Parasites and Applied Medical Parasitology

By:

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Acknowledgments

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Contents

توصيف مقرر دراسى

1- بيانات المقرر		
الرمز الكودى :	اسم المقرر : **Medical Parasitology**	الفرقة /المستوى :شعبة المعاونين
التخصص :	عدد الوحدات الدراسية : نظرى **24 hours**	عملى **24 hours**

2- هدف المقرر:	
	The main aim of medical Parasitology course is to provide the student with knowledge, comprehension and methods of application of medical Parasitology in practical life.
3- المستهدف من تدريس المقرر :	
ا. المعلومات والمفاهيم :	**1.** Describe the morphological characteristics, life cycles, methods of transmission of medically important helminths. **2.** Mention the morphological characteristics, life cycles, methods of transmission of medically important Protozoa. **3.** Describe the morphological characteristics, life cycles and recognize diseases caused or transmitted by medically important Arthropods. **4.** Discuss clinical picture associated with parasitic infections. **5.** List the different diagnostic techniques for detecting parasites. **6.** Outline the plan of treatment of each parasitic disease.
ب- المهارات الذهنية :	Interpret P 1-Interpret different clinical presentations and correlate them to suspected parasites. Differen 3 2-Differentiate and compare similar stages of different parasites. Interpret 3-Choose the most suitable diagnostic technique for each parasitic problem
ج- المهارات المهنية الخاصة بالمقرر:	1.Use the light microscopy 2.Examine mounted slides and identify different parasites 3.Examine laboratory specimens 4.Interpret the results of examination of parasitic specimens
د- المهارات العامة :	d1 1-Review the scientific literature on a research topic d2 2-Retrieve recent data from web sites d3 3-Acquire presentation skills

4- أساليب التعليم والتعلم
Lectures.: small group teaching Practical lessons Tutorial sessions after the practical lessons Enhancing self learning of students (students' presentations)

5- أساليب التعليم والتعلم للطلاب ذوى القدرات المحدودة	**Using colored photos for parasites** **Using simple techniques to help in better understanding like PPT and videos**
6- تقويم الطلاب :	
أ- الأساليب المستخدمة ب-التوقيت ج-توزيع الدرجات	-Mid-Term Examination (20 marks) (10 marks assignments & 10 marks quiz)After 6 weeks from the start -Final-Term Examination (90 marks) At the end of the 12th week -MCQs (20 marks) -Short essay questions (70 marks) -Practical Examination (40 marks) Total : 150 marks

7- قائمة الكتب الدراسية والمراجع :

1- Course Notes	1- Practical notes 2- MCQ and clinical cases notes
2- Essential Books (Text Books)	Department book Clinical Parasitology . A Practical Approach,2013
3- Recommended Books	a-Basic clinical Parasitology (Brown and Neva) b- Colored Atlas of Parasitology c- Medical Parasitology (Markell, vogue, and John) d- Tropical medicine and Parasitology (peters and Gills)
4- Periodicals, Web Sites, …etc	-Parasitology today (Trends in Parasitlogy) Journal. - Advanced pubmed web sites. - CDC website.

Course Description

This course will focus on full analysis for different parasitological related diseases in our community especially those common in Egypt causing serious health problems.

In this course will discuss medical helmithology, protozoology and entomology concerning their morphological features, life cycle, pathogenesis, clinical manifestations, different diagnostic techniques, the most recent lines of treatment and prevention with control strategy for each parasitic infection.

Finally the course will focus on immunology and molecular biology for different parasites affecting human health.

Core Knowledge

By the end of this course, students should be able to:

- Define most parasitological terms with its causing parasite.
- Describe morphology of important helminthic and protozoal parasitic infections.
- Explain how life cycle occurs in different parasitic illness.
- Describe clinical picture in different parasitic infections.
- List types of different and recent diagnostic methods in parasitic diseases.

  Identify lines of treatment, prevention and control strategy for each parasitic infection.

Core Skills

By the end of this course, students should be able to:

- Identify different parasites affecting human beings.
- Analyze symptoms and signs for each parasitic illness.
- Know about the most recent diagnostic procedures in laboratory work.
- Apply information about prevention and control methods in practical fields.

Course overview

		Methods of Teaching/Training with Number of Total Hours per Topic				
ID	Topics	Interactive Lecture	Field Work	Assignm	Research	Lab
1	**1-Basics about helminthology and liver flukes** **2-Intestinal flukes (one hour)**	2				2
2	**3-Blood flukes** **4-Cestodes and teaniasis**	2				2
3	**5-H.nana infection** **6-Hints about Ascaris, Entrobius vermicularis infection and whip worm**	2				2
4	**7-Hook worms** **8-Filarial worms**	2				2
5	**9-Introduction to protozoa** **10-Amoebiasis and control strategy**	2				2
6	**11-Hints about Oro intestinal urogenital flagellates (G.lamblia infection & T.vaginalis)** **12-Cases**	2				2
7	**13-Malaria** **14-T.gondii infection**	2				2
8	**15-Malaria case** **16-Toxoplasma case**	2				2
9	**17-Introduction to entemology** **18-Different types of mosquitoes and control strategy**	2				2
10	**19-Medical importance of flies and myasis** **20-Medical importance of fleas**	2				2
11	**21-Medical importance of lice** **22- Medical importance of ticks**	2				2
12	**23-Sarcobties scabii** **24-Sarcobties scabii case**	2				2
Total hours : 48 hours		24 hours				24 hours

Chapter 1

Introduction to parasitology

Objectives

1- Aims to focus on general parasitological terms that will be discussed later on during the course.

2-Gives general idea about life cycle, methods of infection and different harmful effects caused by parasitic infection.

Introduction

Introduction

A parasite is an organism which lives on or within another organism called a host from which it obtains food and protection. Parasites vary according to their biological habits and can be divided into:

Type of the parasite	**Definition**	**Example**
1-Obligatory parasites	organisms that cannot exist without a host	*Plasmodium* and *Oxyuris*
2-Facultative parasites	organisms that can either live freely in soil or water or as parasites in hosts when unfavorable environmental conditions occur	*Strongyloides*

3-Accidental parasites	free living organisms which enter the human body by mistake	larvae of flies accidentally ingested and live in the intestine of man
4-Temporary parasite	visits its host from one time to another for feeding	Soft tick
5- Specific parasite	affects only one species of host	*Enterobius*
6-Coprozoic (Spurious) parasites	Foreign organisms or stages of non human parasites which have been swallowed and pass through the intestine in feces without causing infection.	
7- Ectoparasite	parasite which lives on the outside of the host	*Pediculus*
8- Endoparasite	parasite which lives within the body of the host	*Ancylostoma*

Hosts

Type of the host	Definition	Examples
Definitive	in which the adult stage of the parasite lives, or in which sexual reproduction takes place	man a definitive host for *Ascaris*
Intermediate	in which the immature or larval stage of the parasite is found, or in which the parasite multiplies asexually	pigs act as intermediate hosts for *Taenia solium.*
Reservoir	when a parasite utilizes a wide range of animal hosts besides man, such animals represent the reservoir hosts of the particular parasite and act as a continuous source for human infection	
Paratenic (transport)	in which the parasite does not undergo any developmental changes	fish 2nd intermediate host
Amplifier	is an intermediate host in which asexual multiplications occur	snail 1st intermediate host
Vector	is a host that transmits parasites from one host to another. It is usually arthropod	Fleas act as vectors for *Pasteurella pestis* from rodents to man.

Medical parasites

The medical parasites of human are contained in three main parts:

I- Medical Protozoology.

II- Medical Helminthology.

III- Medical Entomology.

Chapter 2

Medical Protozoology

Objectives

1-Focus on morphological characters, life cycle, pathogenesis, clinical picture, laboratory procedures, lines of treatment and prevention with control strategy of different protozoa affecting human beings.

MEDICAL PROTOZOOLOGY

Protozoa: These are unicellular organisms that occur singly or in colony formation. Each protozoan is a complete unit capable of performing all functions.

Morphology: Protozoa have wide range of size (1-150µ). The structure of protozoan cell is formed of a cytoplasmic body and a nucleus.

1. **Cytoplasm:**

a. **Ectoplasm:** The outer hyaline layer that is responsible for ingestion of food, excretion, respiration, protection and sensation.

Some structures develop from ectoplasm as:

- Organs of locomotion; pseudopodia, flagella and cilia.

- Organs for food intake or excretion; peristome, cytostome and cytopyge.

b. **Endoplasm:** The inner granular part of cytoplasm that is responsible for nutrition and reproduction. The endoplasm contains number of structures as: food vacuoles, foreign bodies, contractile vacuoles and chromatoid bodies.

2. **Nucleus:** It is the most important structure, as it regulates the various functions and reproduction. It is formed of:

a. **Nuclear membrane**.

b. **Nuclear sap (nucleoplasm)**.

c. **Chromatin granules**.

d. **Karyosome (nucleolus):** It is a DNA containing body, situated centrally or peripherally within the nucleus.

Entamoeba histolytica

Geographical distribution: Worldwide distribution especially in tropical areas and poor communities.

Morphology:

Entamoeba histolytica has 3 stages:

1. Trophozoite (Vegetative or growing stage):

- Size: 10-60 µ (average 20 µ).
- Shape: Irregular outline with finger like pseudopodia and active movement.
- Cytoplasm: It is formed of outer clear hyaline, refractile ectoplasm and inner granular endoplasm containing nucleus, food vacuoles, erythrocytes (RBCs), occasionally bacteria, and tissue debris.
- Nucleus: It has **centrally located fine karyosome and peripheral chromatin dots** arranged regularly at the inner side of the nuclear membrane.

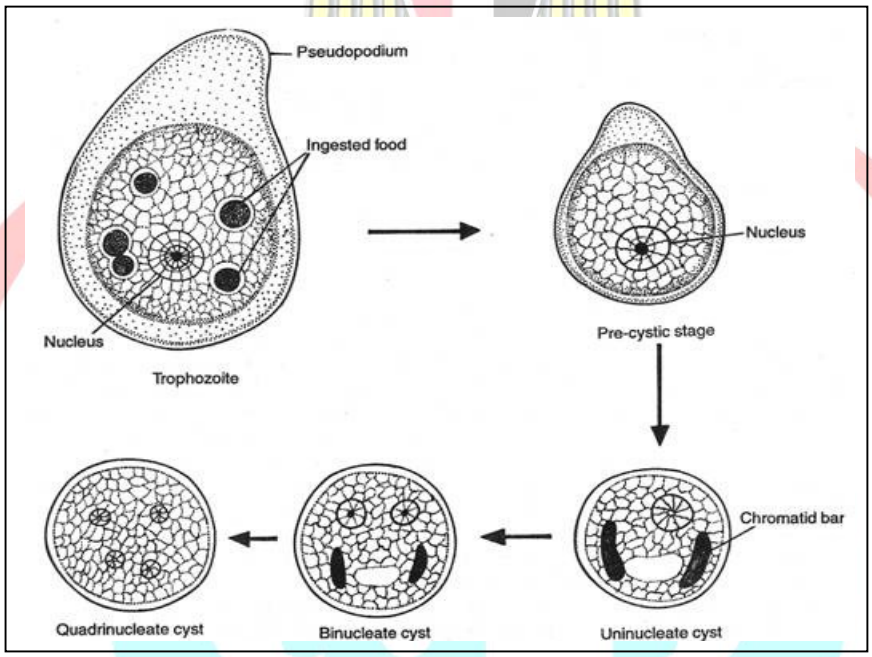
2. Precyst:

- Smaller than the trophozoite but larger than cyst (10-20 µ).
- Rounded or oval with blunt pseudopodia and sluggish movement.
- No food vacuoles or RBCs.
- It contains a single nucleus similar to that of the trophozoite.

3. Cyst:

- It is rounded, 10-15 µ in diameter.
- Has smooth refractile cyst wall.

- The early cyst contains glycogen vacuoles and **1-4 chromatoid bodies** which are sausage-shaped with rounded ends. They are formed of RNA & DNA, and represent stored proteins which are consumed with repeated nuclear division.
  - Immature cysts may be mono- or bi-nucleated.
  - Mature cysts contain 4 nuclei formed by mitotic division.
  - Nuclei are similar to that of the vegetative form.



Three stages of *Entamoeba histolytica*.

Life cycle:

- **Habitat:**
  a. Trophozoite: Inhabits the **wall and lumen of the large intestine**, with extra-intestinal metastases (liver, lung and brain, etc.).
  b. Cyst: Inhabits the **lumen of the large intestine**.
- **Definitive host:** Man.
- **Intermediate host:** No.
- **Reservoir hosts:** Dogs, rats and monkeys.
- **Infective stage:** Mature quadrinucleated cyst.

Mode of infection:

1. Ingestion of **mature quadrinucleated *E. histolytica* cysts** in contaminated food or drink, or through infected food handlers.
2. Mechanical transmission by flies and cockroaches.
3. Autoinfection: feco-oral route (hand to mouth contact).

Clinical picture:

Abdominal pain, Diarrhea, Desentry, weight loss and loss of appetite

Diagnosis:

- **Clinical diagnosis:**

1. History of travel to or residence in an endemic area.
2. Signs and symptoms on physical examination.

- **Laboratory diagnosis:**

1. Stool examination:

a. **Macroscopy**.

b. Microscopy:

-Proper collection, preservation and examination of stool samples using saline, iodine or eosin smears, or permanent stained smears with trichrome or iron- haematoxylin.

-Repeated stool examination and concentration methods by zinc sulphate floatation, may be required especially in chronic cases.

2-ELISA & PCR

MASTIGOPHORA (Flagellates) Intestinal and urogenital flagellates

General characters:

1- Infection occurs in the intestine or the uro-genital system.

2- The infective stage may be either the trophozoite or the cyst form. 3- Transmission of infection is a direct one.

Intestinal flagellates

Giardia intestinalis (*Giardia lamblia*)

Geographical distribution: World-wide. It is considered the main cause of diarrheal out breaks from contaminated water supplies.

Morphology:

1. Trophozoite:

- It is pear-shaped, bilaterally symmetrical, measuring 12x6 µ. It has:
  - **Two sucking discs**, each contains vesicular nuclei.
  - **Four pairs of flagella**, each arises from a **blepharoplast** and has free end.
  - The intracytoplasmic parts of the caudal pair of flagella run along the midline as **axostyles**.

- **Two curved median parabasal bodies**, lie posterior to the sucking discs.

2. Cyst:

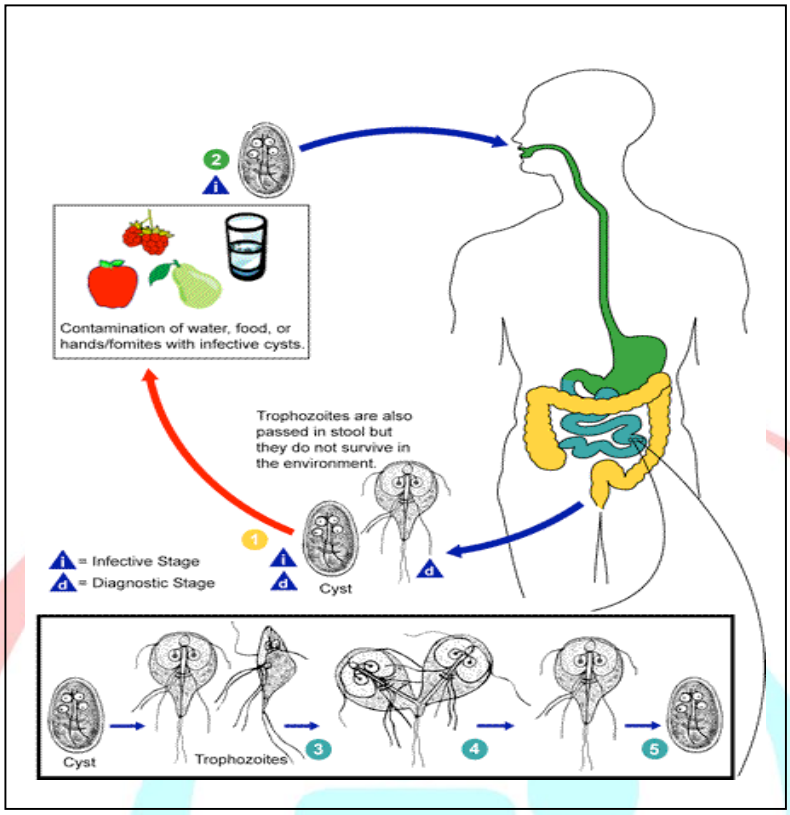
- It is oval, 10x5 µ, and has double-colourless wall.
- Contains **four nuclei** usually gathered at one pole.
- Remnants of flagella and median bodies and axostyles are clearly seen.

Life cycle:

- **Habitat:**
  a. Trophozoite: Inhabits the upper part of the **small intestine**, sticks closely to the mucosa and may penetrate down into the crypts of the mucosa. It may also be found in the **gall bladder** and **biliary drainage**.
  b. Cyst: Inhabits the **lumen of the intestine**.
- **Definitive host:** Man.
- **Reservoir hosts:** Many animals (dogs, rodents, monkeys…etc). *Giardia* is considered one of the most known zoonotic diseases.
- **Infective stage:** Mature quadrinucleated cyst.

Mode of infection:

1. Cysts may be ingested with food, drinks, contaminated water or transmitted by house flies, cockroaches ….etc.
2. Person to person transmission occurs especially in nurseries, male homosexuals, mentally ill persons and among school children. *Giardia* is considered one of the **nosocomial (hospitally-transmitted) infections.**
3. Autoinfection by hand to mouth transmission also occurs.



Life cycle of *Giardia intestinalis*.

Clinical picture:

- The prepatent period is usually 2 weeks.
- **Giardiasis** may be asymptomatic in a good proportion of cases.
- Symptoms may be in the form of:

1. Mucus diarrhea, fat malabsorption (steatorrhea), flatulence, dull epigastric pain, crampy abdominal pain, and anorexia.

2- Severe symptoms: Occur in immunocompromized patients as persistent diarrhea (steatorrhea), hypoproteinaemia, fat soluble vitamin deficiency, lactose intolerance, weight loss, biliary colic and jaundice may occur.

Diagnosis:

- **Clinical diagnosis:** Clinical history and presentation of the disease.

- Laboratory diagnosis:

1. Stool examination:

a. **Macroscopy:** Faecal specimens containing *G. lamblia* may have an offensive odour, are pale in colour and fatty.

b. Microscopy:

- Stool examination for trophozoites and/or cysts by direct smear, eosin and iodine smears, and by concentration methods.

- Repeated stool examination for three times as the parasite is intermittently shed.

c. **Detection of *Giardia* copro-antigens**: By ELISA, immunochromatographic strip tests and indirect immunofluroscent tests (IIF).

d. Molecular diagnosis.

2. Examination of duodenal contents for trophozoites:

a. Entero-test (String test).

b. Duodenal aspiration and duodenal biopsy.

3. Serodiagnosis: Antibodies to *Giardia* are detected by IFA and ELISA.

Treatment:

1. Metronidazole (Flagyl).
2. Tinidazole (Fasigen) is more effective than metronidazole.

Urogenital flagellates

Trichomonas vaginalis

Geographical distribution: Worldwide.

Morphology:

Trophozoite:

- It is pear-shaped, 17X10 µ, with a rapid **jerky** movement.
- It has an antero-lateral **cytostome**.
- The cytoplasm is granular with a single anterior nucleus.
- It has 4 flagella anteriorly, another flagellum attached to the body by undulating membrane, presents at the anterior 1/3 of body with no free end. The 6th flagellum passes through the body as **axostyle** which projects out of the body.
- A thick marked rod called the **parabasal body** is present between the axostyle and the undulating membrane.
- **It has no cyst stage**.

Life cycle:

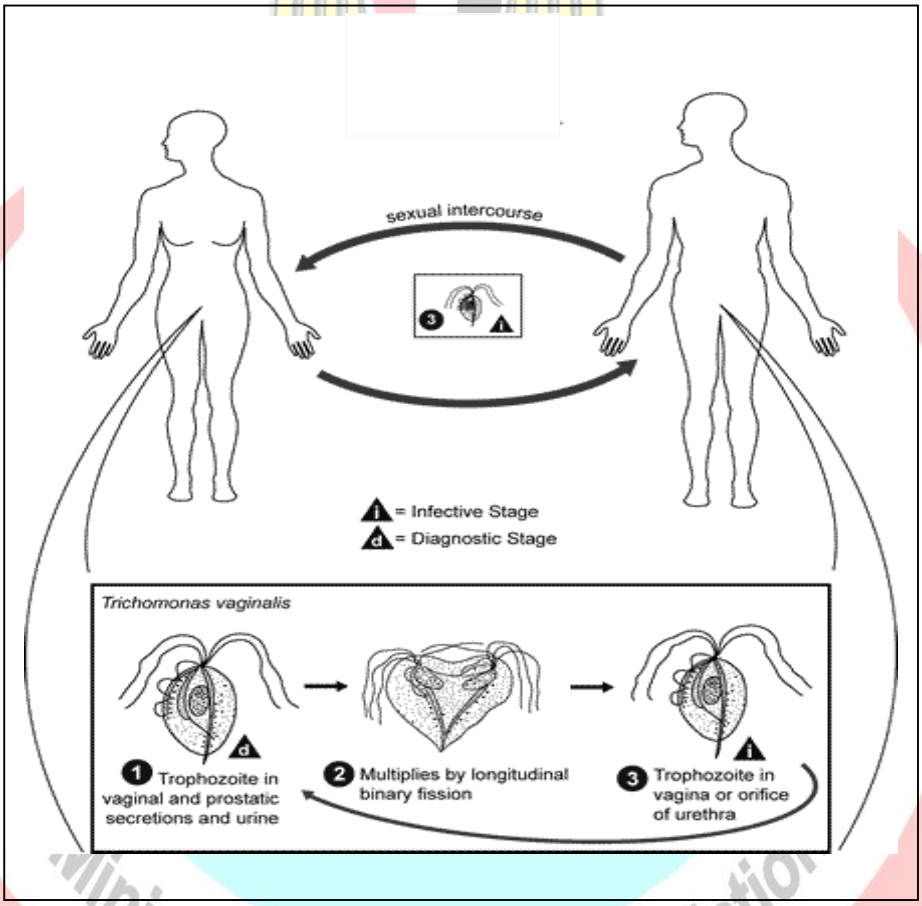
- **Habitat:**
  a. **Female**s: Posterior fornix of the vagina, cervix, and urethra.
  b. **Males**: Urethra, epididymis, seminal vesicles and prostate.
- **Definitive host:** Man.

- **Infective stage:** Trophozoite.

Mode of infection:

1. Sexual transmission or by contaminated toilet seats and towels.
2. From infected mothers to babies during birth.

- **Multiplication:** By longitudinal binary fission.



Life cycle of *Trichomonas vaginalis*.

- epididymitis and prostatitis may occur.

Clinical picture: Trichomoniais may be asymptomatic in infected males (95%) and females (50%).

- Symptoms may be in the form of:

1. Females:

- Vaginal itching and burning with an offensive, frothy, profuse leucorrheic discharge forming a pool in the posterior fornix.
- Dyspareunia (painful sexual intercourse), frequency of micturition and dysuria, also cystitis may occur.

2. Males:

- Dysuria, and prostate may be enlarged and tender.

3. New born: *Trichomonas* respiratory tract infection and conjunctivitis may affect infants during vaginal delivery of an infected mother.

Diagnosis:

- **Clinical diagnosis**.
- **Laboratory diagnosis:**

1. Microscopy:

- **In females:**
- Specimens are obtained through a vaginal speculum by using cotton –tiped applicator stick, and then the applicator is placed in glucose–saline before examination of the precipitate for the organisms.

a. Direct wet smear examination for characteristic jerky motility and shape of trichomonad trophozoites.

b. Fixed smears may be stained with Giemsa, Leishman and Papanicolaou stain.

- **In males:** Examination of prostatic fluid.
- **In both sexes**: Urine examination may beneficial.

2. Culture: On modified Diamond's medium.

3. Immunodiagnosis: For detection of *T.vaginalis* antigens.

a. Direct fluorescent antibody test using labeled monoclonal antibodies.

b. ELISA.

4. Molecular diagnosis.

Treatment:

1. Both partners must be treated at the same time.
2. Metronidazole is the most effective drug.
3. Restoration of normal vaginal acidity by vaginal douching with lactic acid or vinegar seems beneficial in mild vaginal trichomoniasis**.**

Prevention and control:

1. Good personal hygiene.
2. Avoidance of sexual contact with infected partners and use of condoms.
3. Treatment of diagnosed cases, and simultaneous treatment of sexual partners.

Plasmodium

Malaria

Species:

Four species of *Plasmodium* cause human malaria:

1. *Plasmodium vivax*: Benign tertian malaria.
2. *Plasmodium ovale*: Benign tertian malaria.
3. *Plasmodium malariae*: Benign quartan malaria.
4. *Plasmodium falciparum*: Tertian or subtertian malignant malaria.

Geographical distribution:

- *P. vivax*: The most widely distributed species found in tropical, subtropical and temperate areas.
- *P. ovale*: West Africa.
- *P. malariae*: Tropical Africa and Far East.
- *P. falciparum*: Africa and Far East.

Life cycle:

- Definitive host: **Female *Anopheles* mosquito**.
- Intermediate host: **Man**.
- Reservoir host: **No**. **However, in *P. malariae*, chimpanzee can be affected and act as a reservoir of infection**.
- **Habitat:**

In mosquito: Gut, salivary glands.

In man: Intracellular inside the liver cells and RBCs.

- **Infective stage:**
  a. Sporozoites (in **mosquito-borne** malaria).
  b. Merozoites and/or trophozoites (in **blood-borne** malaria).

Mode of infection:

1. Bite of infected female ***Anopheles***.
2. Blood-borne transmission:
   a. Blood transfusion (whole blood and packed RBCs).
   b. Shared syringes among drug addicts.
   c. Transplacental transmission.
   d. Organ transplantation.

Clinical picture:

1. **Incubation period:**
   - It is the interval between the inoculation of the sporozoites into the human host and appearance of the earliest manifestation of the disease (1st paroxysm).

- It represents the duration of exo-erythrocytic cycle.
- Patient may feel malaise, muscle pain, headache, loss of appetite and fever.

2. Malarial paroxysms:

The typical picture of malaria consists of series of **febrile paroxysm**, followed by **anaemia** and **splenomegaly**.

The febrile paroxysm occurs in 3 successive stages; cold, hot and sweating.

a. Cold stage: Intense cold and uncontrollable shivering for 15-60 minutes.

b. Hot stage: Intense heat, flushing, nausea, vomiting and severe headache, lasting for 2-6 hours.

c. Sweating stage: Decreased temperature and profuse sweating, lasting for 2- 3 hours.

- The paroxysm usually begins in the **early afternoon** and lasts for 8-12 hours.
- It synchronizes with the erythrocytic schizogony cycle. With a 48-hour cycle, the **fever recurs every third day; tertian malaria**, and with 72-hour cycle, the **fever recurs every fourth day; quartan malaria**.

3. Anaemia of microcytic or a normocytic hypochromic type and **jaundice**.

4. Splenomegaly and **hepatomegaly**.

Diagnosis:

- **Clinical diagnosis:** In endemic areas, malaria must be suspected in all cases of typical malarial paroxysm or fever.

- Laboratory diagnosis:

1. **Parasitic diagnosis:** Examination of **thin** and/or **thick Leishman** or **Geimsa-stained blood smears**. All erythrocytic stages can be detected in peripheral blood **except in *P. falciparum*, only ring form alone or with gametocytes** can be detected.

2. **Therapeutic diagnosis:** The non-subsidence of the febrile paroxysms after the administration of anti-malarial drug for 3 days, means that the case is not malaria.

3. Serodiagnosis:

a. Circulating antibodies can be detected by IHA, IFA and ELISA.

b. Circulating antigens can be detected by ELISA.

c. **Rapid immunochromatographic test** for detection of malaria antigens by using a dipstick impregnated with specific monoclonal antibodies.

4. Molecular diagnosis.

5. Haematological diagnosis: Anaemia and reticulocytosis.

Toxoplasma gondii

Geographical distribution: Worldwide.

Morphology:

Toxplasma gondii occurs in 4 forms:

1. Trophozoite (Tachyzoite):

- It is crescent, 3X6 µ, with pointed anterior end and rounded posterior end.
- It has an ovoid posterior nucleus and anterior paranuclear granules.
- It is the active multiplying stage, seen intracellular in various tissues.
- It multiplies by **endodyogeny** within cytoplasmic vacuoles of any nucleated cell.
- It is found in the **acute stage** of infection.

2. Pseudocyst:

- It is full of rapidly multiplying **tachyzoites**.
- It has **no cyst wall**.
- It is localized inside the RECs.
- The tachyzoites multiply by **endodyogeny** and **ectomerogeny**.
- It is found in the **acute stage** of infection.

3. True tissue cyst:

- The cyst is round or oval, 5-50 µ and contains slowly multiplying **bradyzoites**.
- It has **cyst wall**.
- It is found in the brain (most common site), skeletal and cardiac muscles and various organs.
- The bradyzoites multiply by **endodyogeny** and **ectomerogeny**.
- It is found in the **chronic stage** of infection.
- It remains viable for years, and immunosuppression causes reactivation of cysts.

4. Oocyst:

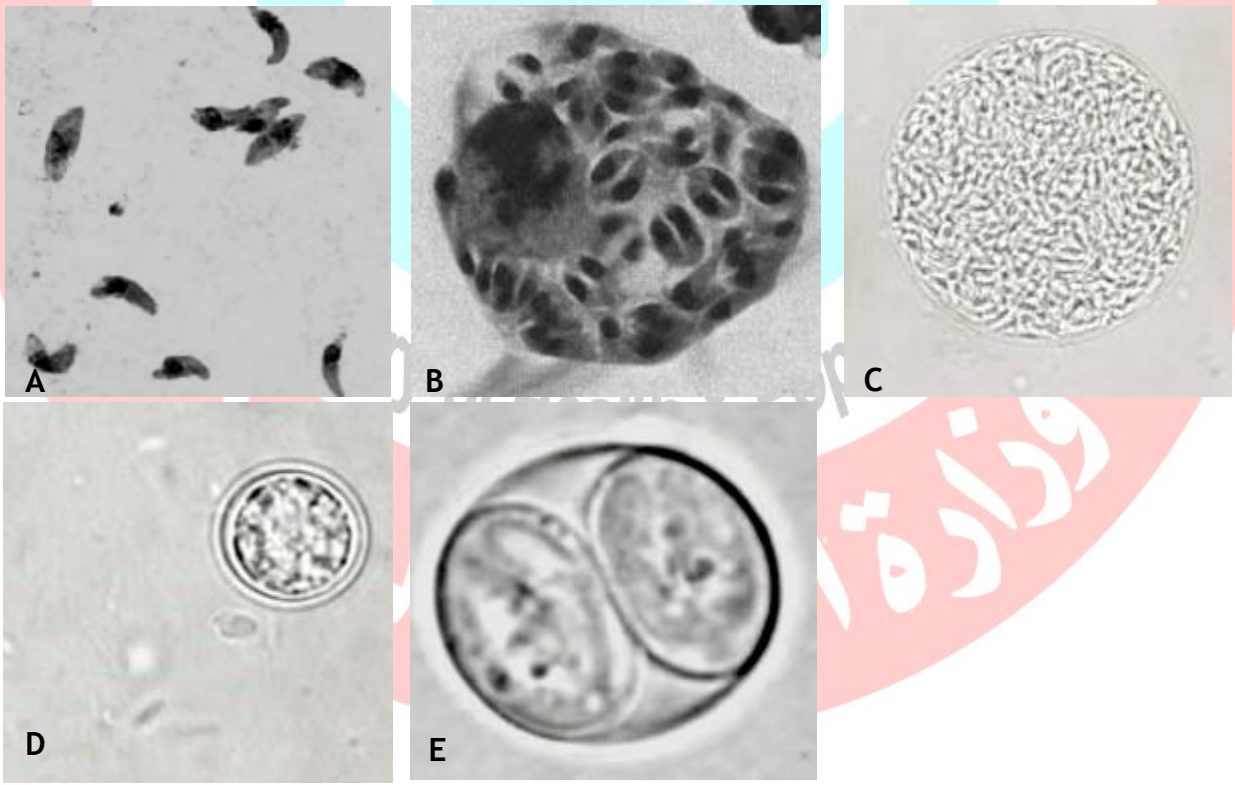
- This stage is only present in **cats and other felines**.
- It is oval, 10X12 µ and surrounded by a thick resistant wall.
- Non-infectious when excreted in unsporulated or immature stage in cat´s faeces.
- It sporulates, by **sporogony**, within 1-5 days and becomes infectious.
- The mature or sporulated oocyst contains 2 sporocysts, each containing 4 sporozoites (**disporocystic tetrazoic oocyst)**.
- It may remain viable in moist shaded soil for a year or more.

Life cycle:

- **Habitat:**

T. gondii is an obligate intracellular parasite, which is found inside the RECs, brain, skeletal and cardiac muscles, and any other nucleated cells.

- **Definitive host:** Cats and other felines.
- **Intermediate host:** Man and other mammals (mice, rabbits, goat, sheep, cattle, and pigs), reptiles and birds.
- **Infective stage:** All stages are infectious to humans; tachyzoites, pseudocysts, true tissue cysts and sporulated oocysts.



***Toxoplasma gondii*. A. Trophozoites; B. Pseudocyst; C. True cyst; D. Unsporulated oocyst; E. Sporulated oocyst.**

Mode of infection:

1. Oral route via ingestion of:

- Mature oocysts in food and drinks contaminated with cat's faeces.
- Pseudocysts or true cysts in raw or undercooked contaminated meat.

-Tachyzoites in unpasteurized goat's and cow´s milk.

2. Inhalation of mature oocysts.

3. Blood transfusion.

4. Organ transplantation.

5. Contamination of mucous membrane, skin abrasions during handling and preparation of fresh infected meat, or laboratory workers who handle infected blood can also acquire infection through accidental inoculation.

6. Transplacental route, where the tachyzoites can be transmitted from infected pregnant woman to the fetus via the blood stream (placenta).

7. Sexually transmitted or by artificial insemination with semen from infected male.

Clinical picture:

1. Congenital toxoplasmosis:

- This occurs when the mother get infected for the first time during pregnancy. But, in some woman with chronic infection, reactivation of tissue cysts leads to liberation of trophozoites, which may infect the fetus.

- The risk of fetal infection rises with progress of pregnancy. In contrast, the severity of fetal damage is high, when infection is transmitted in early pregnancy.

- Clinical manifestations of congenital infections may be:

a. **Early manifestations:** Still birth, abortion, hydrocephalus, microcephaly and microphthalmia. The most common sequelae are **retinochoroiditis** that affects vision and results in blindness, **cerebral calcification**, **convulsions** (**clinical triad**). In some cases, fever, lymphadenopathy, hepatosplenomegaly, anaemia, thrombocytopenia, petechial rash, jaundice, and myocarditis may present at birth.

b. **Late manifestations:** Mental retardation, visual affection and psychomotor disturbance in adolescence and adulthood.

2. Acquired toxoplasmosis:

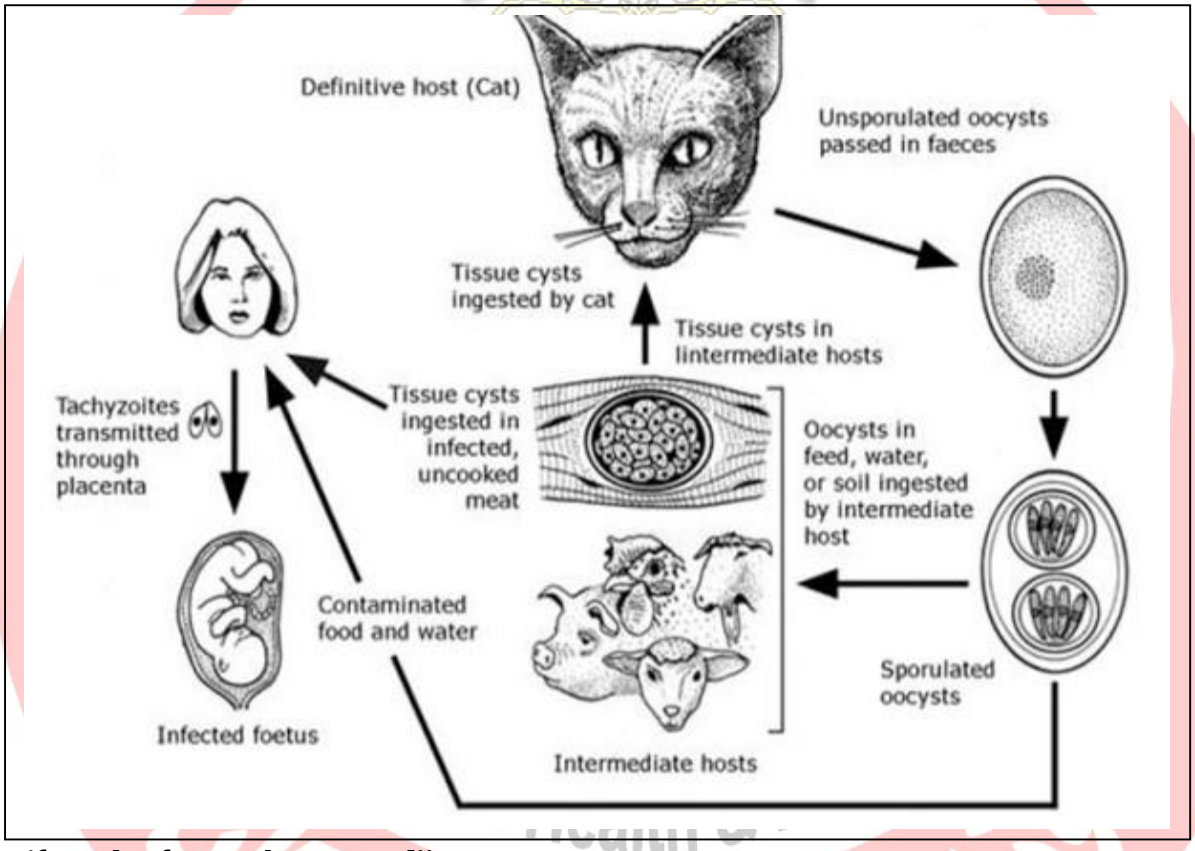
- It is asymptomatic in 80-90% of healthy hosts.

-The classical clinical sign of acute acquired toxoplasmosis is **lymphadenopathy** and the deep cervical lymph nodes are the most commonly affected. The infected lymph nodes are discrete and non-tender.

-Mild fever, headache, myalgia (**Flu-like syndrome**), and hepatosplenomegaly are often present.

3. Toxoplasmosis in immunocompromised patients:

- In these patients affection of brain is more common, with meningoencephalitis, and neuropsychiatric manifestations.
- Pneumonia, myocarditis, chorioretinitis and hepatosplenomegaly may occur.



Life cycle of *Toxoplasma gondii*.

Diagnosis:

- Clinical diagnosis:

- A combination of signs as hydrocephalus or microcephaly, chorioretinitis and signs of intracerebral calcification make diagnosis of congenital toxoplasmosis probable.
- Acquired toxoplasmosis is diagnosed by exclusion from other diseases of the reticuloendothelial and lymphatic systems.

- Laboratory diagnosis:

I. Direct:

1. Microscopy:

- Detection of trophozoites and tissue cysts in lymph node, bone marrow, spleen, placenta, blood, CSF, and amniotic fluid smears stained by Giemsa, PAS, or Gomori methanamine silver (GMS) stain.

II. Indirect:

1. Serodiagnosis:

b. Antibody detection:

- Tests for detecting IgG antibody include: ELISA, IFA, and IHA.

- The serum IgM can be measured by ELISA.

- Detection of specific **IgM** antibodies indicates acute infection, while positive **IgG** titer indicates latent infection.

- IgM detected in babies' blood is fetal in origin as **maternal IgM doesn't cross the placenta**.

- IgA-ELISA test is also used for detecting congenital infection in newborns.

c. Antigen detection:

- Detection of antigen by ELISA indicates recent *Toxoplasma* infection.

- It is useful in immunocompromised patients.

- Detection of antigen in amniotic fluid is helpful to diagnose congenital toxoplasmosis.

2. Molecular diagnosis:

- Can be used for diagnosis of *T. gondii* DNA in blood, CSF, urine, and different tissues.

- It is valuable especially in immunocompromised patients in whom antibody titers are low or absent.

- Also, it can be used on amniotic fluid in case of congenital infection.

3. Imaging:

- MRI and CT scan are used to diagnose CNS involvement.

- US of fetus at 20-24 week of pregnancy is useful to diagnose congenital toxoplasmosis.

Chapter 3

Medical Helminthology

Objectives

1-Discuss morphological characters, life cycle, pathogenesis, clinical picture, laboratory procedures, lines of treatment and prevention with control strategy of different helminthes.

MEDICAL HELMINTHOLOGY

This part deals with the study of helminths (worms) that parasitize man.

They belong to two main groups:

1- Platyhelminths (flat worms) a- Class: Trematoda b- Class: Cestoda	**2- Nemathelminths (round worms)** Class: Nematoda

PLATYHELMINTHS

Class: Trematoda (Flukes)

General characters:

-The members of this class are commonly known as flukes.

-Adults are leaf-like, pear-shaped or elongated worms.

-All trematodes possess two **suckers** as organs of attachment.

-Covered externally by a cuticle that may be smooth, spiny or tuberculated.

- The body is made up of systems:

Hepatic or Liver Flukes

Fasciola gigantica (Large liver fluke)

Geographical distribution: Human infection has been reported from many regions including Egypt, Africa and Far East.

Morphology:

1. Large Fleshy leaf- like worm, measures 3 -7x1 cm.
2. Body formed of small anterior conical part (cephalic cone), shoulders with parallel borders and posterior round end.
3. Suckers: small oral anterior sucker and large ventral sucker.
4. Digestive system: mouth leads to oesophagus with muscular pharynx, two long intestinal caeca with lateral compound branches and medial T or Y-shaped ones.
5. Genital system (reproductive system):
   a. Common genital pore: anterior to the ventral sucker.
   b. Testes: two highly branched, one behind the other, about the middle third of the body
   c. Ovary: branched at the right side in front of the testis.
   d. Uterus: short and convoluted.
   e. Vitelline glands: highly branched and extend along the lateral fields.

Life cycle:

-**Habitat**: adult worms live in the bile ducts and gall bladder.

-**Definitive host**: man.

-**Intermediate host:** snail *Lymnaea cailliaudi*.

-**Reservoir hosts:** herbivorous animals as cattle, sheep, goat and camels.

-**Infective stage:** encysted metacercaria in water and on aquatic vegetations.

-**Stages in the life cycle**: egg →→ miracidium →→ sporocyst →→ 1st and 2nd generation redia →→ cercariae →→encysted metacercariae→→ adult.

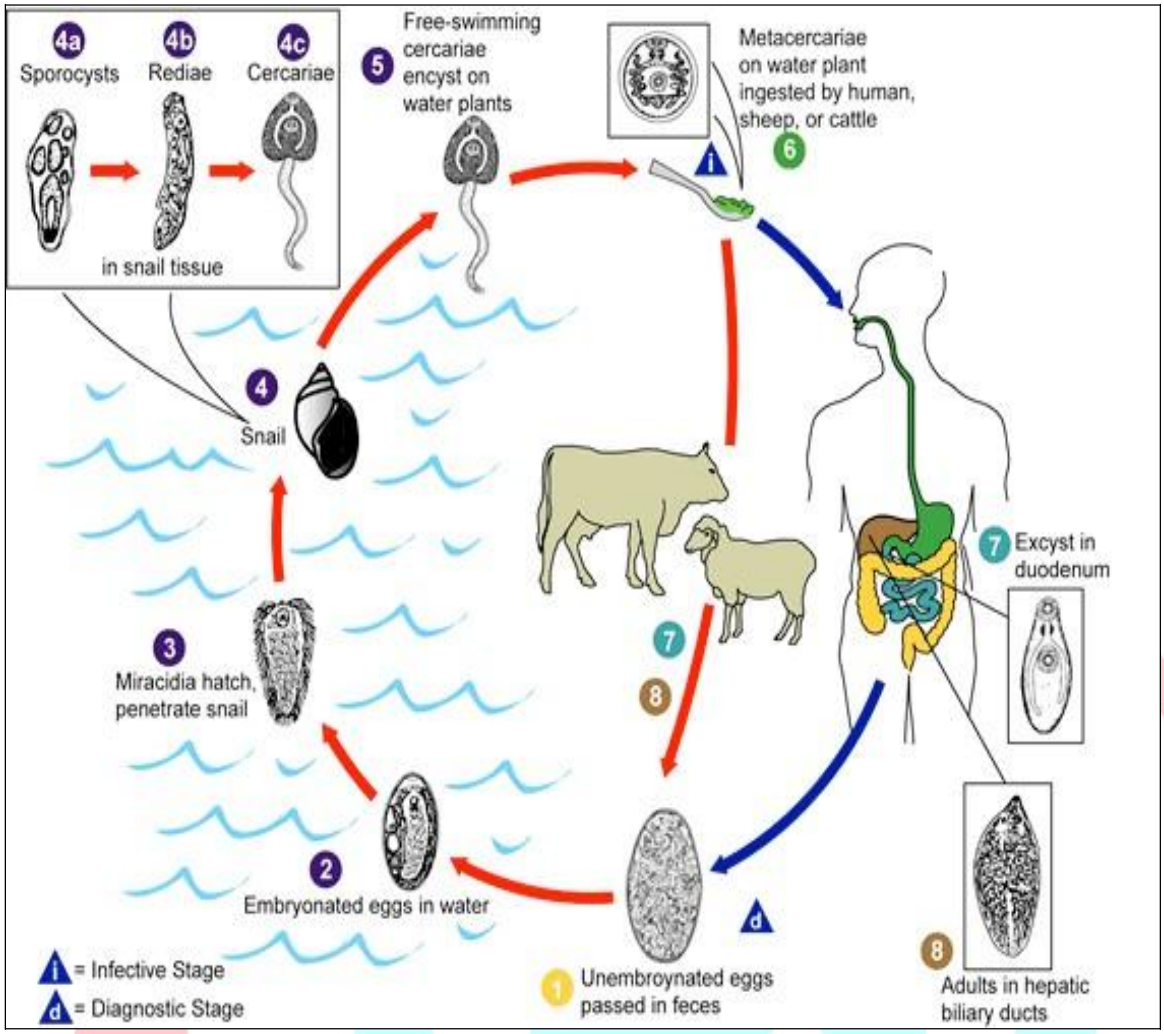
Egg: Size: 160x80 µ. Shape: oval.

Shell: thin. Color: light yellowish brown (bile stained).

Contents: immature (yolk cells).

Special character: operculated.

- Eggs are discharged with feces of infected host, in fresh water of canals, drains and River Nile, hatch within 2 weeks into miracidium.



The life cycle of *Fasciola spp.*

Mode of infection:

- By eating raw water vegetations or vegetables washed in infected water and by drinking infected water polluted by the **encysted metacercaria**.

Pathogenicity and clinical picture: Four Symptomatic Patterns

- **Acute Phase**

- Rarely seen in humans.
- Fever, tender hepatomegaly, and abdominal pain are frequent symptoms.
- Vomiting, diarrhea, and anemia may be present**.**

Chronic Phase

- **Symptoms include:** Irregular fever ,biliary colic, abdominal pain, tender hepatomegaly, and jaundice.
- **In children:** severe anemia and high eosinophilia are common.
- Inflammation of the bile ducts leads to fibrosis and a condition called **"pipe-stem liver".**
- **Liver rot :** mechanical and toxic destruction of liver tissue by passage of large number of immature worms through the liver tissue leads to necrosis , fibrosis , hepatitis, and hepatomegaly
- Severe infections can lead to death.

Diagnosis:

Clinical	fever, hepatomegaly, habit of green salad consumption
Laboratory	**1-Stool examination:** for detection of **eggs,** after asking the patient to stop eating liver for a few days before examination. **N.B.:Flukes do not begin to produce eggs until about 4 months after infection. Prior to 4 months: serological tests can be used** - **Serological tests:** are of value during the migratory stage of the worms and ectopic infection for estimation of specific antibodies, as ELISA, IHA. - **Examination of sample of aspirated duodenal contents.** **4-Eosinophilia.** **5-Ultrasound and CT**

Treatment:

1. Bithionol (Bitin).
2. Triclabendazole (Fasinex).
3. Surgical removal of ectopic flukes.

Prevention and control:

1. Mass treatment of infected man and animal reservoir.
2. Snail control.
3. Sanitary disposal of feces.
4. Protection: - Pure filtered water supply.

-Proper washing or cooking of aquatic vegetation.

Intestinal flukes

Heterophyes heterophyes

Geographical distribution: Common in Egypt in Nile Delta, especially around the lakes of Manzala and Borollos, Turkey and Far East (Japan, China, Korea, Philippine).

Morphology:

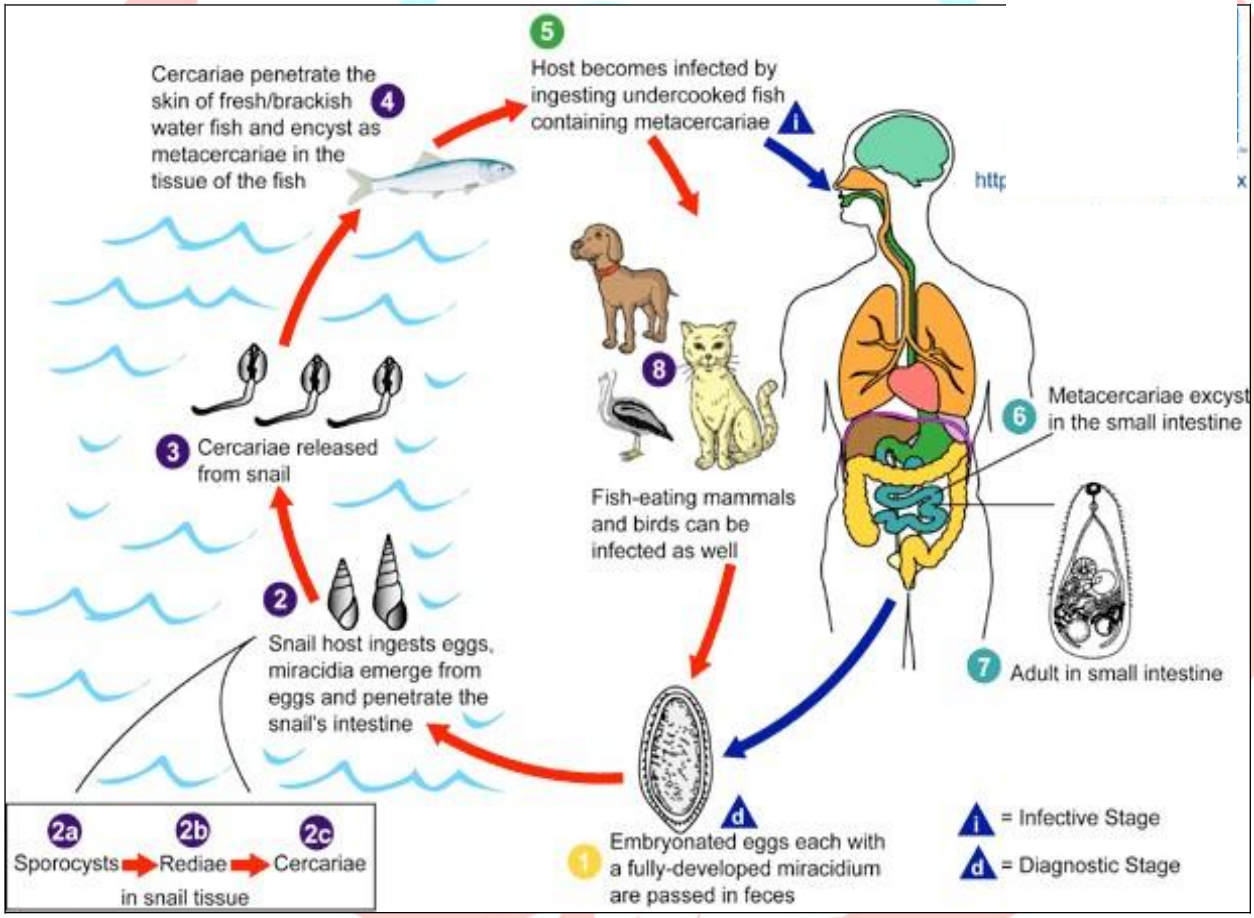
1. Size: 1.5-3mmx 0.5 mm.
2. Shape: Pear shape, the anterior end is more or less narrow, while the posterior end is broadly rounded, some spines cover the cuticle especially anteriorly.
3. Suckers: **three suckers**
   - Oral sucker: small around the mouth.
   - Ventral sucker: large about the middle of the body.
   - Genital sucker: postero- lateral to the ventral sucker.
4. Genital system:
   - Testes: two oval, smooth, and opposite each other in the posterior part of the body.

- Ovary: One ovary, smooth in front of the testes.

Life cycle:

-Habitat: adult lives between the villi of the small intestine.
-Definitive host: man.
-Intermediate host: -first is a snail, called *Pirenella conica*.
-Second is fish, Tilapia (Bolty) and Mugil (Boury).
-Reservoir host: cat, dog, and any fish eating animals.
-Infective stage: encysted metacercaria in the muscles of the fish (2nd I. H.).
-Stages in the life cycle: egg →→ miracidium →→ sporocyst →→ 1st and 2nd generation redia →→ cercaria →→encysted metacercaria →→ adult.

Egg: Size: 30xl5 µ.
Shape: Oval.
Shell: Thick with operculum at one pole and a small Knob at the other.
Colour: golden yellow.
Contents: Full mature embryo (miracidium).



Life cycle of *H. heterophyes*

Mode of infection: By eating insufficient cooked, roasted or salted fish, staked less than ten days (sweet fesekh), containing the infective stage (encysted metacercariae).

Pathogenicity and clinical picture:

Intestinal	Attachment of the parasite to the mucosal membranes; inflammation with superficial ulcers and necrosis occur. *Mild infection with no symptoms *Heavy infections cause: -Abdominal colic. -Abdominal discomfort. -Chronic intermittent diarrhea, sometimes with blood
Extra-intestinal	The eggs may reach the general circulation to different organs and form parasitic granuloma and fibrosis

Diagnosis: Stool examination for the characteristic eggs.

Treatment: 1. Praziquantel (Biltricid).

2. Niclosamide (Yomesan).

Prevention and control:

1. Sanitary disposal of feces.
2. Avoid eating raw, insufficient cooked fish or salted fish, salted less than 10 days (sweet fessekh), and proper grilling of fish.
3. Fried fish is safe as temperature needed for frying is high enough to kill metacercariae.
4. Periodic examination of fishermen stool for *Heterophyes* eggs.
5. Mass treatment of infected cases.
6. Snail control.

Blood flukes (Schistosomes)

Human beings are infected with three main species of schistosomes:

1. ***Schistosoma haematobium*:** causing urinary schistosomiasis. (present in Egypt)
2. ***Schistosoma mansoni*:** causing intestinal schistosomiasis. (present in Egypt)

Schistosoma haematobium

(Urinary schistosomiasis)

Geographical distribution:

Africa: scattered areas. In Egypt, it is prevalent all over the Nile Valley.

Asia: Syria, Palestine, Iraq, Iran, Saudi Arabia, Yemen, India.

Europe: Cyprus and South Portugal.

Adult morphology:

	Male	**Female**
Size	1 -2cm x l mm	long (2 - 2.5 cm x0.25mm)
Shape	flattened, lateral margins are folded ventrally to form the gynaecophoric canal	cylindrical (round in cross section)
Tegument	provided with fine tubercles on the dorsal surface	smooth.
Suckers	sub-terminal oral sucker around the mouth and a larger ventral sucker some distance behind	weakly developed
Digestive system	mouth, oesophagus without muscular pharynx, two simple intestinal caeca that unite in the middle into single blind caecum	like male but union of intestinal caeca occurs at the posterior third.
Genital system	**Testes** :4-5 separate testes, smooth, globular arranged in one line postero-lateral to the ventral sucker. **Male genital pore** :behind the ventral sucker.	**Ovary** :oval, smooth lies just in front of the intestinal union. Uterus: long, straight, terminates at the genital pore, contains one raw of 20 - 30 ova **Vitelline glands**: extend from behind the ovary till the posterior end.

Life cycle:

-Habitat: *Schistosoma haematobium* adults live in the vesical and pelvic venous plexuses in man surrounding the kidney, pelvis, urinary bladder, urethra, prostate, seminal vesicles, lower 1/3 of uterus and vagina.

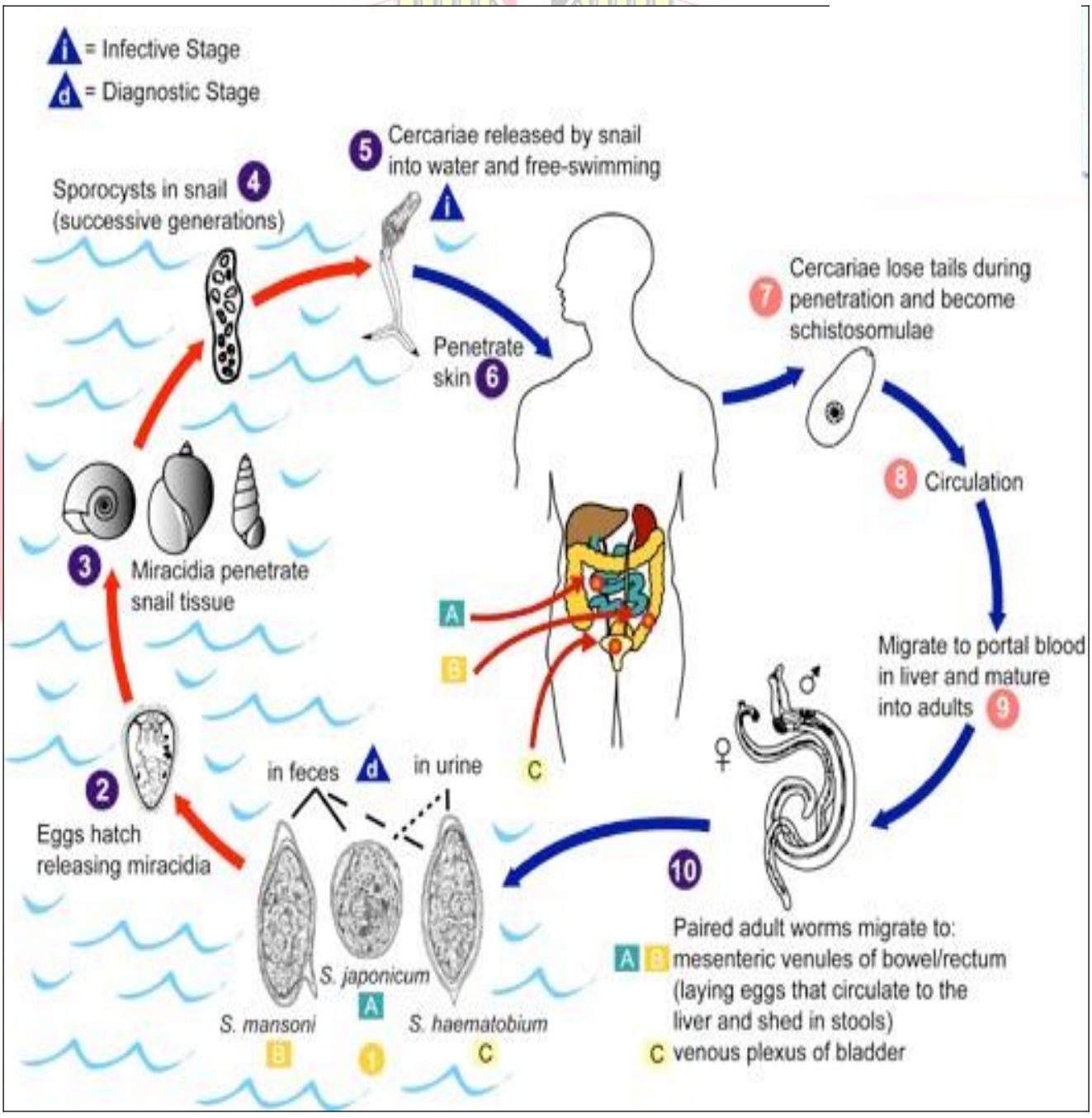
-Definitive host: man.

-Intermediate host: snail *Bulinus truncatus* in Egypt.

-Reservoir host: no reservoir host.

-Infective stage: **furcocercus cercaria**.

-Stages in life cycle: egg →→miracidium→→ sporocyst→→ furcocercous cercaria→→adult.



Life cycle of *Schistosoma* species

Egg: Eggs sweep out in urine and rarely with feces.

Size	120 x 60 µ.
Shape	oval.
Shell	thin with terminal spine.
Colour	translucent.
Contents	mature miracidium.

Miracidium: -In fresh water the miracidium hatches.

- It is distributed homogeneously in water.
- It penetrates the soft tissue of the snail intermediate host **(*Bulinus truncates*)** where it develops into first and second generation sporocysts then cercariae that escape into water. Each miracidium gives rise to 250.000 cercariae.

Cercaria: (**furcocercus cercaria**)

a. Body: 200 u in length with 2 suckers, primitive gut and 5 pairs of penetration glands.

b. Tail: 300 µ in length, bifid or bi-forked **Forked cercaria is the infective stage**.

- The cycle inside the snail takes 1-2 months.

-It survives in canal water for 48 hours and is attracted to man by the body temperature.

- The body of cercaria enters the skin or mucous membrane leaving the tail

Mode of infection:

1. Infection occurs by skin penetration within minutes up to half an hour as water begins to dry, after bathing, washing or playing in infected canals. Penetration is helped by the penetration glands and mechanically by the tail activity.
2. Drinking water may lead to infection when cercaria penetrates the

Pathogenicity and clinical picture:

Disease: **schistosomiasis** haematobium, vesical or urinary bilharziasis:

There are four progressive stages:

Stage of invasion	Skin reaction due to cercarial penetration in the form of local dermatitis, itching (**bather's itch),** irritation and papular rash.
Stage of migration	Due to circulating schistosomules Lung: **verminous pneumonitis** (small patches of inflammation) & hemorrhage, with cough, sputum & heamoptysis. **b-** Liver and spleen: **hepatosplenomegaly.** Metabolic products of maturing parasites →→ toxic and allergic manifestations e.g. urticaria, fever, headache, cough, wheezes, muscle pain, leucocytosis & eosinophilia.
Stage of egg deposition and extrusion (early-acute stage)	Active egg deposition with escape of eggs in urine →→ tissue damage and hemorrhage that manifest with: **Terminal haematuria** (blood in the last part of micturation) which is due to increased contraction of bladder →→ injury of venules by egg spine →→ drops of blood in urine. **b-** Frequency of micturation. **c-** Dysuria (burning pain during micturation).
Stage of tissue proliferation, repair and fibrosis (chronic-late stage)	-Eggs trapped in the wall of blood vessels stimulate both humoral and cellular immune response to miracidial antigen→→aggregation of inflammatory cells around eggs (granulomas) and fibrosis with the formation of sandy patches, bilharzial nodules, papillomata which may ulcerate. - Inflammatory reaction heals by fibrosis : a- Urinary bladder: polyps, ulcers, cystitis, contracted bladder, calcified bladder, diverticulosis, malignancy (due to parasite toxic secretions). b- Ureters: stricture, hydroureter. c-Kidneys: hydronephrosis,2ry infection(pyonephrosis)&renal failure. d-Urethra: stricture, fistula. e-Genital organs: pseudo-elephantiasis of the penis, granuloma in prostate, seminal vesicle, spermatic cord, ovaries, uterus and vagina. -**Embolic lesions**: *Schistosoma* eggs are swept by blood to reach various organs (liver, lungs, brain or other organs). Eggs swept from the pelvic and vesical plexuses to→→ the pulmonary artery branches produce granulomata and fibrosis with obliteration of blood flow →→ pulmonary hypertension, right ventricular hypertrophy and right sided heart failure **(Bilharzial cor-Pulmonale).**

Diagnosis:

I. **Clinical**: history of terminal haematuria & dysuria in endemic area is suggestive. In mild infection, haematuria manifests only after muscular activity. Infection of seminal vesicle manifests by blood in seminal fluid.

II. **Laboratory**:

a. Direct methods:

1. **Detection of eggs in urine**: microscopical examination of last drop of urine sample for the eggs after sedimentation or centrifugation (concentration method).
2. **ELISA** for circulating antigens.

b- Indirect methods: Serological tests for detection of antigen antibody reaction.

1. Indirect haemagglutination test (IHA).
2. Indirect fluorescent antibody test (IFA).
3. Enzyme-linked immunosorbent assay (ELISA): for antibodies detection.

Treatment:

1. Praziquantel (Biltricide or Distocide).
2. Metrifonate (Bilarcil).

Schistosoma mansoni

(Intestinal schistosomiasis)

Geographical distribution:

It is widespread in Africa.

In Egypt, it was prevalent in the region of the Nile delta, but after construction of the high dam, it invaded upper Egypt.

Also *S. mansoni* is found in Saudi Arabia, Yemen and Tropical America.

Morphology: similar to *S. haematobium* with few differences listed below:

1. **Male:** -size: shorter, 8-10mm x l mm.

-Cuticle: more coarsely tuberculated.

-Digestive system: intestinal caeca unite at the anterior third.

-Testes: 6-9 as a mass.

2. **Female:**-size: shorter, 14-22mm x0.15mm.

-Digestive system: union of intestinal caeca occurs at the anterior third.

-Ovary: at the anterior third.

-Uterus: short with 1-4 ova.

3. **Egg:** size: 140 x 70 µ.

Shape: oval.

Shell: thin with lateral

spine. Colour:

translucent.

Contents: mature miracidium.

Eggs sweep out with feces and rarely in urine.

4. **Miracidium:** found in the upper layer of water, has fused penetration glands.
5. **Cercariae:** provided with 6 pairs of unicellular penetration glands.

Life cycle:

-Habitat: radicals of the inferior mesenteric vein draining the large intestine, and in the portal system.

-Definitive host: man.

-Intermediate host: snail *Biomphalaria alexandrina* in Egypt.

-Reservoir host: monkeys and rodents.

Pathogenicity and clinical picture:

Disease: schistosomiasis mansoni, intestinal bilharziasis.

Pathogenicity of ***Schistosoma mansoni*** is similar to that of *Schistosoma haematobium* with the following variations:

-**Stage of egg deposition and extrusion** (early or acute stage):

Active egg deposition especially in the pelvic colon and rectum leads to erosion of submucosa and villous tissue followed by inflammation, tissue damage and hemorrhage. The patient suffers from:

a. Dysentery with mucous and blood in the stool.
b. Abdominal pain.
c. Frequent stool.

-Stage of tissue proliferation, repair and fibrosis (chronic or late stage):

a. Eggs trapped in the wall lead to formation of sandy patches, nodules and papillomata. The wall becomes thickened, fibrosed and may be complicated with strictures, sinuses, fistulae and prolapse.

b. **Embolic lesions**: female *S. mansoni* produces about 300 eggs / day. 50% are swept by blood and reach the liver. They block the presinusoisal capillaries and the soluble egg antigen (SEA) elicits T-cell dependent granulomas around each egg →→ periportal fibrosis and portal hypertension →→ splenomegaly, ascitis and oesophageal varices due to opening of the porto-systemic shunts at the cardiac end of the oesophagus.

c. **Haematemesis**: due to ruptured oesophageal varices.

d. **Melena**: digested blood after ruptured oesophageal varices.

e. Eggs directed to the lungs by collateral circulation lead to **cor-Pulmonale.**

f. Renal involvement occurs due to precipitation of immune complexes in the glomerular vascular bed leading to **end-stage renal failure**.

Diagnosis:

I. Clinical:

a- Early: diarrhea and dysentery with mucus and blood in stool. b- Late:

- Anal fissures and perianal sinuses.
- Bilharzial hepatic fibrosis causing:
  - Portal hypertension.
  - Splenomegaly &ascitis.
  - Hepatic dysfunction.
- Portal hypertension, haematemesis and melena.
- Blood loss, leading to iron deficiency anaemia.

II. Laboratory:

a. Direct methods:

1. Stool examination: detection of the characteristic eggs in stool (lateral spine).
2. Rectal swab using a gloved finger lubricated with soap to palpate the pathological lesion in the rectum and the fecal sample are then examined on a slide for *Schistosoma mansoni* eggs.

3. Sigmoidoscopy and rectal biopsy to visualize the mucosa of sigmoid colon for pathological lesions and *Schistosoma* eggs.
4. ELISA for circulating antigens.

b. Indirect methods: as schistosomiasis haematobium.

Treatment:

1. Praziquantel: a single oral dose is effective against all *Schistosoma* species infecting man.
2. Oxamniquine (Vansil).
3. Chemotherapy followed by surgical interference in portal hypertension.

N.B.: urine and stool examination should be done after 3 months of treatment for *Schistosoma* eggs. The viability test should be done to decide whether the patient is cured or not.

Class: Cestoda (Tapeworms)

- **General characters:**
- Adults are flat, ribbon like and segmented, their length varies from few millimetres to several meters.
- The body is divided into scolex, neck and several proglottids or segments.
- The **scolex** is provided with organs for attachment.
- The **neck** is the region of growth.
- The **proglottids strobila or segments** are differentiated into immature, mature and gravid segments (according to the degree of maturity of the genital organs).
- They have neither a body cavity nor an alimentary tract. Nutrients are absorbed through their cuticle or integument which has also a protective function by secreting substances that inactivate the host digestive enzymes.
- Each mature segment is hermaphrodite having male and female genital systems.

Order: Cyclophyllidea

Taenia saginata (Beef tapeworm)

Geographical distribution: Cosmopolitan.

Morphology: 1-

Adult:

- Size: 10 meters, 2000 segments.
- Scolex: globular, 2 mm in diameter, with 4 suckers without rostellum or hooks.
  - Mature segments: squarish or slightly broader than long (about l x l cm) containing
  - Male system: numerous testes (300).
  - Female system: bilobed ovary lying posteriorly in the segment with a compact
- Gravid segments: longer than broad (about 20x7mm) with the uterus having 15-20 lateral branches on each side.

2-Egg:

Size	30-40 µ
Shape	spheroid.
Shell	thick radially striated embryophore
Colour	yellowish-brown.
Contents	hexacanth embryo (onchosphere)

3- *Cysticercus bovis*: a bladder-like structure lined with a germinal layer enclosing a cavity containing fluid. It has an invaginated scolex with 4 suckers. It measures about 1-2 cm.

Life cycle:

Habitat	adult worm lives in the small intestine.
Definitive host	man.
Intermediate host	cattle.
Reservoir host	no
Infective stage	*cysticercus bovis*.

-**Stages in the life cycle**: egg →→ onchosphere (Hexacanth embryo) →→ *cysticercus bovis* in (I. H.) →→ adult in (D. H.).

- Mature eggs and gravid segments pass in the human faeces.
- Gravid segments are detached separately and disintegrate liberating eggs. Sometimes these segments creep out of the anus by their own activity.

- The eggs or gravid segments are ingested by the intermediate host →the onchosphere hatches→penetrates through the intestinal wall into the lymphatic or blood vessels to the right side of the heart to the lung to the systemic circulation where it is distributed everywhere specially in active muscles, brain, bones, etc... There, it develops into ***Cysticercus bovis*** in about 12 weeks and remains viable for about one year. In muscles, cysticerci become surrounded by fibrous capsules formed by the host, which may be calcified later on.

Mode of infection: -Ingestion of undercooked beef containing viable *Cysticercus bovis*.

- In the intestine, the scolex is evaginated, attaches to the mucosa and the worm develops to maturity in about 10 weeks.

Pathogenicity and clinical picture:

1- Intestinal disturbances as hunger pain, indigestion, abdominal discomfort, diarrhea or constipation.
2- Loss of weight and appetite.
3- Intestinal obstruction.
4- Segments of *T. saginata* migrating out of the anus, cause irritation, itching, insomnia and anxiety.

Diagnosis:

1. Searching mainly for gravid proglottids in faeces to differentiate *T. saginata* from *T. solium*. If not found, give a saline purge (segments pressed between 2 slides and examined for the number of lateral uterine branches on each side).
2. Finding eggs in faeces is rare, may be in peri-anal scraping using a

Treatment:

1. Niclosamide (Yomesan): the tablets should be taken in the morning on an empty stomach and well chewed. The strobila is often evacuated within a few hours, if not a purgative is recommended.

2- Praziquantel.

Prevention and control:

1. Proper sanitary disposal of human faeces to prevent cattle infection.
2. Proper inspection of beef for cysticerci at slaughter houses.
3. Proper cooking of beef products to kill any cysticerci present (cysticerci are killed at -56°C). Freezing at -10°C for 5-10 days are sufficient to kill the cysticerci.
4. Mass treatment of infected patients.
5. Health education.

Hymenolepis nana (Dwarf tapeworm)

Geographical distribution:cosmopolitan. It is the commonest tapeworm in children.

Morphology: 1-

Adult:

- Size: 0.5-5 cm (the smallest tapeworm of man).
- Scolex: globular, 0.2 mm in diameter, with 4 suckers. A retractile rostellum
- Strobila: 200 segments.
- Mature segments: broader than long (0.5 x 0.15 mm).

-Male system: 3 globular testes, in the middle of the segment.

-Female system: as in *Taenia* but the ovary is small and central.

-Genital pores are unilateral and always open to one side.

- Gravid segments: broader than long (0.2x 0.9 mm) and are occupied by a sac-

2-Egg:

Size	30-50 µ.
Shape	spheroid with 2 envelopes; outer egg shell, inner embryophore with **two polar thickenings from each arises 4-8 filaments**.
Colour	translucent.
Contents	mature hexacanth embryo.

***3*- Cysticercoid:** a bladder-like structure, 0.5-1 mm in diameter, having double wall, similar to cysticercus but the head is withdrawn in upright position **(invaginated everted)**, and it has a tail-like appendage (*Cercocystic cysticercoid*).

Life cycle:

Habitat	the small intestine
Definitive host	Man
Reservoir hosts	rodents (rats and mice).
Intermediate host	man, may be insects like flea larva or grain beetles.
Infective stage	mature **eggs** and ***cercocystic cysticercoid***.

-Stages in life cycle: egg →→ onchosphere →→ *cercocystic cysticercoid* in (I.H.) →→ adult in (D. H. and R.H.).

-Mature eggs pass in faeces of definitive and reservoir hosts are immediately infective without requiring intermediate host.

-When the final host swallows the egg in food, drink or by autoinfection, the

onchosphere hatches in the small intestine, penetrates into **the submucosa** to become a cysticercoid. After about one week, it returns to the **lumen** and develops into an adult worm. Man acts as definitive as well as intermediate host.

- Eggs appear in faeces about two weeks after infection.
- Also development may take place in an intermediate host if the egg is swallowed by flea larva (or flour insects, beetles and cockroaches).
- The onchosphere liberates in the intestine of the insect, penetrates into the body cavity where it develops into a cysticercoid. When such flea is ingested with food the cysticercoid is liberated and develops into adult.

Mode of infection:

1- Swallowing of infected insects or their larvae containing cysticercoid. 2- Contaminated food, water with eggs.
3- Autoinfection: by ingestion of mature eggs, either from **person to person** or by **external autoinfection** or **internal autoinfection.**

Pathogenicity and clinical picture:

1. In light infection, usually there are no manifestations.
2. In heavy infections: ulcerations of the mucosa lead to **enteritis**. There may be abdominal discomfort, colic and diarrhea with passage of mucus.
3. Some patients specially children suffer from dizziness and may be convulsion, attributed to **neurotoxin** product of the worms.

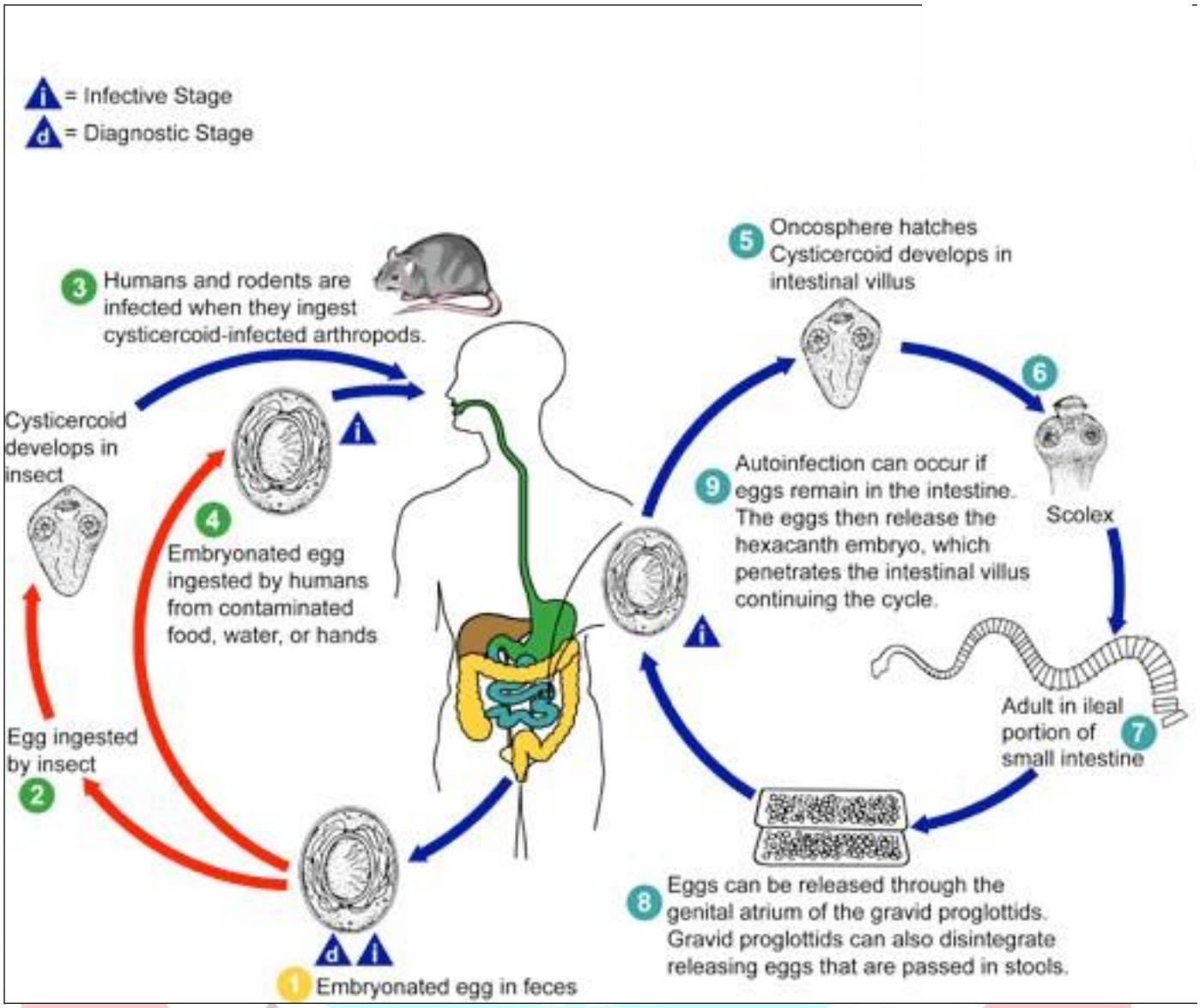
Diagnosis: finding eggs in faeces.

Treatment:

1-Niclosamide: treatment is prolonged or repeated in 3 weeks to kill worms that emerge from cysticercoids in the submucosa.
2-Praziquantel: a single oral dose after breakfast. It acts on both cysticercoid in the villi and the adult in the lumen of small intestine.
3-All infected members of the family should be treated at the same time.

Prevention and control:

1. Avoid contaminated food and drink.
2. Personal cleanliness and proper sanitary disposal.
3. Health education.
4. Mass treatment to prevent autoinfection and infection of others.
5. Rodents control.



Life cycle of *H. nana*

NEMATHELMINTHS

Class: Nematoda (Round worms)

- General characters:

- Cylindrical worms, unisexual, have a body cavity.

-Male is smaller than female and commonly has a curved posterior end.

Ascaris lumbricoides

(Giant intestinal round worm)

Geographical distribution: cosmopolitan, especially in tropical and subtropical countries.

Morphology: 1-

Adult:

a. Long with tapering ends.
b. Creamy or pink in colour.
c. Finely striated cuticle.
d. Terminal mouth with 3 lips, one dorsal and two subventral. Each lip is provided with fine teeth and sensory papillae.
e. Club-shaped oesophagus.

Male: -15-20 cm in length x 3 mm thickness.

- Posterior end curved ventrally.

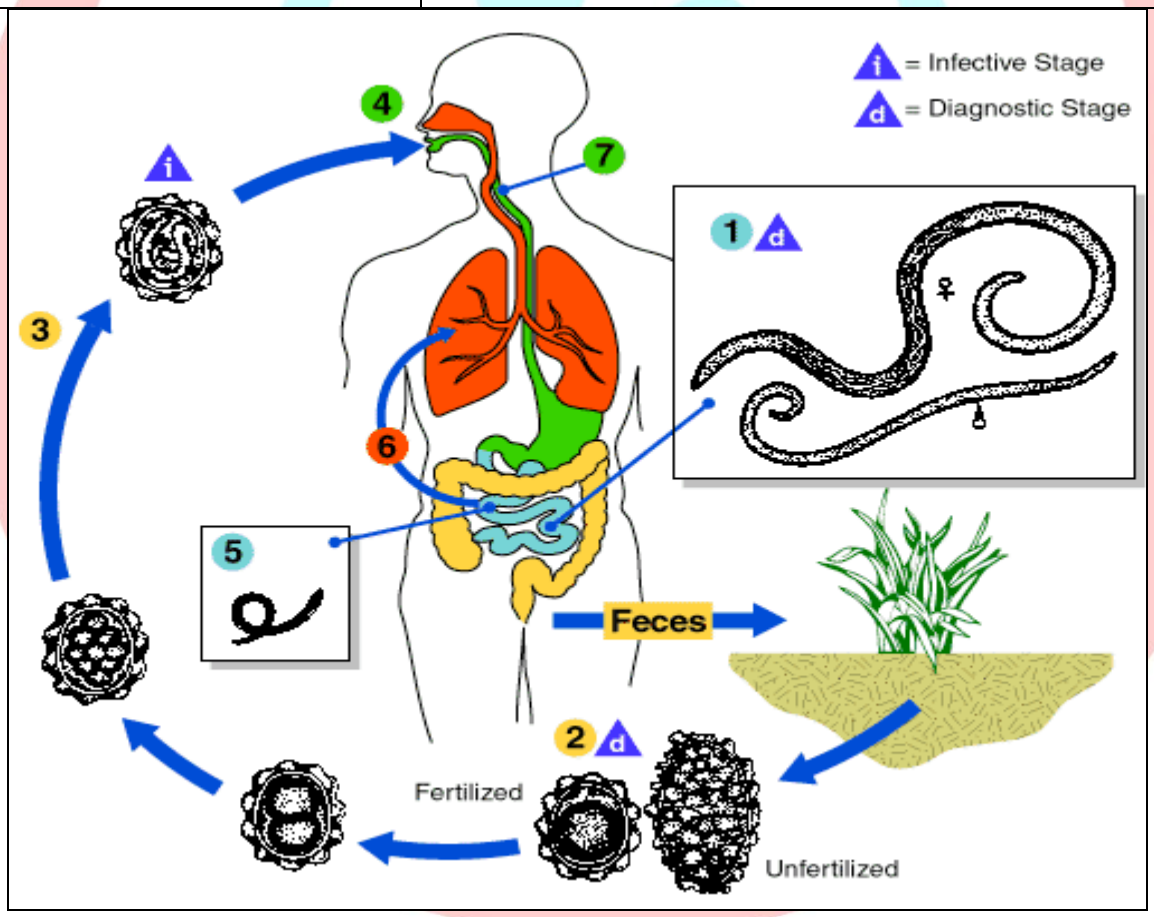
- Has one set of genitalia provided with two small equal spicules.

Female: - About 20-40 cm in length and 6 mm thickness.

- Posterior end straight.
- Has two sets of genitalia.
- The vulva opens ventrally at the junction of the anterior third and posterior two thirds of the body.

2- **Egg:** Three types of eggs:

(a) Fertilized egg Size Shape Color Contents	 • 60 x 45 µ. • Oval with 2 coverings: -Outer thick regular albuminous mammillations. -Inner thick egg shell. • Brownish. • Immature ovum (one-cell stage).
(b) Unfertilized egg Size Shape Shell Color Contents	(Lay by unfertilized females). • 90 x 45 µ • Long and narrow Less developed thin irregular albuminous mammillations • Thin egg shell. • Brownish • Retractile granules.
(c) Decorticated egg	Similar to fertilized egg with no mammillated layer.



Life cycle of Ascaris lumbricoides

Life cycle:

Habitat	Small intestine
Definitive host	Man
Infective stage	Eggs containing second-stage rhabditiform larva.

it is specific parasite of man with no I.H. or R.H.

Stages in the life cycle: egg →→ larvated egg →→ larva →→ adult.
-Immature eggs pass in the faeces (200,000 eggs/female/day).
-Under favorable environmental conditions in the soil (temperature of about 25°C, humidity, shady soil and oxygen) a rhabditiform larva develops inside the egg in about two weeks. After one week this larva moults into a second-stage rhabditiform larvae inside the egg**.**

Mode of infection:

(1) swallowing water or raw vegetables polluted with embryonated eggs containing the infective larva.

(2) through contaminated hands by polluted soil.

(3) by inhalation to nasopharynx.

(4) house flies and cockroaches may carry the larvated eggs to human food.

Pathogenicity and clinical picture:

I- Migrating larvae:

1. Lung: in **light** infection, there is slight damage with unnoticed pathological lesions. In **heavy** infection, the migrating larvae in the lungs result in condition known as *Ascaris* pneumonitis or **Loeffler's syndrome** especially in children. Clinically, from 1-5 days after exposure, cases

manifest with fever, cough, and dyspnea lasting for 1-2 weeks.

In extreme cases there may be lobular pneumonitis, cellular infiltration, serous exudates and haemorrhage causing cough and bronchial irritation, expectoration with blood stained sputum and oedema of lips, microscopically the larvae may be detected in the sputum, with many eosinophils.

2. General circulation: occasionally some larvae reach the general circulation and distributed to various organs as lymph nodes, brain, spleen & kidneys leading to abnormal clinical manifestations as a result of **visceral larva migrans**.

II- **Adult worm:** The usual infection consists of 5-10 worms, often goes unnoticed by the host and is discovered on a routine stool examination or by the discovery of an adult worm passed spontaneously in stool. The most frequent complaint is abdominal pain with distension, diarrhea or constipation, vomiting and dyspepsia.

Diagnosis:

I. **Clinical:** symptoms of ascariasis are indistinguishable from those of other intestinal helminthic infections.

II. Laboratory:

1. Detection of eggs in stool (direct smear, after concentration, Stoll's technique).
2. Detection of migrating larvae in sputum or in gastric lavage contents.
3. Detection of adults passing out with or without stool or in vomitus.
4. Eosinophilia (7-12%).
5. Radiology: Barium meal shows cylindrical filling defect **(string sign)**.

Treatment:

1. Levamizol hydrochloride (Ketrax) as a single oral dose.
2. Mebendazole (Antiver, Vermox) or Flubendazole (Fluvermal).
3. Surgical treatment of complications e.g. obstruction of intestine, appendix or bile ducts.

Enterobius vermicularis
(Oxyuris, pinworm or seat-worm)

Geographical distribution: cosmopolitan.

Morphology:

1- Adult: translucent cuticle, finely transversely striated. There are 2 wings like expansions (cervical alae) at the anterior end. The mouth with 3 small retractile lips, followed by small buccal cavity.

The **oesophagus is double- bulbed**. Intestine ends at the anus ventrally.

Male: 0.5 cm, its posterior end curved ventrally, one set of genital organs that open with the anus in the cloaca and one spoon- shaped spicule.

Female: 1cm, with a long thin sharply pointed tail occupying about 1/3 total length (hence the common name pin worm), 2 sets of genital organs and vulva at the junction of the anterior fourth with the rest of the body.

2-Egg:

Size	50x25 µ.
Shape	Plano-convex (one side is convex and the other is straight).
Shell	2 layers and covered by a 3rd outer thin albuminous sticky layer.
Color	Colorless.
Content	Fully developed larva.

Life cycle:

-**Habitat**: adult worm lives in the caecum, appendix and adjacent parts of small and large intestine.

-**Definitive host**: only man.

-**Infective stage**: fully embryonated eggs containing fully developed larvae.

-The gravid female migrates to the perianal and perineal area where they lay eggs. The eggs are infectious several hours after deposition.

Mode of infection:

1. Ingestion of eggs through contaminated food and drink.
2. Autoinfection: eggs are carried under finger nails to the mouth after scratching of perianal skin (anus to mouth infection).
3. Retro-infection: eggs hatch on the perianal region and larvae migrate back through the anus to the rectum and caecum.
4. Air-borne infection
5. Contact with patients (direct hand to hand or indirect contact by handling contaminated articles as clothes, bed linens, toilet seats, door knobs).

Pathogenicity and clinical picture:

The clinical symptoms are largely due to perianal, perineal and vaginal irritation caused by the migration of the gravid female worm.

1. Local irritation and discomfort, with nocturnal itching and enuresis, insomnia, irritability, restlessness, neurosis, hyperactivity, gridding of teeth and inability to concentrate.
2. **Pruritus ani** due to:
   a- Nocturnal migration of the female worm on the perianal skin with worm like movement.
   b- Skin sensitization by ruptured worms during scratching. c- Striations on the cuticle cause skin irritation.
3. Vaginitis and salpingitis by migrating gravid females. Granulomas are formed around eggs or worms.
4. Irritation of intestinal mucosa with minute ulcers, hemorrhage and 2ry bacterial infection at site of attachment.
5. Obstructive appendicitis rarely occurs.

Diagnosis:

I. **Clinical**: Pinworm infection is suspected in children who show perianal itching, restlessness and insomnia.

II. **Laboratory**:

1- Detection of adult worms in feces or in the perianal region. 2- Detection of the eggs:

-In stool: seldom found (in only 5% of infected patients), unless uterus of gravid female ruptures during migration to the perianal region.

-In urine of female patients.

-On perianal region by swab, this must be done early in the morning before defecation or bathing and should be repeated for several days before the patient is considered free.

Types of swabs:

a. **Scotch adhesive tape swab:** a piece of scotch tape, hold over a tongue depressor is rolled over the perianal skin and removed. The adhesive tape is put on a slide with a drop of toluene and examined for eggs.

b. **Vaseline swab:** the perianal skin is swabbed with a piece of cotton soaked in Vaseline and the swab is put in a mixture of ether and water to dissolve the

Vaseline. The mixture is centrifuged and the deposit is examined for eggs.

c. **National Institute of Health (N.I.H.) swab:** it is a piece of non adhesive cellophane fixed to a glass rod.

Treatment:

1. Mebendazole (Vermox), Flubendazole (Fluvermol) or Pyrantel pamoate (Combantrin) as a single oral dose and a 2nd dose must be given after 2 weeks to prevent re-infection.
2. Local: mercurial ointment is applied to the perianal skin especially at night to relieve itching and kills females that come out to deposit eggs and prevent dispersal of eggs.

Prevention and control:

1. Mass treatment of the whole companions of the infected person.
2. Personal cleanliness.
3. Protection of food and drink from contamination by dust and hands of patients.

Trichuris trichiura (Trichocephalus trichiura or whipworm)

Geographical distribution: cosmopolitan, more in worm moist regions.

Morphology:

1- **Adult:** body is demarcated into an anterior attenuated whip-like thin part (3/5) that contains a cellular oesophagus, and a more robust posterior thick part bluntly rounded (2/5) contains the rest of organs.

Male: 3-4 cm in length coiled posterior end with a single copulatory spicule inside a retractile sheath and a terminal cloaca.

Female: 4-5 cm in length, straight blunt posterior end, has one set of genitalia and the vulva opens at the junction of thin and thick parts. Anal orifice is terminal.

2- Egg:

Size	50 X 25 µ.	**Shape**	barrel-shaped.
Color	yellowish-brown.	**Content**	immature embryo.
Shell	thick-shell, with bipolar mucoid plugs.		

Life cycle:

-Habitat: adult inhabit the human large intestine mainly the caecum but is also found in the appendix and lower ileum.
-Definitive host: man.
-Reservoir host: some mammals.
-Infective stage: egg containing first stage larva.
-Stages in the life cycle: egg →→ larva →→ adult

Mode of infection:

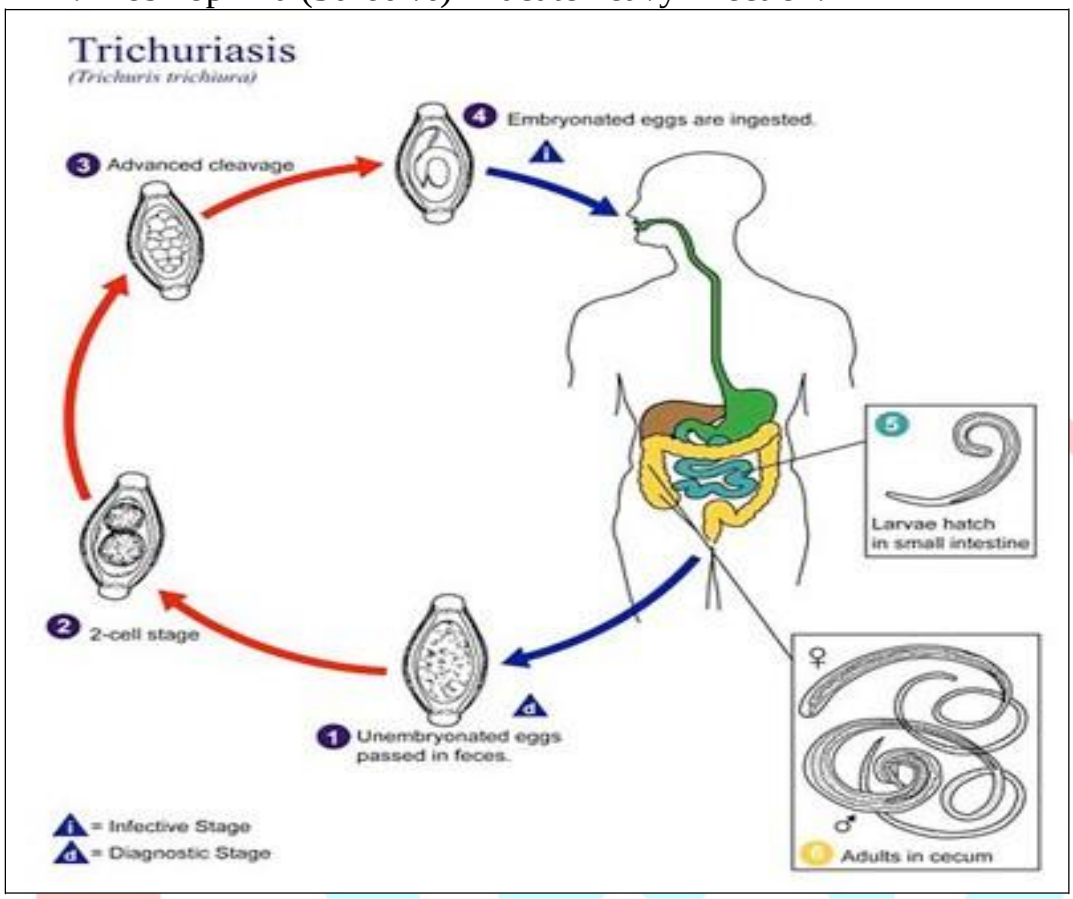
Ingestion of larvated egg with contaminated food and drinks.

- When the embryonated egg is ingested by man, the larva escapes from the egg shell in the upper small intestine and penetrates the intestinal villi, where it remains for 3 to 10 days.
- After reaching the adult stage, it passes downward to the caecum. A spear like projection at its anterior extremity enables the worm to penetrate into and deeply embed its anterior portion into the intestinal sub-mucosa of the host.
- The female is oviparous, life span about 4-6 years, and number of eggs deposited/female/day is about 2000 eggs.
- Ova pass with stool 2 months after infection and require 3-5 weeks for the larva to develop inside and become infective in favorable environment (worm, moist and shaded soil).

Pathogenicity and clinical picture:

1. Light infection is asymptomatic.
2. Heavy chronic infection manifests with:
   a. Frequent, small, blood-streaked diarrheal stools, dysentery.
   b. Abdominal pain and tenderness, nausea, vomiting and weight loss.
   c. **Rectal prolapse** due to oedema as a result of large number of worms embedded in the mucosa, dysentery and toxic effect on the pelvic nerve.
   d. **Hypochromic anemia** due to suction of blood by the parasite and hemorrhage that occur at their attachment sites. Hyperchromic anemia may also occur by the toxic parasitic products (*Trichocephalus* pernicious anemia).

e. Appendicitis.
f. Protein loosing enteropathy in heavy infections.
g. Intestinal wall perforation and peritonitis.
h. Eosinophilia (30-60 %) in acute heavy infection.



Diagnosis:

I. **Clinical**: can't be differentiated from infection with other intestinal nematodes.
II. **Laboratory**:
1- Stool examination for the characteristic egg.
2- Proctoscopy: worms can be seen attached to the inflamed and ulcerated rectal mucosa.

Treatment:

Mebendazole (Vermox or Antivir) or Flubendazole (Fluvermal).

Prevention and control:

1. Treatment of infected patients.
2. Sanitary disposal of human stool.
3. Strict hygienic measures for hands, food and drink.
4. Control of house fly.

Hook worms

Geographical distribution: Tropical and subtropical countries.

Ancylostoma duodenale

Morphology:

1-Adult:

a. The anterior end is bent dorsally.
b. Large mouth cavity (buccal capsule) with two pairs of teeth at the anterior margin (ventral or upper) and two dental plates at posterior margin (dorsal or lower) and two sub-ventral lancets in its bottom.
c. Club-shaped oesophagus (1/6 the length of the worm).

Male:

- About 1 cm in length
- Has one set of genitals provided with a copulatory bursa (posterior expansion of the cuticle) and two long separate spicules.

Female:

- About 1.2 cm in length.
- Has two sets of genitalia.
- Vulva is at the junction of the middle and posterior thirds of the body.

Necator americanus

Morphology:

1-Adult: -Grayish yellow in colour.

- It has a hook-like anterior end. The head is curved opposite to the body curvature.
- Buccal capsule is armed ventrally and dorsally by cutting plates (dental plates). Four lancets at the bottom (two sub-ventral and two sub-dorsal).

Male: - Measures 8 mm in length and 0.3 mm in diameter.
- The copulatory bursa is long and wide.
- The 2 copulatory spicules are fused distally provided with a blade.

Female: - Measures 10 mm in length and 0.5 mm in diameter.
- Its posterior end is straight.

-Vulva is at the middle of the body.

2- Egg (Diagnostic stage): Shape: oval with blunt poles. Color: translucent.
Size: 60 x 40 µ.
Contents: immature ovum (4-cell stage).
An empty narrow space existsbetween the content and

3- Rhabditiform larva:

-About 250-500 µ in length.
-Rhabditiform oesophagus.
- Long buccal cavity.
- Pointed tail end.

4- Filariform larva:

-About 600-700 µ in length with a sheath
-Club-shaped oesophagus (1/3 body length).
-Sharply pointed tail.
-Does not feed but move.
-Thermotropic, histotropic, phototropic and negative geotropic.
-Present in top layer of soil.

Life cycle:

-Habitat: small intestine (Jejunum).
-Definitive host: man.
-Reservoir hosts: no.
-**Infective stage**: sheathed filariform larvae.

Stages of the life cycle:

Egg →→ rhabditiform larva →→ infective filariform larva(IFL) →→ adult.

▪▪ Adults live in the small intestine of man attached by the mouth capsule to the mucosa.

▪▪ Immature eggs pass in the feces (20,000 eggs/female/day in *Ancylostoma* and 10,000 eggs/female/ day in *Necator americanus).*

▪▪ Under favorable environmental conditions in the soil (moist shaded areas, sandy or loose soil, alkaline and free of salinity, suitable temperature and sufficient oxygen), a rhabditiform larva develops and hatches in about 2 days (development does not occur in undiluted stools, being acidic).

▪▪ It feeds and moults in about 3 days giving another rhabditiform larva (500 µ). It moults again after about 7 days (keeping its skin; ensheathed) to become an infective filariform larva.

Mode of infection:

Man is infected when the filariform larva penetrates his intact skin or mucous membrane of the mouth.

Pathology and clinical picture:

Due to larvae		**Due to adult**
-Ground itching -Cutaneous larvae migrans	-Verminous pneumonia	-Anemia -GIT symptoms

(A)Skin lesion:

- Ground itch: local dermatitis caused by FL penetration at the site of entry or contact with soil (feet, buttocks, hands).
- Cutaneous larvae migrans:

It is due to migration of IFL in the skin

Appear as maculopapular rash and itching (± pustules due to 2ry infection).

(B) Lung lesion:

- Löffler's syndrome: caused by Ancylostoma larval migration in the lungs (verminous pneumonitis).
- It is presented by fever, cough, dyspnea, haemoptysis and oesinophilia.
- All symptoms are transient < 2 weeks.

(C) ***Intestinal lesion***:

I- GIT: colic, vomiting, diarrhea.

II- Chronic iron-deficiency anaemia (hypochromic, microcytic) due to blood loss.

Mechanisms of anaemia:

1- Tear by buccal capsule (parasite attached to sucked mucosa, by curved teeth and cutting plates → ulcer → haemorrhage).

2- Anticoagulant secretion by cephalic glands (continued bleeding after detachment).

3- Toxic bone marrow depression.

4-Enteritis (due to 2ry infection) decrease absorption of iron.

III- Complications

- Hypoproteinaemia (due to loss of proteins in blood)& subcutaneous oedema.
- Physical and mental retardation.
- Heart failure (due to tachycardia and hypoxia).

Diagnosis:

I- Clinical: the clinical picture though characteristic is not sufficient to differentiate it from the nutritional deficiency anaemia and oedema from other helminthic infection.

II-Laboratory: depends upon finding the eggs in feces.

Treatment:

1- Mebendazole (Vermox) or Flubendazole. 2- Pyrantel pamoate (combantrin).

3- Supportive treatment: Iron, vitamins and high protein diet.

Prevention and control:

1- Mass treatment of the infected population.

2- Sanitary disposal of human faeces and not to use them as fertilizer.

3- Wearing shoes and gloves for people handling mud or working in mines, gardening, poultry and brick-making.

Filarial worms

Wuchereria bancrofti

Geographical distribution: Tropical and subtropical countries.

In Egypt it is endemic in some localities, in Damietta (Ezbet-El-Borg), Dakahlia (Meet-Ghamr) and Sharkia (Hehya) Governorates.

Morphology:

1 - Adult: as described before.

2- Microfilaria:

- 300 x10 µ.
- Sheathed, the sheath is loose and redundant (project beyond anterior and posterior ends).
- Bluntly rounded anterior end.
- Tapering posterior end and free of nuclei.
- Nocturnal periodicity (maximum at 12 P.M.).

Life cycle: as described before

-Habitat: adult in lymph vessels and lymph nodes especially that draining lower part of the body, while microfilariae are in the peripheral blood.

-Definitive host: man.

-Intermediate host (vector): mainly female *Culex*, also female *Anopheles* and *Aedes.*

-Reservoir host: no.

-Infective stage: filariform larva in the mouth of infected mosquitoes. **Mode of infection**: Through the skin during the bite of infected mosquito.

Pathogenicity and clinical picture:

Disease: Bancroftian filariasis, wuchereriasis, elephantiasis.

- The various pathogenic complications of this disease are mainly due to the adults, the microfilariae seem to have no pathogenic manifestations although they have been associated with granulomatous inflammation of the lung, liver and spleen.

I- Asymptomatic filariasis: this occurs in endemic areas, there is microfilaria in the blood without clinical manifestations.

II- Symptomatic: The main pathological lesions are:

1- Acute inflammatory manifestations:

Due to toxic products of living or dead adult worms with superimposed secondary bacterial infection, it occurs in recurrent attacks and is manifested by:

-Lymphangitis of the genitalia (funiculitis, epididymitis, orchitis and scrotal oedema) with swelling and redness of affected parts.

-Lymphadenitis especially in the groin and axilla.

-Fever, chills, headache, vomiting and malaise.

-Leucocytosis and eosinophilia.

2- Chronic obstructive manifestations:

Due to fibrosis following the inflammatory process , the coiled worms inside lymphatics and endothelial proliferation, this may result in:

- Dilatation of lymphatics leading to **varicosities** especially in genital organs and abdominal wall as hydrocele, scrotal lymphoedema and lymphatic varices.
- Rupture of distended lymphatics (varicosities) e.g. in urinary passages →→ chyluria, pleural sac →→ chylothorax, the peritoneal cavity →→ chylous ascitis, tunica vaginalis of testis →→ chylocele, intestine →→ chylous diarrhea.
- Elephantiasis: oedema of the affected part followed by hypertrophy of the skin and subcutaneous connective tissue, the part become hard, tender and the skin becomes thickened, rough, stretched and fissured lead to secondary bacterial infection. It is common in lower limbs and genitalia (scrotum, penis and vulva) rare in arms and breasts.

3- Tropical pulmonary eosinophilia (diffuse filarial lung disease):

-It is caused by immunologic hyper-responsiveness of the host to microfilarial antigens → local destruction of microfilariae in the pulmonary vascular system and diffuse interstitial lung disease.

-Clinically there is dyspnea, cough, asthmatic attacks and eosinophilia, which respond well to treatment with hetrazan.

- Blood examination: microfilariae are not detected in the peripheral blood (**occult filariasis).**

Diagnosis:

I. Clinical: clinical picture as before.

II. Laboratoy

1- Direct:

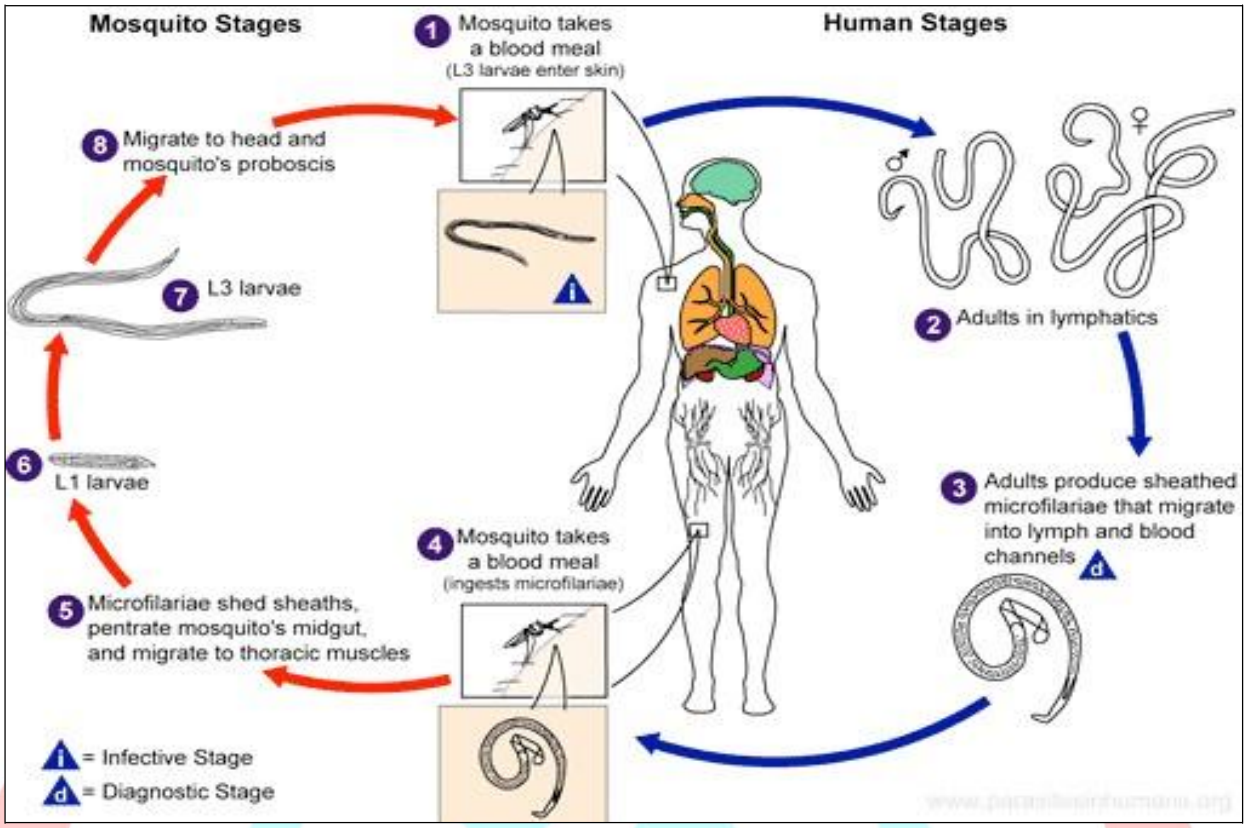
a- Detection of microfilariae in peripheral blood by the following methods:

- Direct fresh smear under dark ground illumination to see motile microfilariae.
- Giemsa-stained thick blood film to show the stained fixed microfilaria.
- Concentration of microfilariae **(knott's method):** if microfilariae are scanty, 2ml of blood are mixed with 10ml of 2% formalin, allow the mixture to stand for 10 minutes then centrifuge, decant the supernatant and examine the sediment.

Indirct: ELISA

Treatment:

1. Diethylcarbamazine (Hetrazan) is the drug of choice, has a lethal action on microfilariae.
2. Surgical treatment: removal of elephantoid tissue.



Life cycle of *Wuchereria bancrofti*

Chapter 4

Medical entomology

Objectives

1-Discuss different morphological differences of variant arthropods, their life cycle, their medical importance with diseases transmitted via important arthropods and explain recent methods for prevention and control strategy.

(Mosquitoes)

Mosquitoes have a worldwide distribution, more common in tropical and temperate countries. They are slender diptera with elongated proboscis, antennae, and legs. Wings are covered by scales. Larvae and pupae are aquatic.

Diseases transmission by mosquitoes:

Only the female mosquito can suck blood and transmit diseases.

I. Anophelines as vectors of human diseases:

1. **Malaria:**
2. **Filarial worms:**
3. **Arbo-viruses (Arthropod-borne viruses):**

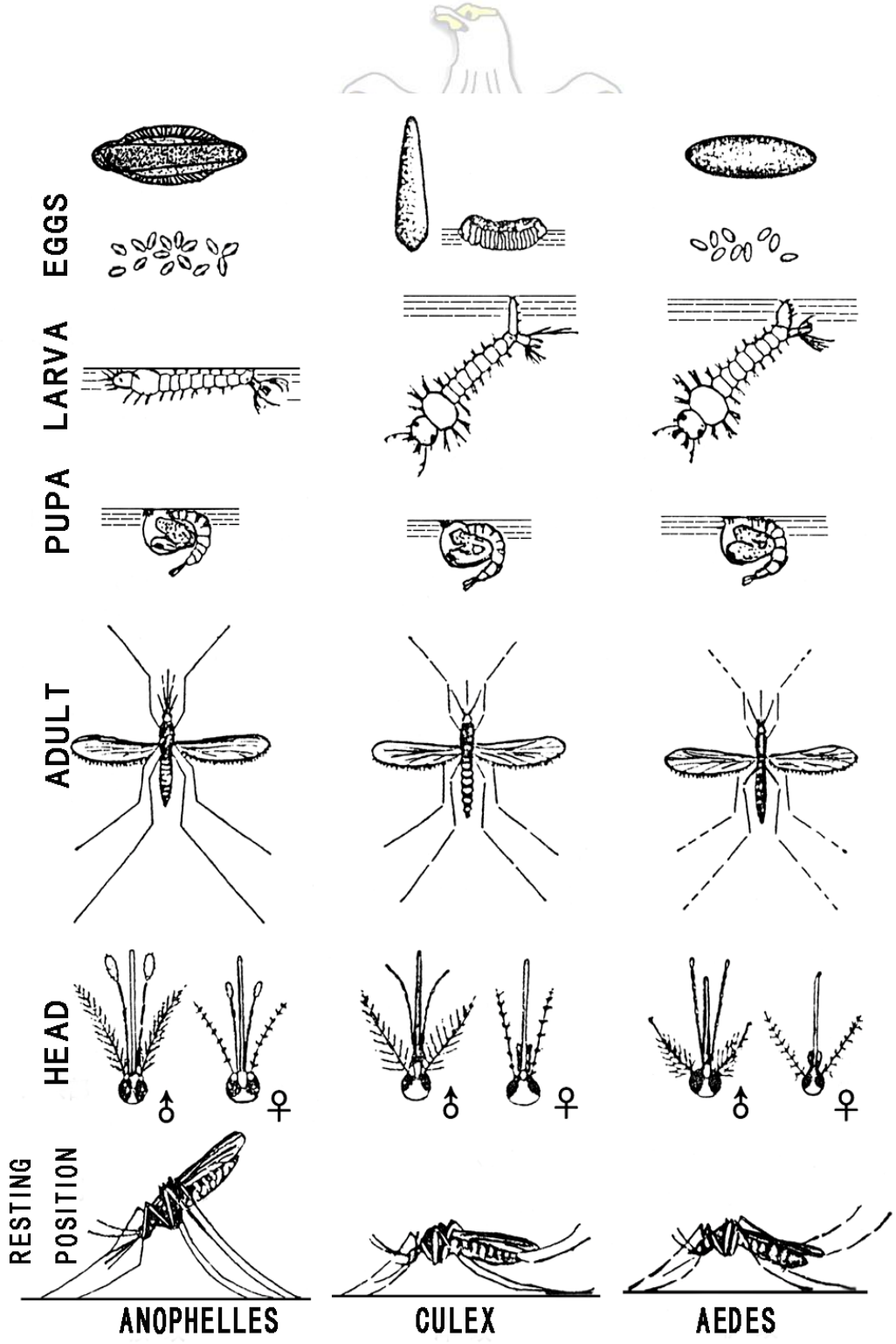
II. *Culex as* vector of human disease: It is the most common mosquito in Egypt. It transmits:

1. **Arbo-viruses**.
2. ***Wuchereria bancrofti*** and ***Brugia malayi***.
3. **Bird malaria**.
4. **Rift-valley fever virus**.

III. *Aedes* as vector of human diseases:

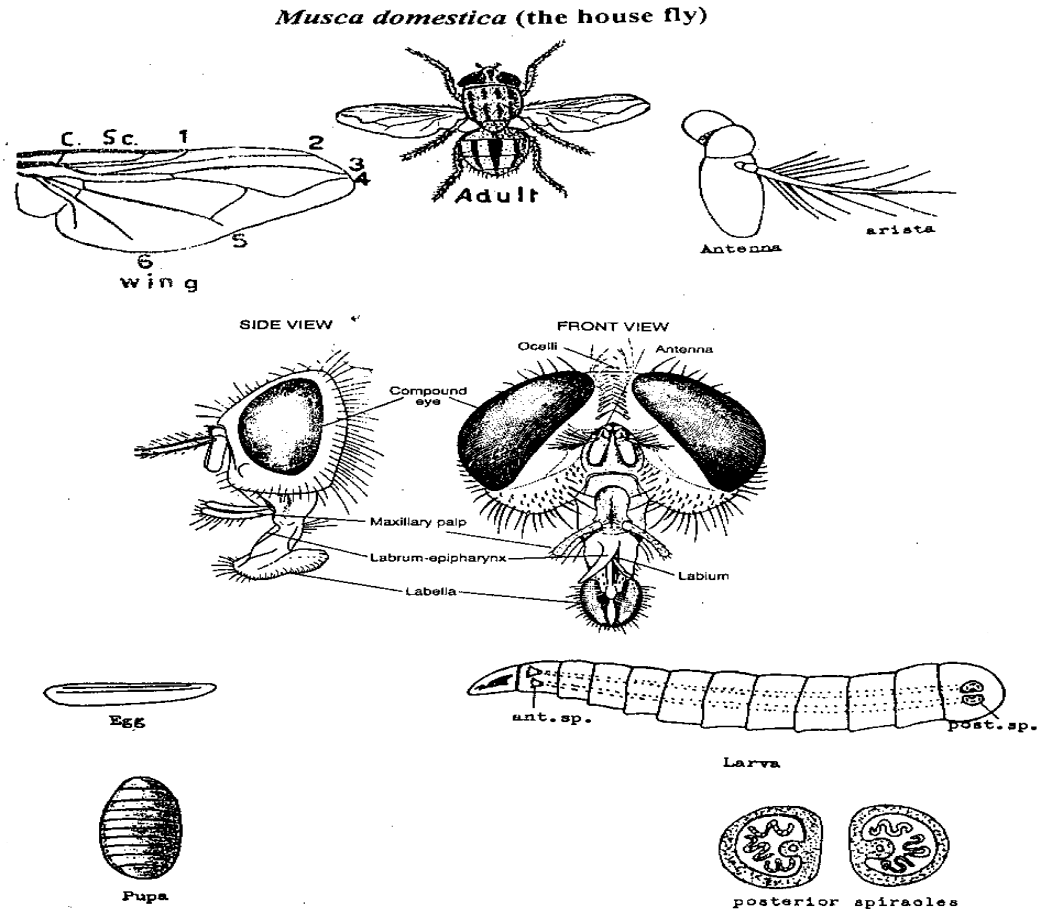
1. **Yellow fever:** This is an acute febrile disease caused by the yellow fever virus. It is transmitted chiefly to man through the bite of the domestic mosquito
2. **Dengue fever (Break Bone Fever):** This is a viral infection transmitted by the salivary secretions of the *Aedes* mosquito.
3. **Arbo-viruses**.

4. **Filarial worms:** *Wuchereria bancrofti.*
5. **Bacterial diseases:** Mechanical transmission of **tularemia** caused by *Francisella tulariensis.*



Stages of life cycle in different mosquito species.

(The house fly)



Medical importance:

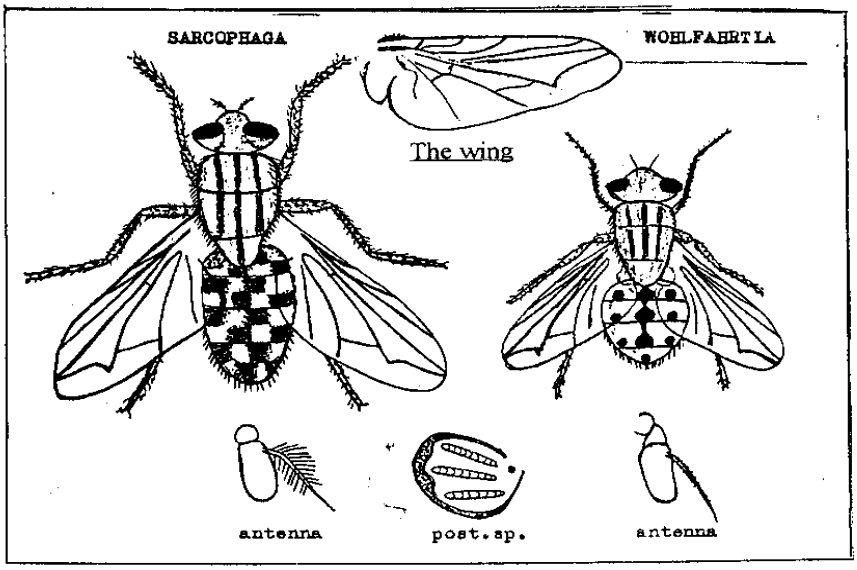
1. House flies are capable of mechanically transmit pathogens causing diseases: on their hairs, mouth parts, legs, faeces and vomitus.

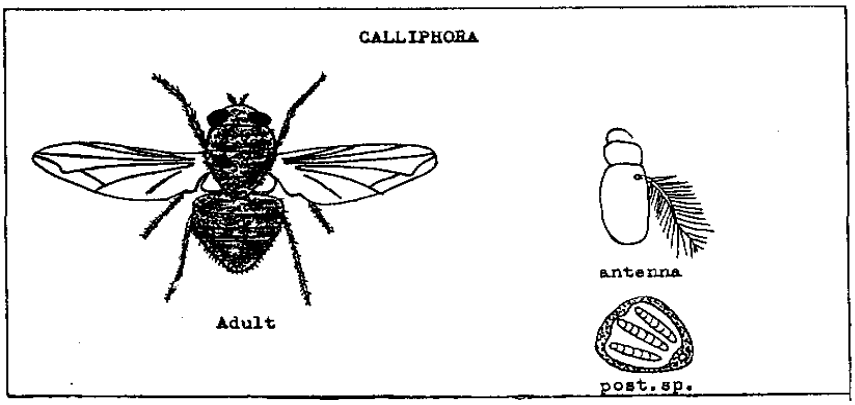
a) Parasites: Cysts of protozoa e.g. *E. histolytica, G. lamblia* and eggs of helminths as *A. lumbricoides, T. trichiura, H. nana, E.vermicularis.*

b) Bacteria: Typhoid, cholera, dysentery, pyogenic cocci, etc.

c) Viruses: Enteroviruses, poliomyelitis, hepatitis,....etc.

2. They cause accidental myiasis.





MYIASIS

- Myiasis means invasion of the tissues of man or animals by the larval stages of some flies.
- In man, myiasis frequently occurs in rural regions where people live in close contact with domestic animals.
- Myiasis is common in domestic and wild mammals all over the world.

Classification of myiasis

I. Internal myiasis
1. Intestinal
2. Gastric
3. Urogenital

II. External myiasis
1. Cutaneous myiasis:
   a. Traumatic cutaneous
   b. Creeping eruption
2. Ocular and nasopharyngeal
3. Aural

I. Internal myiasis

1. Intestinal myiasis:

- Several flies may deposit their eggs or larvae on human food or on the anus (particularly in rural children), during sleep or defecation in open places. Larvae find their way to the intestine and may cause nausea, vomiting, abdominal discomfort or pain with diarrhea.
- Living and dead larvae appear in stools or vomitus and can be diagnosed by their shape and posterior spiracles, e.g. larvae of *Calliphora*, *Lucilia*, *Musca, Sarcophaga*, and *Fannia* (latrine fly).

2. Gastric myiasis:

- It is uncommon in man, the larvae of *Eristalis* fly may find their way to stomach. This larva is commonly called rat-tailed larva.
- Usually these larvae either pass to intestine causing intestinal myiasis or die or get vomited.

3. Urogenital myiasis:

- Caused by*: Fannia, Musca, Calliphora* and *Sarcophaga* species.
- Larvae may enter through urinary or genital orifices or through lesions on orifices during urination in open places.
- They may cause obstruction to the urine flow with pain if larvae are in the urinary tract or inflammation with pus, mucus and blood in urine. Maggots passed in urine are used for diagnosis.

II. External myiasis

1. Cutaneous myiasis:

a. **Traumatic cutaneous myiasis:** This occurs when wounds or ulcers are invaded by flies' larvae. These larvae may cause serious damage e.g. *Wohlfarthia, Chrysomia*, *Cordylobia* and *Dermatobia.*

b. Creeping eruption: The larvae of *Hypoderma* and *Gasterophilus* parasitize some animals but accidentally may find their way to the skin of man and wander in the skin causing papules and pustules along its path leading to creeping eruption.

2. Ocular and nasopharyngeal myiasis:

Larvae of some flies are attracted to the discharge coming from the eye or the nose, find their way to the conjunctiva or the nose and may reach the brain. Severe pain in the eye is the first complaint in ocular myiasis e.g. Larvae of *Oestrus, Calliphora, Sarcophaga, Gasterophilus* and *Hypoderma.*

3. Aural myiasis:

Purulent exudates discharged from running ears attract some flies where they lay their eggs or larvae. Larvae invade middle ear, inner ear or even mastoid sinuses or the brain tissue in extreme cases, for example, *Wohlfahrtia, Sarcophaga, Lucilia* and *Chrysomia.*

Fleas

Medical importance:

Fleas transmit and cause the following diseases**:**

1. Plague:

It is an acute infectious disease; causative organism is *Pasteurella pestis.*

2. Endemic typhus fever (murine typhus):

It is caused by *Rickettsia mooseri*.

3. Fleas act as intermediate host of *Dipylidium caniunm* (*Ctenocephalis canis*)

4. Fleas act as intermediate host of *Hymenolepis diminuta* (*Xenopsylla cheopis* and *Ceratophyllus fasciatus*).

5. Flea dermatitis: Itching due to biting followed by 2ry bacterial infection.

6. Tungiasis (previously known as **Jiggers disease**): Female *Tunga* penetrates the skin between toes to deposit eggs leading to 2ry bacterial infection and cellulites.

(Lice)

Pediculus humanus capitis

(Head Louse)

Pediculus humanus corporis

(Body Louse)

It is similar to *Pediculus humanus capitis* but differs in:

- Bigger in size, paler, longer antennae.
- It is present on the body only.
- Life cycle similar to that of head louse.

Medical importance:

Body lice transmit and cause the following diseases**:**

1. **Epidemic typhus:**
2. **Epidemic relapsing fever:**
3. **Trench fever:**
4. **Pediculosis (Vagabond´s disease):** It is very common among poor crowded area, in prisoners and among soldiers. It is due to long lasting, heavy infection with body lice,

which leads to severe itching, irritation, dermatitis, scratching of the skin with secondary bacterial infection and causes pustule formation and lastly deep pigmentation of the skin.

Treatment: Head louse:

-1% Lindane or gamma lindane is rubbed in the infected areas.

- By using Benzanyl lotion or cream.

Body louse: Dusting the skin with insecticides powder.

Medical importance of ticks:

A. Diseases transmitted and caused by hard ticks (*Dermacentor andersoni*):

1. Rocky mountain spotted fever:

.

2. Q-fever:

3. **Tick bite fever:**

4. Meningoencephalitis fever:

5. Colorado fever:

6. Lyme disease:

7. Tularaemia:

8. Texas cattle fever and babesiosis:

10. Tick paralysis: It is produced by some toxins in the saliva of the tick; which produce a blockage of the neuro-muscular junctions and probably some of the synapses of the spinal cord. Paralysis disappears after removal

B. Diseases transmitted by soft ticks (Argasidae):

Two types of soft ticks:

***Argas*:** It does not transmit diseases.

***Ornithodrous*:**

Only transmits and causes the following diseases:

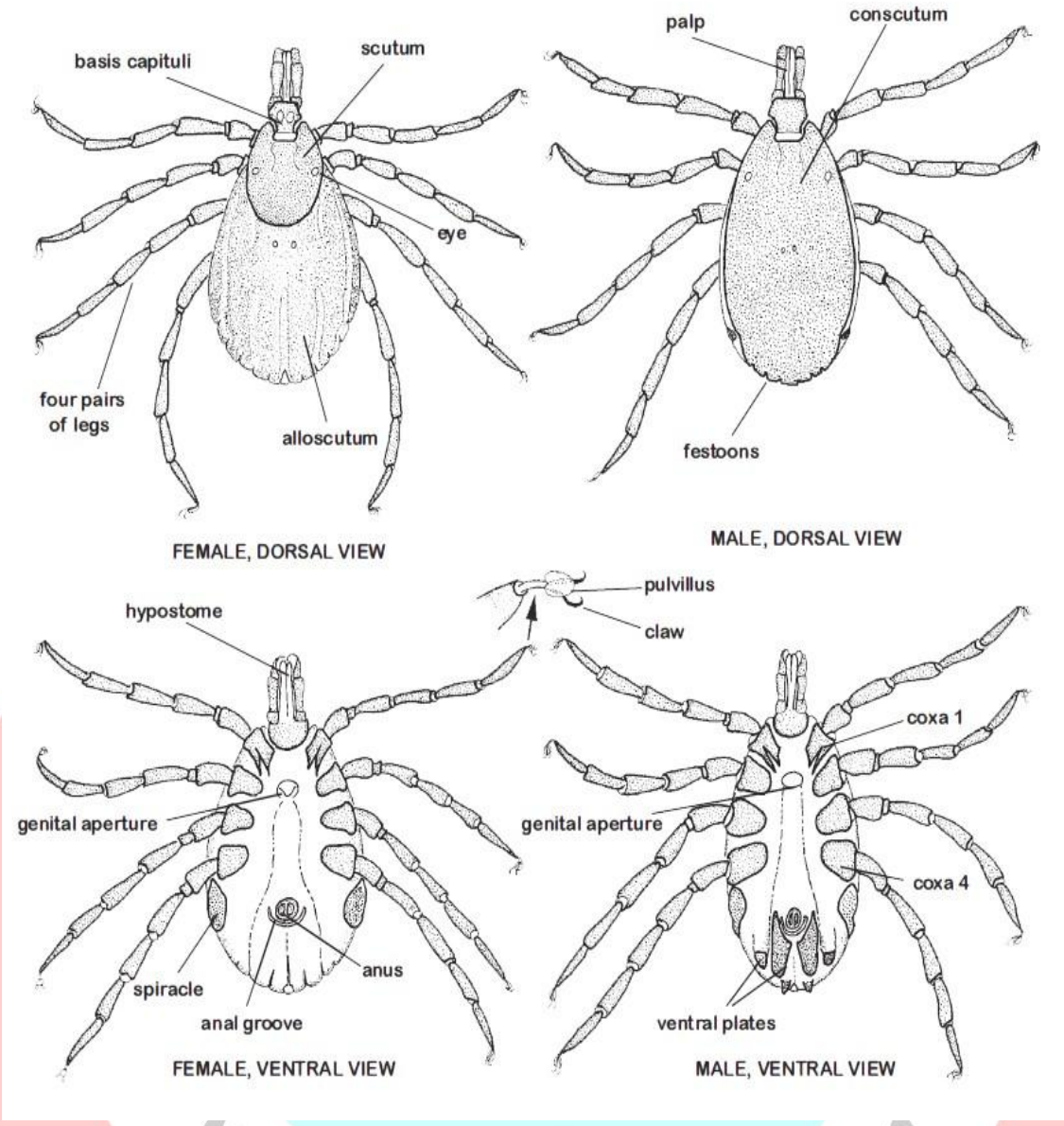
1. **Endemic relapsing fever:**
2. **Q-fever:**
3. **Tick paralysis**.

Treatment:

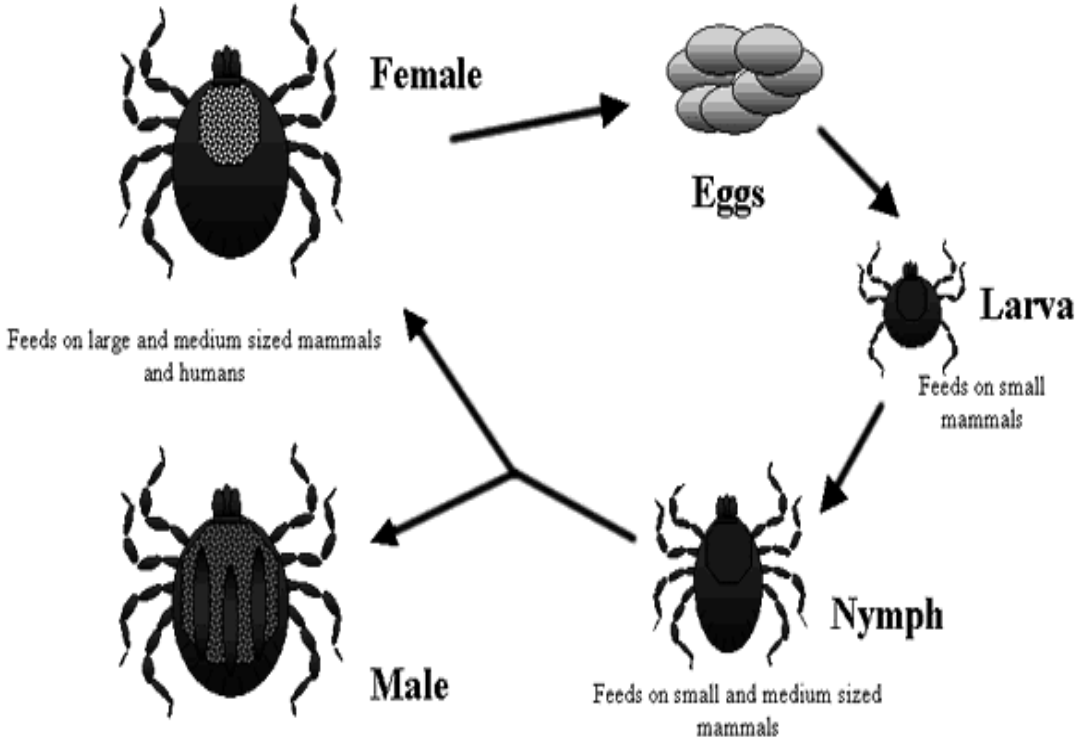
By the removal of tick, it is better to anaesthetize the tick with ether or to suffocate it with gasoline oil, glycerin or kerosene.

Control:

Depends mainly on spraying insecticides on the floors, in cracks in the walls and places where ticks are hide. Also, disinfestations of animals by dipping them in solutions of insecticides.

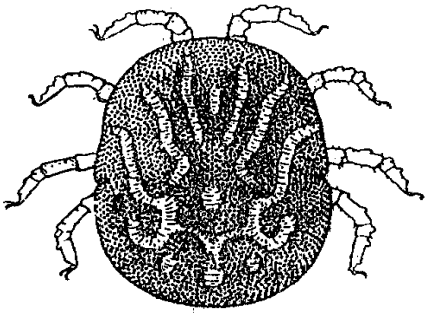


Hard tick morphology.

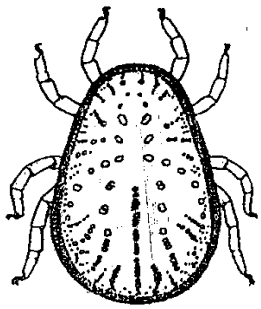


Hard tick life cycle.

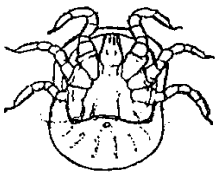
soft ticks



Ornithodorus moubata



Argas persicus



larva

Mites

Sarcoptes scabiei

(The itch mite)

Geographical distribution: Cosmopolitan; the disease is common among overcrowded, poor and dirty classes of populations.

Morphology:

1. It is a small mite, about 400-500x 200-250 µ, grey in colour, and oval in shape.
2. It is one mass.
3. Mouth is adapted for tearing the tissues.
4. It has 4 pairs of legs. The anterior two pairs in both male and female end by suckers. While the posterior two pairs end by bristles in female. In male, its 3rd pair ends by bristle, while the 4th pair ends by suckers.

Life cycle:

Habitat: in intracutaneous tunnels between fingers, toes, ulnar surface of the arm, elbows, axillae, groin, breast, umbilicus, shoulder, back and buttocks.

-The head and neck are not affected.

Mode of infection: It takes place by contact with an infected person or by using his internal clothes.

Pathogenesis and clinical picture:

Scabies is called **seven years itching.** The activity of mites usually occurs during **night**. It is activated by the warmth of the affected part. Mites produce black tortuous tunnels due to their toxics secretions and excretions. Severe itching occurs that interferes with sleep (insomnia). Scratching and secondary bacterial infection occur on top, resulting in vesicles and pustules.

Diagnosis:

I. **Clinically:** By the severe itching during night, its sites distribution in the skin, and by finding the scratches, vesicles and pustules.

II. **Laboratory:** By finding the adult mite or its stages in the tunnels after opening with a needle under a magnifying lens.

Treatment:

1. Bathing every day with sulphur soap for 5 days.
2. Change the internal clothes and bed lining.
3. Using sulphur ointment 10-15% on the affected areas or benzyl benzoate 25% emulsion painted on body.

Prevention and control:

1. Personal hygiene by regular bathing.
2. Avoid contact with patients.

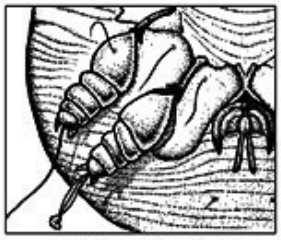
Case study:

A 11-year-old child was presented to the dermatologist suffering from severe nocturnal itching in the groin, lower abdomen, elbows and neck. Clinical examination revealed multiple scratches, elevated red tracks in the skin with small papular lesions in the affected areas. Skin specimens of the affected areas were collected and sent to the laboratory for examination.

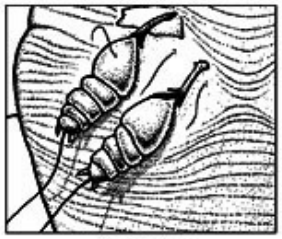
Questions:

1. Do you think that the patient's illness may be a result of parasitic infection?
2. Name the insect that may cause this patient's illness.
3. Name the disease caused by this insect.
4. How is this infection acquired?
5. Describe the life cycle and pathogenicity of this insect.
6. Is this disease opportunistic?
7. How is the diagnosis of this infection made?
8. How is this infection treated?
9. What are the precautions to be followed during treatment of this infection?

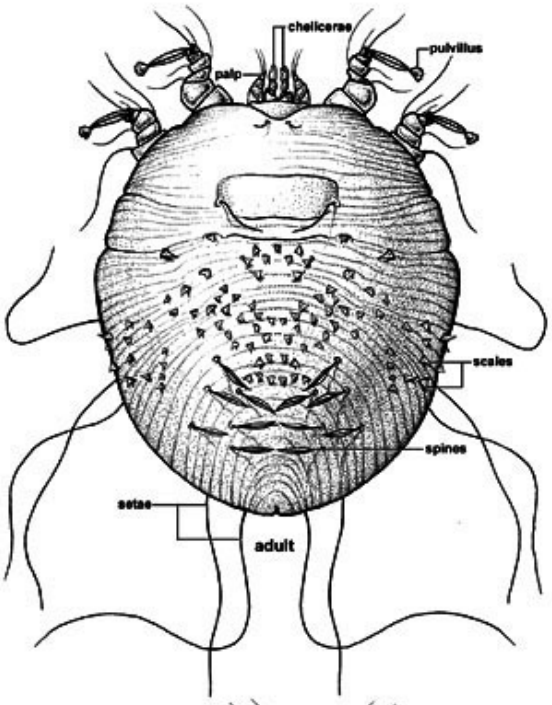
Scabies Mite
Sarcoptes scabiei

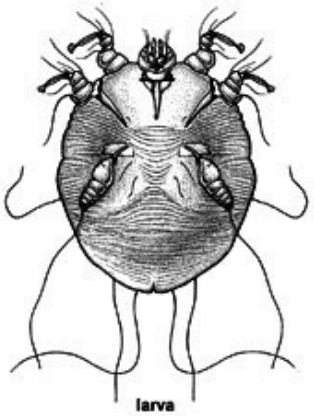


male legs and genitalia
(as seen from ventral aspect of mite)

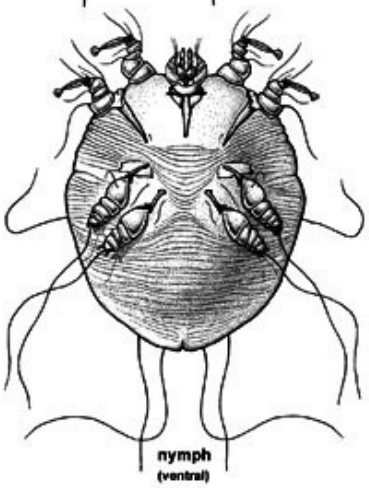


female legs
(as seen from ventral aspect of mite)





larva
(ventral)



nymph
(ventral)

Chapter 5

Practical Parasitology

Objectives

1-Allow students to recognize different parasites with parasite stages under microscope to know morphological differences making them perfect to differentiate between different species.

SECTION I
PRACTICAL HELMINTHOLOGY

A- CLASS : TREMATODA

FASCIOLAE

1- *Fasciola* egg : a- Oval. b- Thin, operculated shell. c- Size : 140X70 u. d- Yellowish-brown. e- Contains an immature embryo.	

HETEROPHYES HETEROPHYES

1- Egg : a- Oval. b- Size : 30X15 u. c- Yellowish-brown. d- Thick-shelled. e- Operculated. f- Small knob at the abopercular end. g- Mature (contains miracidium).	

2- Encysted metacercaria : a- Rounded. b- 300 u. in diameter. c- Between muscle fibers of fish.	

HUMAN SCHISTOSOMES

1- *Schistosoma* cercaria : a- Elongated body and tail. b- Length : 500 u. c- Length, body : tail = 2 : 3. d- Tail is furked (furcocercous). e- Body : 5-6 pairs of penetration glands. f- Oral and ventral suckers. g- Primitive gut.	

B- CLASS : CESTOIDEA

TAENIAE

1- *Taenia* egg : a- Rounded. b- 40 u. in diameter. c- Brownish in colour. d- With thick double-layer and radially-striated embryophore. e- Contains hexacanth embryo.	

7- *Cysticercus bovis* : a- Rounded and bladder-like. b- 0.5-1.0 cm. in diameter. c- Whitish in colour. d- Invaginated and inverted scolex with 4 suckers without hooks.	

C- CLASS : NEMATODA

ASCARIS LUMBRICOIDES

1- Fertilized egg : a- Broad oval. b- Size : 60X40 u. c- Yellowish-brown in colour. d- Thick-shelled with regular albuminous mammillations. e- Immature (contains large single cell stage embryo).	

2- Un-fertilized egg : a- More oval. b- Size : 90X45 u. c- Yellowish-brown. d- Thin-shell with poor mammillations. e- Contains refractile granules.	

ENTEROBIUS VERMICULARIS

1- Egg : a- D-shaped (plano-convex). b- Size : 55X25 u. c- Shell : double-walled. d- Translucent. e- Contains fully developed larva.	

TRICHOCEPHALUS TRICHIURUS

1- Egg : a- Barrel-shaped. b- 50X25u. c- Thick-shelled with translucent bi-polar mucoid plugs. d- Yellowish-brown. e- Immature (contains an embryo in the single cell stage).	

SECTION II
PRACTICAL PROTOZOOLOGY

A- PARASITIC AMOEBAE

i- *Entamoeba histolytica :*

1- Trophozoite : a- 15-20 µ in diameter. b- Cytoplasm : ecto- and endoplasm. c- Pseudopodia may be present. d- Food vacuoles : contain R.B.Cs. e- Nucleus : i- Karyosome : small and central. ii- Peripheral chromatin : fine and regular granules.	

2- Cyst : a- Rounded. b- 12-15 µ in diameter. c- Contains 4 nuclei (at different levels) and rod-shaped chromatoid bodies with rounded ends.	

1- CLASS : ZOOMASTIGOPHORA
INTESTINAL FLAGELLATES

i- *Giardia intestinalis* :

1- Trophozoite: a- Pear-shaped with broad anterior end , (15x8 u.). b- 2 sucking discs anteriorly. c- 2 oval vesicular nuclei anteriorly. d- 4 pairs of flagella. e- 2 axostyles in the middle. f- Comma-shaped parabasal body across the axostyles.	

2- Cyst: a- Oval. b- Size : 12X7 u. c- Double-walled. a- 4 nuclei at one pole. b- Remnants of axostyles and parabasal body.	

URO-GENITAL FLAGELLATES

Trichomonas vaginalis *:*

Trophozoite : a- Spheroid in shape. b- 18X9 u. c- 2 pairs of flagella anteriorly. d- Antero-lateral cytostome. e- Single oval vesicular nucleus anteriorly.	

4- CLASS : SPOROZOA

PLASMODIA

A- *Plasmodium vivax* :

1- Ring form : a- Single ring. b- Large (fills 1/2 R.B.C.). c- Enlarged parasitized RBCs.	

2- Gametocyte : a- Large (fills R.B.C.). b- Rounded or oval.	

B- *Plasmodium falciparum :*

1- Ring stage : a- Multiple marginal rings. b- Small-sized (fills 1/6 R.B.C.). c- Normal size of parasitized R.B.Cs.	

2- Gametocyte : a- Kidney-shaped. b- Central compact or diffuse nucleus. c- Pale or deep blue cytoplasm.	

TOXOPLASMA GONDII

Trophozoite : a- Crescent-shaped. b- One pole is more rounded than the other. c- 6X3 u. d- Nucleus is eccentric (near the rounded end). e- Para-nuclear body (near the pointed end).	

SECTION III
PRACTICAL ENTOMOLOGY

1- CLASS : INSECTA
A- ORDER : DIPTERA
MOSQUITOES
***A. Culex* :**

1- Egg-rafts : a- Laid in groups (250-500 eggs). b- Ovoid, one end broader than the other.	

***B*- Anopheles :**

1- Egg : a- Single. b- Slipper-shaped. c- Provided with air floats. d- Brown in colour.	

C- *Aedes :*

1- Egg: a- Laid singly. b- Black in colour. c- Spindle-shaped. d- Surface : with protuberances.	

MUSCA DOMESTICA

1- Egg : a- Banana-shaped. b- One mm. in length. c- Creamy-white. d- One end broader than the other. e- 2 longitudinal ridges on the surface.	

B- ORDER : SIPHONAPTERA

FLEAS

1- Flea Larva :

a- 14-segmented. b- Covered with short posteriorly-directed hairs.	

C- ORDER : ANOPLURA

PEDICULUS HUMANUS

1- Egg : a- Oval. b- **Operculated.** c- Cemented to hair by ¾ of its length.	

References and recommended readings:

References:

Department book
Clinical Parasitology. A Practical Approach,2013

Recommended readings:

a-Basic clinical Parasitology (Brown and Neva)
b- Colored Atlas of Parasitology
c- Medical Parasitology (Markell, vogue, and John)
d- Tropical medicine and Parasitology (peters and Gills)

Book Coordinator ; Mostafa Fathallah

General Directorate of Technical Education for Health

Practical Diagnostic Methods

URINE EXAMINATION

Precautions for collection of urine:

1-Urine is collected in a sterile tubes with a cover.

2-Urine is directly examined,if it is transported for long distances before examination ,it should be refrigerated not frozen.

Sedimentation method

1-Urine is collected in a conical glass left for 15 min. for sedimentaion .

2-A small amount of the precipitate is taken by a pipette, put on a slide and covered with a glass cover to be examined by low power microscope then by high power.

Specific precautions for some diseases:

1-Bilharzia (mainly haematobium):we take the last drops of urine which contain blood and ova.The urine is better taken after physical effort(exertion).For hatching the ova,add few drops of disteled water to show viable or dead one.

2-Trichomonas vaginalis:take first drops of urine in the morning Vaginal douches are not recommended before taking the sample by2 days at least.

3-Bancroftian filariasis:with chyluria, urine is milky like.So, adding drops of ether will dissolve the chylous material.

4-In urine we can see Enterobius vermicularis adult and ova and Strongyloides larvae.

STOOL EXAMINATION

Precautions for stool collection:

1-Stool sample must be fresh.

2-Stool sample is collected in clean sterile glass or plastic container.

3-Avoid contaminating the sample with urine or water.

4-Cover the container gently with a tight cover to prevent evaporation or contamination.

5-Labell it and write the name and date .

6-If the sample is not examined directly ,by doctor ,it should be preserved by adding formaline,polyvinyle alcohol (PVA) or merthiolate-iodine-formaline (MIF).

Methods of stool examination

1-Simple smears

A-Direct saline smear:-

Direct smear examination should be a routine procedure.

Steps:

1-Place one drop of saline(0.85% NaCl) on the center of a clean slide.Put two mg .of feces with an applicator and mix will, remove any gross fibers or particles untill the mixture is not so thick or so thin.Then cover with glass coverslip.Avoid air bubbles ,then examine the specimen microscopically first by low power then by high power .

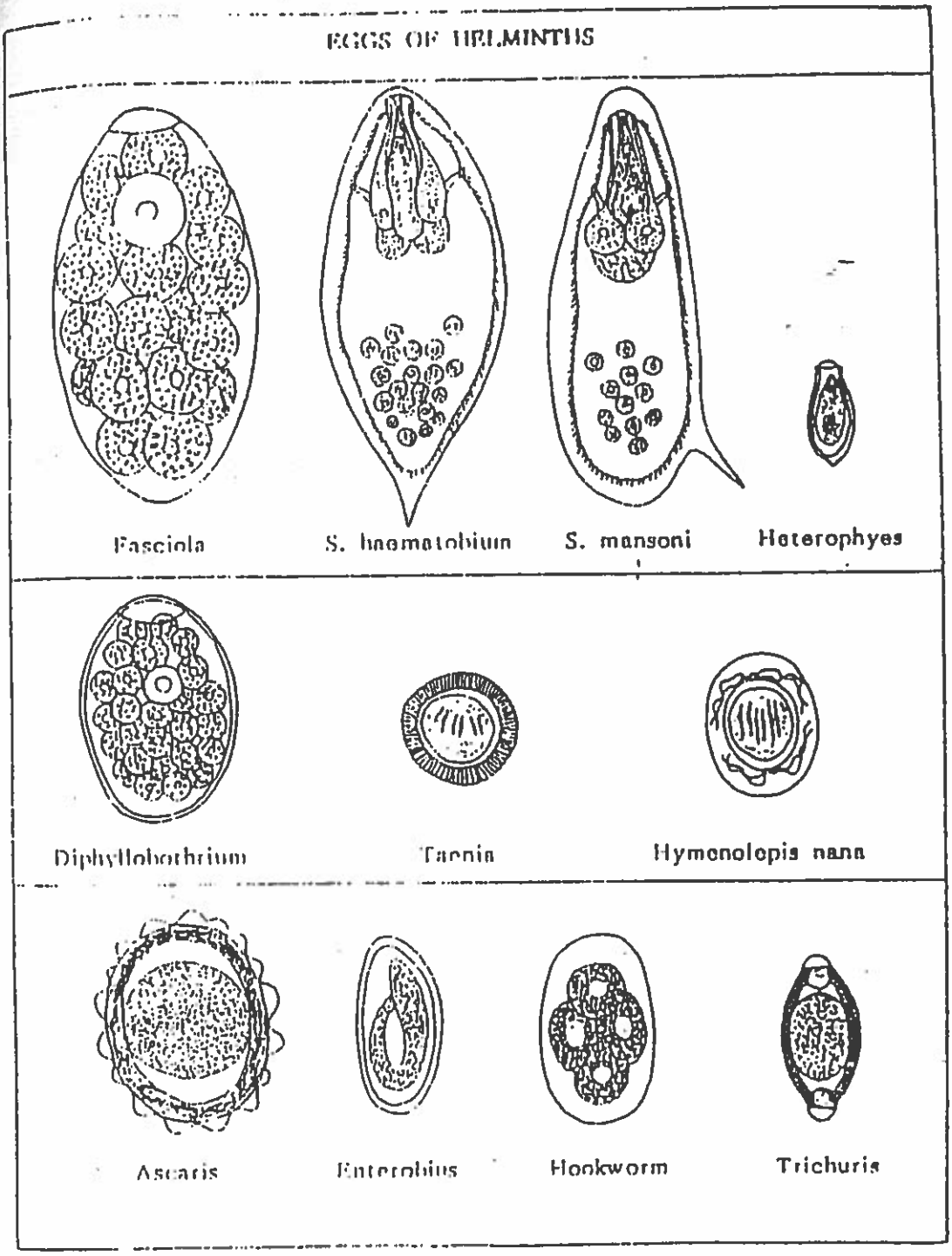
B-Iodine smear:-as saline smear but place one drop of lougal's Iodine to stain protozoal nuclei.

Specific precaution:

1-In case of Entamoeba histolyica it is necessary to examine fresh stool to see motile trophozoites.

2-In a fresh stool sample we can detect *Strongyloides* stercoralis larvae .

3-Female pin worms migrate at night to the perianal folds to lay eggs.Ascaris are frequently passed spontaneously ,such



(drawn to relative sizes)

worms should be preserved in alcohol (70%)or formalie (10%) and identified.

4-Enterobius infection is usually diagnosed by demonstrating the eggs at the anal region.So,the use of an anal scraper or swab to obtain material for microscopical examination is necessary.

5-Tape worm segment are discharged singly or in strands periodically in stools or migrate from the anus.Patients should be instructed not to wrap them in toilet paper or allow them to dry,they can be rehydrated in water.

6-Hatching of bilharzia ova in stool can be tested by adding 2-3 drops of H_2o on one side of the cover and then a filter paper is used on the other side to withdraw the water after few minutes. Viable ova will hatch and miracidium will be seen moving.

7-Stool smear may be stained with iodine and eosin 5%.

2-Kato technique

This technique is one of thick stool smear and concentration technique for examination of heavy and medium sized eggs.

Steps:

1-5grams stool on card paper are seived.

2-Take the seived stools and put it on glass slide,then add malachite green stain,mix and spread.

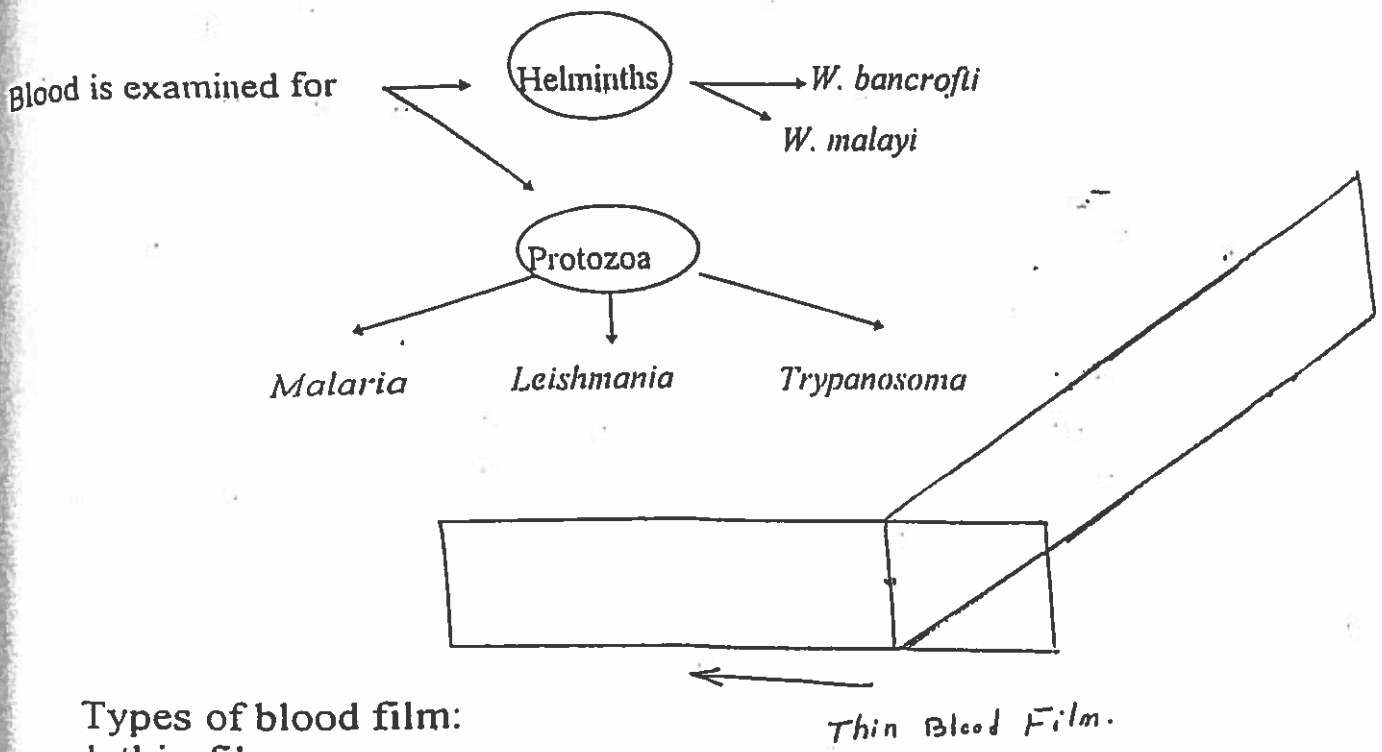
3-Cover with cellophane paper for examination .

4-We can see bilharzia ova,hook worm ova and Ascaris ova.

5-Positivity of this technique is 80%.

6- This smear is used for examination for up to 6-12 months.

BLOOD EXAMINATION



Types of blood film:
1-thin film.
2-thick film

Thin film

One drop of blood is placed near one end of a clean slide.Hold another slide at an angle of about 45 until its edge contact the blood drop, move it steadily from right to left until the other end, then leave to dry.

-Spreading of thin films must not be too quickly nor too slowly and should end before the edge of the slide.

-In thin film R.B.Cs.are one cell thick.It preserves the characteristics of blood cells and parasites inside it.

-Thin film should be fixed before staining by dipping in absolute methyl alcohol(one dip).

Sputum examination

Parasites found in sputum are :

1-the rupture amoebic abscess into a bronchus in coughing up containing blood,necrotic tissue,and trophozoites of E. histolytica.

2-rupture of a pulmonary hydatid cyst followed by scolices of Echinococcus gronulosus.

3-eggs of lung fluke, Paragonimous wersternani (not found in Egypt).

4-migrating larvae of pulmonary phase of Ascaris,Necator, Ancylostoma and Strongyloides with eosinophils.

Examination:

1-direct examination.

2-if sputum is thick add 3% NaOH and centrifuge,then examine the sediment.

Precautions:

1-collect sputum in sterile clean tube and closed well.

2-the sample collected early in the morning.

Notes in

PARASITOLOGY

EXAMINATIONS

Cases

Case 1

Patient complained of pain in the upper right quadrant of the abdomen , fever and jaundice .

On examination he had enlarged tender liver .

Questions :

1- **What is the causative parasite ?**

Fasciola

2- **What is the infective stage ?**

Encysted metacercaria on vegetables

3- **What is the mode of infection ?**

Ingestion of infective stage in contaminated vegetables and water drinks .

4- **What is the diagnostic stage ?**

Fasciola egg in stool

5- **What is the methods of control and prevention ?**

a. Good washing of vegetables before usage

b. Destruction of the snails

6- **What is the habitat is this parasite ?**

Biliary passages of the liver .

Case 2

Fisherman complained of severe diarrhea after eating bory and bolty .

Questions :

1- **What is the causative parasite ?**

Heterophyes heterophyes

2- **What is the infective stage ?**

Encysted metacercaria inside fish muscles

3- **What is the diagnostic stage ?**

Heterophys egg in stool

4- **What is the method of prevention ?**

Proper cooking and salting of fish (bory&bolty)

5- **What is the habitat of this parasite ?**

Small intestine of man , cats , dogs , birds .

Case . 3

A farmer complaining of painful urination and prescence of blood in his urine , by examination of this urine we found eggs with terminal spines .

Questions :

1- What is the causative parasite ?

Schistoma haematobium

2-What is the infective stage ?

Furcocercus cercaria

3- What is the mode of infection ?

Direct skin penetration by cercaria

4- What are the complications of this infection ?

Cystitis , stones

Cancer bladder

Hydroureter

Hydronephrosis , renal failure

5- What is the habitat of this parasite ?

Pelvic ,vesical venous plexuses surround urinary system , genital system

6- Mention the stages of its life cycle ?

Adults → Eggs → Miracidium → Sporocyst → Cercaria (No redia stage)

Case 4

A child complained of abdominal colic , hunger pain , weight loss , perianal itching and passing segments in stool .

Questions

1- **What is the causative organism ?**

Taenia saginata

2- **What is the infective stage ?**

Cysticercus bovis in beef

3- **What is the mode of infection ?**

Ingestion of infective stage in insufficiently cooked beef

4- **What is the diagnostic stage ?**

Eggs of taenia and gravid segments in stool

5- **What is the methods of prevention ?**

Good cooking of meat to kill the larvae .

Case 5

Child complained of pain in the right hypochondrium .

On examination , there was enlarged liver . Ultrasound showed huge cyst .

Questions :

1- **What is the causative organism ?**

Echinococcus granulosus causing Hydatid disease

2- **What is the infective stage ?**

Eggs of Echinococcus granulosus

3- **What is the mode of infection ?**

Ingestion of eggs in contaminated food or drink with dog faeces

4- **What are the common sites ?**

Liver , lung , brain

5- **What is the methods of prevention ?**

Avoid contamination of hands , food , drinks with dogs faeces .

Case 6

Child complaining od diarrhea and abdominal colic , by examination of his stool , there are eggs with 4 filaments in each pole .

Questions :

1- **What is the causative parasite ?**

Hymenolepis nana

2- **Habitat of the parasite**

Small intestine of man

3- **What is the method of infection ?**

Autoinfection

Contaminated foods and drinks .

4- **Infective stage**

Eggs

5- **Methods of prevention**

Good washing of hands

Treatment of cases

Washing of vegetables and pure water supply .

Case 7

Farmer complained of abdominal pain , allergy dyspepsia and pass worm about 20 cm length .-

Questions:

1- **What is the parasite ?**

Ascaris

2- **What is the infective stage ?**

Larvated egg

3- **What is the mode of infection ?**

Ingestion of infective stage in contaminated water and vegetables

4- **What is the diagnostic stages ?**

Eggs and adult worms

5- **What is the methods prevention ?**

Proper washing of hands and vegetables before eating

Pure water supply

Case 8

Child complained of itching around the anus especially at night and nervousness and nocturnal enuresis .

Questions :

1- **What is the parasite ?**
Enterobius(oxyuris)

2- **What is the infective stage ?**
Larvated egg

3- **What is the mode of infection ?**
Ingestion of infective stage in contaminated food and drink
Inhalation of infective stage
Autoinfection

4- **What is the diagnostic stage ?**
Egg and adult (1-2 cm) in stool .

5- **What is the methods of prevention ?** Personel hygiene (cutting nails - washing hands - good washing of clothes) .

Case 9

Patient suffering from severe anaemia , abdominal colic and by examination of the stool we find eggs with 4 cell embryo

1- **What is the causative parasite ?**

Ancylostoma duodenale

2- **What is the infective stage ?**

Filariform larva in soil

3- **What is the methods of infection ?**

Penetration of skin and mucus membrane

4- **Habitat**

Small intestine of man

5- **Methods of prevention**

Treatment of cases

Wearing shoes and gloves in the field .

Case 10

Man complained of edema and swelling of lower limbs , genitalia with thickened and rough skin .

Questions

1- **What is the parasite ?**

Filaria which cause elephantiasis

2- **What is the infective stage ?**

Filariform larva in mosquitoes

3- **What is the mode of infection ?**

Bite of female anopheles mosquito (culex)

4- **What is the diagnostic stage ?**

Microfilaria in blood

5- **What is the prevention ?**

Mosquitoes control via insecticides e.g : pyrosol and repellents

Treatment of cases

6- **Habitat**

Lymph nodes and lymphatics of lower limbs and genitalia .

Case 11

- Patient suffering from dysentery , Abdominal paian , by stool examination revealed mucus , blood and revealed quadri nucleated cysts.

1- What is the possible parasite ?

Entamoeba histolytica

2- Mention the infective stage ?

Mature quadri - nucleated cyst

3-What is the methods of transmission ?

Ingestion of contaminated food or water with eggs

Autoinfection

4- What is the methods of prevention , control ?

Avoid defecation on the ground

Control of flies

Personel hygiene

5- Mention the extra intestinal lesions ?

Liver and lung amoebic abscesses

Case 12

Woman suffered from vaginal discharge with burning sensation .

Questions :

1- **What is the parasite ?**
Trichomonas vaginalis

2- **What is the infective stage ?**
Trophozoite

3- **What is the mode of infection ?**
Sexual intercourse and contaminated under wears , WC seats .

4- **What is the diagnostic stage ?**
Trophozoite in vaginal discharge

5- **What is the prevention ?**
General good hygiene

6- **Habitat :** Urogenital system of female and males .

Case 13

Patient complained of fatty diarrhea and abdominal colic , by examination the stool we found oval quadrinucleated cysts .

Questions :

1- **What is the causative parasite ?**

Giardia lamblia

2- **Habitat :**

Small intestine of man (duodenum)

3- **Infective stage**

Quadrinucleated cyst

4- **Stages in life cycle**

Trophozoites and cysts

5- **Methods of prevention**

Washing of hands

Treatment of cases

Good washing of raw vegetables and drinking pure water .

Case 14

Patient complained of fever consist of cold stage (2 hours) and hot stage (4 hours) and sweating stage (2 hours)

Repeated every three days , on blood examination there is anaemia .

Questions

1- **What is the disease ?**
Malaria

2- **What is the infective stage ?**
Sporozoites by female anopheles

3- **What is the mode of infection ?**
By bite of female mosquitoes (female anopheles)

4- **What is the diagnostic stages ?**
Parasitic stages in blood sample

5- **What is the prevention ?**
Mosquitoes control via insecticides as pyrosol and repellents .

Case 15

Woman complained of repeated abortions and she had cat in her house .

Questions:

1- **What is the parasite ?**

Toxoplasma

2- **What is the infective stage ?**

Oocyst

3- **What is the mode of infection ?**

Contaminated food and drink with infected cat faeces

4- **What is the diagnosis ?**

Serum examination as ELISA and IHA

5- **What is the methods of prevention ?**

Periodic examination of cats , avoid contamination of food or drink with cat faeces .

Case 16

Soldier complains of severe itching especially at night associated with reddish skin and small vesicles at wrists and interdigital spaces .

Questions

1- **What is the causative parasite ?**

Sarcopetes scabii

2- **Habitat**

Under the skin

3- **What is the mode of infection ?**

Contact with infected persons or clothes

4- **What is the diagnosis?**

Depend on clinical picture.

5-**What is the methods of prevention ?**

Avoid contact with infected persons or his clothes and personnel cleanliness.

Case 16

Soldier complains of severe itching especially at night associated with reddish skin and small vesicles at wrists and interdigital spaces .

Questions

1- **What is the causative parasite ?**

Sarcopetes scabii

2- **Habitat**

Under the skin

3- **What is the mode of infection ?**

Contact with infected persons or clothes

4- **What is the diagnosis?**

Depend on clinical picture.

5-**What is the methods of prevention ?**

Avoid contact with infected persons or his clothes and personnel cleanliness.

collections

Parasites causing diarrhea and mention the infective stage , mode of infection and prevention in each parasite

1- Heterophyes
2- H.nana
3- Giardia
4- Entamoeba histolytica
5- Ancylostoma
6- Ascaris

Parasites causing dysentery , mention the infective stage , mode of infection

and prevention in each parasite ?

1- Schistosomamansoni
2- Entamoebahistolytica

Parasites causing fever and mention the infective stage , mode of infection , and prevention in each parasite

1- Malaria
2- Toxoplasma

Parasites causing haematuria , and mention the infective stage , mode of infection , and prevention in each parasite

Schistosoma haematobium

Parasites causing jaundice , and mention the infective stage , mode of infection , and prevention in each parasite ?

1- Fasciola
2- Malaria
3- Giardia
4- Schistosoma

Parasites causing dyspepsia , and mention the infective stage , mode of infection and prevention in each parasite

1- Ascaris
2- Ancylostoma
3- Hymenolepis nana

Parasites causing perianal itching , and mention the infective stage , mode of infection and prevention in each parasite :

Oxyuris

Parasites causing elephantiasis , and mention the infective stage , mode of infection , and prevention in each parasite :

Filaria

Parasites causing vaginal discharge and itching , mention the infective stage , mode of infection and prevention in each parasite :

1-Trichomonas vaginalis

2-Oxyuris

Parasites causing anaemia , and mention the infective stage , mode of infection and prevention in each parasite

1-Malaria

2-Ancylostoma

3-Schistosoma

Common questions.

Parasites causing diarrhea:

1-Heterophyes.
2-Hymenolepis nana.
3-Ascaris.
4-Ancylostoma.
5-Giardia.

Parasites causing dysentry:

1-Entamoeba histolytica.
2-Schistosoma mansoni.

Parasites causing Anaemia:

1-Schistosoma.
2-Ancylostoma.
3-Malaria.
4-Lieshmania.

Parasites causing abdominal colic:

1-Fasciola.
2-Heterophyes.
3-Schistosoma.
4-Taenia.
5-H.nana.
6-Ascaris.
7-Ancylostoma.
8-Giardia.
9-Entamoeba histolytica.

Parasites causing hepatosplenomegaly:

1-Schistosoma.
2-Malaria.
3-Amoeba.
4-Leishmania:

Parasites causing jaundice:

1-Fasciola.
2-giardia.
3-schistosoma.
4-Malaria.

Parasites found in the liver:

1-Fasciola gigantica.
2-Schistosoma mansoni.
3-Hydatid cyst.
4-Visceral larva migrans.
5-Entamoeba histolyica.
6- Malaria.
7-Leishmania donovani.
8-Trypansoma cruzi.
9-Toxoplasma gondii.

Parasites of the small intestine:

1-Ascaris.
2-Trichinella spiralis.
3-Ancylostoma.

Parasites of the large intestine:

1-Trichocephalus.
2-Enterobius(Oxyuris).
3-Entamoeba histolytica.
4-Plasmodium falciparum.

Parasites that may be acquired from servants in the houses:

1-E.histolytica.
2-Giardia.
3-Enterobius.
4-Hymenolepis nana.
5-Cysticercosis.
6-Sarcoptis scabiei.
7-Lice.