



Intestinal Disorders Caused By Bacteria Part 2

*This article is the second in a 2-part series on intestinal disorders in calves caused by bacteria.
Two types of bacteria may be found in the intestinal regions of the calf: salmonella and coli.*

SALMONELLA INFECTION (SALMONELLOSIS)

*Intestinal disorders may be caused by non-infectious factors (housing, feeding)
or by infectious factors (viruses, bacteria, protozoa).*

Salmonellosis is an epidemic with a high morbidity and mortality rate. The pathogens, salmonella bacteria, initially multiply in the intestine where they cause severe inflammation and diarrhea.

Incidence

In calves Salmonellosis usually appears in an epidemic from at the age of 2 to 6 weeks, causing heavy losses.

Calves surviving the disease often become carriers. These are animals which have survived the infection in the intestine and continue to excrete salmonellae without showing any signs of the disease. They continually infect other animals.

Pathogen/Cause

Salmonellae are 1 to 3 cm long, encapsulated rod-shaped bacteria capable of ciliary movement. More than 2000 types are known so far. In cattle, Salmonella enteritidis and Salmonella typhimurium are of particular importance.

The capsules make the salmonella very resistant. In dried-out feces they retain their contagion for several years, on contaminated pastures for several months and in hay obtained from these pastures they remain contagious for up to 11 weeks.

Transmission/Route of Infection

Salmonella infection may be transmitted to livestock by many routes:

- Purchase of calves is the main source. The danger is particularly high if the animals purchased originate from several different herds or have passed through stock yards or auctions, have contracted the infection there and thus introduce Salmonellosis into the cattle. Healthy animals contract the infection by direct contact with salmonella contaminated feces or by contact with feces-contaminated feed, drinking water, stalls etc. The outbreak of the disease is further promoted by the stress of transport, re-housing and change of feed.
- Man must be regarded as a further source of infection. Salmonellosis is introduced by persons moving from barn to barn in the course of their work (i.e. veterinarians, inseminators, drivers of cattle and feed trucks, etc.) by the transmission of salmonella-containing feces adhering to their clothes and especially boots or shoes. Since man is attacked by the same type of pathogen, he is himself a possible source of infection. A particular danger arises where a person has recovered from an infection and has become a carrier. Persons excreting salmonellae are often unaware of having the disease. This is why when Salmonellosis has been officially diagnosed in calves – the persons taking care of the animals may also be examined if an infection in man is suspected.
- Domestic and wild animals (dogs, cats, mice, rats, deer, rabbits, birds) may also transmit the disease.
- Salmonellae may also be introduced by the purchase of contaminated feedstuffs.
- During the grazing season waterways, ponds and lakes also constitute a danger. Protein-containing impurities (blood, waste material) sink to the bottom where they offer the salmonella an ideal growth medium. If the bottom of the waterway, pond or lake is disturbed (ducks, high water, flooding) the pathogens rise to the surface of the water. If the animals drink the



water, they infect themselves directly. In the event of flooding, the pasture is contaminated and the cattle contract the infection by eating the grass.

Course and Symptoms of the Disease

The pathogens taken up by the mouth initially settle only in small numbers on the villi of the small intestine, but multiply rapidly, causing damage to the protective layer of intestinal villi and intestinal infection due to harmful substances (toxins, enzymes) excreted by the salmonellae. The goblet cells of the small intestine react with increased production of mucus. This greatly dilutes the digestive enzymes, so that the chyme cannot be processed and broken down completely. The undigested chyme is broken down by bacteria in decomposition and fermentation processes, whereby a shift in the intestinal pH occurs. The body tries to balance this pH shift by moving more fluid from the body tissue into the intestine. The calf shows dullness and raised body temperature right from the start of the disease, soon giving rise to diarrhea with yellow fluid and malodorous feces. The feces increasingly change color, become grayish green and contain mucosal fragments.

As a result of the decomposition of the large amount of undigested protein present in milk, the intestinal pH rises. Here too, pathogens may ascend from the large intestine and cause a secondary infection which may be so massive that the coli infection often masks the original Salmonellosis when the diagnosis is established.

With the further process of the disease, the infection affects the entire intestinal tract and hemorrhages appear in the large intestine and the rectum. The feces become dark brown or black, contain tracers of fresh blood (unchanged blood from the rectum) and remain fluid. The salmonellae provoke a defense reaction in the intestine of the calf whereby blood components (fibrin) are released. This fibrin and fragments of the intestinal mucosa appear as off-white flakes in the feces.

The severe, bloody intestinal infection alone can lead to the animal's death within a few days, following the same processes as with the advanced stage of the intestinal disorder originally caused by viruses. This condition, too, finally gives rise to dehydration of the body tissues and thickening of the body fluids leading to a breakdown of the metabolism and the death of the animal. As a result of the damage to the protective layer of intestinal villi, the salmonellae themselves, their toxins and incompletely broken down therefore incompatible feedstuffs may be released into the blood stream (septicaemic form of Salmonellosis). The salmonellae can settle in all organs of the body (organ form of Salmonellosis). Inflammations of the joints, lungs, meninges and spinal cord are frequently seen. If the joints are affected, the clinical profile of septicaemia in newborn calves appears. Damage to the brain and spinal cord in conjunction with paralysis very quickly leads to the death of the animal. If the lungs are affected, fibrinous pneumonia occurs.

The severe forms of the infection which carry a high mortality rate (30% to 50%) are found particularly in calves from the 2nd to the 6th week of life.

If older calves contract the disease, the losses are much smaller. In such cases we frequently observe diarrhea which abates after a few days. With these animals, some of the pathogens remain in the intestine without causing further symptoms. The salmonellae continue to multiply there and are constantly excreted in the feces. Since such calves show no visible symptoms, they cannot be identified when they are brought to market. They are the dreaded "carriers".

The stress suffered by moving calves promotes the multiplication of salmonellae and increases the risk of infection.

Other calves purchased at the same time are then particularly at risk. The change in feed brings about a shift in the intestinal pH value. This disturbs the normal intestine flora, enabling the remaining salmonellae to spread and causing an outbreak of the disease which, like a secondary bacterial infection, is due in the last resort to a change in the intestinal environment. The same processes take place as with the casual salmonellae infection by mouth.

Diagnosis

In the living animal a definite demonstration of the pathogen can only be achieved by an examination of fecal samples in the laboratory. For this purpose the so-called "enrichment method" is employed, using culture media which promote the multiplication of salmonellae and at the same time inhibit the growth of other intestinal bacteria (e.g. E. coli). The culture media



are coated with this enriched solution and incubated once more. If salmonellae are present, a characteristic change in color is observed. By means of further examinations it is then possible to determine individual types of salmonellae.

The pathogens are not continuously excreted in the feces. If the fecal examination reveals salmonellae, it is certain that an infection is present. If the finding is negative, i.e. if no salmonellae are secreted, this does not necessarily mean that there is no infection, since the pathogens are often excreted intermittently.

Autopsy of animals that have died or have been slaughtered reveals an infection of the intestine and an enlargement of the spleen. Small punctiform grayish white or yellowish tissue changes are found in the intestine, liver, spleen, kidneys and lungs. The kidneys often show minute punctiform hemorrhages which are an important sign of salmonellae in meat inspections. The cultivation of pathogens from the organs of animals that have died is carried out on similar lines to the bacteriological examination of fecal samples.

A further aid in diagnosis is the serological blood test which demonstrates the antibodies formed as a result of the infection. However, this test only shows that the animal has been in contact with the infection at some time. The serological blood test does not become significant until a high level of antibodies is found in the blood or repeated tests show a rising antibody level (rising positive titre).

Treatment

Salmonellosis is a bacterial disease, for which reason specific treatment with antibiotics is possible.

As with all diarrheal conditions, further steps need to be taken to preserve life and subsequently to restore normal intestinal function. The specific treatment of Salmonellosis is extremely difficult and protracted for the following reasons:

- There is a large number of different salmonella strains with differing pathogenic properties.
- The great adaptability of salmonellae quickly leads to resistance. After a short period of treatment the drugs are no longer sufficiently effective or fail altogether. This applies particularly if the dosage was inadequate and the duration of use too short.
- After the initial intestinal infection, salmonellae may settle in all parts of the body. It is difficult to combat the abscess-like encapsulated foci in the organs and the high salmonellae concentrations in the synovial fluid with antibiotics. These foci can provoke a new infection at any time.
- Because of the possibility of carriers, the infection may flare up again and again. It is only by repeated bacteriological examination of fecal samples from every animal of the stock that these carriers can be identified.

When salmonellae have been demonstrated on a farm, either by the examination of fecal samples or by autopsy, we proceed as follows:

1. Notification of the local veterinarian.
2. Immediate treatment of all animals at risk via the drinking fluid.

After receipt of the result of a sensitivity test, the treatment already started is continued or modified according to the test result. The antibiotics found to be effective in the sensitivity test are selected in accordance with the following criteria: Efficacy, tolerance, absorbability and price.

3. For the treatment of salmonella infection, antibiotics are required in high dosage. Here the necessary high dose alone can damage the intestinal flora, although in principle the drug used does not, or only to a very slight extent, impair micro-organisms in the intestine if it is given in low dosage. Often it is vital, especially after the sensitivity test has been carried out, to use active substances which are known to damage the intestinal flora.



After completion of antibiotic therapy in Salmonellosis, the natural intestinal flora should therefore be restored as soon as possible.

With the use of lactic acid-forming bacterial cultures the normal intestinal flora is quickly restored. The intestinal villi are surrounded by the protective shield of the lactoflora, which prevents the salmonellae from attaching themselves to the villi. In this way the sick calf can recover more quickly and the stunting of some animal, which is often seen after Salmonellosis, is prevented.

These immediate measures (notification, specific treatment) are supported by an appropriate program. Here the following points should be considered.

- Best possible separation of different parts of the barns and entire barns.
- Laying down disinfection mats
- Allocate separate feeders to affected barns/herds.
- Separate clothing for barns (shoes, coveralls).
- Improve cleanliness.
- Mucking out, thorough cleaning and disinfection after treatment.
- Even if all technical and hygienic measures are carried out, they are often unable to prevent renewed infections. After some time has elapsed, we therefore administer lactic acid-forming bacterial cultures to all calves at risk in order to prevent a renewed flare-up of Salmonellosis in the stock. The constantly acid environment thus obtained in the small intestine supports and strengthens the lactoflora and creates unfavorable conditions for salmonellae.

Prevention

Specific measures for the prevention of salmonella infection, such as vaccination, are not possible. If the presence of the infection is suspected, treatment of the calves is inappropriate for the following reasons:

For the treatment of salmonella infection, antibiotics must be given in high dosage. However, such treatment also destroys bacteria which are vital for the digestion. Loss of appetite and intestinal disorders may thus be caused unnecessarily.