic anemia and gangrene of distal extremities. In our case the calf was reared in an opened area exposed to cold wind and that may result in hemolytic anemia from the binding of cold agglutinins in the cooler peripheral capillaries; although the antibodies detach when the cells return to the core of the body, complement remains bound. Gangrene of distal extremities results from the agglutination of red cells in smaller vessels [15].

**CONCLUSION**

This disease can be zoonotic and constitute a menacing disease for susceptible individuals [19]. *Escherichia coli* is responsible for mortality before the first two weeks of age while *Salmonella dublin* is incriminated after the two weeks of age; therefore, early vaccination programs for *Escherichia coli* and *Salmonella dublin* have best results in reducing the mortality rate of calves [20]. Salmonellosis in cattle needs careful attention and drastic measures to avoid possible human transmission through contact or food ingestion and prevent animals from being potential carriers of the disease and instauration of vaccination programs and good hygiene practices.

**REFERENCES**


