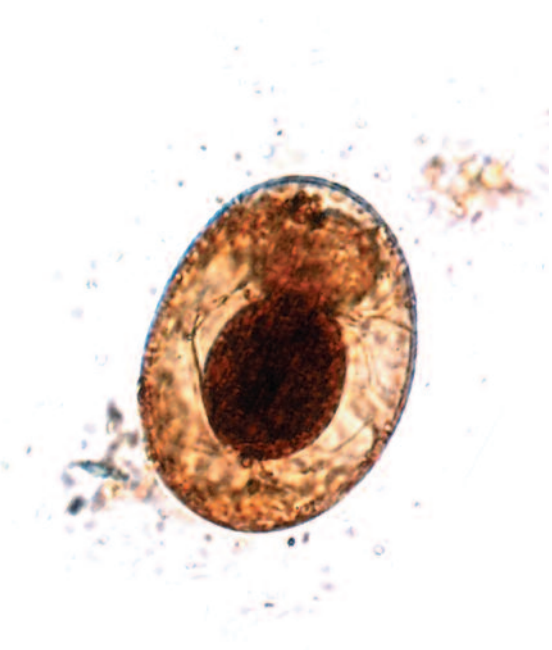


Comprehensive Parasitology Profile



Overview

With every new outbreak of food- and waterborne parasite infection, more people are coming to realize the enormous impact of parasites and diarrheal diseases on human health. Diarrheal diseases (bacterial as well as parasitic) constitute the greatest worldwide cause of morbidity and mortality.¹ Numerous studies show parasitic infection up to 99% in undeveloped countries.²

In the United States, diarrheal diseases caused by intestinal infections are the third leading cause of morbidity and mortality. Most Americans have grown up with modern sanitation, and it is often assumed parasitic infections are encountered only in impoverished foreign countries.³ According to Neva, “The United States citizen can acquire amebiasis, giardiasis, pinworms, and strongyloides, for example, without so much as a passport application.”⁴

The increase in worldwide travel, coupled with increasing immigration into the United States and a rise in imported foods, contributes to the spread and incidence of parasitic infections. In a study of outpatients at the Gastroenterology Clinic in Elmhurst, N.Y., a 74% incidence of parasites was found.⁵ A total of 20% of this population harbored pathogens. One survey of public health laboratories reported that 15.6% of specimens examined contained a parasite.⁶ At Genova Diagnostics, almost 30% of specimens examined are positive for a parasite.

The prevalence of parasitic infections in the United States is difficult to quantify. Most figures are underestimates that can be traced to inadequate parasitologic training of physicians and laboratory technicians.³ As detection methods become more accurate and sophisticated, physicians are recognizing the increased incidence of parasitic infection and its relationship to a broad spectrum of diseases.

What are parasites?

The two major classifications, predator and scavenger, are differentiated by their nutritional relationships.⁷ Further modification leads to symbiosis and commensalism. Parasitism is where the host is injured through the activities of the parasite during an intimate and protracted relationship between the two.

Some organisms have a changing interaction with their host—sometimes as a parasite and sometimes commensal.

Clinical significance

In general, a parasite interferes with the host’s vital processes through secretions, excretions, or other products.⁷ These products include proteolytic enzymes that erode the intestinal wall, enterocytotoxins (from *E. histolytica*), and serotonin-like products.⁸

Parasitic infections can trigger autoimmune reactivity. The parasite might cause tissue destruction, thus releasing high amounts of self antigens which stimulate the autoreactivity.⁹

What this test does:

Uncovers parasitic infections which may be associated with systemic complaints.

Turn-around Time 14 days

APPLICATION
GUIDELINES

APPLICATION
GUIDELINES

Symptoms of Parasitic Infection

- Abdominal pain and cramps
- Anorexia
- Autoimmune disease
- Chronic fatigue
- Constipation
- Depressed sIgA
- Distention
- Fever
- Food allergy
- Gastritis
- Inflammatory bowel disease
- Altered intestinal permeability
- Irregular bowel movements
- Irritable bowel syndrome
- Low back pain
- Pruritus ani
- Rash and itching of skin
- Urticaria
- Weight loss
- Arthritis
- Bloody stools
- Colitis
- Crohn's disease
- Diarrhea
- Dysentery
- Flatulence
- Foul-smelling stools
- Headaches
- Leukopenia
- Malabsorption
- Rectal bleeding
- Vomiting

Table 1

The most common symptoms of intestinal parasitic infections are abdominal pain and moderate or severe diarrhea, but there is a wide range of both acute and chronic effects (table 1).

Giardiasis is an interesting model for the systemic effects of gastrointestinal parasites. *Giardia lamblia*, although capable of causing acute illness (diarrhea), can hide in the GI tract for years with few symptoms.¹⁰ Among the common systemic complaints of this disease are fatigue and anorexia. It is reasonable to suspect that many long-term effects are due to phenomena occurring at or within the mucosal membranes. Zinneman reported that *giardiasis* is associated with reduced secretory IgA, a primary mucosal defense mechanism against foreign infections.¹¹ Moreover, *Giardia lamblia* is known to be a cause of malabsorption, suggesting a decreased mucosal permeability. *Giardiasis* is also associated with asthma, urticaria, arthritis, and uveitis, suggesting increased mucosal permeability.¹²

It could be hypothesized that *giardiasis* results in altered permeability—increased permeability to some types of molecules and decreased permeability to other types. Decreased secretory IgA levels, either as a cause or as a consequence of this phenomenon, would result in increased susceptibility to secondary infections and systemic symptoms.

Symptoms of parasitic infection

The most common symptom of parasite infection is diarrhea, with abdominal pain as the second most common symptom.^{10,13} Other symptoms include flatulence, foul-smelling stools, cramps, distention, anorexia, nausea, weight loss, belching, heartburn, headache, constipation, vomiting, fever, chills, bloody stools, mucus in stools, and fatigue.¹⁰ Although specific symptoms are associated with certain organisms (e.g. fever with malaria), most symptoms can be present with almost any parasite. In addition, there is an increasing number of parasite cases with systemic complaints not traditionally thought to be caused by parasites. *Endolimax nana* has been associated with urticaria, and *Blastocystis hominis* with infective arthritis.¹⁴

Substantial literature associates parasites with allergy, but it isn't known whether parasites enhance the probability of getting allergies or whether being allergic predisposes one to parasitic infection.¹⁵ Two reports associate *Trichuris* infection with diminished mental development in children and recovery of mental function after treatment.^{16,17} Leo Galland, M.D., has reported intestinal protozoans as an unsuspected cause of chronic illness and fatigue among his patients.^{18,19} Potentially pathogenic protozoa were detected in 27% of a group of urban patients with irritable bowel syndrome.²⁰ Organisms included *B. hominis*, *D. fragilis*, *G. lamblia*, *E. histolytica* and *Entamoeba coli*.

Cryptosporidium, a supposed weak pathogen most frequently causing a self-limited diarrhea in adults, is a major cause of diarrheal disease in the pediatric population.²¹ Cryptosporidiosis has been associated with reactive arthritis and acute pancreatitis.^{22,23} Cryptosporidium has rapidly become the most frequently cited cause of outbreaks of parasite-related gastroenteritis in drinking and recreational waters (fresh and treated), highlighting the inability of many water systems to protect people from this organism. In the most widely publicized outbreak of cryptosporidiosis (1993 in Milwaukee), over 400,000 people were infected and more than 100 died.^{24,25}

Pathogenicity

Among the many organisms classified as parasites, only some are referred to as "pathogens." In fact, the classification of organisms as pathogens continues to fluctuate. Few people realize that only a few decades ago *Giardia lamblia*, the leading cause of intestinal parasitic infections in the United States, was not considered a pathogen.²⁶ Even more recently, *Cryptosporidium*, a well-known pathogen in animals, was identified as a human pathogen. Today, a controversy continues about the status of *Blastocystis hominis*. Next to yeast, *B. hominis* is the most frequently observed organism in fecal samples.

Part of the problem in classifying parasites is defining “pathogen” and “commensal.” Many individuals harbor pathogens such as *Giardia lamblia* or *Entamoeba histolytica* but don’t have discernible gastrointestinal symptoms. And conversely, the apparent pathological effects of supposed commensals such as *Entamoeba coli* or *Endolimax nana* have been reported.²⁷⁻³⁰

One hypothesis to explain variable pathogenicity is that distinct pathogenic and non-pathogenic strains of organisms appear morphologically identical.³¹ Another hypothesis postulates pathogenic and nonpathogenic states of an organism and proposes mechanisms whereby modulators related to the microenvironment or the host could switch the parasite from one state to the other.³¹

The true nature of pathogenicity, however, may rest in both hypotheses. Pathogenicity and symptom severity may vary depending on the parasite itself, the host (especially its immune status), and the microecological environment where the parasite lives.

Factors relevant to the parasite include production of toxins, cytolytic ability, and adherence.³² Factors related to the host include immune competence, secretory IgA levels, T and B lymphocyte levels, gut motility and permeability. Affecting both the parasite and the host are the stool transit time and microenvironment (pH, fat and fiber content, the health and number of bacterial organisms making up the normal flora, and the ability of normal flora to compete for nutrients with potential pathogens).³³

Common protozoal parasites

Information on parasites is available in several excellent texts.^{26,34} The protozoa that parasitize the intestinal lumen belong to five groups: amoebae, flagellates, ciliates, coccidia, and microsporidia. Most are transmitted through fecally contaminated food, water or other materials. Contaminated water supplies are a particular problem because many cysts are not killed by usual levels of chlorination - especially the common pathogens *Giardia*, which is relatively chlorine-resistant, and *Cryptosporidium*, which is >50-fold more resistant to chlorine than *Giardia*. Few water supplies are equipped with the sophisticated and expensive filtration systems necessary to effectively control these organisms.²⁴

Blastocystis hominis

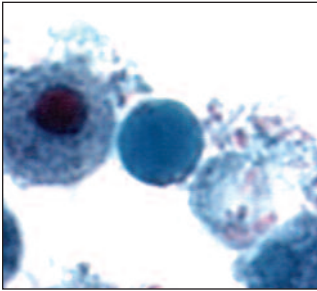
Blastocystis hominis is the most prevalent parasite but often isn’t detected due to poor laboratory techniques.³⁵ At Genova Diagnostics, Blastocystis is found in more than 20% of clinical specimens.³⁶ The weight of evidence supports treating it as a potential pathogen.³⁷ Together with other weak pathogens, it is associated with many chronic conditions, including irritable bowel, chronic fatigue, and arthritic/rheumatoid complaints.

Three forms have been identified, and the vacuolated form is most commonly seen in fecal specimens. Blastocystis has been found to produce gastrointestinal cramps, vomiting, sleeplessness, nausea, weight loss, lassitude, dizziness, flatulence, anorexia, and pruritus. *B. hominis* is often found in patients with classic symptoms of irritable bowel syndrome.³⁸ Treatment with metronidazole has been found to eradicate the organism.

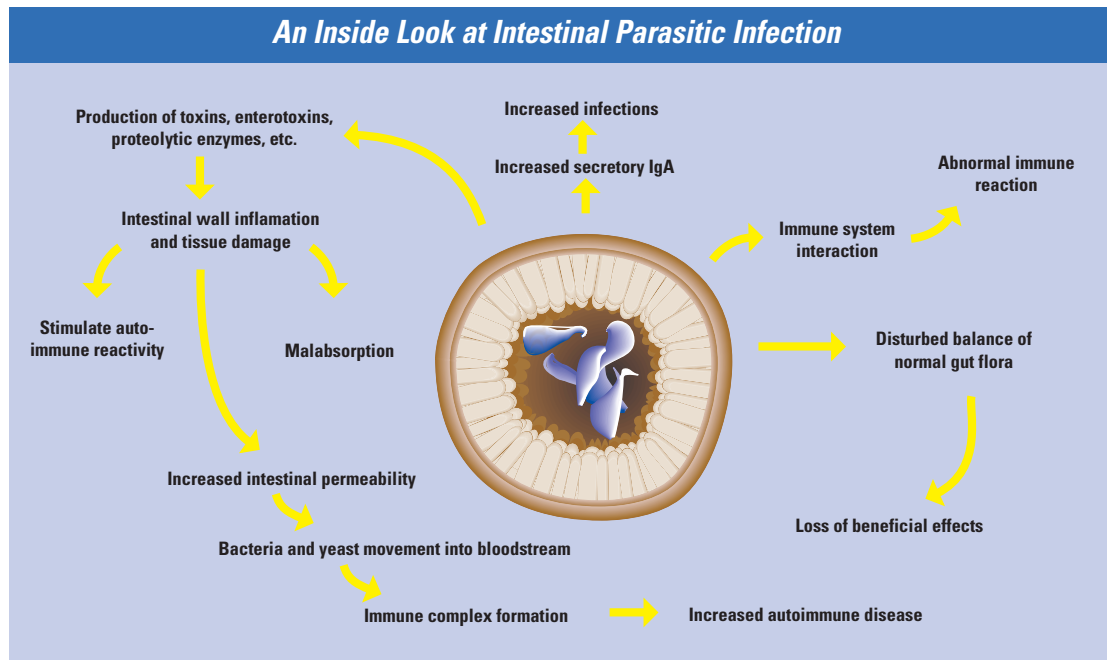
Blastocystis hominis may be highly variable in its pathogenicity. The organism is present in a number of healthy individuals, and an asymptomatic carrier state has been postulated.³⁹ In many patients with gastrointestinal illness, this organism is the only identifiable parasite, and these patients improve when Blastocystis is eradicated.³⁷ We find its presence highly correlates with gastrointestinal symptoms; and, along with others, suggest it may be a pathogen in symptomatic patients.^{14,40}

Dientamoeba fragilis

Dientamoeba fragilis, a pathogenic flagellate and one of the most frequent parasitic infections, often goes undetected due to poor laboratory technique.⁴¹⁻⁴³ Symptoms include diarrhea and abdominal discomfort. It resides in the colon, has a cosmopolitan distribution, is found as a trophozoite, and has no cyst stage. Transmission is by direct ingestion of the trophozoite and can be found within the eggs of some helminths, especially pinworms.



Blastocystis hominis



Amoeba

Amoeba including *Endolimax nana*, *Entamoeba histolytica*, *E. coli*, and *E. hartmanni* are cosmopolitan in distribution. *E. histolytica* is linked to acute diarrhea, GI distress, and hepatic disease (by means of blood draining the intestine and returning to the liver). While other amoeba, such as *E. nana*, *E. hartmanni*, and *E. coli*, may be only occasionally pathogenic,⁴⁴ their identification is important to differentiate them from other amoeba, which are pathogenic.⁴⁵

There are two forms of amoeba—the motile trophozoite and the cyst—and transmission is by ingestion of the cyst stage. The cyst, the infective form of the organism, resists environmental changes and may spread from person to person or indirectly via food or water. Symptoms occur primarily with tissue invasion and include intermittent diarrhea and constipation, flatulence, and cramping. Intestinal infection symptoms include mild diarrhea, food intolerance, fatigue, and dysentery.

Giardia lamblia

Giardia lamblia, a flagellate with cosmopolitan geographic distribution, is found in duodenal contents and bile. In the duodenum it can be demonstrated in the mucosal crypts where it attaches itself to the mucosal cells, causing gastroenteritis. When swept into the fecal stream, the trophozoite encysts. Consequently, most fecal specimens contain the encysted parasite rather than the flagellated trophozoite form, which is usually found only in severe diarrhea. In the cyst (resistant) form, they spread the disease from host to host by fecal/oral routes, either directly (as between children in day-care centers or between sexual partners) or by food and water.⁴⁶ Waterborne epidemics involve mountain streams, well water, and even some chlorinated community water systems. (See the preceding section for more detailed signs and symptoms.)



Giardia lamblia

Iodamoeba butschlii

Iodamoeba butschlii is an amoeba with a low pathogenicity associated with chronic complaints. It has a cosmopolitan distribution and is located in the lumen of the colon and cecum. Transmission is by ingestion of the cyst stage.

Fungal conidia

Fungal conidia are yeast. They are very small (2 to 4 microns), have considerable structure (typically with pointed ends and an interior vacuole), and are difficult to culture. The few studies on this organism cite its ability to ferment complex polysaccharides to produce alcohol. In a recent review of Genova Diagnostics'

parasitology results, we found *fungus conidia* in 5.4% of the samples.⁴⁷ They were more prevalent in women and frequently found in the absence of other parasites. Almost all the patients suffered from gastrointestinal complaints, but diarrhea (38%), gas (33%), and bloating (33%) were most common.

At this time we know little about *fungus conidia* pathogenicity. Our advice is to put *fungus conidia* in the same category as *Blastocystis hominis* or yeast overgrowth and treat (or not treat) with the same criteria.

Intestinal helminths

Intestinal worms are a leading cause of morbidity and mortality and usually diagnosed by detection of eggs or larvae in fecal specimens. Some of the more common helminths are Nematodes, including *Enterobius vermicularis*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus*, and *Strongyloides stercoralis*.

Detection of parasites

The diagnosis of most parasitic infections depends on the laboratory.⁴⁶ For intestinal parasites, morphological demonstration of diagnostic stages is the principal means of diagnosis. The emerging area of immunodiagnostic techniques is of growing importance.

Detection rates are a function of:

- Specimen collection and handling
- Number, kind, and type of specimens examined
- Concentration procedures
- Staining procedures
- Macroscopic and microscopic examination techniques
- Quality of microscopes
- Use of advanced immunoassay methods
- Quality of training, frequency of practice, and dedication of laboratory personnel.

Many studies show that detection rates dramatically increase with the sophistication of detection procedures, such as adding

concentration, flotation, appropriate preservatives, specialized permanent stains and other methods.⁴⁸⁻⁵⁰

Various studies show that when increasing from a single specimen to three specimens, detection can increase as much as 30%, depending upon species.⁴⁹⁻⁵¹

In addition to using formed stools as a specimen, purged samples (induced by oral purgative) provide valuable specimens.⁵² Recent reports show that a rectal mucosal swab specimen aids in detection of certain parasites.

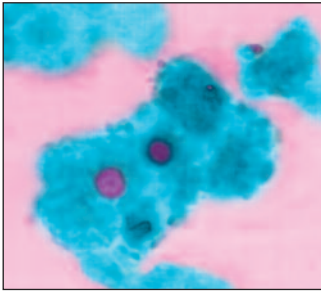
Computer-enhanced video microscopy also aids in identification and provides the physician with a picture of organisms found. Several immunoassay techniques are now available, increasing detection of intestinal organisms from 40 - 60 % to >90% for some species.⁵³

When to suspect parasitic infections

Office diagnosis of parasitic infections requires physicians to check for such symptoms as diarrhea, unexplained fever, cough, itching or rash of the skin, abdominal pain, and bloody stools.

Certain people are at particular risk for infection, including those who recently traveled outside the United States and individuals who are immune compromised.^{44,54,55}

In addition to diarrhea, the most common symptom, other symptom complexes may suggest parasitic infection. For example, amoebic colitis can mimic Crohn's disease of the colon and ulcerative colitis.⁵⁶ Fulminant amoebic colitis may be present with rectal bleeding and colonic ulcerations and can be difficult to differentiate from inflammatory bowel disease.⁵⁷ Inflammatory bowel disease patients can also be carriers of amoebae. Because steroids can provoke amoebic activity and cause a fulminating colitis, it is necessary to determine if amoebae exist.



Entamoeba histolytica



Trichuris trichiura

Comprehensive Parasitology Profile Application Guide

Recent reports suggest that intestinal infections with *Giardia lamblia* and *Blastocystis hominis* cause symptoms identical to those observed in patients with inflammatory bowel disease.⁵⁸ Treatment led to resolution of symptoms in approximately 90% of the study population. As more data becomes available, stool examination for parasites may become an integral part of the evaluation of patients with inflammatory bowel disease or other undiagnosed gastrointestinal complaints.

Nutrition and parasites

Antiparasitic drugs, while effective, are powerful pharmacologic agents to be taken with careful consideration. (see table on following page.)⁵⁹

Therefore, nutritional and other approaches to parasite infestation are worth noting. Leitch et al. reported that dietary fiber reduces the rate of intestinal infection by *Giardia lamblia*.⁶⁰ The authors speculate that fiber induces mucus secretion and reduces the attachment of trophozoites. It may also affect the growth of bacterial flora, pH, and the competition for nutritional resources among organisms. Measures that build and restore the gastrointestinal immune system are worthwhile interventions. Modification of bowel flora, bowel environment, and digestive enzymes can produce effects synergistically in eradicating parasites.

Natural alternatives

Mirelman reported that allicin, the active principle of garlic extract, is an inhibitor of growth for *Entamoeba histolytica*.⁶¹ Other studies suggest its effectiveness with other parasites as well.

Other reports claim that berberine, the active ingredient of goldenseal (*Hydrastis*), oregon grape root (*mahonia aquifolium*), and Barberry (*Berberis vulgaris*) are effective against *Entamoeba histolytica* and compare favorably to Quinacrine HCl in the treatment of *giardiasis*.^{62,63}

Quassia appears to be another useful anti-helminthic, which anecdotally has been used successfully for *Ascaris lumbricoides*, amoebic dysentery and *giardiasis*. An advantage of Quassia is its low toxicity.^{64,65}

Common drugs for parasitic infection

A number of drugs are available for treatment of parasitic infections. The Medical Letter in December 1993 listed treatment recommendations from the CDC.⁵⁹ Listed below are its recommendations for some common parasites.

Infection	Drug (trade name)	Adult dosage	Adverse effects	
Amebiasis	asymptomatic	Iodoquinol (Yodoxin)	650 mg tid x20d	Rash, acne, slight enlargement of thyroid gland, nausea, diarrhea cramps, anal pruritus. Rare: optic atrophy, loss of vision, iodine sensitivity, peripheral neuropathy after prolonged use (months) in high doses.
		Paromomycin (Humatin)	25-30 mg/kg/d in 3 doses x7d	GI disturbances. Occ: Eighth-nerve damage (mainly auditory) or renal damage.
	symptomatic	Metronidazole (Flagyl)	750 mg tid x10d	Nausea, headache, dry mouth, metallic taste. Occ: vomiting, diarrhea, insomnia, weakness, stomatitis, vertigo, paresthesia, rash, dark urine, urethral burning. Rare: seizures, encephalopathy, pseudo-membranous colitis, ataxia, leukopenia, peripheral neuropathy, pancreatitis.
Blastocystis		Metronidazole	750 mg tid x10d*	See above
		or Iodoquinol **	650 mg tid x20d	See above
Dientamoeba		Iodoquinol	650 mg tid x20d	See above
		or Tetracycline	500 mg qid x10d	
Giardia		Quinacrine HCl (Atabrine)	100 mg tid p.c.x5d	Dizziness, headache, vomiting, diarrhea. Occ.: yellow staining of skin, toxic psychosis, insomnia, bizarre dreams, blood dyscrasias, urticaria, nail pigmentation, psoriasis-like rash. Rare: acute hepatic necrosis, convulsions, severe exfoliative dermatitis, ocular effects similar to those caused by chloroquine.
		Metronidazole	250 mg tid x5d	See above

*Sources disagree on proper dosage for Metronidazole. Some recommend 250 mg tid, which causes fewer side effects. Others recommend 750 mg tid as a more effective treatment, although there may be more side effects with the higher dose.

**Anecdotal reports suggest that Iodoquinol may be more effective than Metronidazole and may cause fewer side effects.

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