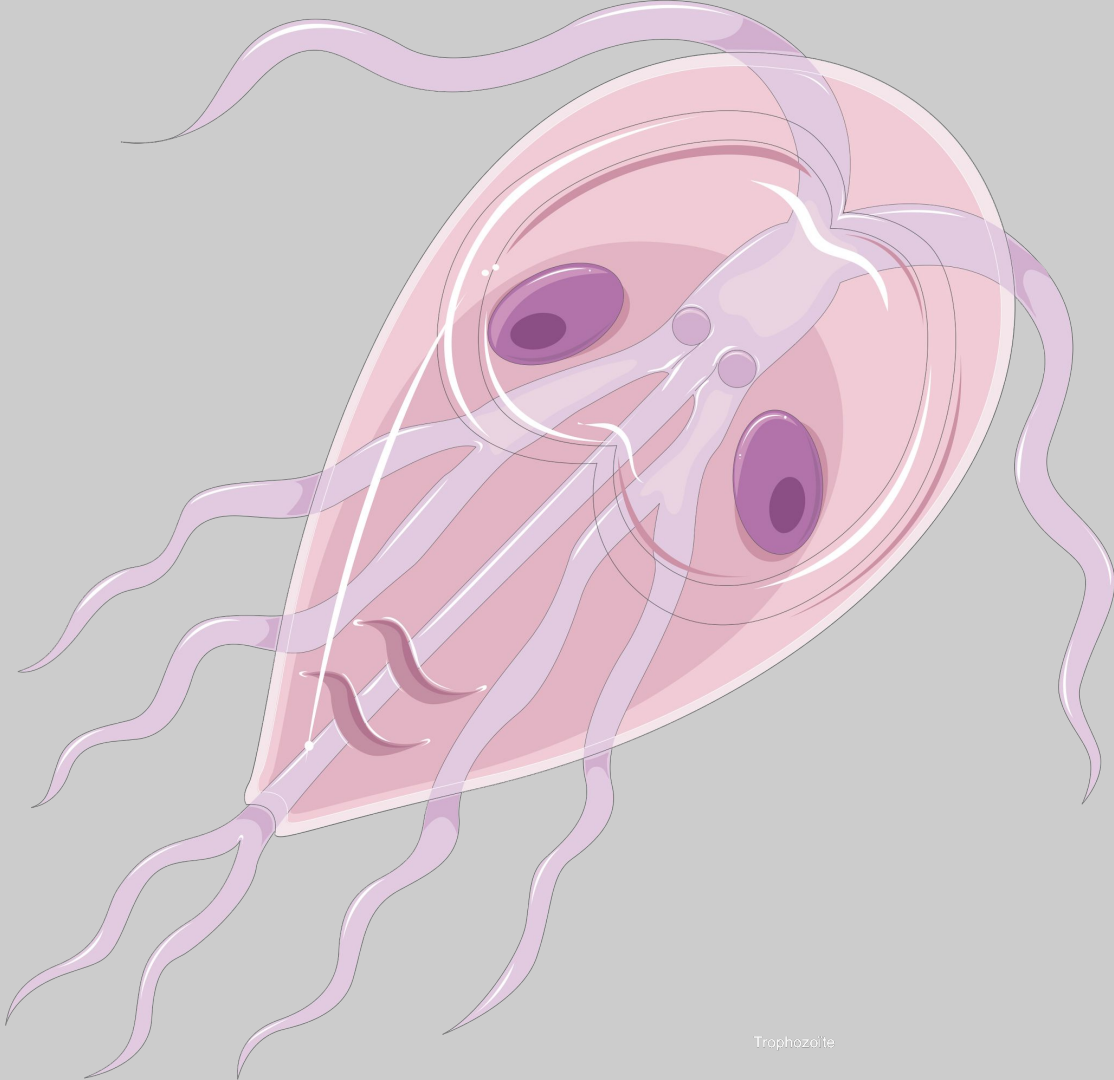
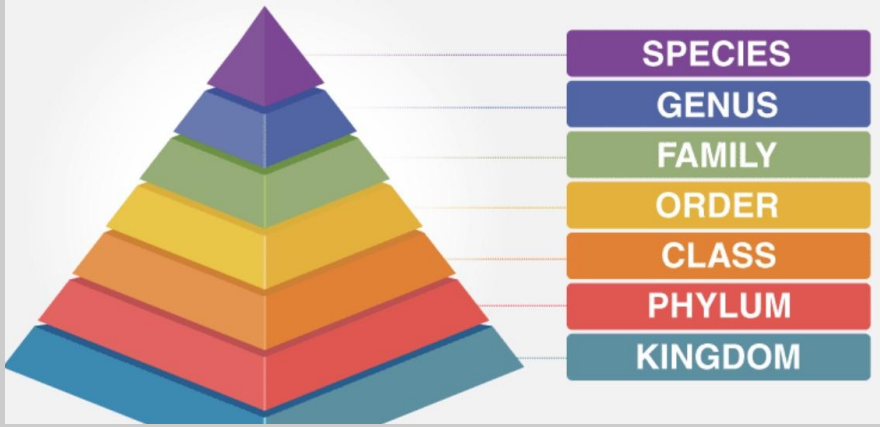
Giardia lamblia

Julian Garcia



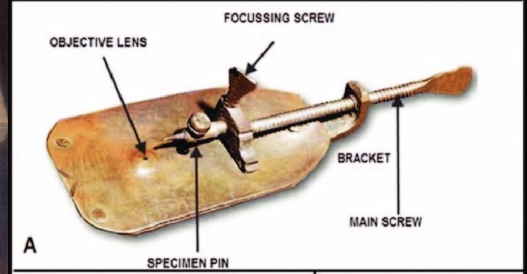
Taxonomy

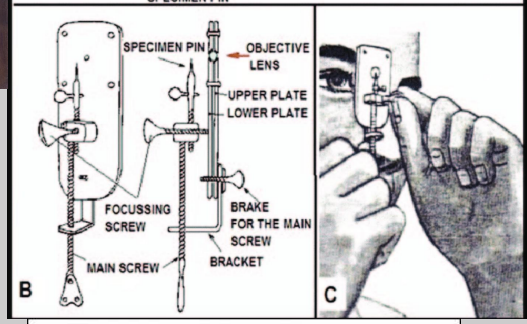


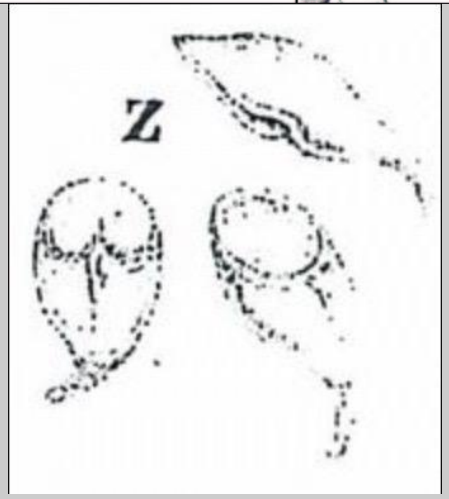
- Kingdom: Protozoa
  - Phylum: Metamonada
    - Class: Trepomonadea
      - Order: Distomatida
        - Family: Hexamitidae
          - Genus: *Giardia*
            - Species: *lamblia*

History

- Leeuwenhoek in 1681
- Czech physician Vilem Lambl in 1859
- Raphael Blanchard in 1882
- Charles Stiles in 1915
- Officially named in 1954
- Recognized as a global pathogen in 1970
- Today

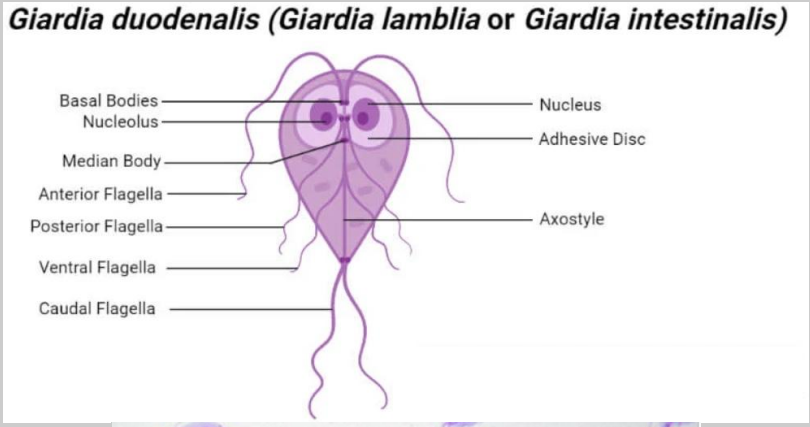


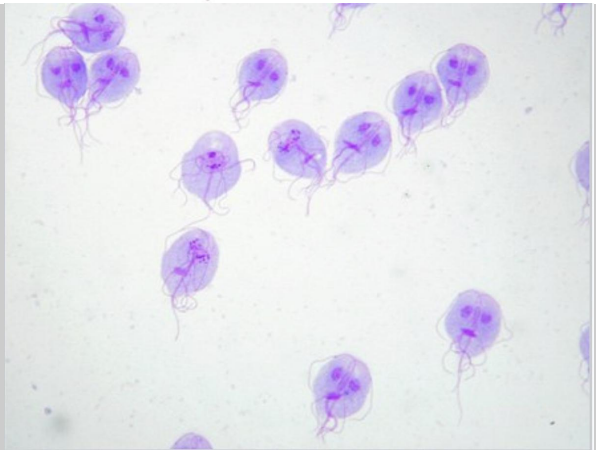




Morphology: Trophozoite

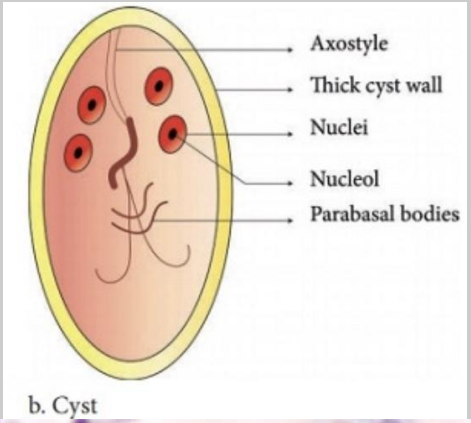
- 12-15 µm in length
- 5-15 µm wide
- 2 nuclei
- Bilateral symmetry
- 8 flagella
- Flattened ventrally
- Adhesive disc



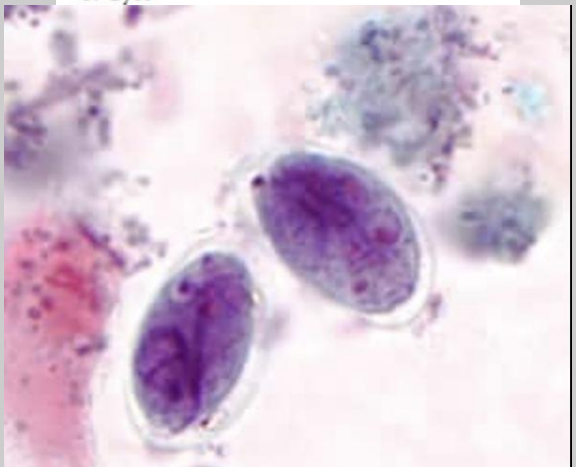


Morphology: Cyst

- Ovoid shape
- 8-12 µm long
- 7-10 µm wide
- Mature contain 4 nuclei
- Thick cyst wall
- Axostyle
- Parabasal bodies

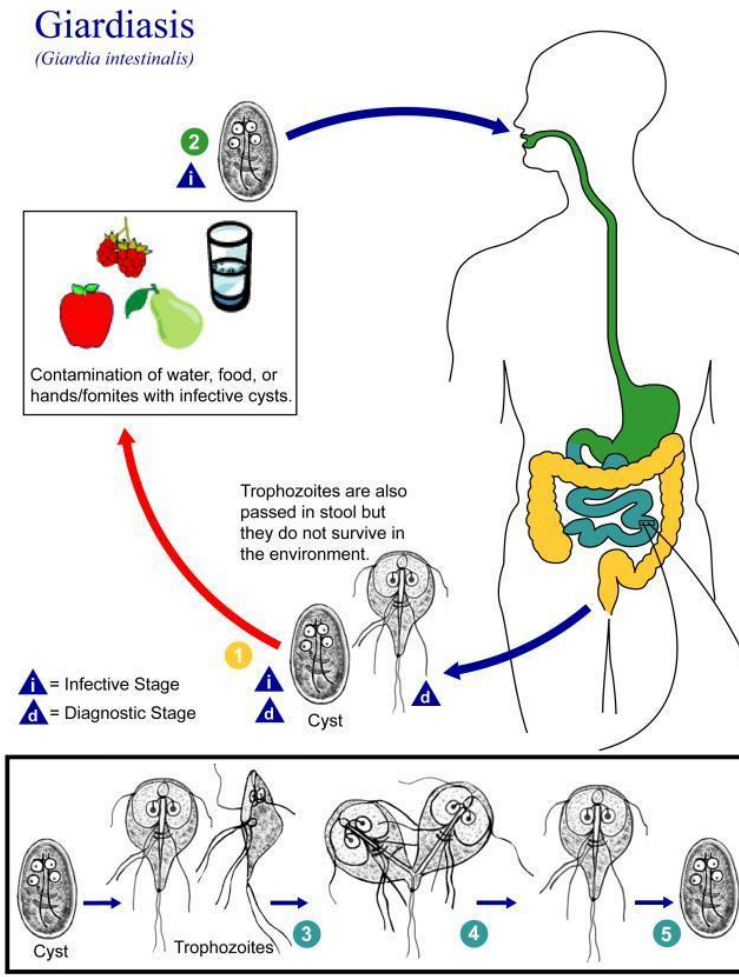


b. Cyst



Life Cycle

- Infection begins when water or food is ingested that is contaminated with cysts
- Excystation in SI
- Trophozoite replication in SI
- Encystation in LI
- Reinfection through stool



Monsters Inside me: Giardia

- https://www.youtube.com/watch?v=jiQ297MGkJU

Epidemiology

Giardia infections happen all over the world. But they are more common in certain areas, including:

- Sub-Saharan Africa.
- South and Southeast Asia.
- Central America.
- Western parts of South America.
- Eastern Europe.

- Globally distributed protozoan
- Endemic to warm climates
- Only *Giardia lamblia* infects humans
- Most common flagellate of human digestive tract
- Causes giardiasis, highly contagious
- Transmission through mature cyst ingestion; via contaminated water, person-to-person transmission, international travel, immunocompromised individuals, and children
- Reservoir hosts can include dogs, cats, and beavers
- Zoonotic
- More cases in summer time

Epidemiology continued

- More prevalent in developing countries (sub-Saharan Africa, Asia, and Latin America) due to inadequate sanitation. Approximately 33% infected.
- Infects 2% of adults and 8% of children in developed areas
- CDC estimates 1.2 million cases in the U.S. annually ; 200 million globally
- Higher prevalence in children, immunocompromised, and populated areas
- Travelers, campers, and hikers consuming untreated water are at increased risk

Pathogenesis

- Severe intestinal disorders
- Intense diarrhea +/- blood
- Intestinal mucosa damage
- Damage of villi leading to food absorption interference (fats & fat-soluble vitamins)
- Abdominal cramps
- Dehydration
- Weight loss
- Fatigue

Pathogenesis continued

- Symptoms can appear 3-25 days after exposure and can last 1-6 weeks
- Asymptomatic could be up to 50%
- If travels to gallbladder, nausea/vomiting, and jaundice may develop
- Intestines may become reinfected and relapses could occur for years
- Fatality is less common if treated adequately

Diagnosis

- Microscopic examination of feces
- Mature cysts present
- Usually numerous and recognized by ovoid shape and number of nuclei

Treatment

- Metronidazole
- Tinidazole
- Nitazoxanide

Prevention and Control

- Drink filtered/boiled or bottled water abroad
- Practice good hygiene
- Avoid fecal-oral interactions
- Wash hands and raw fruits/vegetables before consumption
- Avoid contaminated areas
- Water pipes should be checked regularly and water tx methods

Case Study #1

- A 61-year-old Japanese man from japan presented with a 2 month history of abdominal pain and watery diarrhea.
- He began organic farming using cattle manure 1 year previous
- Physical examination revealed mild abdominal tenderness
- Blood tests showed low total protein (5.8 g/dL ; range 6.4-8.3 g/dL) and albumin (3.5 g/dL; range 3.5-5.0 g/dL)

Case Study #1

- Abdominal CT revealed small intestinal wall thickening
- A trophozoite was detected in a fecal smear, thus diagnosing *Giardia lamblia*
- Metronidazole 250 mg was prescribed three times daily for 10 days
- This resolved symptoms completely

Case Study #2

- A 9.5 year old from Mexico with chronic abdominal pain
- History of diarrhea, although no fever or vomiting
- Feces screened for pathogenic bacteria, resulting in a negative test
- Microscopic examination of cysts and ova was negative
- Lactose hydrogen breath test was positive

Lactose hydrogen test

- Indicates secondary lactose intolerance
- Mechanism
- Undigested lactose passes into colon, get bacteria ferment it, producing hydrogen gas, which absorbs into bloodstream and exhaled

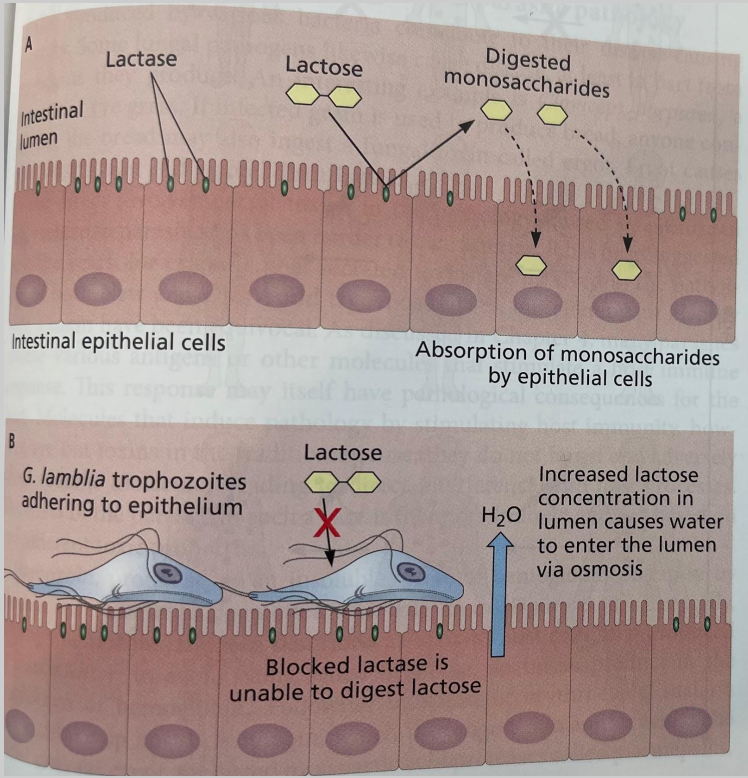


Figure 5.8 A mechanism for increased lactose intolerance and diarrhea in *G. lamblia* infections. (A) Ordinarily, lactose is digested to its component monosaccharides, glucose and galactose, in the intestinal lumen. This digestion is catalyzed by lactase associated with the plasma membrane of intestinal epithelial cells. (B) As it adheres to the epithelium, however, *G. lamblia* can interfere with this digestion, resulting in a reduced ability to digest lactose and a buildup of the disaccharide in the lumen. The increased lactose concentration alters the osmotic balance between the epithelial cells and the lumen, resulting in the movement of water into the lumen. This excess water contributes to the watery diarrhea characteristic of *Giardia* infection.

Case Study #2

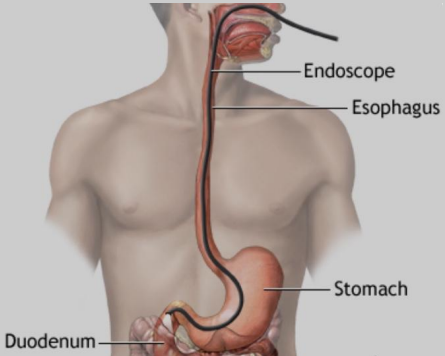
- Presumptive clinical diagnosis was giardiasis and medicated with nitazoxanide (7.5 mg/kg/12h/3 days)
- Patient persisted with abdominal pain

Test	Normal Range	Result	Interpretation
White Blood Cell (WBC) Count	4,500 – 11,000 / µL (or per mL)	4,700 / µL	Normal (low-normal)
Neutrophils	40 – 70%	44%	Normal
Hemoglobin (Hgb)	13.5 – 17.5 g/dL (men) / 12 – 15.5 g/dL (women)	14.7 g/dL	Normal
Hematocrit (Hct)	38 – 50% (men) / 34 – 44% (women)	43.2%	Normal
Mean Corpuscular Volume (MCV)	80 – 100 fL	83.4 fL	Normal
Platelet Count	150,000 – 450,000 /µL	262,000 /µL	Normal

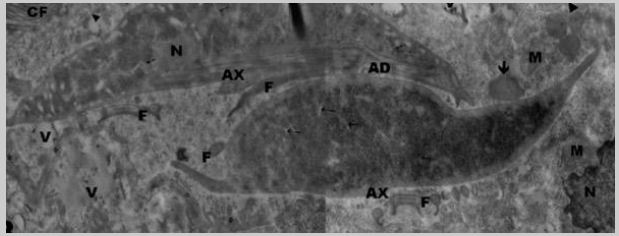
Test	Normal Range	Result	Interpretation
Prothrombin Time (PT)	11 – 14 seconds	13.6 seconds	Normal
Prothrombin Activity (% Activity)	70 – 120%	90.4%	Normal
International Normalized Ratio (INR)	0.8 – 1.2 (for individuals not on anticoagulants)	1.13	Normal

Case Study #2

- Endoscopy performed to search for *Giardia*
- Biopsies taken from the first and second duodenal portions
- Microscopic analyses of duodenal fluid revealed *Giardia* trophozoites

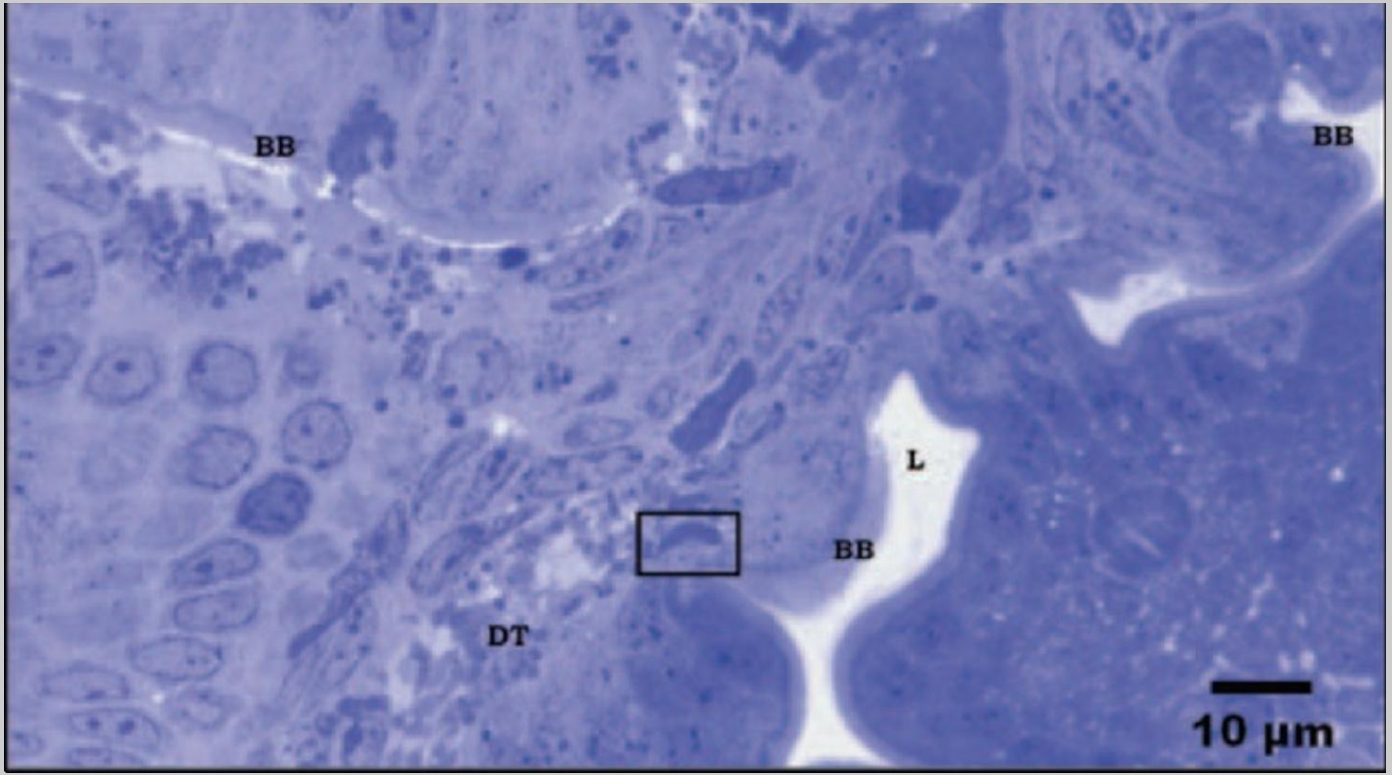


Case Study #2



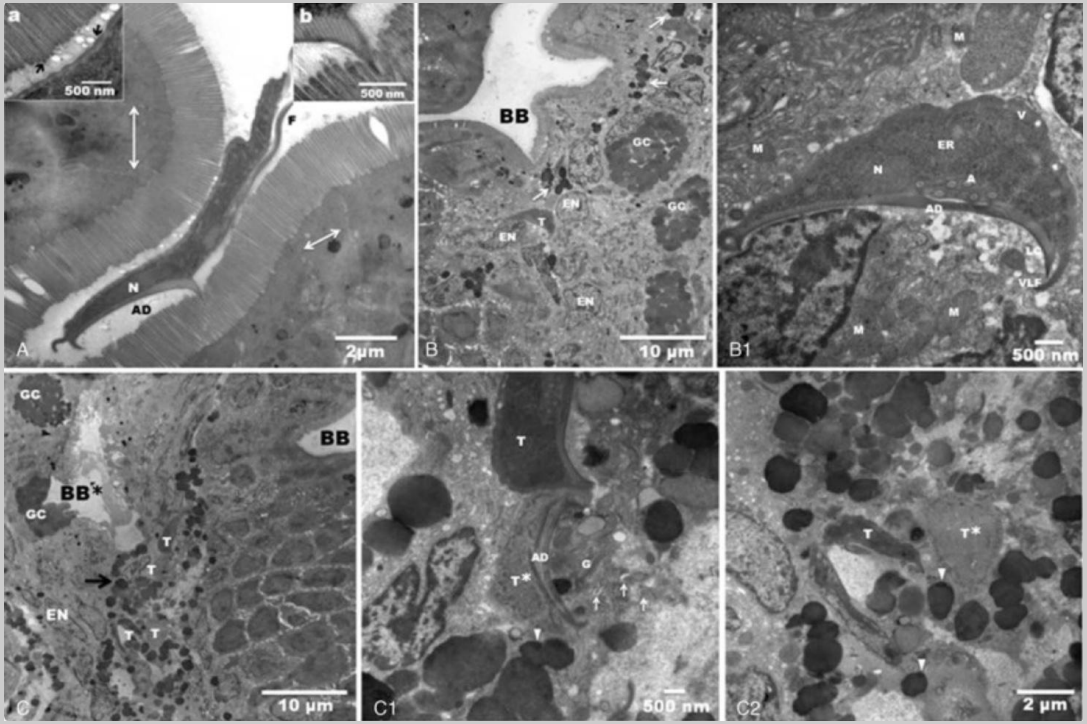
- *Giardia* trophozoites found in several areas: submucosa, lumen, within the epithelium, in contact with intestinal microvilli, embedded in the tissue between the enterocytes nuclei and goblet cells, and found between granules at the level of the nuclei and goblet cells.
- Diagnosed with intraepithelial *Giardia lamblia*, which is very rare

Biopsy



Semi-thin section from duodenal biopsy shows panoramic view of different cutting planes. Several areas of the epithelium with normal appearance and intact trophozoite within the damaged submucosa are shown. BB: Brush border; DT: Damage tissue. Stain toluidine blue.

Biopsy- TEM



A: T attached to duodenal brush border
B: Pano of duodenal epithelium brush border
B1: High mag.
C: Low mag. of duodenal epithelium
C1: High mag.
C2: High mag.

Case Study #2

- Patient medicated with tinidazole at 75 mg/kg/day/4 days
- Subsequent tests showed lactose absorption was normal, stool examinations were negative, and abdominal pain resolved

Case Study #3

- A 54-year-old caucasian man from Italy with a 3-week history of muscular weakness, diarrhea, and weight loss
- Neurological examination showed muscular weakness in all four limbs and the neck
- Patient suffered 4-8 bouts of diarrhea every 24 hours for the past 2 weeks

Case Study #3

- *Giardia lamblia* cysts were identified through microscopic examination of stool sample

Test	Normal Range	Results	Interpretation
Potassium (K^+)	3.5 – 5.0 mEq/L	1.6 mEq/L	Severely Low (Hypokalemia) ⚠
Magnesium (Mg^{2+})	1.7 – 2.2 mg/dL	1.1 mg/dL	Low (Hypomagnesemia) ⚠
Total Protein	6.4 – 8.3 g/dL	5.6 g/dL	Low (Hypoproteinemia) ⚠
Creatine Kinase (CK/CPK)	30 – 200 U/L	4,655 U/L	Very High (Muscle Damage, Possible Rhabdomyolysis) ⚠
Lactate Dehydrogenase (LDH)	125 – 250 U/L	912 U/L	Elevated (Tissue Breakdown, Hemolysis, or Liver/Muscle Damage) ⚠

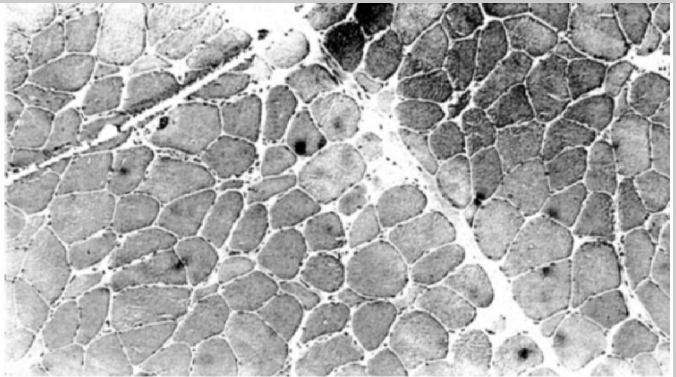
Case Study #3

- Electromyographic study was performed using a concentric needle electrode
- The number of activated motor unit action potentials (MAUP) was reduced and the incidence of polyphasic MUAP was higher than normal (on average 23%) in both muscles.
- An open muscle biopsy was performed on the left bicep muscle

Case Study #3 (Fig.1)

- Microscopic examination showed an abnormal fiber size due to the presence of numerous rounded atrophic (smaller/darker) and hypertrophic (pale/large) fibers (Fig.1)
- Motor neurons supplying muscle fibers degenerate
- Motor neurons take over function of lost neurons

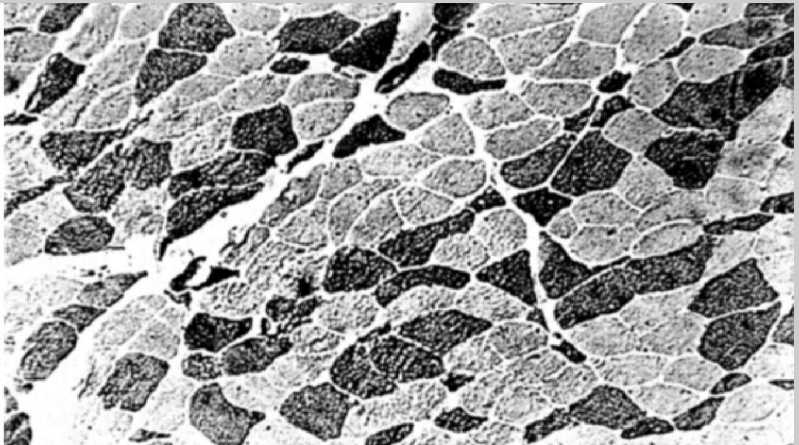
Fig. 1 Several atrophic and hypertrophic fibers with some internal nuclei (hematoxylin and eosin, ×450)



Case Study #3 (Fig.2)

- Myosin ATPase-stained sections showed an almost normal checkerboard pattern, except for a few areas with small fiber type 1 (lighter clustered) groups (Fig.2)
- Reinnervation after denervation
- Loss of normal mosaic pattern

Fig. 2 Some small groups of type 1 muscle fibers (ATPase with preincubation at pH 9.4)



Case Study #3

- Hypokalemia can lead to degeneration and structural changes within muscles
- Diagnosed with severe and transient myopathy secondary to hypokalemia induced by *Giardia lamblia*, which is very rare.

Case Study #3

- Treatment of metronidazole 2-g dose in conjunction with paromomycin and intravenous electrolytes
- The ECG, serum potassium level, and muscular strength were monitored for 2 weeks to compensate for the potassium loss and to achieve a steady clinical improvement
- After 3 weeks of therapy, the patient had gained 5 kg in body weight and showed marked improvement
- 6 months later the patient showed no signs of myopathy

Case Study #3

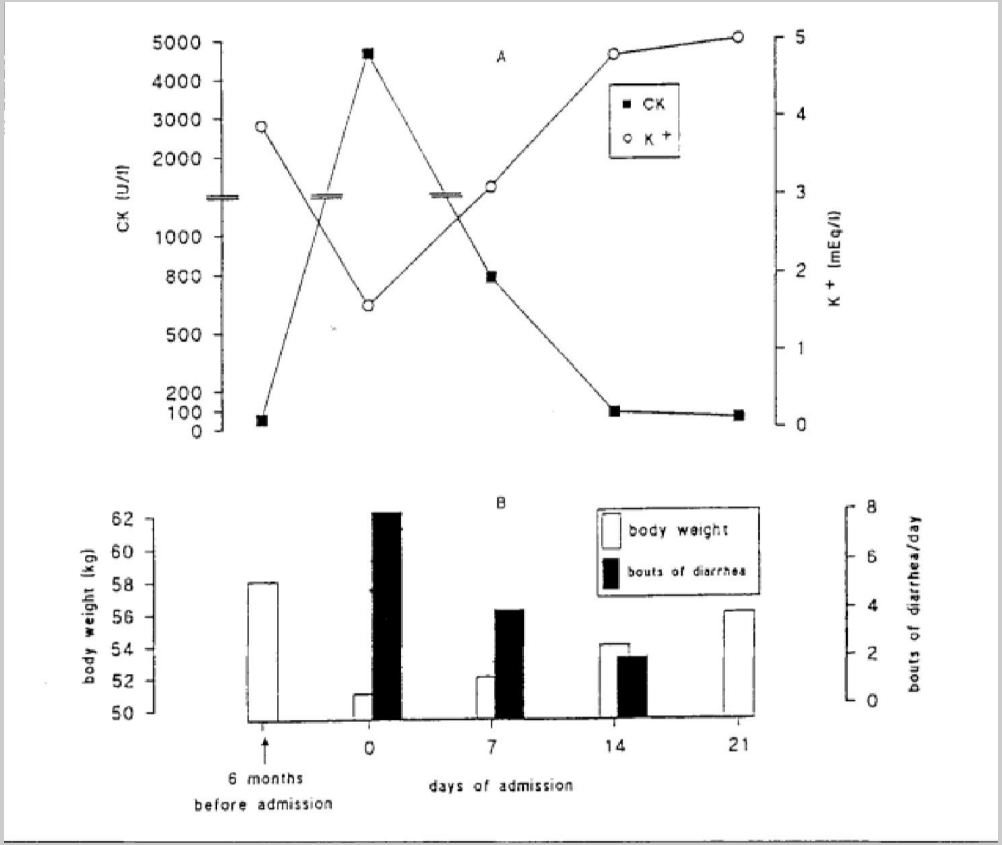
Laboratory test results:

	1	7	14	20
Glucose	120	100	89	85
Urea nitrogen (mg/dl)	74	41	49	43
Creatinine (mg/dl)	1.1	0.8	1.1	1.1
Protein (g/l)	5.6	4.1	4.9	4.9
Albumin (g/dl)	3.6	3.0	3.6	3.7
Na^+ (mEq/l)	146	142	139	138
K^+ (mEq/l)	1.6	3	5	5
Ca^{2+} (mg/dl)	8.6	8.4	–	8.5
AST (U/l)	247	90	32	24
CK (U/l)	4,655	735	83	50
LDH (U/l)	912	480	369	340
Mg^{2+} (mg/dl)	1.1	–	–	1.2

Test	Normal Range
Glucose (mg/dL)	70 – 140
Urea Nitrogen (mg/dL)	7 – 20
Creatinine (mg/dL)	0.6 – 1.3
Protein (g/dL)	6.4 – 8.3
Albumin (g/dL)	3.5 – 5.0
Sodium (Na^+, mEq/L)	135 – 145
Potassium (K^+, mEq/L)	3.5 – 5.0
Calcium (Ca^{2+}, mg/dL)	8.5 – 10.2
AST (U/L)	10 – 40
Creatine Kinase (CK, U/L)	30 – 200
Lactate Dehydrogenase (LDH, U/L)	125 – 250
Magnesium (Mg^{2+}, mg/dL)	1.7 – 2.2

Case Study #3

A time course of serum creatine kinase (CK) and potassium (K) related to **B** body weight and bouts of diarrhea in a patient with *Giardia lamblia* infection



Question #1

- In case study #2, patient was diagnosed with _____ *Giardia lamblia*?

A. extraepithelial

B. intraepithelial

C. hepatic

D. renal

Answer to #1

B. intraepithelial

Question #2

- In Case Study #3, the patient was diagnosed with severe and transient myopathy secondary to _____ induced by *Giardia lamblia*.

A. hyperkalemia

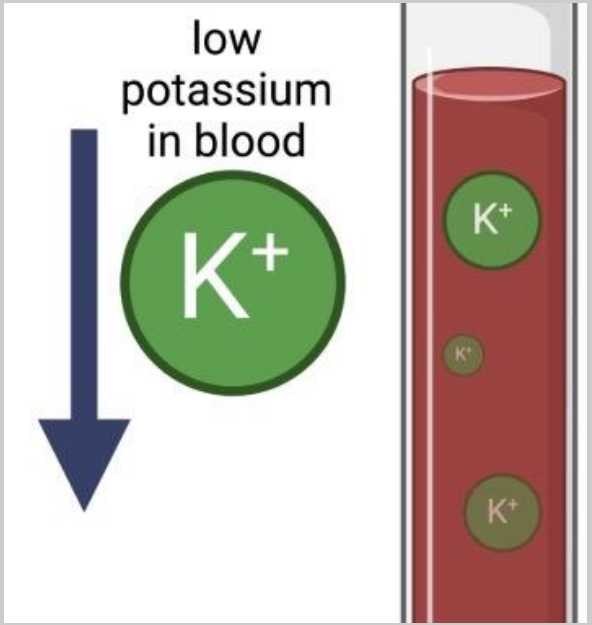
B. hypokalemia

C. hypernatremia

D. hyponatremia

Answer to #2

- B. hypokalemia



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