**ENTERIC DISEASE ASSOCIATED WITH *Clostridium perfringens***

*Clostridium perfringens* resides in the intestinal tract of domestic animals and can produce a number of toxins that result in enteric and histotoxic disease. *C. perfringens* isolates are classified into one of five types, types A,B,C,D&E, depending on their ability to produce the four major lethal toxins: the alpha, beta, epsilon, and iota toxins. The activities of these major lethal toxins are the basis of the pathogenesis of the classical enterotoxaemia attributed to this organism and described below.

**Equine intestinal clostridiosis**

A syndrome historically named equine intestinal clostridiosis has been attributed to intestinal infection with *C*. *perfringens* type A in adult horses .The syndrome was characterized by an acute profuse watery diarrhea with high mortality in adult horses

**Enteritis in piglets**

*C. perfringens* type A is associated with diarrheic food poisoning in humans and a similar diarrhea in pigs.

The disease is manifest with a watery yellow diarrhea occurring in piglets under 5 days of age, usually in the first 3 days of age, and a high morbidity but low case .At postmortem there is a mild enterocolitis and villous atrophy.

**Hemorrhagic enterotoxaemia and hemolytic disease in cattle, sheep, and goats**

In the hemolytic disease there is an acute onset of severe depression, collapse, mucosal pallor, jaundice, hemoglobinuria, dyspnea, and the presence of severe abdominal pain. Temperatures range from normal to 41 C. The disease is highly fatal, most affected animals dying within 12 hours of the onset of illness, although occasional animals survive for several days.

**At necropsy**

the cardinal features are pallor, jaundice, and hemoglobinuria. The kidneys are swollen, dark brown in color, and may contain infarcts; the liver is pale and swollen and there may be hydropericardium and pulmonary edema. There is extensive

necrosis of the small intestine.

The syndrome is very similar to that associated with chronic copper poisoning and leptospirosis in calves.

**In the hemorrhagic enteritis**

of calves, foals, and adult cattle the syndrome observed is indistinguishable from that associated with C. perfringens types B and C. The disease in adult cattle occurs most commonly in the period shortly after calving.

The experimental disease in lambs and calves produced by the intravenous injection of toxin is characterized by transitory diarrhea and hyperemia of the intestinal mucosa.

**Enterotoxaemia Associated With *Clostridium Perfringens* Types B, C, and E**

The causative clostridia occur commonly in soil, the animals' housing environment and the alimentary tract of healthy animals, and management factors precipitate disease. The diseases produced by these organisms occur in animals in the first few days of life, with the exception of the disease struck in sheep.

The bacteria are capable of forming spores that survive for long periods. In general, rapidly growing, well-nourished animals are most susceptible. The toxins produced are alpha, beta, and epsilon in type B, and alpha and beta in type C. Beta-2 toxin is also produced by some of these organisms and appears important to their pathogenicity in pigs and horses. Alpha and iota toxin are produced by type E, which is a rare cause of enterotoxemia in calves and lambs.

**The diseases that are produced by these organisms in the different animal species, and the organisms' names, are as follows:**

**1-Lamb dysentery** associated with *C. perfringens* type B. An enterotoxemia of young lambs is also associated with *C*. *perfringens* type C

2-**Goat enterotoxemia** associated with *C. perfringens* type C and rarely by type B

3-**Necrotic enteritis of pigs**, pig enterotoxemia associated with *C. perfringens* types C

**4-Foal enterotoxemia** associated with *C. perfringens* types C and B

**5-Calf enterotoxemia** associated with *C. perfringens* types B and C

6-**Struck**, associated with *C. perfringens* type C, affects adult sheep.

**EPIDEMIOLOGY**

**Lamb dysentery and type C** **enterotoxemia**

**Animal and environmental risk factors**

In **lamb dysentery**, the incidence of

1-disease may reach as high as 20-30%.

2-In an outbreak, the disease initially affects 1-4-day-old lambs and the clinical course is very short.

3-A characteristic of the disease is the tendency for an increase in incidence rate as lambing progresses and for the involvement of older lambs, up to 2-3 weeks of age, which survive for longer periods.

4-The case fatality rate approaches 100 % .

**Type *C enterotoxemia* in lambs** **and goats**

1- The disease prevalent in cold weather and on farms where ewes are kept closely confined in small yards or fields for lambing and kidding.

2-The disease can occur as an outbreak with an attack rate of 15-20% and a case fatality that approaches 100%.

**Enterotoxaemia in foals**

Enterotoxemia in foals has been associated with both *C. perfringens* type B and type C. The disease generally occurs in foals under7 days of age, although enterotoxemia associated with type B has been recorded in a 4-week-old foal. The factors that predispose to disease in foals are poorly defined.

**Enterotoxemia in calves**

Enterotoxemia due to *C. perfringens* type B or C is uncommon in calves. The disease usually occurs as outbreaks of severe dysentery with some deaths in calves7 -10 days old, although calves up to10 weeks of age may be affected.

**Struck in sheep**

Struck in adult sheep on good pasture in spring is limited in its occurrence to certain localities in Britain and is rarely reported.

**PATHOGENESIS**

The organism is ingested from soil and fecal contamination on the surface of the dam's udder. It proliferates and attaches to the surface of the epithelial cells of the intestinal villus but toxin production and mucosal damage may precede attachment.

The factors that allow proliferation and attachment are poorly understood. Toxigenic strains of C. perfringens types B and C both produce both alpha and beta toxin.

**The alpha toxin** is a lethal toxin and is produced in varying amounts by isolates of both types. It is a phospholipase, and hydrolysis of membrane phospholipids in erythrocytes, platelets, leukocytes, and endothelial cells results in cell lysis or other forms of cytotoxicity.

**The beta toxin**

causes increased capillary permeability and may facilitate its uptake from the intestine. Beta toxin is a necrotizing toxin and initially produces damage to the microvilli with degeneration of mitochondria, with eventual destruction and desquamation of the intestinal epithelial cells and the production of a hemorrhagic enteritis and ulceration of the intestinal mucosa

The age incidence of these diseases may be partially explained by the observation that beta toxin is highly sensitive to inactivation by trypsin, which is a component of normal pancreatic proteases. Colostrum contains a trypsin inhibitor and trypsin is decreased or absent in affected pigs. Experimentally administered soybean flour used as a protease inhibitor converts experimentally induced clostridial enteritis from a nonfatal to a fatal disease.

**CLI N I CAL FINDINGS**

**in** **per acute cases**, Lamb dysentery manifest by sudden death without premonitory signs .

**acute form**, there is loss of sucking drive and severe abdominal pain manifest by bleating, stretching, and looking at the abdomen. Lambs pass brown, fluid feces sometimes containing blood, and defecation is often accompanied by painful straining.

Death usually occurs after a period of recumbency and coma within 24 hours of the onset of illness.

**A chronic form** of the disease in older lambs called 'pine', and manifest with chronic abdominal pain and reluctance to suck but no diarrhea, is recognized and responds to treatment with specific antiserum.

**Foals** with enterotoxemia associated with C. pelfringens type B or C show evidence of severe depression, toxemia, marked abdominal pain and collapse with bloody feces, subnormal temperature, fast pulse and respiratory rate, and death within a

few hours.

**In calves** signs include diarrhea, dysentery, and acute abdominal pain accompanied by violent bellowing and aimless running. There may be additional nervous signs. In very acute cases, death occurs in a few hours

In less severe cases, the illness lasts for about 4 days and recovery is slow, usually requiring10-14 days.

**Struck in adult sheep** is manifested only by sudden death, clinical signs not being observed beforehand. Occasionally death is preceded by abdominal pain and convulsions.

**NECROPSY FINDINGS**

1-All species is a hemorrhagic enteritis and some time ulceration in mucosa.

2-in type B infections localized areas of necrosis in the ileum.

3-The intestinal mucosa is dark red and the ulcers are large (up to 2.5 cm in diameter)

4-Intestinal contents are bloodstained and may contain fibrin clots.

5-in type C infection the areas of necrosis are more extensive, involving entire segments of small intestine and often inducing a peritonitis. Subendocardial and subepicardial hemorrhages.

**histological features**

affected segments gut include

1-mucosal hemorrhage

2-, necrosis,

3- fibrin exudation.

4- a neutrophilic infiltrate.

5- Large numbers of bacterial rods line in the luminal surface of these lesions.

**DIAGNOSIS**

1- Bacteriology - 20-30 mL of intestinal content

 (latex

agglutination, anaerobic CULT,

bioassay, PCR)

2-Histology - fixed ileum, jejunum

(several segments of each).

**Differential Diagnosis**

DIFFERENTIAL DIAGNOSIS

All species should be different from other causes of diarrhea in young animals.

• Enteritis associated with *C. perfringens*

type A

• Salmonellosis

• Enteric colibacillosis

• Cryptosporidiosis

**Foals**

Enteritis associated with:

• Strongyloides westeri

• Clostridium difficile

• Actinobacillus equuli.

Struck is strictly regional in distribution and in affected areas can usually be diagnosed on the basis of necropsy lesions.

**TREATMENT**

In individual cases the disease is often too acute for effective therapy but fluid and supportive therapy are indicated. Hyper immune serum is the specific therapy and the major therapy of value. Oral and parenteral administration of penicillin may prevent further proliferation of organisms and production of toxins.

CONTROL

Vaccination, preferably with type-specific toxoid or bacterin, is the specific preventive measure.

**ENTEROTOXEMIA ASSOCIATED WITH *CLOSTRIDIUM PERFRINGENS* TYPE D (PULPY KIDNEY, OVEREATING DISEASE)**

**ETIOLOGY**

Enterotoxemia results from the proliferation of C. *perfringens* type D in the small intestine. This organism produces a number of toxins, the epsilon toxin is the most important and results in vascular damage and the damage to the nervous system typical of this disease.

**EPIDEMI O LOGY**

**Occurrence**

1- The disease most common in lambs, it is also an important of calves and goats.

2-It occurs rarely in adult cattle, deer, domesticated camels, and possibly horses.

3-The prevalence in flocks varies a great deal but seldom exceeds 10%.

4-The case fatality rate approximates 100%.

**Animal and management risk factors**

*1-C. pcrfringcns* type D normally inhabits the alimentary tract of sheep and other mminants but only in small numbers.

2-Under certain conditions, the organisms proliferate rapidly in the intestines and produce lethal quantities of epsilon toxin.

3-In most, if not all circumstances, the affected animals are on highly nutritious diets and are in very good condition.

4-The husbandry conditions in which the disease occurs include grazing on lush, rapidly growing pasture or young cereal crops, and heavy grain feeding in feedlots. Lambs on well-fed, heavy-milking ewes are particularly susceptible. The occurrence of the disease under these conditions has given rise to the **name 'overeating disease'.**

**Sheep & goat**

1-The highest incidence of the disease is in suckling lambs between 3 and 10 weeks of age.

2-The disease occurrence is highest when ewes are grazed on lush pastures that result in profuse lactation.

3-The disease can occur following rain, and in flocks newly introduced to lush pastures is often manifest 5-14 days after introduction.

4-Single lambs are more susceptible than twins.

5-Weaned lambs up to 10 months of age are the second most susceptible age group and the disease associated with highly nutritious diets.

 6-Sudden changes in diet appear to be the most common predisposing factor.

7-Calves Enterotoxemia is most common between1 and 4 months of age and the same risk factors pertain as for lambs.

8- The disease rare in horses but it has been suspect in a group of mature horses fed concentrates during a drought period

**Pathogenesis**

After ingested C. perfringens type D, this destroyed in large numbers in the rumen and abomasum, although some survive to reach the duodenum, where multiplication occurs and toxin is produced. The disease not occur until the certain circumstances,

1-passage of large quantities of starch granules into the duodenum when sheep overeat on grain diets or are changed suddenly from a ration consisting largely of roughage to one consisting mainly of grain.

2-heavy milk feeding may have the same effect.

A slowing of alimentary tract movement has also been thought to permit excess toxin accumulation and it may be that any factor that causes intestinal stasis will predispose to the disease.

The effect of epsilon toxin of *C. perfringens* type D .

1- Increases the permeability of the intestinal mucosa to this and other toxins.

2-Vascular damage and increase in vascular permeability .

**CLINICAL FINDINGS**

**Lambs**

1-The course of the illness is very short, 2 - 12 hours.

2-Many lambs are found dead without previously manifesting signs

In closely observed flocks the first signs may be dullness, depression, yawning, facial movements and loss of interest in feed.

Cases that survive for a few hours show a green, pasty diarrhea, staggering, recumbency, opisthotonos, and severe clonic convulsions.

**Acute cases** severe clonic convulsions with frothing at the mouth and rapid death.

**Adult sheep**

1-These usually survive for up to 24 hours.

2-They lag behind the flock and show staggering and knuckling, champing of the jaws, salivation, convulsions, muscle tremor and rapid, shallow, irregular respiration.

3-There may be bloat in the terminal stages.

**Calves**

The syndrome is similar to that seen in adult sheep, with nervous signs predominating.

1-Peracute cases are found dead without signs of illness and with no evidence of struggling

2-acute cases show a sudden onset of bellowing, mania, and convulsions, the convulsions persisting until death occurs 1-2 hours later.

3-Subacute cases ,do not drink, are quiet and docile, and appear to be blind, this state for 2-3 days and then recover completely.

**Goats**

Diarrhea is a prominent sign in affected goats, especially in survive for more than a few days.

those that

1- per acute form, most common in young kids, characterized by convulsions after an initial attack of fever (40 C) , with severe abdominal pain and dysentery; death occurs in 4-36 hours.

2-In the acute form, which is more common in adults, usually no fever, and abdominal pain and diarrhea are prominent with death or recovery within 2-4 days.

3-In chronic cases, the goats may be ill for several weeks and show anorexia, intermittent severe diarrhea and, in some cases, dysentery. Chronic wasting, anemia, and emaciation

**NECROPSY F I N DINGS**

1-The body condition of the animal is usually good

2-fecal staining of the perineum and rapid decomposition of the carcass.

3-excess of clear, straw-colored pericardial and thoracic fluid that clots on exposure to air.

4-petechiae are present in the epicardium , endocardium and there is pulmonary edema.

5-Patchy congestion of the abomasal and intestinal mucosa

**Differential diagnosis**

Lambs

• Acute pasteurellosis

• Septicemia associated with Histophilus

somni (formerly Haemophilus agm)

• C. sordellii

• Polioencephalomalacia

• Rumen overload

**Sheep**

• Hypocalcemia

• Hypomagnesemia

• Focal symmetrical encephalomalacia

(chronic enterotoxemia)

• Rabies

• Pregnancy toxemia

• Louping ill

**Calves**

• Lead poisoning

• Polioencephalomalacia

• Hepatoencephalopathy

• Histophilus somni (formerly

Haemophilus somnus)

**Goats**

• Salmonellosis

• Coccidiosis

 **TREATMENT**

1-In general, the clinical course of the disease is too acute for effective treatment.

2-In goats the course is longer, and antitoxin in combination with orally administered sulfadimidine may be effective in treatment.

**CONTROL**

There are three major control measures available: reduction of the food intake, administration of antitoxin, and vaccination.

These may be used individually or in combination.

**Reduction in food intake**

is effective in control and is used as a short-term control while waiting for immunity to develop after vaccination.

**Antitoxin**

Antitoxin can be administered to all sheep as soon as an outbreak commences. The administration of epsilon antitoxin200 ill/kg BW will provide for protective circulating antitoxin levels for 21-29 days.

**Vaccination**

Immunity in sheep is produced by suitable vaccination. Ewes should be vaccinated twice at an interval of at least 1 month and with the last vaccination approximately4 weeks before lambing will result in good passive immunity in young lambs, having protective antibody levels at 8 weeks of age.

Lambs can be vaccinated with toxoid when 4-10 weeks of age and again a month later.

Available vaccines are toxoids, and adjuvants generally improve the antigenicity. Activated alum-precipitated toxoid is the common vaccine in use.