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Bovine cryptosporidiosis in calves : A Review

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Introduction

One of the culprits during this tough spring was a parasite called Cryptosporidium. It is an important zoonotic pathogen transmitted primarily through water.Cryptosporidiosis is a common cause of diarrhoea in young calves. It is caused by a protozoan parasite of the genus Cryptosporidium,family Crptosporididae,order Eucoccidiorida,class Coccidian and phylum Apicomplexa.The parasite infects epithelial cells in the microvillus border of the gastrointestinal tract of all class of vertebrates7.and causes severe chronic and even fatal diarrhea with malabsorption and dehydration 19

Currently,there are 16 recognized species and nearly triple this number of unnamedNeonatal calves becomes infected within the first few days after birth.Feces containing eggs are a major source of infection, but calves may also spread the parasite through direct contact. Since the egg survive well in the environment, calves can also pick up infections from water,feed and soil.In addition to calves, cryptosporidiosis affects other young animals including piglets,lamb,kid,oats,foals and fawn (farmed deer).

Stressors such as inadequate milk consumption,cold weather and wind may also play an important role in determining how severe the infection will be and how long it will last.

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Life cycle of Cryptosporidium;

Cryptosporidium Oocyst are transmitted between hosts via fecal oral route, either directly via contact with feces from infected hosts,or indirectly through environmental contamination or ingestion of contaminated food or water. Following ingestion of infective Cryptosporidium Oocyst by the host[17], The Oocyst may contain remain in the environment for very long period without losing its infectivity; due to a very robust oocyst wall that protects the four sporozoites against physical and chemical damage.The endogenous phase begins with the ingestion of oocyst by a suitable host.When a new host ingests the oocyst, the suture in the oocyst wall open (encystations), triggered by the body temperature and the interaction with stomach acid and bile salts. Four sporozoites are released in to the small intestine,mainly jejunum and ileum [20].The invasion process is likely to involve molecules discharged from parasite organelles found in the apical end of the sporozoites affix to the luminal surface of the epithelial cell and differentiate asexually in to trophozoites which to produce two different types of meront (type I and II) by merogony.Type I meronts form eight merozoites,which then rupture out of the host cell, infect other neighboring host cells and either develop in to IImeronts or complete another cycle of type I meronts.Type II meronts produce four merozoites, which become microgamonts[9]. The differentiated gametes,undergo sexual reproduction within the same host.Fertilization between macrogamete results in formation of a zygote and develop in to cystwhich containing four sporozoites.thickwalled,oocyst which is commonly excreted by the host, after sporogony and thin walled oocyst,which is primarily involved in autoinfection.The thin-walled oocyst may exist within the same host and start a new lifecycle (autoinfection).This may leads to a heavily malabsorption or secretarydiarrhea.The thick-walled oocyst is excreted with the fecesand is environmentally robust.The oocyst is the results of the sexual reproduction cycle[18].

Epidemiology

Geographical Distribution:

In India theCryptosporidium oocyst were first demonstrated in the feces of buffaloes and zebu cattle and organized dairy farms in and around Bangalore,South India [10].Since the first of its presence in cattle; the disease has been the object of many prevalence studies worldwide and has been documented in animals and human being. Most infections have been attributed to C.parvum associated with clinical disease. Most of the published studies were from industrialized countries and little is known on the prevalence of the disease in African countries [5]Cryptosporidiosis has world wide distribution[4]

Cryptosporidiosis in cattle has been recognized as an emerging threat in different parts of the world.

Reports of Cryptosporidiosis have been made from many countries including United States, Canada, South America, United Kingdom,Norway,Iron,Africa,Pakistan,Thailand, Australia,Japan,Germany,and Hungary[6].

In developing countries, Cryptosporidium infections occur mostly in children younger than 5 years,with peak occurrence of infections and diarrhea in children younger than 2 years.In industrialized countries,epidemic Cryptosporidiosis can occurs in adults by the food-born or water borne route [8].

In addition to carpological data, several immune-serological surveys have been conducted.Sero-prevalence ranges from 25-30% in industrialized countries and 50-60% in developing countries.These data strongly suggest that Cryptosporidiosis highly prevalent in humans and animals,both in developed and developing countries[8].

Source of Infection and modes of Transmission

Oocyst infection begins when we ingest the one-celled cryptosporidium parasite. Some

strains of cryptosporidium may cause more serious disease.

The source of infection in feces which contain oocystthat are fully sporulated and infective when excreted. Large numbers are excreted during the patent period in calves resulting in heavy environmental contamination[14]. These parasites then travel to intestinal tract, where they settle in to the wall of intestine. Eventually, more cells are produced and shed in massive quantities in to the feces.Where they are highly contagious.

The role of cows as a possible infection source for calves has been addressed.Such transmission could be facilitated by a per parturient rise in oocyst shedding in infected cows.Per parturient rise have been shown for C. parvum and for C. andersonioocyst[15].

Transmission from one host to another is achieved by ingestion of encysted,sporulated oocyst for Cryptosporidium[11].The routes through which oocyst are transmitted from feces to the mouth are diverse and reflect the main transmission routes for many intestinal pathogens[1]Transmission may be direct from host to host or indirectly by ingestion of fecal contaminated feed or water. Transmission is likely to be direct between infected animals since environmental contamination on farms with oocyst would be insufficient to account for the high levels of infection seen in cattle [11].

Contact with any acquaintances or household member with a similar illness attendances or work of a child care facility by case a household member; scourers of drinking water, intending water of homes and work,as well as streams, lakes and other untreated sources, high risk foods(e.g. raw milk or raw milk products) are the common source of infection or humans.

Risk factorsassociation with Cryptosporidium infection

The common occurrence of Cryptosporidiosis in young animal reflects their susceptibility to infection with a low number of Oocyst and common exposure to oocyst[7].

People who are at increased risk of developing cryptosporidiosis include:

- Those who are exposed to contaminated water
- Children particularly those wearing diapers, who attend child care centers
- Parents of infected children
- Child care workers
- Animal handlers
- Those who engage in oral to anal sexual activity
- International travelers, especially those traveling to developing countries
- Backpackers, hikers and campers who drink untreated, unfiltered water
- Swimmers who swallow water in pools,lakes and rivers
- People who drink water from shallow,unprotected wells.

There is a significant association between age and risk of infection with Cryptosporidium. Cryptosporidiosis due to C. parvum is predominantly a problem of neonatal animalswih maximum rate of excretion of oocyst between the age of 4 and 21 days. Although exceptions occur, older animals generally develop poor infections even when unexposed previously to this parasite[21].

Age related resistance, unrelated to prior exposure, has been observed in lambs but not calves[14].

Symptoms-

Neonatal animals infected with C.parvum may suffer from profuse watery diarrhea, in appetence. lethargy, dehydration and in some cases death can occur. The onset of diarrhea usually occurs around 3-4 days after ingestion of infective oocysts and lasts for approximately 1-2 weeks. Oocyst shedding occurs between 4 and 12 days post infection though this can vary depending on the initial challenge dose [22].The first symptoms of cryptosporidium infection usually appear within a week after infection and may include:

- Watery diarrhea

- Dehydration
- Lack of appetite
- Weight loss
- Stomach cramps or pain
- Fever
- Nausea
- Vomiting

Symptoms may lasts for up to two weeks,through they may come and go ssporadically for up to a month, even in people with healthy immune systems.Some people with Cryptosporidium infection may have no symptoms.

Complications

Complications cryptosporidium infection includes:

- Malnutrition resulting from poor absorption of nutrients from the intestinal tract (malabsorption)
- Severe dehydration
- Significant weight loss (wasting)
- Inflammation of a bile duct-passage between the gallbladder and small intestine
- Inflammation of gall bladder, liver or pancreas

Diagnosis-

The diagnosis is confirmed by laboratory testing that identifies the presence of the parasite in the feces. Treatment is often limited to supportive care: keeping calves warm hydrated and fed. Scouring calves should be isolated from the rest of the herd whenever possible to limit the spread.

Numerous techniques including histology and ultra structural examination of biopsy material for lifecyclestages,examination of feces for the presence of Oocyst and detection of Cryptosporidium antigen and DNA,have been used to diagnose infection inhuman and animals. Molecular based techniques are required for species identification.

Histological,the diagnosis of cryptosporidiosis rests on the identification of sphericalOocyst in stool or the intracellular stages with in biopsy specimens of human GIT mucosa. In tissue section, simplehematoxylin and eosin should sufficient to identify the morphology of the intracellular life stage of the parasite in its unique apical location within the intestinal epithelium cell.However, this method of testing can give false negative due to “patchy” nature of the intestinal parasitic infection[17].

A wet mounting using saline and/or iodine is the basis of all microscopic technique. Routine diagnosis of Cryptosporidiosis in most countries has been based on microscopic detection of Oocyst after staining of fecal smears[9]

In specimens containing small numbers of oocysts,increased sensitivity can be achieved by employing a concentration method[7].

Concentration methods using the principals of flotation and sedimentation have been widelyused, with solution such as sucrose, salt and zinc sulphate[9].

Detection of Oocyst- Stool samples from most clinically ill cases will contain large numbers of thick-walled Oocyst and sufficient Cryptosporidium antigen; therefore,the use of standard staining and immunological techniques, should result in a positive diagnosis. Staining methods were then developed to detect and identify the Oocystdirectly from stool samples[17]

The modified acid-fast (Ziehl-neelson) stain is used most reliably and specifically to detect the presence of cryptosporidium oocyst.The Oocyst will appear as pink diameter,containing distinct internal structures.Acid fast stains can also be performed by using either the hot staining method or the cold method.CryptosporidiumOocystsacid-fast and readily identified microscopically with oil immersion at a magnification of 400X.This method is low cost,good for screening large number of samples, permanent stain,making it possible to send doubtful or scanty positive slides to a reference laboratory for confirmation. However,it is time consuming procedure (about

30-45 minutes),requires intensive training and experience to interpret the results [13].

Treatment-

There is no effective drug therapy available for Cryptosporidiosis, due to antimicrobial resistance. However spiramycin, halofuginone and paromomycin may be of some value in reducing Oocyst output and the severity of diarrhea and/or mortality in infected animals[7,14]

One possible explanation for the antimicrobial resistance is thatCryptosporidium establishes a compartment within the host cell, which is morphologically different from the setting used by the related parasites. This unique vacuole may shelter the parasite from antimicrobial. In calves treatments of Cryptosporidiosis consist of supportive therapy. Keep affected animals warm, dry, well fed and at a constant ambient temperature, to minimize their energy requirement during the course of clinical disease. If managed in this fashion,most calves with uncomplicated infection will recover in 5-10 days.Calves that becomes dehydrated should be given appropriate IV fluids or orally. Early electrolyte treatment protocols addressed electrolyte and partial energy balance. The last treatment protocols addressed electrolyte balance, compensate for metabolic acidosis resulting from long term fluid losses, addressed energy balance and partially addressed protein balance by incorporating milk or milk replacer feeding between electrolyte treatments[2].

Prevention

All preventive methods aim to reduce or prevent the transmission of the Cryptosporidium germs that are shed in human and animal feces.Cryptosporidium infection is contagious, so take precautions to avoid spreading the parasite to other people.Currently there are no vaccines available to prevent Cryptosporidiosis in either farm livestock or humans. However, several attempts to develop such a vaccine have been made, some of which were partially successful under experimental conditions.

Public Health and Economic Importance

There is evidence of zoonotic Cryptosporidiosis associated with farms and exposure to infected livestock,particularly young cattle,animal manure and contaminated water, and one of the more common opportunistic pathogen affecting human patient with AIDS.Infection in domestic animal and pets may be a reservoir for infection of susceptiblehuman.In most healthy people, a cryptosporidium infection produces about of watery diarrhea and the infection usually goes away within a week or two. Zoonotic transmissions to veterinary students working in practice for the first time are common, in addition to outbreaks associated with petting zoos or farm visits.

In recent study which analyzed the species and genotypes of Cryptosporidium present within livestock and wildlife grazing on a water catchment area with a history of cryptosporidiosis revealed that farm livestock (cattle and sheep) and wild life (red and roe deer) all shed the same species of Cryptosporidium (C.parva) which was detected in local water supply[19].

In humans, Cryptosporidiosis is considered to be a relatively common non viral cause of self-limiting diarrhea in immune competent persons, particularly in children. Other manifestations include nausea,vomiting abdominal cramps,weight loss and fever.

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