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Cryptosporidiosis

Slide 2

Overview

- Organism
- History
- Epidemiology
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention

In today's presentation we will cover information regarding the organism that causes cryptosporidiosis and its epidemiology. We will also give a brief history about the disease. Additionally, we will talk about how it is transmitted, the species it affects, clinical signs, necropsy findings, and diagnosis and treatment of the disease. Finally, we will address how to prevent the disease.

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THE ORGANISM

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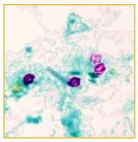
Cryptosporidium parvum

- Coccidian protozoa
- Obligate intracellular pathogen
- Primarily infects intestine
- Forms oocysts
  - Resistant to disinfection
  - Killed by ozone, desiccation



Cryptosporidium parvum is a coccidian protozoan and is an obligate intracellular pathogen that causes a mild diarrhea in humans and animals. The organism primarily infects the small intestine of humans and mammals. Sporulated thick-walled oocysts are infectious and are resistant to many chemical disinfectants. Ozone, which is sometimes used in the water treatment process, effectively kills oocysts. Oocysts may also be killed with 5% ammonia solution or by desiccation. [Photo: *Cryptosporidium* oocysts (purple stain). Source: CDC Public Health Image Library]

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IMPORTANCE

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History

- 1912
  - Discovered by Tyzzer
    - American parasitologist
- Outbreaks associated with
  - Drinking water, food
  - Swimming pools and lakes
  - Hospitals (nosocomial), HIV wards, pediatric hospitals

In 1912, Earnest Edward Tyzzer reported discovery of *C. parvum*, which is now recognized as the parasite usually responsible for mammalian cryptosporidiosis. In the 1970's, it was not clear whether *C. parvum* was an opportunistic parasite or a pathogen. Many outbreaks have occurred in recent years. Some have been associated with drinking water, food, swimming pools and lakes, unpasteurized apple cider and hospitals (nosocomial infections).

[Photo: E. Tyzzer. Source: Illustrated history of tropical diseases, the Wellcome Trust. Edited by FEG Cox]

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History

- 1993: Milwaukee, WI
  - Largest known water supply outbreak
  - 40,000 persons became ill
- 1997: Minnesota Zoo
  - Decorative water fountain
  - 369 cases
    - Most cases in children <10 years old

There have been numerous outbreaks of *Cryptosporidium* in recent years. In 1993, there was an outbreak in the municipal water supply in Milwaukee, WI, causing about 40,000 illnesses. Another outbreak occurred at the Minnesota Zoo, associated with a large decorative water fountain where children were allowed to play. There were 369 cases of *Cryptosporidium* infection, most occurring in children under the age of 10 years. Many other outbreaks have occurred since then and most of them associated with recreational water venues (from CDC website).

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EPIDEMIOLOGY

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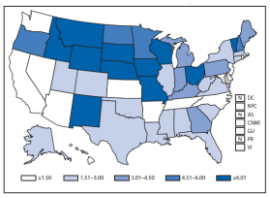
Geographic Distribution



Cryptosporidium can be found worldwide. Cryptosporidiosis is widespread geographically in the U.S. Cases typically increase during the summer with increased use of recreational water.

[Photo: This figure is a map of the United States and U.S. territories that presents the incidence range per 100,000 population of cryptosporidiosis cases in each state and territory in 2011. Source: Summary of Notifiable Diseases – United States, 2011 at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6053a1.htm?s_cid=mm6053a1_e]

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Morbidity/Mortality

- North America
  - 2% of population infected
  - 80% previously exposed
- Worldwide
  - Prevalence lower in developed countries, higher in developing countries
- Animals
  - Morbidity high, mortality low

In North American, approximately 2% of the population is infected and 80% has been exposed at some point. Worldwide, the prevalence is 1 to 4.5% in developed countries and 3 to 20% in developing countries. The infection is usually self-limiting in healthy people and they usually recover after 2 to 4 days. However, episodes of diarrhea can last 1 to 4 weeks. In normal healthy animals, morbidity is high but mortality is low. Animals that are immunosuppressed and neonatal animals are more susceptible to severe disease.

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TRANSMISSION

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Transmission

- Fecal-oral route
  - Person-to-person
  - Person-to-animal
  - Waterborne
  - Foodborne
  - Mechanical
- Aerosol (rare)

Transmission is usually by the fecal-oral route. Sporulated oocysts are shed in the feces and are immediately infectious. If in a moist environment, the shed oocysts can survive for 2 to 6 months. Direct transmission between animals and humans is common. It is estimated that 50% of dairy calves shed oocysts; calves can then spread cryptosporidiosis to each other or to humans. Transmission of cryptosporidiosis from household pets to humans can also occur but is rare and poorly documented. Additionally, humans and animals can ingest the organism through eating or drinking contaminated water or food, or from contacting or licking contaminated non-living objects (fomites). It is also possible to inhale (aerosol) the organism, but aerosol transmission is very rare.

[Photos: (Top) Calf. (Bottom) Lake. Source: Wikimedia Commons]

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ANIMALS AND CRYPTOSPORIDIOSIS

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Disease in Animals

- All mammals
- Common in calves and lambs
- Other species
  - Pigs
  - Dogs (rare)
  - Cats (rare)
  - Horses (rare)

Cryptosporidium parvum is not host specific and can infect all mammals. Cryptosporidiosis is common in young calves, lambs, and other ruminants. Infections usually occur in neonates. It can occur in pigs and is rarely seen in dogs, cats, and horses. Other species of *Cryptosporidium* can affect birds and reptiles.

[Photos: (Top) Calves. Source: Danelle Bickett-Weddle/CFSPH; (Bottom) Lambs. Source: Pixabay.com (public domain)]

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Disease in Animals

- Incubation period
  - ~ 4 days in calves
- Anorexia
- Diarrhea
- Tenesmus
- Weight loss

The incubation period is approximately 4 days in calves. Clinical signs of cryptosporidiosis include anorexia, diarrhea, weight loss, and tenesmus. More severe disease can occur with concurrent infections. Animals can also be colonized without symptoms.

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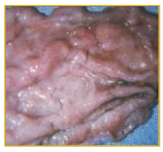
Post Mortem Lesions

- Gross lesions
  - Hyperemia of intestinal mucosa
  - Yellowish intestinal contents
- Microscopic lesions
  - Mild to severe villous atrophy
  - Spherical organisms in the brush border



An animal with cryptosporidiosis will typically have hyperemia of the intestinal mucosa, with yellowish contents. Cryptosporidiosis can affect most of the intestinal tract but usually the most severe lesions are found in the distal small intestine. Horses are usually affected only in the small intestines. Microscopic examinations can show mild to severe villous atrophy. Spherical organisms may also be noted in the brush broader.

[Photo: The mucosal folds of the stomach are markedly thickened, and there are numerous pinpoint foci of hyperemia. Hypertrophic gastritis due to *Cryptosporidium* sp. From: Armed Forces Institute of Pathology/CFSPH]

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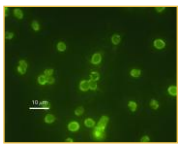
Diagnosis

- Differentials
  - *Giardia, Isospora*
  - Microsporidia
  - *Salmonella*
  - Rotavirus
- Diagnostic tests
  - Fecal flotation
  - Acid-fast staining
  - Immunofluorescence



A differential diagnosis list for cryptosporidiosis should include *Giardia*, *Isospora*, microsporidia, *Salmonella*, rotavirus and other diarrheal diseases. Cryptosporidiosis can be diagnosed by finding *C. parvum* after a fecal flotation in either sucrose or zinc sulfate solutions. The mature oocysts are 4-5 µm in diameter and contain four thin, flat, motile sporozoites. *Cryptosporidium parvum* can also be detected through an acid-fast staining. Oocysts are not shed continuously and repeated sampling may be necessary. The oocysts appear red after the staining. Immunofluorescence can also be used to detect *Cryptosporidium* in feces. Finally, cryptosporidiosis can be detected by stained biopsy/necropsy specimens or fresh intestinal scrapings.

[Photo: Immunofluorescence of *C. parvum* oocysts. Source: CDC Public Health Image Library]

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Treatment

- No specific treatment
  - Supportive care
- No vaccine

There is no specific treatment for cryptosporidiosis other then supportive care. The disease tends to be self-limiting. No vaccine has been developed.

[Photo: Herd of cattle. Source: Bob Nichols/US Department of Agriculture]

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HUMANS AND CRYPTOSPORIDIOSIS

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Disease in Humans

- Similar to disease in animals
- Parasite is accidentally swallowed
  - Contaminated water, food, hands, stool
- People affected:
  - Children
  - Immunosuppressed
  - Travelers
  - Swimmers

Humans, like animals, can become infected by *C. parvum*. People usually become infected by accidentally swallowing contaminated water (e.g. lakes, streams, swimming pools, etc.), eating contaminated food or by contact with objects contaminated with feces or unwashed hands. Also, like animals, young humans and humans that are immunosuppressed (e.g. AIDS patients) are more susceptible to become infected.

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Disease in Humans

- Incubation period: 1 to 12 days
- Clinical signs
  - Profuse, watery diarrhea
  - Abdominal pains
  - Anorexia
- Self-limiting in healthy people
- May become serious in immunocompromised people

The incubation period in human infections is 1 to 12 days with 7 days being typical. The clinical signs for cryptosporidiosis is similar those in animals. In humans, it is characterized by profuse, watery diarrhea with cramping, abdominal pains, nausea, anorexia, flatulence and malaise. Some individuals can also experience vomiting, weight loss, fever, or myalgia. The disease is usually self-limiting in healthy people but can become chronic, debilitating and severe in those who are immunosuppressed. Asymptomatic infections can also occur.

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Diagnosis and Treatment

- Differential diagnosis
  - Similar to animals
- Diagnostic tests
  - Fecal flotation
  - Acid-fast staining
  - Immunofluorescence
- No treatment
- No vaccine

The differential diagnosis for humans should be similar to that for animals and include diseases that cause diarrhea. The diagnostic tests to detect cryptosporidiosis are similar to those done in animals. The tests include fecal flotation with sucrose or zinc sulfate, acid fast staining (oocysts appear red), immunofluorescence, and by staining a biopsy specimen (occasionally done this way). Just like animals, other than supportive care there is no specific treatment available for cryptosporidiosis. No vaccine is available.

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PREVENTION AND CONTROL

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Prevention in Animals

- Keep sick away from healthy animals
- Clean and disinfect
- Good nutrition

Cryptosporidium organisms are common in the environment and can be carried by animals without any symptoms. Keeping sick animals away from the healthy animals is a good way to limit exposure. Chlorine does not effectively kill the organism and it is resistant to many disinfectants. Clean and disinfectant (5% ammonia solution can work) areas where sick animals have been or had diarrhea. Also, provide good nutrition to the animals and keep the animals healthy to minimize the risks.

[Photo: Disinfection supplies. Source: Danelle Bickett-Weddle/CFSPH]

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Prevention in Humans

- Wash hands
- Wash fruits/vegetables
- Don't swallow water from:
  - Lakes
  - Streams
  - Public pools
- Minimize contact with young animals

After working with or touching animals, make sure to wash your hands thoroughly. Also wash your hands thoroughly after using the restroom and before handling foods. Make sure to wash all raw fruits and vegetables before eating. Do not drink water (or swallow) water from lakes, streams, hot tubs, or public pools and do not swim in public pools if you have recently had diarrhea.

[Photo: Taking a swim in the lake. Source: Oakley Originals/Flickr Creative Commons]

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Additional Resources

- World Organization for Animal Health (OIE)
  - www.oie.int
- U.S. Department of Agriculture (USDA)
  - www.aphis.usda.gov
- Center for Food Security and Public Health
  - www.cfsph.iastate.edu
- Centers for Disease Control and Prevention
  - http://www.cdc.gov/parasites/crypto/

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Acknowledgments

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