INTESTINAL AND UROGENITAL PROTOZOA

Prof. Dr. Gulden Celik Yılmaz, MD.
Asst. Prof. Dr. Mehmet Ilktac
TYPES OF ORGANISM RELATIONSHIPS

- **Normal Flora.** Normal flora consists of microorganisms that are normally and consistently found in or on the body in the absence of disease.

- **Symbiosis.** This is the close association or living together of two organisms of different species; each party involved in this relationship is called a symbiont.

- **Mutualism.** This is a type of symbiosis in which both organisms (host and parasite) benefit from the association.
**Types of Organism Relationships**

- **Commensalism.** This is also a type of symbiosis, but in this case, the parasite (commensal) is benefited and the host is neither benefited nor harmed by the relationship.

- **Parasitism.** Parasitism is an obligatory relationship in which one organism, the parasite, is metabolically dependent on another organism, the host. The host may be harmed by such a relationship.
Parasite

- Eukaryotic organisms:
  - Protozoa: Single celled microscopic

- Kingdom Animalia: Metazoans
  - Multicellular animals
  - Life functions occur in cellular structures organized as tissue and organ systems.
    - Helminths
    - Some arthropods
Kingdom: PROTOZOA

Phylum:
- The Flagellates
- Amoebozoa
- Sporozoa
- Ciliophora
The Flagellates:

✓ Move by the lashing of their whiplike flagella

✓ The number and position of the flagella vary a great deal in different species.

✓ Flagella may produce a characteristic morphologic appearance that may be useful in species identification.

✓ Some have spores; not all
Amoebozoa

- Locomotion of amebae is accomplished by the extrusion of pseudopodia ("false feet").
- Amoebae are phagocytic and contain mitochondria with tubular cristae.
- Cyst and trophozoite form
PROTOZOA

- Sporozoa

- Large group
- Sexually reproducing
- Spore-forming protozoans
- Similar morphology at the electron microscopic level
- Have a system of organelles at their apical end that produces substances to help the organism penetrate host cells and thus become an intracellular parasite
PROTOZOA

4. Ciliophora

- Free-living and symbiotic species.

- Locomotion involves the coordinated movement of rows of hairlike structures, or cilia.

- Cilia are structurally similar to flagella but are usually shorter and more numerous.

- Some ciliates are multinucleate.

- The only ciliate parasite of humans, *Balantidium coli*, contains two nuclei: a large macronucleus and a small micronucleus.
FLAGELLATES

- **Intestinal flagellates**
  - Giardia intestinalis
  - Trichomonas spp
  - Dientamoeba fragilis

- **Urogenital flagellates**
  - Trichomonas vaginalis
Giardia intestinalis (lamblia)

- Cysts:
  - resistant forms
  - responsible for transmission of giardiasis (infective stage).
- Both cysts and trophozoites can be found in the feces (diagnostic stages).
- The cysts are hardy and can survive several months in cold water.
Giardia intestinalis (lamblia)

- Infection occurs by the ingestion of cysts in contaminated water, food, or by the fecal-oral route (hands or fomites).

- Because the cysts are infectious when passed in the stool or shortly afterward, person-to-person transmission is possible.
Contamination of water, food, or hands/fomites with infective cysts.

Trophozoites are also passed in stool but they do not survive in the environment.

=i = Infective Stage
=d = Diagnostic Stage
SYMPTOMS

- Diarrhea
- Abdominal pain
- Bloating
- Nausea
- Vomiting

Incubation period: 1 to 14 days (average of 7 days)
Cysts or trophozoites in the feces, using direct mounts (repeated samplings)

Samples of duodenal fluid (e.g., Enterotest)

Duodenal biopsy may demonstrate trophozoites

Alternate methods

- Antigen detection tests (enzyme immunoassays)
- Detection of parasites by immunofluorescence.
Trichomonas vaginalis

- Resides in the female lower genital tract and the male urethra and prostate
- Transmitted among humans, its only known host, primarily by sexual intercourse
- No cyst formation
Trichomonas vaginalis

1. Trophozoite in vaginal and prostatic secretions and urine
2. Multiplies by longitudinal binary fission
3. Trophozoite in vagina or orifice of urethra

i = Infective Stage

d = Diagnostic Stage
SYMPTOMS

In women
✓ Vaginitis with a purulent discharge is the prominent symptom
✓ Vulvar and cervical lesions
✓ Abdominal pain
✓ Dysuria
✓ Dyspareunia.

In men
✓ Asymptomatic
✓ Urethritis,
✓ Epididymitis
✓ Prostatitis

the incubation period is 5 to 28 days.
DIAGNOSIS

- Microscopic examination of wet mounts
- Culture
Dientamoeba fragilis

- Not an ameba but a flagellate
- No cyst formation
It has been postulated that transmission occurs via helminth eggs, such as *Ascaris* and *Enterobius*.

1. **Trophozoites in feces**
2. Transmission via fecal-oral route.
3. No cyst stage has been identified.
4. **Trophozoites ingested**

**i** = Infective Stage

**d** = Diagnostic Stage

Binary fission

Trophozoites in lumen of colon
SYMPTOMS

- Diarrhea
- Abdominal pain
- Anorexia
- Nausea
- Vomiting
- Fatigue
- Weight loss
DIAGNOSIS

- Detection of trophozoites in permanently stained fecal smears (e.g., trichrome, iron haematoxyline).
- Not detectable by stool concentration methods.
- Trophozoites can be easily overlooked, they are pale-staining and their nuclei may resemble those of *Endolimax nana* or *Entamoeba hartmanni*. 
<table>
<thead>
<tr>
<th></th>
<th>Trichomonas hominis</th>
<th>Chilomastix mesnili</th>
<th>Giardia lamblia</th>
<th>Enteromonas hominis</th>
<th>Retortamonas intestinalis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trophozoite</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Cyst</strong></td>
<td>No cyst</td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**Scale:**

![Scale Image](image10.png)
AMEBAS

- **Intestinal amebas**
  - Entamoeba histolytica
  - Entamoeba coli
  - Balantidium coli (CILIATED PROTOZOOM)

- **Free-living amebas**
  - Naegleria fowleri
  - Acanthamoeba castellani

<table>
<thead>
<tr>
<th>Features</th>
<th>Intestinal amoebae</th>
<th>Free-living amoebae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>Intestine</td>
<td>Soil and water</td>
</tr>
<tr>
<td>Pathogenicity</td>
<td>Pathogenic (diseases in colon, liver and other extra-intestinal sites)</td>
<td>Opportunistic (affect CNS, cornea and skin)</td>
</tr>
<tr>
<td>Flagellated forms</td>
<td>Absent</td>
<td>May be present</td>
</tr>
</tbody>
</table>
**Amebae**

<table>
<thead>
<tr>
<th></th>
<th>Entamoeba histolytica</th>
<th>Entamoeba hartmanni</th>
<th>Entamoeba coli</th>
<th>Entamoeba polecki*</th>
<th>Endolimax nana</th>
<th>Iodamoeba bütschlii</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trophozoite</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Cyst</strong></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
</tbody>
</table>

*Rare, probably of animal origin*
AMEBIASIS

Parasitic infection of the intestines is known as Amebiasis.

Signs & Symptoms of Amebiasis:
- Patient has loose stools
- Stomach pain
- Stomach cramping
- Amebic dysentery
- Fever and tenderness
- Abscess

- Entamoeba histolytica
- Entamoeba coli
- Entamoeba hartmanni
CDC
SAFER・HEALTHIER・PEOPLE™
http://www.dpd.cdc.gov/dpdx

Mature cysts ingested

1. Passed in feces
   - Infective Stage (i)
   - Diagnostic Stage (d)

A = Noninvasive Colonization
B = Intestinal Disease
C = Extraintestinal Disease

Excystation → Trophozoites → Multiplication

4. Trophozoites (d)

5. Cysts (d)

Exits host
SYMPTOMS

- Asymptomatic infection ("luminal amebiasis")
- Invasive **intestinal amebiasis**
  - Dysentery
  - Colitis
  - Appendicitis
  - Toxic megacolon
  - Amebomas
- Invasive **extraintestinal amebiasis**
  - **Liver abscess**, 
  - Peritonitis
  - Pleuropulmonary abscess
  - Cutaneous genital amebic lesions
DIAGNOSIS

- **Fresh** stool: wet mounts and permanently stained preparations (e.g., trichrome).
- **Concentrates** from fresh stool: wet mounts, with or without iodine stain, and permanently stained preparations (e.g., trichrome). **Concentration** procedures, however, are **not useful** for demonstrating trophozoites.
- **E. histolytica** trophozoites can also be identified in **aspirates** or biopsy samples obtained during **colonoscopy** or **surgery**.
- **Erythrophagocytosis** is the only morphologic characteristic that can be used to differentiate **E. histolytica** from the nonpathogenic **E. dispar**.
E. histolytica trophozoites
Entamoeba histolytica cysts

E. histolytica cysts

1000x

4 Nuclei
Central karyosome
Cyst wall
Chromatoid Bar
Peripheral chromatin

12-18 μm
E. coli trophozoites

Composite of Trophozoites
ENTAMOEBA HISTOLYTICA
& ENTAMOEBA COLI

E. histolytica troph
- 10-30 u
- single nucleus
- may have ingested RBC's
- directional purposeful motility

E. coli troph
- 15-30 u
- single nucleus
- sluggish non-directional motility
- no ingested RBC's

Fig. 6.2 Entamoeba coli.
Composite of Cysts of
ENTAMOEBA HISTOLYTICA
&
ENTAMOEBA COLI

E. histolytica cyst
- 20 μ in diameter
- never more than 4 nuclei
  in mature cyst

E. coli cyst
- 10-30 μ in diameter
- 4 or more nuclei
- 8 nuclei in mature cyst

Entamoeba coli cyst
more than 4 nuclei

20μm

E. coli cysts
E. hartmanni
Balantidium coli

- A large ciliated protozoan parasite
- Most cases are asymptomatic.
- Clinical manifestations
  - persistent diarrhea
  - occasionally dysentery
  - abdominal pain
  - weight loss
The cyst is the infectious stage and is acquired by the host through ingestion of contaminated food or water.

Some trophozoites invade the wall of the colon.

- **i** = Infective Stage
- **d** = Diagnostic Stage
DIAGNOSIS

- Trophozoites in stool specimens or in tissue collected during endoscopy. Cysts are less frequently encountered.

- *Balantidium coli* trophozoites
  - their large size (40 µm to more than 70 µm).
  - the presence of cilia on the cell surface
  - a bean shaped *macronucleus* which is often visible,
  - a smaller, less conspicuous *micronucleus*. 
**SPOROZOANS**

- **Blood sporozoans**
  - *Plasmodium vivax*
  - *Plasmodium malariae*
  - *Plasmodium ovale*
  - *Plasmodium falciparum*
  - *Babesia microti*

- **Other**
  - *Isospora belli*
  - *Sarcocystis bovihumanis*
  - *Cryptosporidium parvum*
  - *Cyclospora*
  - *Toxoplasma gondii*

![Images of P. falciparum, P. ovale, Babesia, Cyclospora, and T. gondii bradyzoites]
Cystoisospora belli (Isospora belli)

Oocysts mature in the environment

1. Oocysts in feces
2. Mature oocysts with sporozoites
3. Immature oocysts with sporocysts
4. Immature oocysts with sporoblasts
5. Mature oocysts

Sporozoites

Schizogony

Microgamete

Fertilization

Macrogamete

Sporogony

= Infective Stage
=d = Diagnostic Stage
Symptoms

- Acute, nonbloody **diarrhea** with **crampy abdominal pain**, which can last for weeks and result in malabsorption and weight loss.

- In **immunodepressed** patients, and in infants and children, the diarrhea can be **severe**.

- **Eosinophilia** may be present (differently from other protozoan infections).
Diagnosis

- Wet mount
- UV
- Modified acid-fast
- Safranin stain

Unsporulated oocyst  Sporulated oocyst

Modified EZN
Sarcocystosis
*Sarcocystis bovihumanis*

- **Asexual reproduction**
  - Merozoites penetrate muscle cells and develop into cysts with bradyzoites.
  - Schizonts rupture releasing merozoites.
  - Merozoites ingest by cows and pigs.
  - Sporocysts rupture releasing sporozoites that enter endothelial cells of blood vessels and undergo schizogony.

- **Sexual reproduction**
  - Oocysts and sporocysts passed in feces.
  - Sporocysts ingest by cows and pigs.

- **Sarcozyst with bradyzoites**
Symptoms

- Often asymptomatic and clear spontaneously
- Mild fever
- Diarrhea
- Chills
- Vomiting
- Respiratory problems
Cryptosporodiosis

- Cryptosporidium parvum and Cryptosporidium hominis (formerly known as C. parvum anthroponotic genotype or genotype 1) are the most prevalent species causing disease in humans.

- Infections by C. felis, C. meleagris, C. canis, and C. muris have also been reported.
Symptoms

- Asymptomatic infections to severe, life-threatening illness;
- Incubation period is an average of 7 days (but can range from 2 to 10 days).

- Watery diarrhea
- Dehydration
- Weight loss
- Abdominal pain
- Fever
- Nausea
- Vomiting
Symptoms

- In immunocompetent persons, symptoms are usually short lived (1 to 2 weeks); they can be chronic and more severe in immunocompromised patients, especially those with CD4 counts <200/µl.

- While the small intestine is the site most commonly affected, symptomatic Cryptosporidium infections have also been found in other organs including other digestive tract organs, the lungs and possibly conjunctiva.
Oocysts in stool smears stained with modified acid-fast stain:

A Cryptosporidium sp.  B Cyclospora cayetanensis  C Cystoisospora belli
Reference

• Medical Microbiology
  – Patrick R Murray
  – Ken S Rosenthal
  – Michael A Pfaller

2013