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Lecture title: SALMONELLOSIS IN RUMINANTS AND HORSES

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Summary:

***Introduction and Etiology*:**

- Salmonella is gram-negative, rod-shaped bacilli belonging to the family Enterobacteriaceae, it is the causative agent of salmonellosis Salmonella spp.
- Salmonella belong to the most important food-borne pathogens causing human infection.
- The bacterium is a facultative intracellular organism with worldwide occurrence in all mammal species.
- The genus Salmonella consist of only two species, *S. enterica* and *S. bongori*. Based on molecular characteristics.
- Currently over 2600 serovars are recognized, of which most of them causing infection in people and other mammals.
- The clinical presentation can range from a healthy chronic carrier state to acute or chronic enteritis to septicemia, others less common clinical presentations include abortion, arthritis, respiratory disease, necrosis of extremities, and meningitis.
- The serovars that most commonly cause salmonellosis in farm animal species are as follow:
  - Cattle: *S. Typhimurium, S. Newport, S. Enteritidis*
  - Sheep and goats: *S. Typhimurium, S. enterica sub sp. arizonae, S. Abortusovis*
  - Horses: *S. Typhimurium, S. Abortusequi, S. Newport, S. Enteritidis*

***Epidemiology*:**

1- Occurrence

- Worldwide occurrence.
- Prevalence of infection in healthy animals varies according to species and country.
- The morbidity rate in outbreaks in calves and sheep is usually high (50% or more).
- Morbidity and mortality are usually highest in calves under 12 weeks of age.
- In all species the case–fatality rate often reaches 100% if treatment is not provided.

2- Methods of transmission and source of infection:

o Direct or indirect means.

The infected animal is the source of organism → feces can contaminated feed and water.

- Carrier animals shed organism with feces and may introduce infection into herd.

- Rodents and wild birds are also sources of infection for domestic animals.

3- Risk factors

A- Infection with a *Salmonella spp.* is usually not sufficient to cause clinical salmonellosis, except in the newborn.

B- The response to the infection varies depending on

- The infectious dose.
- The immunologic status of the animal, dependent on:

- Colostrum intake in neonates.
- Previous exposure to infection.
- Exposure to stress factors such as:
  - Deprivation of feed and water.
  - Transportation.
  - Drought.
  - Intensive grazing and housing.
  - Mixing animals from different sources.
  - intercurrent disease.
  - anesthesia and surgery.
  - dosing with antimicrobials or anthelmintics.

C- Temperature and wetness are most important environmental risk factors. Salmonella are susceptible to drying and sunlight.

***Pathogenesis*:**

Infection (fecal-oral route)
↓
Proportion of the organisms resists the low pH of the stomach
↓
Reach the distal ileum and the cecum
↓
Invade the mucosa
↓
Replicate in the submucosa and Peyer's patches
↓
In young and stressed adult animals, spread beyond the mesenteric lymph nodes occurs
↓
The infection is established in the reticuloendothelial cells of the liver
↓
Invades the bloodstream
(Systemic infection is established and salmonellosis as a disease is developed)

***Principal manifestations of salmonellosis pathogenesis*:**

1. Septicemia

Bacteremia after invasion of the bloodstream
↓
Febrile reaction
↓
Early septicemia may be rapidly fatal.

- If the systemic invasion is not sufficient to cause septicemia, other manifestations can occurs.
- Many animals survive this stage of the disease, but localization of the salmonellas occurs in mesenteric lymph nodes, liver, spleen, and particularly the gall bladder.

2. Enteritis

Bacterial invasion of the mucosal epithelium of the distal ileum or proximal colon
↓
Extensive local tissue damage
↓
Shortening of the villi and degeneration of the enterocyte layer
Inflammatory response → fever

(Massive infiltrate of polymorphonuclear cells into the lamina propria and submucosa and secretion of fluid into the intestinal lumen)

- Enteritis may develop at the time of first infection or at some other time in carrier animals.

3. Abortion

Primary lesion in maternal tissues
↓
Bacteria invade and multiply in the placenta
↓↓
Bacteria invade the fetus
↓
Fetal death

- Common manifestation in the second and third gestational stages.

4. Terminal Dry Gangrene and Polyarthritis

Possible sequelae are:

- Terminal dry gangrene caused by arteritis of the extremities of the limbs, ears, and tail.
- Epiphyseal osteomyelitis affecting the metaphyses, and polysynovitis and arthritis.

***Clinical Findings*:**

- The most common clinical manifestation of salmonellosis is ***enteritis***.
  - Other conditions including: *acute septicemia, abortion, arthritis, and respiratory disease*.

- The disease is described as three syndromes:
  - Septicemia
  - Acute enteritis.
  - Chronic enteritis.

- **Septicemia**
  - Common in newborn foals, calves, and lambs.
  - Depression, dullness, prostration, high fever.
  - Death within 24 to 48 hours.
  - Newborn animals that survive the septicemic state usually develop severe enteritis, with diarrhea evident at 12 to 24 hours after the illness commences.
    - If they survive this stage of the illness, ***residual polyarthritis or pneumonia*** may complicate the recovery phase.

- **Acute Enteritis**
  - Common in adult animals of all species.
  - High fever with severe diarrhea, sometimes dysentery, and occasionally tenesmus.
  - Complete anorexia, but in some cases increased thirst.
  - Heart rate is rapid, respirations are rapid and shallow, mucous membrane are congested.
  - Severe dehydration and loses of weight, and weakness.
  - Pregnant animals commonly abort.
  - Case–fatality rate without early treatment may reach 75%.

- **Chronic Enteritis**
  - Common form in pigs following a severe outbreak.
  - Occurs occasionally in cattle and adult horses.
    - Intermittent or persistent diarrhea, with spots of blood, mucus, and firm fibrinous casts.
    - Intermittent moderate fever.
    - Loss of weight leading to emaciation.

- **Abortion**
  - May occur without any previous clinical evidence of salmonellosis in the herd.
  - Occurs in the second and third stages of pregnancy.
  - Cows that abort may be ill with a fever, anorexia.
  - Retain fetal membranes.
  - Calves may be born shortly before term and die in the perinatal period.

- **Terminal dry gangrene of the extremities of calves**
  - Lameness, swelling of the hind limbs below fetlocks, and separation of the skin above fetlock.
  - The distal portion of the limb is cool, loss of sense.
  - Clear line of demarcation of the skin at the level of the fetlock joints

- Phalanges may be separated from the metatarsus.
- Tips of the ears may become hard and deviated medially.

***Clinical Pathology*:**

1- Bacterial Culture
- Usually from feces, but it is difficult and unreliable for different factors including:
  - the method used to collect samples.
  - the amount of fecal material submitted.
  - variation in the fecal shedding of the organism.
  - The bacteriologic method used.

 DNA Recognition and Immunologic Methods, e.g., PCR and ELISA.

***Necropsy Findings*:**

 Septicemic hemorrhages.
 Mucoenteritis: fibrinohemorrhagic necrotic enteritis; enlarged mesenteric lymph nodes.
 Foci of necrosis and thickened intestinal wall in chronic enteritis

***Differential Diagnosis*:**

 The clinical diagnosis of salmonellosis is difficult because of the number of other diseases that resemble each form of the disease.
 The septicemic form of salmonellosis resembles coliform septicemia.
 Acute enteric salmonellosis:
- Coccidiosis.
- Winter dysentery: (no toxemia, no dehydration, and the disease is self-limiting in 24–48 h.)
- Mucosal disease: (viral, typical oral erosions, persistent diarrhea, lesions in the interdigital clefts, and a high case–fatality rate).
- Bracken fern poisoning: (dysentery, scleral hemorrhages, a history of access to the bracken plant.)

 Chronic enteric salmonellosis:
- Paratuberculosis (Johne's disease).
- Chronic molybdenum poisoning.
- Massive stomach fluke infestations may also cause diarrhea and dysentery.

***Treatment*:**

 Primary Treatment: Antimicrobial Therapy(5-10 days)
o Trimethoprim-sulfonamide (20 mg combined/ kg) IV/IM every 12–24 h).
o Amoxicillin (10 mg/kg IM every 12 h).
o Enrofloxacin (2.5–5.0 mg/kg SC/IM every 24 h).
o Ceftiofur* (1.1–2.2 mg/kg BW every 24 h SC/ IM for 3 days)
 Oral treatment in cattle is satisfactory but it is not recommended, in horses not recommended too (worsening of the diarrhea resulting from an alteration of the normal population of intestinal microflora).

Supportive Therapy

o Use of fluids and electrolyte solutions orally and intravenously to replace fluid loss and correct electrolyte and acid-base imbalances.

o Non-steroidal anti-inflammatory drugs (NSAIDs):

- decrease endotoxin related symptoms.
- control pain.
- possibly prevent the risk of laminitis in horses.

***Control and prevention*:**

Prevent introduction of infection into herd.

o Introduce the animals from farms free of salmonellosis.

o Introduce only those animals likely not to be carriers.

Limit spread of infection within the herd:

o Identify carrier animals.

o prevent mix husbandry of different animal species in farm.

o Use prophylactic antimicrobials.

o Restrict movement of animals

o Clean water supply.

o Hygiene and disinfection of buildings.

Avoid spread of infection in veterinary clinics and dispose of infective materials.