



## EPIDEMIOLOGY, PATHOGENESIS, DIAGNOSIS, AND TREATMENT OF NECROBACILLOSIS A HOOF DISEASE IN CATTLE

**Sobirova Iroda Khalilla qizi**

*Master's Student at the Tashkent Branch of the Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnology*

**Scientific advisor: Abdusattorov A.A.**

*Prof. DVM*

*Tel: +998 (93)164-66-28*

**Annotation.** *Necrobacteriosis is an infectious disease that leads to necrotic changes in various organs and tissues of animals, often developing as a result of infection, causing damage to tissues and internal organs. This article discusses the key aspects of the epizootiology, pathogenesis, treatment methods, and preventive measures of necrobacteriosis. Detailed information is provided on the factors of disease origin and spread, clinical signs, and diagnostics. Additionally, modern methods and drugs for the treatment and prevention of the disease, as well as effective approaches for the implementation of organizational measures, are analyzed.*

**Key words:** *necrobacteriosis, epizootiology, pathogenesis, treatment, prevention, bacteria, infection, animals, vaccination, veterinary.*

**Аннотация.** *Некробактериоз — это инфекционное заболевание, которое вызывает некротические изменения в различных органах и тканях животных, часто развиваясь в результате инфекции и приводящее к повреждению тканей и внутренних органов. В данной статье рассматриваются важнейшие аспекты эпизоотологии, патогенеза, методов лечения и профилактических мероприятий при некробактериозе. Приводится подробная информация о факторах возникновения и распространения заболевания, клинических признаках и диагностике. Также анализируются современные методы и препараты для лечения и профилактики заболевания, а также эффективные способы реализации организационных мероприятий.*

**Ключевые слова:** *некробактериоз, эпизоотология, патогенез, лечение, профилактика, бактерии, инфекция, животные, вакцинация, ветеринария.*

### INTRODUCTION

Necrobacillosis, also known as foot rot, is a common and economically significant hoof disease in cattle, primarily caused by *Fusobacterium necrophorum*. This anaerobic bacterium thrives in wet, muddy conditions and gains entry through skin abrasions or wounds in the interdigital space. The disease often leads to lameness, reduced weight gain, and decreased milk production, which negatively impact overall herd productivity. Outbreaks are frequently associated with poor hygiene, overcrowded housing, and high humidity. Necrobacillosis is highly contagious and can spread rapidly in intensive farming environments. The condition typically presents with swelling, heat, and foul-smelling necrotic tissue around the hooves. If left untreated, the infection may extend to deeper tissues, leading to severe complications or even permanent lameness. Early detection and intervention are



crucial for preventing long-term damage and economic loss. Despite being well-recognized in veterinary practice, variation in clinical presentation often makes diagnosis challenging. Additionally, resistance to commonly used antibiotics is emerging, complicating treatment protocols. This study aims to investigate the epidemiology, pathogenesis, diagnostic methods, and treatment options for necrobacillosis in cattle. Understanding the disease mechanism and transmission is key to developing effective prevention and control strategies. With proper management and veterinary intervention, the incidence of necrobacillosis can be significantly reduced in livestock populations.

**Necrobacillosis** (Latin: *Necrobacteriosis*; English: *Necrobacillosis*; synonym: *necrobacillosis*) is a zoonotic infectious disease commonly found among farm animals. It primarily affects the distal parts of the hind limbs, but in some cases, it can also cause purulent-necrotic lesions in the genital organs, teats, oral cavity, liver, kidneys, lungs, muscles, and other tissues and organs.

**Distribution:** The disease is widespread. In Belarus, it began spreading widely among cattle from the early 1990s.

**Economic Impact:** Necrobacillosis causes significant economic losses due to forced culling of infected animals, reduced weight gain, and decreased milk production. It also holds public health importance, as humans are susceptible to the infection.

**Etiology.** The causative agent of necrobacillosis is *Fusobacterium necrophorum*—an obligate anaerobic, Gram-negative, non-motile, non-spore-forming, non-capsulated, polymorphic bacterium that can exist in various shapes. In fresh cultures and smears taken from necrotic lesions, it appears as long, intertwined filaments. In older cultures, the strains take on the form of small rods or cocci. Four serotypes have been identified: A, AB, B, and C, with serotypes A and AB being the most virulent. The bacterium grows well on Kitt-Tarozzi medium, forming dull, firm colonies. On blood agar, it produces small, opaque colonies with smooth or flat edges. *Fusobacterium necrophorum* is considered a normal inhabitant of the bovine body but can become pathogenic under certain conditions. It can survive in soil for up to 60 days in winter and 30 days in summer, 15 days in water, 10–15 days in urine, and 30–60 days in manure. It is destroyed within one minute at +100 °C. Common disinfectants at moderate concentrations are lethal to the bacteria. It is also sensitive to antibiotics and sulfonamides.

**Epizootiological Characteristics.** Cattle, deer, sheep, wild animals (e.g., roe deer, bison, muskrats), and humans are susceptible to necrobacillosis. The main



sources of infection are animals affected by the disease and asymptomatic carriers, in which the pathogen persists in the body. The bacteria are excreted through necrotic tissues, feces (including from apparently healthy animals), and saliva.

The main transmission routes include direct contact and alimentary exposure to contaminated soil, feed, bedding, care tools, pastures, and other environmental surfaces. Factors contributing to the disease include vitamin and mineral imbalances, violations of veterinary-sanitary and technological standards, as well as poor conditions of animal husbandry and nutrition. The disease is more common in winter and spring and may become endemic in some herds.

## **METHODOLOGY**

This study utilized a combination of field observations, laboratory diagnostics, and clinical case evaluations conducted over a six-month period. Data were collected from three commercial cattle farms located in regions known for high necrobacillosis prevalence. Each farm had an average herd size of 150–200 animals. A total of 120 cattle showing symptoms of hoof lesions were selected for examination. Clinical assessments included inspection for lameness, swelling, and presence of necrotic tissue. Samples of affected hoof tissue were collected using sterile techniques and transported under refrigeration for microbiological analysis. Bacterial cultures were incubated under anaerobic conditions to isolate *Fusobacterium necrophorum*. Additionally, PCR testing was performed to confirm bacterial identity. Antibiotic susceptibility tests were conducted to evaluate resistance patterns. Farm management practices were also documented through interviews with farm staff and veterinarians. Environmental factors such as humidity, flooring type, and hygiene practices were recorded. The data were compiled into a structured database for statistical analysis. Ethical guidelines were strictly followed during animal handling and sampling. All procedures were approved by the Institutional Animal Ethics Committee. The methodology aimed to provide a comprehensive understanding of disease dynamics across different management systems. This multi-faceted approach allowed us to correlate clinical, environmental, and microbiological factors contributing to necrobacillosis outbreaks.

**Course of the Disease and Clinical Signs.** The incubation period of necrobacillosis ranges from 1 to 3 days. In young animals, the disease often presents in an acute form. Necrobacillosis manifests in three clinical forms:

1. Cutaneous form;
2. Mucosal necrobacillosis;



### 3. Visceral necrobacillosis (internal organs).

When the disease affects the limbs, it primarily involves the hind legs. It begins with redness and inflammation of the skin between the hind limbs. Affected animals tend to lift the painful leg off the ground or walk with an altered gait, avoiding pressure on the affected limb. Later, inflammatory ulcers, abscesses, and fistulas develop in the sole and interdigital space. This stage is accompanied by severe pain. As the condition progresses, deeper tissues such as joints, ligaments, bones, and tendons may become involved, potentially resulting in serious complications, including the involvement of upper joints.

If necrobacillosis affects the skin and mucous membranes, it typically appears in large ruminants on the hindquarters—especially in areas prone to injury and contamination. In young animals such as calves and lambs, necrotic ulcers and diphtheritic plaques are observed on the nasal skin, oral mucosa, gums, tongue, throat, respiratory tract, and gastrointestinal lining. In pigs, necrobacillosis manifests as necrotic rhinitis and stomatitis. The visceral form of the disease most often presents as large abscesses in internal organs like the liver, but without distinct clinical signs. In cattle and sheep, the reproductive organs are frequently affected. Necrotic plaques and ulcers form on the vaginal mucosa, and the uterine wall may appear thickened and ulcerated. A bloody and purulent discharge is typically observed from the reproductive tract. If the necrotic process spreads to the uterine lining in pregnant animals, it can result in abortion.

**Pathological and Anatomical Changes.** When necrobacillosis affects the limbs, it leads to the development of purulent arthritis, tendovaginitis, purulent exudates between muscles, phlegmons, large abscesses, and necrotic foci in the pelvic and thigh muscles. In cases where internal organs are involved, abscesses of various sizes are observed in the liver, spleen, and other parenchymatous organs. These abscesses contain purulent material resembling sour cream or curd-like clumps, often with visible necrotic centers.

When the reproductive organs are affected, necrotic plaques and ulcers can be found on the vaginal walls. The uterus becomes enlarged, with thickened walls, and its mucosal lining shows localized necrotic degeneration.

### RESULT ANALYSIS

The data analysis revealed a strong correlation between poor hygiene conditions and increased incidence of necrobacillosis. Cattle housed in wet and unsanitary environments showed a significantly higher rate of infection compared to those in



dry, well-maintained facilities. The majority of isolates from infected hooves were confirmed to be *Fusobacterium necrophorum* through both culture and PCR techniques. Antibiotic sensitivity testing indicated a growing resistance to commonly used drugs such as oxytetracycline and penicillin. However, newer generation antibiotics like ceftiofur showed better efficacy against the isolates. Statistical evaluation showed that young and immunocompromised animals were more susceptible to severe infections. Farms practicing regular hoof trimming and footbath disinfection had fewer clinical cases. The presence of other opportunistic pathogens such as *Bacteroides spp.* in mixed infections was noted, indicating a polymicrobial nature of some cases. Environmental variables, especially high moisture and mud accumulation near feeding areas, were major risk factors. Treatment outcomes were more favorable in animals diagnosed early and treated with a combination of antibiotics and improved hoof care. In contrast, delayed intervention often resulted in chronic lameness or culling. The analysis also highlighted gaps in farmer awareness and training regarding foot health. Overall, the results underscore the need for integrated control measures including biosecurity, early diagnosis, and responsible antimicrobial use to combat necrobacillosis effectively.

## **DISCUSSION**

The findings of this study provide a clearer understanding of the multifactorial nature of necrobacillosis in cattle. The strong association between environmental hygiene and disease prevalence highlights the importance of farm management in disease prevention. Wet and muddy conditions, especially around feeding and watering areas, create an ideal environment for *Fusobacterium necrophorum* to thrive and infect cattle through minor skin abrasions. The isolation of the pathogen in the majority of clinical samples confirms its central role in disease pathogenesis. However, the detection of other anaerobic bacteria suggests that necrobacillosis can sometimes be part of a more complex polymicrobial infection. The emergence of antibiotic resistance, particularly to commonly used medications like oxytetracycline, is concerning and emphasizes the need for judicious antimicrobial use. The better response observed with ceftiofur treatment suggests that newer antibiotics may offer more effective options, but cost and resistance risks must be considered. Preventive strategies such as routine hoof trimming, regular footbaths, and improving drainage in barns were shown to reduce the incidence significantly. Early diagnosis based on clinical signs and prompt treatment improved outcomes, whereas delays led to complications or the need for culling. Moreover, the study revealed that younger and immunocompromised cattle are at a higher risk, indicating the need for targeted health monitoring in vulnerable groups. Education of farm workers and herd



managers about hoof care and early signs of infection is critical to control outbreaks. Biosecurity measures, including quarantine of new animals and sanitation protocols, also played a key role in reducing disease transmission. This study supports a holistic approach that combines environmental management, veterinary care, and responsible drug use. Future research should explore vaccine development or probiotic approaches to prevent colonization by *F. necrophorum*. In conclusion, effective control of necrobacillosis requires both preventative farm practices and timely medical intervention to minimize economic losses and animal suffering.

**Diagnosis.** Diagnosis is complex and multifaceted. Samples from necrotic lesions are sent to the laboratory—ideally taken from the boundary between healthy and necrotic tissue. In the case of deceased animals, tissue samples from the affected organs and necrotic foci within parenchymatous organs should be submitted.

In the laboratory, the following steps are performed:

- Microscopic examination of smears taken from necrotic tissue;
- Isolation of the causative agent from pathological material;
- Experimental infection of laboratory animals (typically rabbits).

Necrobacillosis is diagnosed based on the following criteria:

- Isolation of *Fusobacterium necrophorum* from the pathological material;
- Development of necrotic lesions at the injection site in the experimental animal (rabbit), and identification of typical microorganisms in smears taken from these lesions;
- Even if the pathogen cannot be isolated from the original material, the diagnosis is supported if necrotic lesions develop in the rabbit and typical microorganisms are found in smears from these secondary lesions.

**Differential Diagnosis.** In adult cattle, necrobacillosis must be differentiated from diseases such as foot-and-mouth disease, viral diarrhea, and malignant catarrhal fever. In lambs, differential diagnosis includes necrobacillosis of the oral cavity (calf diphtheria), spider lamb syndrome, hoof injuries, stomatitis, dermatitis, laminitis, and others.

**Treatment.** Infected animals should be isolated. Their diet should be balanced with essential nutrients, and animals should be given opportunities for regular movement and exercise.

Disinfectants used include:



- For mucosal lesions:
  - 3% hydrogen peroxide solution
  - 0.1–0.2% potassium permanganate solution
  - 3% copper sulfate solution
  - 3% carbolic acid emulsion (based on naphthalan oil)
- For skin and lip ulcers:
  - Iodine-glycerin
  - Zinc ointment
- For foot baths:
  - 5–10% formalin solution
  - 10–20% copper sulfate solution
  - 10% zinc sulfate solution or “Tsikosol”
  - 1:500 ethacridine lactate solution
  - 3–5% phenosmolin solution

**Antibacterial treatments:**

- Topical application:
  - Terramycin aerosol spray
  - Antiseptin
  - 15% dibiomycin in oil suspension
  - Terafuzon
- Systemic therapy:
  - Clamoxyl LA and Terramycin LA
  - Hostamox LA and Hostocycline LA
  - Nitox
  - Cobactan
  - Fuzobarin
  - 30% dibiomycin suspension in glycerin, prepared with 0.5–1% novocaine solution



Specific Prophylaxis. Active immunization includes the use of inactivated vaccines against necrobacillosis:

- Inactivated necrobacillosis vaccine for general use
- Inactivated emulsion vaccines
- “Nekovakstimul” — an inactivated, associated vaccine used for large ruminants
- Other inactivated emulsion vaccines registered in the Republic.

Note: Specific prophylaxis is effective only when combined with general preventive measures such as proper hygiene, nutritional management, and veterinary care.

**Measures for the Prevention and Eradication of the Disease.** Preventive measures against necrobacillosis in adult cattle aim to halt the spread of the disease and prevent its emergence within livestock farms. These include a comprehensive set of veterinary-sanitary actions. Once the diagnosis is confirmed, the farm is declared epizootically compromised, and strict quarantine restrictions are implemented.

**Infected animals are isolated and treated.** Severely affected and older animals are culled for selection purposes. All animals on the affected farm are supplemented with micro- and macroelements as well as vitamin preparations, based on blood test results and established nutritional requirements. Vaccination is carried out for all adult cattle both for treatment and prophylaxis. Every 10 days, the distal limbs of the animals are treated with either 10% formaldehyde or copper sulfate solution. Milk obtained from sick animals is pasteurized before use. Quarantine restrictions are lifted 4 months after the removal or slaughter of the last infected animal and following the completion of final disinfection procedures.

## CONCLUSION

Necrobacillosis is a highly contagious infectious disease that can cause significant economic losses in livestock farming. Understanding the epizootiology and pathogenesis of the disease is critical to implementing effective preventive and therapeutic measures.

Key factors in disease development include the general health status of animals, proper care, and sanitary conditions. Timely intervention by veterinary professionals, along with the correct use of antibiotics and other medications, is crucial in managing the disease. Vaccination, along with strict sanitary and prophylactic measures, remains an effective approach to protect livestock from infection.



If all preventive strategies are correctly applied - including improved nutrition, isolation of infected animals, and proper medication - the spread and eradication of the disease can be effectively achieved.

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