Intestinal Protozoa of Relevance
Giardia, Cryptosporidium, and Cyclospora

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Learning objectives

1. Learn the epidemiology of the most important intestinal protozoa.
2. Learn the impact of these diseases in resource poor settings.
3. Learn to diagnose the diseases caused by these intestinal protozoa.
4. Learn the treatment of the diseases caused by these parasites.
Case 1

• A 3 year old male brought by his mother to the emergency department in Cuzco, Peru with 7 days of non-bloody diarrhea 5 to 6 times per day, nausea with belching but no vomiting, and anorexia.

• On exam he is afebrile, his weight is 9.8 Kg and his height 87 cm. He appears mildly dehydrated. The rest of the exam was unremarkable.

• Stool examination did not reveal red or white cells. On fresh wet mount examination, the following organisms were found.
Fresh wet mount preparation

• Giardia is the protozoan parasite most frequently reported as a cause of diarrhea worldwide.
• Giardia is classified in 6 species. One of them, *Giardia duodenalis* is further divided in to 6 assemblages.
• *Giardia duodenalis* assemblages A and B are the only capable of producing infection in humans.
• Assemblage B is the most common. It is unclear if different assemblages are responsible for different clinical presentations.

**Giardia species:**
Giardia classification is based on genetics, morphology of the trophozoite on electron microscopy, and host specificity.

The differences in symptoms and clinical presentations in relation to the each assemblage have been studied and are an area of controversy. One study by Homan ML and Mank TG in 2001 showed that G duodenalis assemblage A caused acute self-limited diarrhea among Dutch patients, in contrast, assemblage B caused chronic diarrhea and malabsorption in the same patient population.
Giardia: Life cycle

• There are two stages:
  – The cyst which is the infective stage and is found in the environment.
  – The trophozoite which is the stage causing the disease in the intestine.
• Both forms of the parasite are found in the stools.
Giardia: Life cycle

Cysts are found in the environment most commonly in water and food. For infection to take place, the host must ingest the cysts. Excystation is initiated when environmental stimuli like gastric acid and pancreatic enzymes are detected across the cyst wall. A single trophozoite containing four nuclei (4N each) is released; this divides twice without further DNA replication, resulting in four daughter trophozoites. These, under certain conditions in the jejunum (i.e. lack of cholesterol) encyst and are passed in the stools.
Giardia: Epidemiology

• The infective dose can be as low as 10 to 25 cysts.
• Cysts are infectious immediately after excreted in the stools.
• Cysts are resistant to environmental aggressions and can survive for many weeks and even months.
• Environmental dispersal can lead to contamination of food and water supplies.

With very low infective doses transmission through contaminated water is likely, either directly by drinking it or by contamination of vegetables and food in contact with this water. Cysts are infectious immediately after excreted in the stools, which makes the transmission from person to person possible as demonstrated in studies of transmission among household contacts and among homosexual groups.

The common use of sewage water for agricultural purposes in resource poor settings and the cysts capacity to endure environmental conditions for prolonged periods of time make the contamination of vegetables and the transmission of the infection possible. Large outbreaks of giardiasis have been reported in developed countries through the contamination of water supplies.
Giardia: Epidemiology

- Transmission can be direct by fecal-oral route, through contact with people passing cysts in the stools or indirect through contamination of food and water. Being the later the most common.
  
  **Giardia cysts are not cleared from water supplies by chlorination.**

- There is potential for zoonotic transmission of giardiasis, but controversies exists based on genotyping.
Giardia: Epidemiology

- Groups at risk are institutionalized individuals, day-care center attendees, foreign travelers, those drinking water from streams, lakes or swimming pools, men who has sex with men and immunocompromised individuals.
- In developing countries, poor sanitary conditions are the common denominator. Unsafe food supplies and most importantly unsafe water supplies are risk factors.
- Special high risk situations are refugee camps and post-disaster displaced populations.

Multiple studies have addressed the sanitary conditions and the prevalence of parasitic infestation in children of developing countries. These studies have shown that poor sanitary conditions in the homes, peridomestic conditions like waste disposal methods, garbage disposal systems, number of children in the household, number of persons per latrine and source of water supply influence the prevalence of giardiasis in young children.

Post disaster conditions when overcrowding of displaced population occurs in camps and refuges are especially risky. Difficulties in excretal disposal and contamination of water supplies are likely in these settings.
Giardia: Occurrence

• In cohorts studies
  – 88% Bedouin children within 18 to 23 months of follow-up.
  – 86% Peruvian children within 2 years of follow-up.
  – 100% Nicaraguan children within 3 years of follow-up (2 children positive at 4th day of life!).

• In cross sectional studies
  – 20% Mexican children 1 to 4 years old in farms.
  – 17.4% school aged children with diarrhea in Cote de Ivoire.
  – 14.5% in asymptomatic Brazilian children.
  – 60.4% in Colombian children after a natural disaster.

  2.6% of travelers with diarrhea in Peru by stool ELISA (Cabada M. personal communication)
Giardia: Pathogenesis

- Different pathogenic mechanisms have been proposed:
  - Disruption of the enterocyte brush border
  - Mucosal invasion
  - Elaboration of an enterotoxin
  - Stimulation of an inflammatory infiltration leading to fluid and electrolyte secretion and occasionally to villous changes.

Electron microscopy has documented disruption of the brush border in some patients, which could lead to the disaccharidase deficiencies commonly seen in giardiasis. Studies have shown lactose, d-xilose, vitamin and iron malabsorption in children infected with giardia. In vitro Giardia disrupt tight junctions, increasing permeability, and inducing apoptosis in small intestinal epithelial. Mucosal invasion is uncommon and, although, some studies suggested the activity of an enterotoxin, this has not been found.
Giardia: Clinical presentation

- Three major presentations:
  - Asymptomatic individuals: 40% to 80% of susceptible individuals that ingest giardia cysts will remain asymptomatic. Around 5% to 15% will be asymptomatic cyst passers.
  - Acute diarrhea: 25% and 50% will have diarrhea. Which can eventually have a chronic course associated with malabsorption and weight loss.
  - Dyspepsia: the rest of patient will develop non-specific symptoms. Some authors used the term non-ulcer dyspepsia. There are some reports of IBS like symptoms.

The incubation period range between 3 and 25 days. The incubation period can be shorter than the time that takes to start passing cysts in the stools. Diarrhea lasts between 1 and 4 weeks. In the majority of patients it is self-limited and mild to moderate. It is usually associated with abdominal cramps, bloating, and flatulence. Stools are usually watery with no blood or mucus/leukocytes on microscopic examination. Patient dyspeptic symptoms may last from 1 to 6 months in more than a third of patients. These include fullness sensation, abdominal pain, flatulence, nausea and vomiting.
Giardia: Impact

- Children living in developing countries have a high prevalence of giardiasis and frequent re-infections. People living with infected children will most likely get infected as well.
- Giardiasis have been found to cause decreased weight and height for age.
- Asymptomatic children infected with giardia also showed growth impairment.
- Cohort studies have shown that children with giardiasis have less school success and cognitive impairment.
Giardia: Diagnosis

• Stool examination:
  – Wet mount of fresh stools and saline.
  – Iodine, trichrome or iron hematoxylin staining.
  – Enzyme immunoassay (EIA) and direct fluorescent antibody.
  – Polymerase chain reaction.
Notes on Giardia: Diagnosis

Stool examination is a non invasive diagnostic procedure that allows the diagnosis of multiple parasites with a single test. Giardia shedding in the stools is intermittent, thus examination of 3 samples is recommended to increase sensitivity.

Direct stool examination in wet mount/stained samples has a sensitivity of around 90%. The use of newer tests, like enzyme immunoassay and direct fluorescence antibodies have a sensitivity of 85% to 98% and a specificity of 90% to 100%. The exact role of these newer techniques in clinical decision making is still to be determined and should be use when giardiasis is high in the differential diagnosis list, when following treatment outcomes, or during outbreaks. Protein chain reaction test usefulness is being tested in surveillance of water supplies.

Duodenal biopsy is probably one of the most sensitive tests with values ranging between 82.5% and 100%. But its invasiveness limits the use of this test to certain clinical situations.

Serology for giardia IgG is useful for epidemiologic studies, since after infection, IgG antibodies level remain high for prolonged periods of time. It is not clear if testing for IgM antibodies is useful in the clinical management of giardiasis.
Giardia: Diagnosis

• Endoscopic examination:
  – Duodenal aspirate
  – Duodenal biopsy

• Blood examination
  – Serologic testing
Giardia: Treatment

- **Metronidazole**: Cure rates range from 80 to 95%. Cases of metronidazole resistance are not uncommon.
- **Albendazole**: As effective as metronidazole when given for 5 days.
- **Furazolidone**: 80 to 85% cure rate
- **Nitazoxanide**: 70 to 85% cure rate
- **Tinidazole**: Between 90 and 100% effective with single oral dose.
Giardia: Prevention

- Proper food and water handling.
- Good hand hygiene.
- Chlorination, flocculation, sedimentation, and filtration of public water supplies.
- Avoidance of oral-anal or oral-genital sex.
- Treatment of asymptomatic carriers may be considered in special situations.
Case 2

- A 28 years old male is seen in the clinic at a hospital in Lima, Peru. He complains of 9 weeks of diarrhea with bulky stools 3 to 6 times a day, associated with significant weight loss and occasional cramps.
- The physical exam was unremarkable except for a BMI of 19 and genital warts.
- An ELISA test for HIV antibodies was positive.
- A modified Ziehl Nielsen stain of the stools showed the following organisms.
Modified acid fast staining

Cryptosporidium

- Cryptosporidium is a common cause of protozoal diarrhea in immunocompetent and immunocompromised humans worldwide.
- Cryptosporidium is classified in 14 species. There are several genotypes with great genetic diversity among each species.
- *Cryptosporidium parvum* and *Cryptosporidium hominis* are the most common species implicated in human disease.
- Geographic variations in their incidence have been reported.
Cryptosporidium: Life cycle

- Oocysts are the infecting stage and are also the forms found in the stools.
- Cryptosporidium can complete cycles of auto-infection in the host intestine.
  - Thin-walled oocysts excyst inside the host and complete their life-cycles by auto-infection, while thick-walled oocysts are excreted in the stools and are ready to infect other hosts.
- Cryptosporidium goes through asexual and sexual cycles inside the cells of the intestinal epithelium.
Notes on Cryptosporidium: Life cycle

Human infection occurs by ingestion of cryptosporidium oocysts. These will excyst in the intestine and release the sporozoites. The sporozoite attaches to the membrane of the intestinal epithelium and is engulfed to form a vacuole called meront. The sporozoite matures inside the vacuole and undergoes asexual reproduction, producing merozoites.

At this point, the merozoites will be released in the intestinal lumen and will infect the intestinal cells again. Then they will either form a new meront, going through asexual reproduction and producing more merozoites. Or they will mature into sexual forms called microgamonts and macrogamonts. Later microgametes will be released from the microgamont to fertilize the macrogamont and form a zygote.

In the last step of the cycle, the zygote will develop into thick walled oocysts that will be excreted in the stools or will develop into thin walled oocysts that will release sporozoites which will re-infect the host intestinal cells to start a new cycle.
Cryptosporidium: Life cycle

1. Thick-walled oocyst (sporulated) exits host
2. Contamination of water and food with oocysts
3. Thick-walled oocyst ingested by host

http://www.dpd.cdc.gov/dpdx

= Infective Stage
= Diagnostic Stage

Auto-infection
Asexual Cycle
Sexual Cycle
Cryptosporidium: Epidemiology

- The infective dose can be as low as 1 to 1000 oocysts in individuals without prior exposure.
- The number of cysts excreted varies according to the species and these are immediately infectious.
- Oocysts can remain viable up to 6 months in the environment if the conditions are appropriate.
- Oocyst resist chlorination and some filtration methods used to treat public water supplies.

Variations of infectiveness depend on the host immunity and the cryptosporidium isolate.

People with prior exposure need higher infective doses. Tests on people with positive serology for cryptosporidium have shown that infectious doses are 20 to 50 times higher. These patients are also less likely to develop symptomatic infection and in the event of developing symptoms these will tend to be milder. In developing countries cryptosporidiasis is a disease affecting mostly children and its incidence decreases with age. As the population ages, repeated exposure to cryptosporidium is more likely and less symptomatic infections will be diagnose.

Different cryptosporidium species have different infective doses. Even within species, different genotypes will differ in their infective dose. C parvum isolate Texas has showed a dose necessary to infect 50 % of subjects of fewer than 10 oocysts.
Cryptosporidium: Epidemiology

- Transmission is direct through contact with people with symptomatic infection or indirect through contamination of water. Use of sewage water for irrigation has been implicated in food contamination. 
  
  **Very large outbreaks of cryptosporidiasis have been reported in relation to contamination of water supplies in developed countries.**

- There is proven zoonotic transmission of C. parvum.

Animal to human transmission of cryptosporidium

Zoonotic transmission has been reported through different animals like cattle and sheep. These animals are susceptible to the infection with cryptosporidium and may even develop diarrheal illnesses.

Other animals important in cryptosporidium dispersion are birds like ducks, geese, waterfowls, and gulls. They are no susceptible to cryptosporidial disease, but they have been implicated in its dispersion.

Insects like cockroaches and flies have also been reported as reservoirs for cryptosporidium.
Cryptosporidium: Epidemiology

- Groups at risk are travelers to developing countries, contacts of infected people, day care centers attendees, people in contact with livestock or water contaminated with livestock feces.
- HIV/AIDS, people undergoing chemotherapy, children less than 5 years old, and the elderly are at higher risk of infection, of symptomatic disease and of severe forms.
- In developing countries unsafe water and food supplies are the main risk factors.

Since antiretroviral medication and highly active regimens are in use, the frequency and severity of cryptosporidial disease have decrease dramatically among patients with AIDS. This is true in developed countries where wide access to this kind of medication is possible. In contrast, AIDS patients in developing countries have limited access to anti-retroviral therapy and cryptosporidiosis continue to be a problem.

Patients with immunosupression, especially those with AIDS, are more susceptible to extraintestinal disease.

In developing countries food contamination by food handlers and by the use of sewage water for irrigation of crops are factors in cryptosporidium epidemiology. Poor sanitation and lack of water treatment standards also play a role.
Cryptosporidium: Occurrence

- Prevalence using modified acid fast stain in different studies among the immunocompetent
  - 1.46% of adults and children with diarrhea in Germany
  - 1.7% of southern Italy children admitted to the hospital with enteritis
  - 5.9% of Ugandan children with persistent diarrhea
  - 8.0% of Cuban children with diarrhea
  - 8.4% of children with diarrhea and 5.9% of asymptomatic children in Liberia
  - 25.6% of humans with diarrhea in Iran
  - 27.8% of children with diarrhea in Ghana
Cryptosporidium: Occurrence

• Seroprevalence of IgG antibodies in different studies
  – Almost all children older than 2 years in Fortaleza and 80% of children age 10 years in Sao Paulo-Brazil
  – Up to 57.1% of asymptomatic children less than 16 years old in China
  – 16.9% of people age less than 29 years in Virginia-USA

  48.7% of travelers with diarrhea in Peru by stool ELISA (Cabada M. personal communication)
Cryptosporidium: Occurrence

• Prevalence using modified acid fast stain in different studies among the immunocompromised
  – 73% of Ugandan children with AIDS and persistent diarrhea.
  – 33% of Southern Italy AIDS patients with diarrhea
  – 28.6% of AIDS patients with diarrhea in Ghana
  – 25.9% of Ethiopian patients with AIDS and diarrhea
  – 13.3% of AIDS patients with diarrhea and 22.8% of AIDS patients with persistent diarrhea in Peru
  – 7% of AIDS patients with diarrhea in Brazil
  – 10.8 of HIV infected patients in Northern India
  – 55.4% of Egyptian patients with severe diarrhea and hematologic malignancies.
Cryptosporidium: Pathogenesis

- Cryptosporidium infection of the intestinal epithelium is associated with villous atrophy, crypt hyperplasia, and mixed inflammation of the lamina propria.
- Cryptosporidium causes diarrhea by malabsorption and increased secretion.
- The molecular mechanisms by which disease is produced are unknown, but it is believed that apoptosis of the intestinal epithelium cells may play a role.
Cryptosporidium: Clinical presentation

• The immunocompetent host:
  – The three major presentations are asymptomatic carriage, acute diarrhea, and persistent diarrhea.
  – More than 90% of infected individuals in low endemicity areas develop acute diarrhea associated with abdominal cramps, fever and weight loss.
  – Diarrhea is usually self-limited and lasts 14 days.
  – In developing countries with high endemicity, children are the most affected, while adults usually have milder forms of the disease if they become symptomatic at all. In children persistent diarrhea and malabsorption are common.
Cryptosporidium: Clinical presentation

• The immunocompromised host
  – The four clinical presentations are
    • Asymptomatic infection (4% of the cases)
    • Transient infection with less than 2 months of diarrhea (29% of the cases)
    • Persistent infection with more than 2 months of diarrhea (60% of the cases)
    • Fulminant infection with 2 or more liters of diarrhea per day (8% of the cases) usually in patients with less than 50 CD4+ 
  – Extraintestinal involvement is possible and has been reported in the biliary tract, the respiratory tract, the pancreas and the middle ear.
Cryptosporidium: Impact

- Symptomatic and asymptomatic infections cause weight and height growth retardation.
- Early cryptosporidiosis is associated with permanent growth retardation and impaired cognitive function.
- Cryptosporidium is associated with excess mortality in children in the developing world.
- AIDS patients with lower CD4+ cell counts are at risk for malnutrition. Studies in the pre-ART era showed that cryptosporidium infection is an important predictor of death among AIDS patients.

Up to 40% of immunocompetent patients with cryptosporidiosis will report recurrent intestinal and extraintestinal symptoms for up to 2 months after the first diarrheal episode is resolved.

Cryptosporidium is more common in malnourished children. These children will have longer courses of diarrhea when compared with other malnourished children with diarrhea. These children will ultimately have a greater degree of malnutrition.

AIDS patients are at higher risk for fulminant cryptosporidial diarrhea as well as of cryptosporidial biliary disease, which are associated with lower survival.
Cryptosporidium: Diagnosis

• Stool examination:
  – Modified Ziehl Nielsen stain (Kinyoun’s method).
  – Enzyme immunoassay (EIA) in serum or stools
  – Direct fluorescent antibodies.
  – Polymerase chain reaction.
Cryptosporidium: Diagnosis

- Abdominal ultrasound
  - May be useful in HIV/AIDS patients with suspected biliary tract involvement.
- Endoscopic retrograde cholangiopancreatography
  - Useful to get specimens and to rule out other causes of biliary tree disease.
Cryptosporidium: Treatment

- In the immunocompetent
  - Nitazoxanide
    - It is partially active against cryptosporidiosis.
    - Nitazoxanide treatment has demonstrated to shorten the duration of diarrhea in malnourished children and to decrease mortality.
    - Treatment with nitazoxinide also demonstrated activity in the treatment of adults with persistent diarrheal disease.

Among the most important interventions, fluid and electrolyte imbalance correction should be carried out in patient with diarrhea. Oral re-hydration solutions are preferred over intravenous fluids, unless the patient is unable to tolerate oral intake or unable to drink fluids.

In patients with AIDS, antimotility agents like loperamide improve symptoms. Octreotide is an intravenous agent with antimotility properties approved for this use, but its effectiveness is similar to that of loperamide and its cost is considerably more.
Cryptosporidium: Treatment

• The immunocompromised
  – Nitazoxanide
    • AIDS patients usually improve with treatment but cures rates are low.
    • Patients with very low CD4+ cell counts are less likely to respond.
  – Paromomycin
    • AIDS patients have a partial response to treatment. Relapses are common.
Cryptosporidium: Treatment

• In the immunocompromised
  – Macrolides
    • Observational studies showed some activity of macrolides like azithromycin, but controlled trials have generally shown no effectiveness.
  – Antiretroviral treatment
    • Specially regimens including protease inhibitors have demonstrated to improve diarrhea.
    • Protease inhibitors are believed to have antiparasitic activity.
Cryptosporidium: Prevention

• Ensure a clean water supply is the most important measure. This should involve performing flocculation and filtration of the water.

• Recreational waters and swimming pools are associated with transmission and should be avoided by immunocompromised patients.

• Hand washing, water boiling and filtration are individual measures that are effective.
Case 3

A 27 years old Canadian traveler on his fourth week of volunteer work for an NGO in Cuzco, Peru. Coming to clinic with complains of 3 weeks of watery diarrhea characterized by a remitting and relapsing course. Diarrhea is associated with severe fatigue and unquantified weight loss.

Physical examination was unremarkable. Stool wet mount preparation was negative and a modified acid fats stain showed the following organisms.
Modified acid fast staining

Cyclospora

- *Cyclospora cayetanensis* is a human exclusive parasite.
- It is an emergent pathogen gaining particular importance among travelers visiting developing areas and immunocompromised individuals.
- Cyclospora has also been reported as the cause of food and water borne outbreaks of diarrhea in developed countries.
- In developing countries it presents as a cause of sporadic diarrhea as well as in outbreaks.
Cyclospora: Lifecycle

• Freshly passed oocysts in the stools are not infective. They need days to weeks in the environment to become infective.
• Sporocysts are the infective stage.
• Once ingested, sporocysts excysts in the small intestine freeing sporozoites.
• Sporozoites will infect intestinal cells and complete asexual and sexual cycles.

Since freshly excreted oocysts are not infective right away, fecal oral transmission of Cyclospora cayetanensis is not possible.

Oocysts undergo sporulation at temperatures between 22°C to 32°C. One oocyst will generate two sporocysts each containing two sporozoites.

Sporocysts are ingested in contaminated food or water. Once sporocysts reach the small intestine, they excyst freeing the sporozoites. These infect the epithelial cells and undergo asexual multiplication and sexual development to mature into oocysts, which will be shed in stools. The different stages in the cyclospora life cycle are similar to that of cryptosporidium.
Cyclospora: Epidemiology

- There are 17 Cyclospora species, but it is assumed that *C. cayetanensis* is the only species causing disease in humans.
- Marked seasonality has been reported in endemic areas. Although, they are different according to the region studied.
- Sporocysts can stay in the environment for prolonged periods.
- The infective dose is unknown. Data from outbreaks suggest that the dose is small.

Cyclospora spp have been described in feces of monkeys and baboons.

Marked seasonality in the peak incidence of cyclospora associated diarrhea has been described in endemic areas. This seasonality is not the same in the different regions. In Haiti, the peak coincides with the drier and cooler season, whereas in Peru it coincides with the warmer season.

Outbreaks have been related to contamination of several fresh produces like strawberries and basil.

The infective dose is unknown and multiple studies have failed to produce experimental infection of healthy volunteers. The reason for this is not fully understand, but it is believed that some environmental triggers besides sporulation are necessary to produce infective sporocysts.

Mean attack rate after exposure is around 90%, which suggests that the infectious dose is very low.
Cyclospora: Epidemiology

- Direct human to human transmission does not happen. Cyclospora is a food and water borne parasite.
- The incubation period averages 1 week, the disease usually lasts 6 weeks and relapses are common. Especially in untreated patients.
- Groups at risk are travelers to endemic areas, immunocompromised individuals, people in crowded living arrangements. People without access to clean food and water supplies. People in contact with contaminated soil.
Cyclospora: Occurrence

- Outbreaks are described in developed countries (Florida, Missouri, Germany), in travelers to developing countries (Spanish travelers to Guatemala), and in developing countries (Peruvian military).
- 1.1% of German patients with persistent travelers’ diarrhea.
- 1.7% of symptomatic and asymptomatic children in Thailand.
- 2.0% of children with diarrhea in Tanzania
- 2.1% of stools sent for testing in Guatemala.
- 9.8% of AIDS patients and 5.3% of children with diarrhea in Venezuela.
- 14.1% of children and 3.0% in adults with diarrhea in a cross sectional study in Venezuela.
- 15 to 20% of symptomatic and asymptomatic individuals in a Haitian cohort.
- 33% of the study population had at least 1 episode during the study period in a Peruvian cohort.
Cyclospora: Pathogenesis

- Infection of the small intestine by cyclospora produces inflammation with leukocyte infiltration of the lamina propria.
- Histological changes include villous atrophy and crypt hyperplasia.
- The exact pathogenic mechanism is not well understood, it is believed to be mediated by endotoxin like substances.
- Infection of the biliary tree has been described, being this more common among immunocompromised patient.
Cyclospora: Clinical presentation

• Cyclospora can present as an asymptomatic infection, this is not uncommon in developing countries.
• The second presentation is as watery diarrhea, with fatigue, weight loss and anorexia as prominent associated symptoms. Abdominal cramps, nausea, vomiting and fever can also be present.
• Diarrhea usually last for more than 4 weeks. The severity of the diarrhea is variable and depends on immune status and repeated exposure to the parasite.
• The symptoms often have a remitting/relapsing course.
Cyclospora: Impact

- There are gaps in the knowledge of the epidemiology and impact of cyclosporidiasis.
- Cyclospora as a cause of chronic diarrhea can impact rates of growth and long term cognitive function among children in developing countries as demonstrated with other intestinal protozoa.
- As a cause of diarrhea in travelers, it will cause economical losses for the traveler and its’ host country.
- And as contaminant of food supplies in an era of globalised trade, it is a threat to developed countries.
Cyclospora is said to be acid fast variable because some oocysts will not uptake the fuchsin stain. Thus, under the microscope some oocyst will show as pale round bodies surrounded by the blue background staining. This is a characteristic that differentiates cyclospora from cryptosporidium. The other crucial distinctive characteristic is the size of the oocysts. Cyclospora oocysts have a diameter of approximately 10 microns compared to 5 to 6 microns of those from cryptosporidium.

Cyclospora have the property of being auto-fluorescent when exposed to ultraviolet light at a wave length of 365 nm. In these conditions the oocysts look like very bright blue circles.

Cyclospora: Diagnosis

- Modified acid fast staining (Kinyouns’ method).
- Autofluorescence
- Protein chain reaction (from intestinal fluid, stools, or biopsies)
- Esophagogastroduodenoscopy (useful to obtain specimens of fluid and intestinal biopsies, but not routinely done)
- ELISA for serum antibodies (not useful for patient management)
Cyclospora: Treatment

• Trimethoprim/sulfamethoxazole (TMP-SMX)
  – It is the treatment of choice for the acute phase and for relapses.
  – It is almost 100% effective.
  – It reduces the length of oocyst excretion to 2 or 3 days after treatment initiation.
  – Studies also suggest its usefulness as secondary prophylaxis. Specially among AIDS patients in whom relapses are common.
Cyclospora: Treatment

- Nitazoxanide
  - Its efficacy ranges from 71 to 87%.
  - It is well tolerated.
  - It is an alternative for patients allergic to TMP-SMX.

- Ciprofloxacin
  - It is less efficacious than TMP-SMX when compared in clinical trials.
  - Its use is controversial, for some authors it could be an alternative for TMP-SMX.
Cyclospora: Prevention

- As with other coccidian, improving the standards of the food and water supplies is crucial.
- Improving the sanitary conditions and avoiding the use of sewage water for irrigation are also important.
- Hand washing, water boiling and filtration are effective individual measures.
Summary

• We have reviewed the epidemiology of three different intestinal protozoa. All three have in common that they affect more often children and immunocompromised patients in developing countries.

• The impact of these diseases is greater among children. Affecting their development and probably their cognition in the long term. They are also associated with increased mortality in children and immunocompromised.

• We have reviewed some of the common clinical features and the way to diagnose and treat these entities.

• We now know that sanitation, as well as, safe food and water supplies are key in preventing these entities.
Papers -- Giardia

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Books


Web links

http://www.who.int/nutrition/media_page/en/
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