CHAPTER III. PARASITIC DISEASES

III.1 MALARIA

A. DEFINITION

Malaria is a febrile parasitic disease caused by the pathogenic action hematozoa of different species of the genus Plasmodium transmitted to humans through the bite of a mosquito vector; female Anopheles.

B. ETIOLOGY, TRANSMISSION AND PATHOGENESIS.

Four species of the genus Plasmodium are responsible for human malaria: These are **P. Falciparum**; the most prevalent agent of malaria, which kills, **P. vivax, P. ovale, and P. malariae.**

Only female mosquitoes feed on blood while male mosquitoes feed on plant nectar, thus males do not transmit the disease. The females of the *Anopheles* genus of mosquito prefer to feed at night. They usually start searching for a meal at dusk, and will continue throughout the night until taking a meal. Malaria parasites can also be transmitted by **blood transfusions,** although this is rare.

C.Life Cycle of the Malaria Parasite

The life cycle of malaria parasites in the human body. Malaria develops via two phases: an **exoerythrocytic and an erythrocytic phase**. The exoerythrocytic phase involves infection of the hepatic system, or liver, whereas the erythrocytic phase involves infection of the erythrocytes, or red blood cells. When an infected mosquito pierces a person's skin to take a blood meal, **sporozoites** in the mosquito's saliva enter the bloodstream and migrate to the **liver**. Within minutes of being introduced into the human host, the sporozoites infect **hepatocytes,** multiplying asexually and asymptomatically for a period of over 5-16 days*,.Once in the liver, these organisms differentiate to yield thousands of **merozoites**, which, following rupture of their host cells, escape into the blood and infect **red blood cells,** thus beginning the erythrocytic stage of the life cycle. Then, the merozoites infect red blood cells, where they develop into ring forms, **trophozoites and schizonts** which in turn produce further **merozoites** over 1-3 days*. . This asexual multiplication can result in thousands of parasite-infected cells in the host bloodstream, leading to illness and complications of malaria that can last for months if not treated.

Some of the merozoite-infected blood cells leave the cycle of asexual multiplication.Instead of replicating, the merozoites in these cells develop into sexual forms of the parasite, called **male and female gametocytes**, that circulate in the bloodstream which, if taken up by a mosquito, will infect the insect and continue the life cycle. When a mosquito bites an infected human, it ingests the

gametocytes. In the mosquito gut, the infected human blood cells burst, releasing **the gametocytes**, which develop further into mature sex cells called gametes. Male and female gametes fuse to form **diploid zygotes**, which develop into actively moving **ookinetes** that burrow into the mosquito midgut wall and form **oocysts.** Growth and division of each oocyst produces thousands of active haploid forms called **sporozoites.** After 8-15 days*, the oocyst bursts, releasing **sporozoites** into the body cavity of the mosquito, from which they travel to and invade the mosquito salivary glands. The cycle of human infection re-starts when the mosquito takes a blood meal, injecting the sporozoites from its salivary glands into the human bloodstream.

Some *P. vivax* and *P. ovale* sporozoites do not immediately develop into exoerythrocytic-phase merozoites, but instead produce **hypnozoites** that remain dormant for periods ranging from several months (6–12 months is typical) to as long as three years. After a period of dormancy, they reactivate and produce **merozoites. Hypnozoites** are responsible for long incubation and **late relapses** in these two species of malaria.

* Time-frame depends on the malaria parasite species.

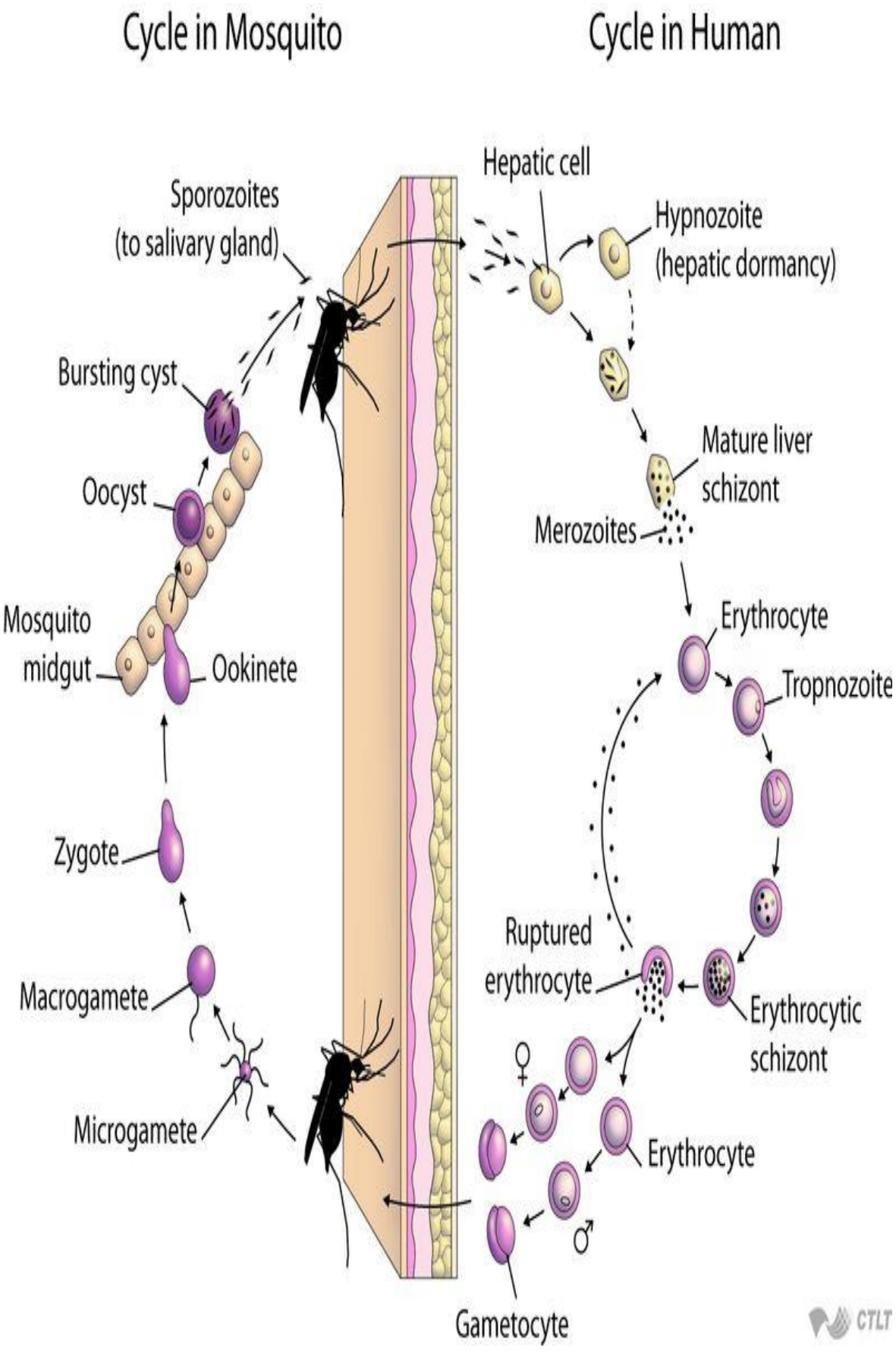
Glossary

Diploid: Cells containing a full set of chromosomes.
Gametes: Reproductive elements, male and female.
Gametocytes: Precursors of the sexual forms of the malaria parasite, which release either male or female gametes within the stomach of the mosquito.

Haploid: Cells containing a half set of chromosomes.
Merozoite: The form of the malaria parasite that invades red blood cells.
Oocyst: A stage of the malaria parasite within the mosquito which is produced when male and female gametes combine.
Ookinete: The actively moving zygote of the malarial organism that penetrates the mosquito stomach to form an oocyst under the outer gut lining.
Sporozoite: The infectious form of the malaria parasite, which is injected into people by mosquitoes.
Zygote: The diploid cell resulting from union of a male and a female gamete.

The fever in malaria occurs at the end of erythrocytic phase. During this phase the Merozoites lyse the RBCs and this hemolysis is accompanied by the release **of HEMOZOIN pigment** which directly goes and disturbs the HYPOTHALAMIC functioning and cause the occurrence of fever.

The erythrocytic phase occurs every 48 h in cases of P. falciparum, P. vivax and P. ovale and 72 h in case of P. malariae. Thus, P. falciparum, P. vivax and P. ovale are responsible for **Tertian fever** (fever occurring at every 3^{rd} day or after 2 days) and P. malariae is responsible for **quatarn fever** (fever occurring at every 4^{th} day or after 3 days). Then, the fever is **intermittent**(fever occurring at regular intervals).


Cycle in Mosquito
Cycle in Human
Hepatic cell
Sporozoites
(to salivary gland)
Hypnozoite
(hepatic dormancy)
Bursting cyst
Mature liver
schizont
Oocyst
Merozoites
Mosquito
midgut
Ookinete
Erythrocyte
Tropnozoite
Zygote
Ruptured
erythrocyte
Erythrocytic
schizont
Macrogamete
♀
Microgamete
Erythrocyte
♂
Gametocyte
CTLT

-Sexual cycle happens in mosquito and is called **SPOROGONY**

-Asexual cycle happens in human and is called **SCHIZOGONY**

D. PHYSIOPATHOLOGY

* The symptoms of malaria are directly or indirectly linked to the erythrocytic schizogonia, while hepatic schizogonia is asymptomatic. The severity of the clinical picture depends on the parasite species.

* Fever results from the release of pyogens (HEMOZOIN) during hemolysis.

*Pallor of the mucous membranes or anemia is due to lysis of red blood cells parasitized.

*Hepathomegaly and Splenomegaly occur after a certain period of evolution. This is related to macrophage hyperactivity (phagocytosis of residue of RBCs) and congestion of these organs.

*Severe forms of malaria are primarily due to P.falciparum which multiplies in the capillary vascular organs. These mechanical phenomena cause a slowdown in the local circulatory flow, plus the parasitized red blood cells lysis and release of cytokines by the activated macrophages. The result will be a circulatory anoxia, anemic and cytotoxic responsible for the suffering and the multi-organ failure, especially with cerebral coma and convulsions.

P.falciparum has a tropism to capillaries of deep organs, and its multiplication inside the erythrocytes of those organs create the thrombosis (capillary obstruction) and cause cellular anoxia.

E. CLINICAL FEATURES

According to clinical manifestations, malaria is classified into three forms:

- Simple malaria
- Simple malaria with minor digestive symptoms and.
- Severe malaria

1. Simple Malaria

The incubation varies according to plasmodial species. But generally it is about 15 days.

- **Onset or prodromal phase**: headache, anorexia, nausea, fatigue, arthralgia, lombalgia, myalgia, herpes labialis. These signs are the same for each patient. This phase lasts 1 to 2 hours, then suddenly occurs overwhelming phase.
- **Overwhelming phase**; access is done in 3 stages, easily identifiable Chills,-Fever-Sweating.

***STAGE CHILLS (cold stage);** Marked by feeling of cold with tremors throughout the body, slam of the teeth, the patient seeks coverage, vibrating bed by intense chills. The fever rises to 39^{o}C, and digestive signs may occur; nausea, vomiting and diarrhea. This stage lasts 1 to 2 hours.

***STAGE HEAT;** Shivering stops, the patient rejects blankets claimed earlier, the skin is dry and hot, the fever reaches 40^{o}C or more, the earlier signs are functional their maximum (headache , vomiting). The pulse is often rapid in connection with temperature and sometimes it is slower. The patient is thirst. This stage lasts 3 to 4 hours.

***STAGE OF PROFUSE SWEATING;** bathing the sick, the temperature suddenly collapses with a phase hypothermic (36.5^{o}C), BP rises, this stage lasts 2 to 4 hours. It is sometimes followed by a feeling of euphoria or well being.

This is an illness characterized by axillary temperature superior or equal to 37.5 °C (hot body) or history of fever in the last 24 hours with or without the following signs: headache, weakness, chills, loss of appetite, stiffness, joints pain and muscular pains.
Laboratory confirmation using either **a blood smear or a rapid test** is compulsory in all cases without exception; signs of severity and other illnesses must be looked for and excluded systematically.

In endemic areas of malaria, moderate pallor of the palms without an obvious cause in a pregnant woman and children under 5 years, or isolated splenomegaly in a child less than 5 years with history of fever oriente to clinical simple malaria.

2. Simple malaria with minor digestive symptoms

This is an illness characterized by signs of simple malaria where the patient presents also with vomiting that prevents oral medication, with or without associated moderate diarrhea.
The signs of gravity as well as other differential diagnosis must be excluded. The parasitological confirmation of plasmodium by either blood smear or rapid test is obligatory without any exception.

3. Severe malaria

Severe malaria is marked by the presence of severe signs. This form of malaria is an extremely emergency and requires hospitalization in a district or in reference hospital.
It is characterized by positive parasitaemia due to **plasmodium falciparum**, and the presence of **one or more** of the following signs of severity or danger signs:

Clinical signs (gravity signs of malaria)	**Frequency**	
	Children	**Adults**
Prostration (extreme weakness, failure to be upright or walk)	Very frequent	Very frequent

Altered level of consciousness (somnolence, unconsciousness or deep coma)	Very frequent	Very frequent
Respiratory distress (difficulties of respiration, rapid respiration)	Very frequent	Rare
Acute pulmonary oedema(radiological)	Rare	Rare
Repeated convulsions (≥ 2 convulsions in 24 hours)	Very frequent	Rare
Cardiovascular collapse or shock(weak pulse, cold extremities)	Rare	Rare
Spontaneous haemorrhages	Rare	Rare
Jaundice (yellow colouration of the conjunctival membranes)	Rare	Frequent
Heamoglobinuria (coca cola or dark urine)	Rare	Rare
Paraclinical signs	**Frequency**	
	Children	**Adults**
Severe anaemia (haemoglobin < 6 g/dl) ;	Very frequent	Rare
Hypoglycaemia (Blood glucose < 40 mg/dl)	Frequent	Rare
Renal failure (little or dark urine)	Rare	Frequent
Hyperparasitaemia (over 200 000 parasites/µl or over 5% RBC containing parasites);	Frequent	Rare
Acidosis(Ph <7.25)	Very frequent	Frequent

N.B. It may be possible to exist a case of severe malaria with negative blood smear due to P.falciparum's tropism to deep capillaries.

- **General danger signs for children are**;

-Incapacity of breastfeeding or drinking
-Vomiting every thing
-Convulsions
-Lethargy or unconsciousness

- **Vulnerable groups to severe malaria**

-Children less than 5 years old in highly endemic zones
-People in zones of low endemicity
-Pregnant women

-Patients with splenegtomy

- **Factors influencing the gravity of the disease**

-**Type of plasmodium**; P.falcipparum that causes severe malaria while also it is the commonly cause of simple malaria.
-Age; it is probable that very earlier infection during the first three months of life, where maternal antibodies are still protecting the infant, reduce the gravity of the disease for infants.
-Intensity of transmission; adults and old children in endemic zones of malaria are less sensible for severe malaria.
-Degree of drug resistance to paras

- **Complications of severe malaria**

  ***Anemia;** the more common complication
  ***Coma**
  ***Convalusions;** beyond 2 times/ day
  ***Hypoglycemia;** glycemia < 0,45g/l due to parasite and quinine therapy
  ***Hypovolemia**
  ***Respiratory difficulties:** APO (Acute Pulmonary Odema)
  ***Renal failure**

Severe malaria can have different forms:

- Severe malaria associated with anaemia;
- Cerebral Malaria;
- Evolutive viscera malaria
- Splenomegalic malaria

1. Cerebral malaria

It is due to P.falciparum. It occurs in young children between 4 months and 4 years, but it is described in adults who are not immunized, recently submitted to the malaria infection
The beginning is often progressive, following simple malaria non or poorly treated. It is the most sudden in a child in apparent good health. The overwheliming phase is reached in a few hours and involves fever(40^oC), neurological disorders (coma or convulsions, abnormal reflexes, meningeal signs).
Anemia is always present, sometimes jaundice, signs of pulmonary edema, cardiovascular collapse with hypothermia, signs of hypoglycemia, bleeding. It is a true medical emergency.

2. Evolutive viscera malaria

It is a chronic form observed for individual living in endemic zones and undergoing repeated infections with irregular and insufficient treatment and favourized by malnutrition. It is characterized by;

- Anemia sometimes intense
- Moderate Splenomegally for children between 2-5 years old
- Irregular fever
- Alteration of general state; asthenia, anorexia, weight loss

3. Splenomegalic form of malaria

This splenomegally is seen for some individuals who live in endemic zones of malaria. These people present abnormal immunological response to the infection caused by malaria. This abnormal immunological response results in;
- Splenomegally
-Hepatomegally
-Increasing of immunoglobuline in the blood (IgM, Anti-malaria)
-Increasing of lymphocytes

Symptoms;

* The presence of abdominal mass
*Abdominal pain (peri-splenic; due to inflammation of tissue surrounding the spleen)
*Anemia
*The lab doesn't show the presence of parasites in the blood

F. GUIDELINES FOR THE MANAGEMENT OF DIFFERENT FORMS OF MALARIA

1. Guidelines of management of simple malaria

***At family level**

Strengthening information, education and communication (IEC):

- Knowledge of the mode of transmission of malaria in Rwanda
- Utilization of long lasting insecticide treated nets (LLINs) as the principle means of prevention and utilization of other preventive measures
- Membership to the community health insurance scheme (mutuelle de sante) as means of ensuring earl access to health care
- Recognition by the family members of the signs of simple malaria, simple malaria with minor digestive symptoms and severe malaria;
- Seeking care in a timely manner from a community health worker or the nearest health facility, after reducing fever, if present by using sponging.

***At community level (Community health workers)**

The role of the community health worker is to:

- Sensitize the population on the mode of transmission of malaria in Rwanda;
- Sensitize the population on the recognition of the signs of the simple malaria, malaria with minor digestive symptoms and severe malaria;

- Sensitize the population on seeking care in a timely manner from a community health worker or the nearest health facility, after reducing fever, if present by using tepid sponging.
- Manage cases of children under five with malaria in accordance with the national guidelines after confirmation using a rapid diagnostic test (RDT), under the framework of CCM(community case management), and when necessary refer to a health facility
- Orient the population to the health facility for appropriate management;
- Sensitize the population to the use of the long lasting insecticide treated nets as principle means of prevention, environment hygiene and sanitation as well as other preventive measures;
- Participate in other malaria control activities at the community level such as indoor residual spraying campaigns, application of larvicides, etc;

***At the level of the health facility.**

It is indicated to prescribe the first line of treatment only after obtaining a positive blood smear or positive rapid diagnostic test. A negative blood smear or rapid diagnostic test excludes the diagnosis of malaria and the administration of an antimalarial. Another cause of the fever should be sought systematically and treated accordingly.
The first line treatment recommended is an artemisinin combination therapy (ACT) of 2 molecules in one tablet. That is: Artemether 20 mg and Lumefantrine 120 mg to be taken preferably during meals.
The combination of artemether – lumefantrine (COARTEM^{R}) is administered orally, twice a day for 3 days.

Important instructions to follow:
- Respect the dose prescribed by the health provider;
- Directly observe the administration of the first dose;
- Do not exceed the prescribed dose;

Table 1. Posology of artemether-lumefantrine (COARTEM^{R}) in function of body weight or age

Weight(kg)	**Age**	**Number of tablets/ intake**
5-14	3months-3years	**1**
15-24	3-8 years	**2**
25-34	9-14 years	**3**
>35	>14years	**4**

- Artemether-lumefantrine is contraindicated ;

  -In children weighing less than 5 kg;
  -During first trimester of pregnancy,
  -In case of allergy to one of the two drugs in the combination and
  - In cases of severe liver or renal disease.

In such cases, oral quinine sulphate is indicated as 10 mg per kg body weight per dose, taken three times a day over seven consecutive days.

Table 2. Posology of oral quinine in function of weight or age

Weight(kg)	**Age**	**N^{o} of tablets of 300mg/ intake**
<10	<1year	**¼ of tablet**
10-14	1-3years	**½ of tablet**
15-18	4-6years	**¾ of tablet**
19-30	7-11years	**1 tablet**
31-35	12-15years	**$1^{1/2}$ tablets**
>35	>15years	**2tablets**

N.B. If there is no improvement after 48 hours of treatment, verify if the patient swallowed the drugs correctly, re-examine the patient carefully and do another peripheral blood smear. If the test is positive, change the treatment to oral quinine sulphate as 10 mg per kg body weight per dose, taken three times a day over seven consecutive days. If the peripheral blood smear is negative, exclude and treat other causes of illness and/or refer the patient to the nearest district hospital;

If there is no improvement after 48 hours of treatment with quinine, refer the patient to the nearest District hospital because there is suspicion of other associated pathologies other than malaria.

1. Guidelines for the management of simple malaria with minor digestive symptoms

The minimum required criteria for treating simple malaria with minor digestive symptoms at a health facility are the following:

- Qualified and trained staff;
- The existence of a continuous system of clinical and para clinical monitoring of patients, 24 out of 24 hours ;
- A laboratory with the capacity to do a peripheral blood smear, rapid diagnostic tests and measure haemoglobin

The management of simple malaria with minor digestive symptoms is done at the health centre, or when not possible in the district hospital.
The patient must be admitted in the health centre where he/she will receive treatment for 24 hours maximum.

After this period, a clinical and paraclinical re-evaluation is done to assess if the patient can be discharged to go home (if there has been improvement and transition towards simple malaria), or be transferred to the district hospital (in cases where there has been no improvement)

- The recommended drugs are artemether IM or quinine IR or quinine in IV infusion if diarrhea is present

Modes of administration of the antimalarials

Depending on the general status and level of hydration of the patient, drugs may be administered as follows:

1. **Artesunate** in intramuscular or intravenous administration: for all patients, Artesunate 2,4mg/kg of body weight in IV or IM given at 0hour, then 12hours after the first dose and at 24hours, then once a day is the recommended treatment: duration is five days. If the patient's condition does not improve within 24hours of treatment, refer the patient to the nearest district hospital, if the condition improves change to oral Artemether-lumefantrine twice a day for three consecutive days.

   Attention: artesunate powder is diluted in 1ml 5% sodium bicarbonate (provided in the package), and then further diluted with 5ml of 5% glucose or 0,9% normal saline to a total volume of 6ml, making a final concentration of 10mg/ml. For IV injection.
   Artesunate powder is diluted in 1ml 5% sodium bicarbonate and then further diluted in 2ml of 5% of glucose or 0.9% normal saline to a total volume of 3ml making a final concentration of 20mg/ml. For IM injection.
   Prepare the dosage for the client after the preparation of the artesunate.
   Once reconstituted, the artesunate solution is not stable and should be administered within a half hour. .

If the patient's condition does not improve within 24h of treatment, refer the patient to the nearest district hospital. If the patient's condition improves, change to oral Artemether-lumefantrine twice a day for three consecutive days.

2. **Quinine dihydrochloride** IR (intra-rectal) for children: 15 mg par kg body weight diluted in 4 ml of distilled water or physiological solution and administered rectally with a 5 ml syringe every eight hours. This dose is justified by the slow absorption of quinine by the rectal mucosa. The drug is administered slowly through the anus, and the buttocks are held together for 5 minutes to prevent a premature reflex ejection of the drug. If the patient's condition does not improve after 24hours of treatment, refer the patient to the nearest hospital. If the patient's condition improves, change to oral Arthemether-Lumefantrine, twice a day for three consecutive days, or in the case of contraindications to Arthemether-Lumefantrine, gove oral quinine.

   Note:

- If the drug is ejected during the first 10 minutes following its administration, administer other half dose;
- Diarrhoea and anal lesions limit the use of this route of administration.

3**. Quinine dihydrochloride IV administration** (Children and adults):
In infusion; Administered as 10 mg per kg body weight per dose, diluted in 5 to 10 ml of 5% or 10% glucose per kg body weight, every eight hours. If the patient's condition does not improve within 24 hours of treatment, refer patient to the nearest district hospital. If the patient's condition improves, change to oral Arthemether-Lumefantrine, twice a day for three consecutive days, or to oral quinine in case of contraindications to Arthemether-Lumefantrine. .

NB: Whatever the medicine and the mode of administration used, (IM/IV artesunate, IR/IV quinine), if the state of health of the patient doesn't improve in 24 hours, do a rapid diagnostic test and refer the patient with the referral note or treatment file, giving detailed information on the treatment provided so far, to the nearest hospital.

Symptomatic treatment
In case of diarrhoea and/or vomiting:
- Evaluate and monitor the hydration status of the patient;
- Rehydrate the child with ORS or other available liquids, encourage breast feeding and other modes of feeding and if necessary use a naso-gastric tube;
- Anti emetics should be avoided.

In case of fever, give oral Paracetamol 15 mg/ kg, or any other antipyretic as may be indicated.

N.B. In case of pregnant woman with this type of malaria, the treatment is as follow;
1st trimester of pregnancy: -give **Quinine dihydrochloride** in infusion until she is able to take oral quinine and continue oral quinine to complete the totality of 7 days
2nd and 3rd trimester of pregnancy; give quinine IV infusion until she is able to take oral treatment and pass to oral COARTEM 4tablets twice a day in 3 days.

***Guidelines for the management of severe malaria**
The management of severe malaria must be done in either district hospital or the national referral hospital (private or public) as ordered by the ministry of health. The management of severe malaria should be done in either a district hospital or a national referral hospital (private or public) that meets the corresponding requirements of the Ministry of Health.

The minimum of required criteria are:

- Qualified staff, trained in the clinical management of malaria by Malaria Unit;
- The existence of a continuous system of 24 hours clinical and paraclinical follow-up of patients;
- A laboratory with the capacity to at least do:
  - peripheral blood smear,
  - hemoglobin and hematocrit,
  - blood sugar and

- proteinuria;

- Capacity to do a lumbar puncture, (recommended in cerebral malaria form);
- Possibility to transfuse in case of severe anaemia;
- Possibility to provide oxygen;
- Availability of the drugs and consumables required for the treatment of severe malaria (IV quinine, 50% and 5% glucose, phenobarbital, diazepam, antipyreticsand furosemide).

Pre-transfer treatment at the health centre

While preparing for the transfer of the patient, urgently administer Artesunate IM or IV (currently recommended) quinine IR or IV (IV infusion). Depending on the general condition of the patient (weak pulse or not, dehydration or none), the health centre staff will administer, either:

- Artesunate IM or IV: 2.4mg per kg body weight.
- Quinine, preferably by intravenous infusion as a loading dose of 20 mg per kg body weight to run in 4 hours (not exceeding a total dose of 1200 mg for the loading dose); or
- Quinine by intrarectal route in children; as 20mg per kg body weight diluted in 4ml of distilled water or physiological solution, administered with a 5 ml syringe without a needle. The drug is gently guided through the anus and the buttocks are held together for 5 minute to prevent the premature reflex expulsion of the drug. If the drug is expelled within the first 10 minutes following its administration, administration is repeated using half the original dose. Diarrhoea and anal lesion limit the use of this route for the administration of drugs

Note:

- Regardless of the pre-transfer treatment that is given (loading dose of Quinine or Artesunate), treatment with Quinine in intravenous infusion continues at a dose of 10 mg of quinine per kg body weight diluted in 10ml of 5% or 10% Glucose per kg body weight every 8 hours.
- For cerebral malaria, administer the first dose of antibiotics :
  - For children: Ampicillin 50 mg/kg body weight per dose, four times a day accompanied by chloramphenicol 25 mg/ kg body weight per dose, four times a day.
  - for adults: Ampicillin 1.5 g four times a day and chloramphenicol 1 g four times a day ;

The intramuscular use of Quinine is prohibited in all health facilities in Rwanda.

- In case of hypovolaemia (severe anemia, rapid breathing, coma or systolic BP < 80 mm Hg), start with normal saline or Ringer's lactate infusion in a dose of 20 ml/kg to run for 30 minutes to move the patient out of shock.
- For malnourished children (kwashiorkor or marasmas), give the loading dose of quinine in IV perfusion without fluid replacement (as it is difficult to ass hypovolaemia and dehydration, fluid replacement can increase the risk of circulatory overload).
- The administration of quinine in intravenous infusion is preferable in cases of signs of vital distress (repeated convulsions, coma. respiratory distress, and cardio-vascular shock). In the

case where it has been impossible to establish an intravenous line to administer quinine intravenously, use intra-rectal quinine

4.3.3. **Symptomatic treatment**

If the temperature is higher or equal to 38°C:

- Do sponging ;
- Give Paracetamol 15 mg /kg body weight by oral route or suppository form, or any other antipyretic that may be indicated.

To prevent hypoglycemia (characterized by lack of consciousness, severe weakness):

- Give 20-50 ml of 50% hypertonic serum of glucose by intravenous injection administered over 5-10 minutes in adults; and for children 3 ml/kg body weight of 10% glucose or if not available 1 ml/kg of 50% glucose;
- Or administration of water with 10% sugar per mouth or with nasogastric tube, at a rate of 5 ml/kg for children and 50 -100 ml for the adults;

Water with 10% sugar is readily prepared in the following way: take 100 ml of boiled clean water and add 10 g of sugar or 2 coffee spoons.

In case of convulsions:

- Administer Diazepam 0.5 mg/kg body weight Intra- Rectal for children and 10 mg slow IV for adults; and
- If convulsions persist, give Phenobarbitane 10-15 mg/kg IM;
- Treat or prevent hypoglycaemia;
- Treat the fever if necessary.

Refer the patient to the nearest district hospital or national reference hospital.

***Treatment of the severe malaria in the hospital**

In children and adults

Artesunate IM or IV 2.4mg per kg body weight, then management of the symptoms and complications.

Administer a loading dose of 20 mg/kg body weight of quinine dihydrochloride (do not exceed 1200 mg) diluted in an isotonic solution or 5 or 10% glucose on the basis of 5 to 10 ml/kg body weight to run for 4 hours in IV perfusion. Then run IV glucose 5 or 10% for 4 hours as maintenance drip. Thereafter, i.e. 8 hours after the beginning of the administration of the loading dose or 4 hours after the beginning of the maintenance drip, administer a maintenance dose of 10 mg/kg body weight of quinine dihydrochloride in infusion, to run for 4 hours. This maintenance dose of quinine will be repeated every 8 hours until the patient can swallow, at the most within 48 hours.

If after 48 hours, if the patient's state doesn't permit the patient to take quinine orally, one may continue the drip of quinine by reducing the doses to 7 mg/kg every 8 hours to run for 4 hours.

Change to oral quinine 10 mg/kg of quinine sulphate every 8 hours as soon as the patient can swallow; to complete the 7 days of treatment or oral Artemether 20 mg and Lumefantrine 120 mg, as recommended for the treatment of simple malaria.

NB:

- For the patient with over 60kg bodyweight give the loading dose, and decrease the dose from 1200mg to 800mg after divided in two doses for not to exceed 2000mg per day,
- The loading dose of quinine is not administered if the patient received quinine the past 12 hours or Mefloquine in the 7 past days.
- Never exceed 2 gm of daily dose of quinine.
- For the cerebral form of severe malaria (cerebral malaria or neurological malaria), , the association of IV antibiotherapy is recommended
    - Children: (Ampicillin 50 mg/kg /dose 4 times a day plus Chloramphenicol 25 mg/kg/dose 4 times a day)
    - Adults: (Ampicillin 1.5 g 4 times a day plus Chloramphenicol 1g 4 times day)
- For the anaemic form of severe malaria antibiotherapy is not indicated.
- The recommended dose for oral quinine is 10 mg Quinine salt per kg body weight every 8 hours for 7 days ;
- Syrup Quinine is not recommended

The management of complications

Hypovolaemia

Normal saline or Ringer's lactate 20 ml/kg to run for 30 minutes to stabilize the patient. For malnourished children (kwashiorkor or marasmus), give normal saline or Ringer's lactate 10 ml/kg plus 5 ml/kg of 5% glucose solution, This solution is given over an hour.

Hyperthermia

Administer oral Paracetamol 15 mg/kg body weight, 4 times per day or any other available antipyretic. Physical means, such as sponging, ventilation and wearing of light clothing are also recommended.

Convulsions

For children, diazepam 0.5 mg/kg is recommended. For repeated convulsions, Intramuscular Phenobarbital at a dose of 15 mg/kg for infants, 10 mg/kg for children and 5 mg/kg for adults is recommended.

Severe anaemia

Transfusion with packed cells is recommended, 10 ml/kg body weight to run for 2 hours for children. The height of the stand should be raised to increase the speed of flow. In case of lack of packed cells, transfuse with complete blood at a rate of 20 ml/kg body weight. For children with severe malnutrition, complete blood is preferable to correct anaemia, administered as 10 ml/kg body weight and it is recommended to prolong the transfusion for at least 3 hours.

Hypoglycaemia

Hypoglycaemia must be ruled out in all patients with severe malaria. It is defined as levels of blood sugar (< 2.5 mmol/l or 45 mg/dl) in a well fed child and < 40 mg/dl in adult: severe hypoglycaemia).

When measuring blood sugar is not possible, for children it is recommended to give 3 ml/kg of 10 % glucose or if not available, 1 ml/kg of 50 % glucose IV slow (over 5 minutes)

For adults in coma, a test dose of 20 ml of 50% dextrose by intravenous injection is administered over 5 minutes. Monitoring of the clinical status and blood sugar must continue even when the hypoglycaemia is corrected.
In order to prevent hypoglycaemia in children, it is advisable to maintain a drip of 5 ml/kg of 5% glucose or 3-4 ml/kg body weight of 10%, (between the two doses of quinine infusion).

Respiratory distress

In cases of respiratory distress, undertake the following measures:

- Clear the respiratory tract;
- Administer oxygen, 5 litres per minute continuously until the patient's respiratory status improves;
- Verify the level of hemoglobin and treat anaemia if necessary. Treat possible cardiac insufficiency or pulmonary oedema;
- If the respiratory distress persists , think about an associated infection, then it may necessitate to administer antibiotics:
    - If renal function is normal (urea and creatinine are normal) administer Ampicillin IV 75 mg/kg/dose 3x/day and IM Gentamycine, 7,5mg/kg body weight, once a day for 5 days;
    - If renal function is unknown, administer penicillin G IV 50 mg/kg/dose, 4 times a day and chloramphenicol 25 mg/kg/dose, 4 times a day for 5 days.

- In the immunocompromised adult with HIV whose respiratory distress persists, think about a lung infection due to Pneumocystis jiroveci (opportunistic infection) or pulmonary tuberculosis.

Coma

- Clear the respiratory airways;
- Put the patient in lateral decubitus position;
- Systematically administer quinine and antibiotics systematically (as shown below);
- If the peripheral blood smears (GE) and the rapid diagnostic test (RDT) are negative or if the coma persists after 48 hours, a lumbar puncture must be done again;
- For monitoring of a comatose patient:
    - Evaluate the level of coma regularly, at least twice a day;
    - Monitor blood sugar and treat accordingly;
    - Monitor temperature and treat accordingly;
    - Treat convulsions if any;
    - Put the patient in the lateral decubitus position;
    - Aspirate if necessary;

- Monitor the quantity of inputs and outputs (fluids);
- Change the position at least 4 times in 24 hours;
- Mark all these elements on the patient' s monitoring card/chart
-

Renal Insufficiency

It is important to monitor the daily diuresis in order to detect possible renal insufficiency in time. For children, the diuresis in this case is lower than 12ml / kg/24 hours. For the adults, it is lower than 400 ml/24 hours; blood creatinine is > 265 µmols (3mg/dl
It is recommended that this complication be managed in a national referral hospital.

Guidelines for the management of malaria in pregnant women

At the family level, at the community level
Strengthen IEC on:

- Knowledge of the mode of transmission of malaria in Rwanda
- Utilisation of long lasting insecticide treated mosquito nets as principle means of prevention and other preventive measures
- Membership to the community health insurance schemes (mutuelle) as a way of ensuring better access to care
- Recognition of the signs of simple malaria, simple malaria with minor digestive symptoms and severe malaria by the family members;
- Seeking timely care from the community health care worker or the nearest health facility after lowering fever, if any, using tepid sponging.

At the Community level (Health Animator)
The role of the community health worker is to educate the pregnant woman on:

- The mode of transmission of malaria (mosquito bite);
- The effects of malaria on pregnancy (on the mother and the baby)
- Recognition of the signs of the simple malaria, malaria with minor digestive symptoms and severe malaria, and the ill effects of fever during pregnancy;
- The benefits of sleeping under long lasting insecticide treated nets
- Destruction of breeding sites (stagnant water)
- Seeking health care from the health facility as soon as they feel signs of malaria
- The importance of taking all the drugs as prescribed by the health worker;
- The benefits of 4 ANC visits

At the level of the Health facility

To educate the pregnant woman on the preventive measures of malaria in pregnancy during the antenatal consultations:

- What causes malaria and its transmission;
- The effects of malaria on the mother and the baby;
- The advantages of sleeping under long lasting insecticide treated mosquito nets;

- The danger signs of severe malaria;
- The importance of seeking medical care when the symptoms of malaria present;
- The importance of taking a complete dose of antimalarials,
- The benefits of 4 ANC visits.

Antenatal care

During antenatal care, the health facility staff must do the following to the pregnant woman:

- Give her a long lasting insecticide treated mosquito net ;
- Give other components of antenatal care : vaccination, iron, vitamin A and Mebendazole ;
- Discuss with her the program of the ANC visits;
- Record on the ANC card, her ANC appointment card and the registers all the drugs prescribed and given as well as LLINs;
- Register all illness relate to the pregnancy in the ANC register.

The management of malaria

Simple malaria

Because Malaria during pregnancy can aggravate latent anaemia, it is recommended to do a complete clinical exam.

- The first line treatment of malaria in pregnancy is quinine sulphate per os 10 mg/kg/dose, 3 times a day for 7 days during the first trimester of pregnancy.
  COARTEM is indicated during the 2nd and 3rd trimesters of pregnancy

NB:

- In case of fever, administer paracetamol tablets, 500 mg three times per day;
- Directly observe the woman as she swallows the first dose of antimalarials;
- Respect the dose prescribed by the health provider ;
- Record all the information on the ANC card, ANC register and the hospitalization file;
- Give advice on the prevention of the malaria and the necessity to consult in time in case of illness;
- Recommend to the pregnant woman to come back any time if the symptoms persist and/or she develops signs of severe malaria.

Simple malaria with minor digestive symptoms

The symptomatology of this type of malaria is similar to the one described earlier in children and adults. The alteration of the general status can be accentuated by the vomiting and other symptoms related to the pregnancy.

Curative treatment

First trimester:

Administer Quinine dihydrochloride in intravenous infusion: 10 mg/kg/dose diluted in 10 ml of 5% or 10% glucose per kg, every eight hours until patient is able to take drugs orally making sure the treatment does not exceed 24 hours. Once the patient can take orally, complete the remaining quinine 3 X10 mg/kg/day to make 7 days by oral route of drug administration.

Second and third trimester

Depending on the general status and level of hydration of the patient, drugs may be administered as follows:

1. Artesunate IM or IV 2.4mg per kg body weight. If the patient's condition does not improve within 24 hours of treatment, refer patient to the nearest district hospital. If the patient's condition improves, change to oral Arthemether-Lumefantrine, twice a day for three consecutive days.

If the patient's condition does not improve within 24 of treatment, refer the patient to the nearest district hospital. If the patient's condition improves, change to oral Artemether-lumefantrine twice a day for three consecutive days.

2. Quinine dihydrochloride intravenous administration:

Administered as 10 mg per kg bodyweight per dose, diluted in 5 to 10 ml of 5% or 10% glucose per kg, every eight hours. If the patient's condition does not improve within 24 hours of treatment, refer patient to the nearest district hospital. If the patient's condition improves, change to oral Arthemether-Lumefantrine, twice a day for three consecutive days, or to oral quinine in case of contraindications to Arthemether-Lumefantrine. .

NB: Whatever the medicine and the mode of administration used, (IM/IV artesunate, IR/IV quinine infusion), if the state of health of the patient doesn't improve in 24 hours, do a rapid diagnostic test or blood smear and refer the patient with the referral note or treatment file, giving detailed information on the treatment provided so far, to the nearest hospital.

In this case of transfer, the loading dose won't be administered at hospital.

Symptomatic treatment

In case of diarrhoea or vomiting:

- Evaluate and monitor the state of hydration;
- Rehydrate with ORS or other available liquids and even introduce nasogastric tube if necessary ;
- Anti-emetics are not recommended.

In case of fever, administer paracetamol 15 mg/kg orally or any other antipyretic that may be indicated.

Severe malaria in the pregnant woman

At the health centre

- Severe malaria in the pregnant woman is characterized by the same signs as those described earlier for adults and children.
- While organizing an emergency transfer, administer Artesunate IM or IV 2.4mg per kg body weight or administer loading dose by intravenous infusion of quinine 20 mg/kg

body weight in 10 ml of 5% or 10 % dextrose per kg to run for 4 hours (without exceeding 1200 mg);
- It is important to do a complete clinical examination of the woman and to regularly check the vitality of the fœtus.

Symptomatic treatment

If the axillary temperature is ≥ 38°C, give paracetamol 500 mg 3 times per day if able to swallow, or any other antipyretic as may be indicated.
For the prevention of hypoglycaemia that may manifest as loss of consciousness, severe asthenia):

- Give 20-50 ml of 50 % of dextrose by intravenous injection to run for 5-10 minutes; or administer water with 10 % sugar orally or by NGT (50 -100 ml).
  Preparation of water with 10% sugar: To make 100 ml of water with 10% sugar: you take 100 ml of clean water and add to it 10 g (also equivalent to 2 teaspoons) of sugar.

In case of convulsions:

- Administer diazepam, 10 mg IV slow; and if convulsions persist, administer diazepam, 10 mg in 500 ml of 5 % glucose to run slowly.
- Treat or prevent hypoglycaemia;
- Treat the fever if necessary;
- Fill in the transfer card correctly and clearly,
- Record all the necessary information in the register and the ANC card;
- Refer the patient immediately to the nearest district or national reference hospital.

At the hospital
The treatment of severe malaria in pregnant women at the hospital level is the same as in others adults. Some complications are more frequent in pregnant women and require a particularly close monitoring. These include hypoglycaemia, respiratory distress (APO) and severe anaemia.
NB: It is important to do close obstetrical follow-up in general and monitoring of the fatal vitality in particular.

Choice of antimalarial drugs for the treatment of simple malaria with minor digestive symptoms

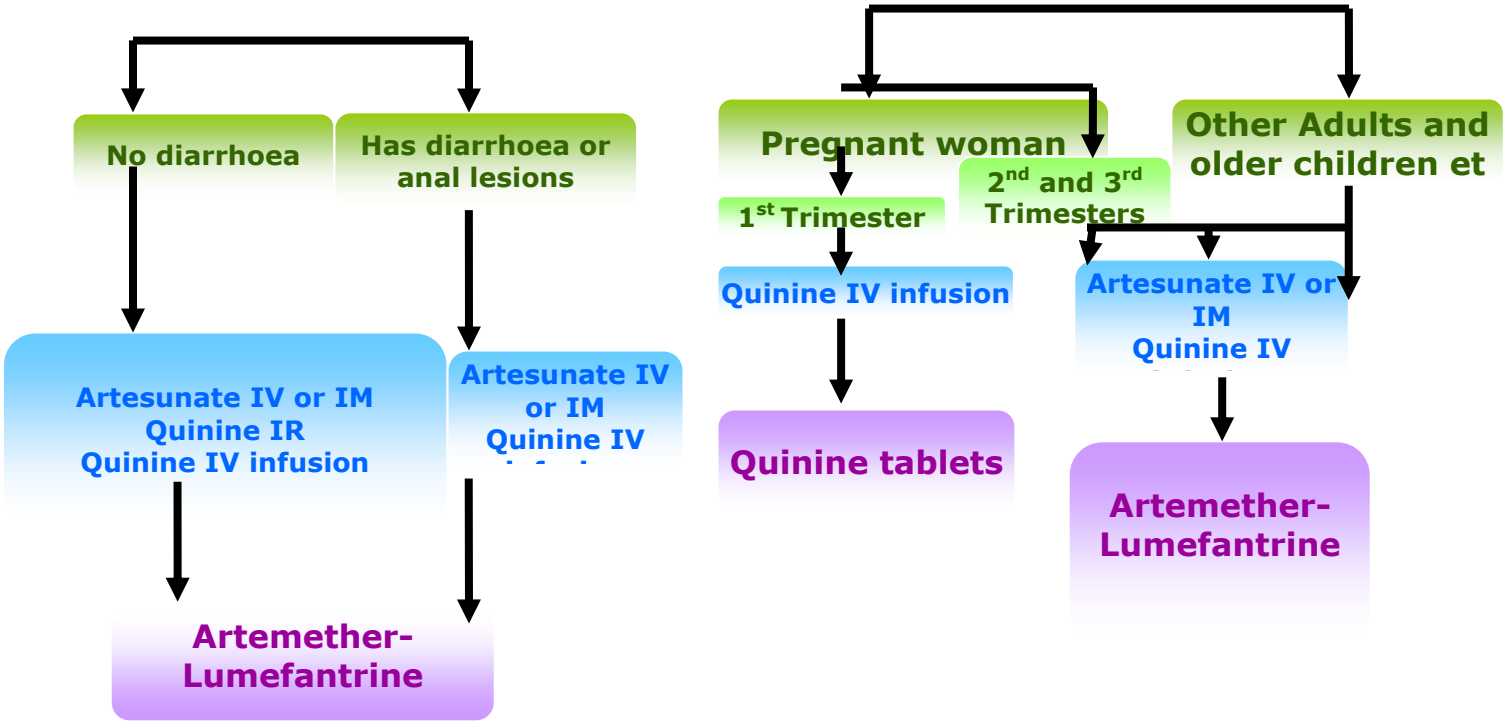
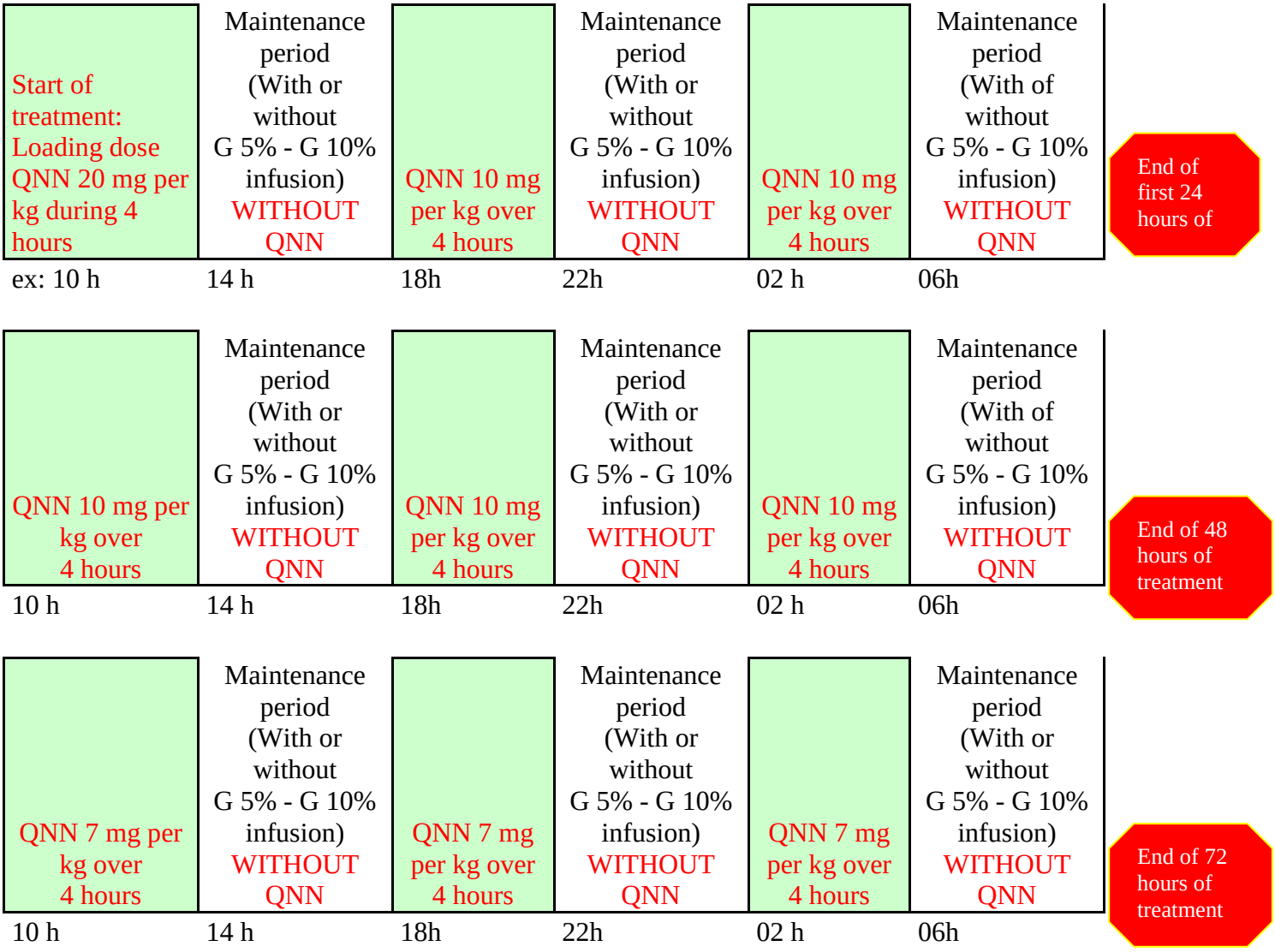

No diarrhoea
Has diarrhoea or anal lesions
Artesunate IV or IM
Quinine IR
Quinine IV infusion
Artesunate IV or IM
Quinine IV
Artemether-Lumefantrine
Pregnant woman
Other Adults and older children et
1st Trimester
2nd and 3rd Trimesters
Quinine IV infusion
Artesunate IV or IM
Quinine IV
Quinine tablets
Artemether-Lumefantrine

Diagram showing dosage of intravenous quinine in the treatment of severe malaria.



III.2. AMOEBIASIS

a. Definition

Amoebiasis is an infection with the intestinal protozoa ***Entamoeba histolytica***. About 90% of infections are asymptomatic, and the remaining 10% produce a spectrum of clinical syndromes ranging from dysentery to abscesses of the liver or other organs.

B.Epidemiology and transmission

The reservoir is a human and the parasite is eliminated through the faeces. The transmission is interhuman either directly by dirty hands or indirectly by water and food contaminated by the cysts. Lack of hygienic measures is an important factor and the role of flies must not be neglected. Infection is spread through ingestion of the **cyst** form of the parasite, a semi-dormant and hardy structure found in feces. Any non-encysted amoebae, **or *trophozoites***, die quickly after leaving the body but may also be present in stool: these are rarely the source of new infections. Amoebiasis results from infection with *E. histolytica* and is the third most common cause of death from parasitic disease (after schistosomiasis and malaria).

c.Pathogenesis

In asymptomatic infections the amoeba lives by eating and digesting bacteria and food particles in the gut. It does not usually come in contact with the intestine itself due to the protective layer of mucus that lines the gut. Disease occurs when amoeba comes in contact with the cells lining the intestine. It then secretes the same substances it uses to digest bacteria, which include **enzymes** that destroy **cell membranes** and **proteins.** This process can lead to penetration and digestion of human tissues, resulting first in flask-shaped ulcers in the intestine. ***Entamoeba histolytica*** ingests the destroyed cells by phagocytosis and is often seen with red blood cells inside when viewed in stool samples.

In about 10% of invasive cases the amoebae enter the blood stream. If the parasite reaches the blood stream it can spread through the body, most frequently ending up in the liver where it causes **amoebic liver abscesses. Liver abscesses** can occur without previous development of amoebic dysentery. When no symptoms are present, the infected individual is still a carrier, able to spread the parasite to others through poor hygienic practices

d.Clinical manifestations

* Intestinal Amoebiasis

Intestinal amoebiasis has 2 forms;

-Acute form=Amoebic dysentery;

Symptoms develop 2–6 weeks after the ingestion of infectious cysts.

Lower abdominal pain and mild diarrhea is followed by malaise, weight loss, and diffuse lower abdominal or back pain.

Patients may pass 10 to12 stools per day. The stools are less abundant but repeated and contain little fecal material and consist mainly of blood and mucus. (Crachats rectal), tenesmus

More fulminant intestinal infection, with severe abdominal pain, high fever, and profuse diarrhea, is rare and occurs predominantly in children.

Diagnosis; Direct exam of the fresh stool to search for hematophage amoeba

-Chronic form (colitis)

Patients may develop a chronic form of amoebic colitis, which can be confused with inflammatory bowel disease.

It is due to the presence of cysts in the colon. It is manifested by abdominal pain, alternance of diarrhea and constipation.

Complications;

- Digestive hemorrhage
- Intestinal perforation
- Amoebomas; parasitic tumor(mass) that lead to intestinal obstruction
- Tissue amoebiasis

Diagnosis; Direct exam of the stool (cysts can be seen)

***Hepatic amoebiasis (amoebic liver abscess)**

Extraintestinal infection by *E. histolytica* most often involves the liver.

-Most patients are **febrile** and have **right-upper-quadrant pain** and may radiate to the shoulder.

-Point tenderness over the liver.

-Hepathomegaly

-Jaundice is rare.

-Weight loss

N.B. For tissular amoebiasis, the diagnosis is done by detecting anti-amoebian antibodies.

For hepatic abscess; **ultrasonography** is also necessary

- **Complications of Amebic Liver Abscess**

*Pleuropulmonary involvement is the most frequent complication of amoebic liver abscess. Pulmonary amoebiasis can occur from hepatic lesion by haemotagenous spread and also by perforation of pleural cavity and lung. It can cause lung abscess, pulmono pleural fistula, empyema lung and broncho pleural fistula.

*Subdiaphragmatic abscess, perforation of diaphgram to pericardium and pleural cavity, perforation to abdominal cavital *(amoebic peritonitis)* and perforation of skin *(amoebic cutis).*

N.B. Other Extraintestinal Sites

*The genitourinary tract may become involved by direct extension of amoebiasis from the colon or by hematogenous spread of the infection. Urogenital tract amoebiasis derived from intestinal lesion can cause amoebic vulvovaginitis *(May's disease)*, rectovesicle fistula and rectovaginal fistula

*Cerebral involvement; It can also reach brain through blood vessel and cause amoebic brain abscess and amoebic meningoencephalitis. .

e.Treatment

Metronidazole (Flagyl) or tinidazole

Surgical drainage of liver abscess if necessary

Surgery should be reserved for instances of bowel perforation and rupture into the pericardium.

f.Prevention

To help prevent the spread of amoebiasis around the home :

- Wash hands thoroughly with soap and hot running water for at least 10 seconds after using the toilet or changing a baby's diaper, and before handling food.
- Clean bathrooms and toilets often; pay particular attention to toilet seats and taps.
- Avoid sharing towels.
- Early screening and treatment of carriers of the cysts

To help prevent infection:

- Avoid uncooked vegetables when in endemic areas, as they may have been fertilized using human feces.
- Boil water or treat with sur eau or iodine tablet.

- Avoid eating Street Foods especially in public places where others are sharing sauces in one container
- Avoid flies
- Use of latrines

III.3 GIARDIASIS (Lambriasis)

a.Definition and etiology

Giardiasis is one of the most common parasitic diseases in both developed and developing countries worldwide, causing both endemic and epidemic intestinal disease and diarrhea. It is caused by ***Giardia lamblia*** (also known as *G. intestinalis*) which is a cosmopolitan protozoal parasite that inhabits the small intestines of humans and other mammals.

b.Transmission

Transmission is by dirty hands, food and water contaminated by the cysts which are eliminated in faeces (Feco-oral)

c.Clinical Manifestations

Often asymptomatic.

Disease manifestations of giardiasis range from asymptomatic carriage to fulminant diarrhea and malabsorption.

Most infected persons are asymptomatic, but in epidemics the proportion of symptomatic cases may be higher.

Symptoms may develop suddenly or gradually. In persons with acute giardiasis, symptoms develop after an incubation period that lasts at least 5–6 days and usually 1–3 weeks.

Prominent early symptoms include diarrhea made of soft stool alternating with constipation or normal stools, abdominal pain or epigastric pain, bloating (swelling), nausea, and vomiting.

The duration of acute giardiasis is usually >1 week, although diarrhea often subsides.

d.Diagnosis

-Direct exam of the stool; it permit to identify the cysts or trophozoites

-Biopsy of intestinal wall

e.Treatment

Metronidazole (Flagyl) 500mg three times a day in 5-7 days for adults

Children; 30 mg/kg per os three times a day

OR Tinidazole 2 gr single dose for adults, Children 50mg/ kg

f.Prevention

*Although *Giardia* is extremely infectious, disease can be prevented by Consumption of noncontaminated food and water and by personal hygiene when caring for infected children.

*Hand washing

*Boiling or filtering potentially contaminated water

*Using latrines

III.4.ASCARIASIS

a. Definition; It is a parasitic disease caused by ***Ascaris lumbricoides***

Ascaris lumbricoides is the largest intestinal nematode parasite of humans. It inhabits in small intestines where it takes intestinal content as its food.Clinical disease arises from larva migration in the lungs or effects of the adult worms in the intestines.

b.Life Cycle

Adult worms live in the lumen of the small intestine (12 to 18 months). Mature female produces up to 240,000 eggs a day, which pass in the faeces and develop in external environment where they can also be ingested through food and water contaminated by the faeces. After ingestion, the larva in the developed egg is released in intestine, travels the intestinal wall and gains blood stream where it is disseminated to the liver, heart and to the pulmonary capillaries. The larva penetrates the alveolar wall, ascends the respiratory airways and reaches the pharynx where it is swallowed and invades again the intestine and becomes adult and produces the eggs which will be apparent in faeces.

c.Clinic

- The disease can be asymptomatic
- The migration of the larva through the lungs results in pulmonary symptomatology called; **LOEFFLER SYNDROME**.

This syndrome is the result of allergic reaction of the the lung and is manifested by cough, sometimes dyspnea or hemoptysia. Also characterized by radiologic signs and increased eosinophils in the blood.

- Abdominal pain, nausea, vomiting or diarrhea

d.Complications

The presence of the worms in the intestine can complicate in;

-**Intestinal occlusion**; due to a package(accumulation) of ascaris
-**Ascardian appendicitis**; due to migration of worms in the appendice
-**Pancreas inflammation**; due to engagement of worm in the pancreatic canal
-**Pertonitis** due to intestinal perforation

e.Diagnosis

- Adult worms can be seen in stool or in vomit
- Stool exam to search for eggs
- In severe cases , the larva are ejected in sputum (in case of pulmonary complication)

f.Treatment
-Mebendazol (Vermox) ; 100mg twice a day in 3 days for adults and children
Or Albendazol (Zentel) 400mg in a single dose
-Surgical intervention to treat complications caused by obstruction.

g.Prevention

***** Hand washing and food hygiene
*Latrines use
*Avoid the use of human faeces to fertilize vegetables.

III.5. HOOKWORM

a.Definition and cause

Hookworm is a parasitic intestinal infection. A disease resulting from infestation in the duodenum with **Ancylostoma duodenale or Necater americanus**.

b.Transmission; Both forms of hookworm disease are transmitted to humans through **direct skin penetration** (usually in the foot) by hookwonn larvae in soil contaminated with feces that contain hookworm ova. These ova develop into infectious larvae in 1 to 3 days.

c.Physiopathology

- The larvae attach to the cell surface of the mucosa of the small intestine. There, the larvae nourish the blood, causing minor bleeding from the wounds caused by their bite in the mucosa. This results in anemia.
- Other hand, the larvae secrete substances that destroy the RBCs (hemolysis).

- The larvae (immature form of the worm) penetrate the skin, where an **itchy rash** called **ground itch** may develop. This itchy rash consist what we call **preanemic phase of encylostomiasis**. The larvae migrate to the lungs via the bloodstream, enter the airways and cause coughing.

d.Life cycle of Hookworm

Infection of the host is by the larvae, not the eggs. While ***A. duodenale*** can be ingested, the usual method of infection is through the skin; this is commonly caused by walking barefoot through areas contaminated with fecal matter. The larvae are able to penetrate the skin of the foot, and once inside the body, they migrate through the vascular system to the lungs, and from there up the trachea, and are swallowed. They then pass down the esophagus and enter the digestive system, finishing their journey in the intestine, where the larvae mature into adult worms. The adult worms inhabit the intestine and produce eggs. The eggs are eliminated in the feces and embyonate in external environment to give the larvae. These, will undergo maturation and become infestant.

Once in the host gut, ***Necator*** tends to cause a prolonged infection, generally 1–5 years (many die within a year or two of infecting), though some adult worms have been recorded to live for 15 years or more. On the other hand, ***Ancylostoma*** adults are short lived, surviving on average for only about 6 months. However, infection can be prolonged because dormant larvae can be "recruited" sequentially from tissue "stores" over many years, to replace expired adult worms.

Infective larvae of ***Necator americanus*** can survive at higher temperatures, whereas those of ***Ancylostoma duodenale*** are better adapted to cooler climates. Generally, they live for only a few weeks at most under natural conditions, and die almost immediately on exposure to direct sunlight or desiccation

a. Clinic

-Sign due to skin penetration; Itching of the ground itch

-The migration of the larvae to the respiratory system causes the irritation of the airways that is manifested by **dry cough**

-Installation of adult worms in the digestive tract causes the inflammation of the duodenum that is manifested by epigastric pain, diarrhea (sometimes muco-purulent), nausea and vomiting.

-Anemia for prolonged infestation

e.Diagnosis

*Stool examination to search for the eggs

f.Treatment

* Albendazol

*Mebendazol

f.Prevention

-To prevent hookworm, do not walk barefoot or contact the soil with bare (exposed or uncovered) hands in areas where hookworm is common or there are likely to be feces in the soil or sand.

-Latrines use

-Don’t use human feces to fertilize

g.Complication

.-Anemia

-Pneumonitis

III.6 TRICHOMONIASIS

Trichomonas are human parasites and are divided in 3species; **Trichomonas intestinalis** (Trichomonas hominis), **Trichomonas vaginalis** and **Trichomonas tenax**. The 3 species are distinguished by their anatomical localization, their pathogenicity and their morphology.

The table summarizing different species of trichomonas

	TRICHOMONAS VAGINALIS	**TRICHOMONAS INTESTINALIS(HOMINIS)**	**TRICHOMONAS TENAX**
Brief description	Protozoa with flagella, cosmopolitan, vegetative form, 3 or 4 anterior flagella and 1 recurrent flagella, feed by osmosis, multiply by longitudinal division and move actively	Mobile protozoa with flagella, cosmopolitan, 3 to 5 free anterior flagella and 1recurrent flagella , vegetative form, multiply by binary division	Cosmopolitan parasite, the smallest one among 3 species, 4 anterior flagella and 1 recurrent flagella, vegetative form, also called trichomonas gingivalis or trichomonas of the mouth

Habitat	*__For female__ -Often in the vaginal cavity, urethra -Also in skene and bartholin gland *__For male__ -Urethra, sillon balanoprepucial, prostate ,..	* Large intestine (saprophyte of the colon)	Saprophyte of *Dental tartor *Cryptes amygdaliennes
Mode of transmission	*Sexual contact *Direct contact with contaminated objects; pants, towels, linen...	*Feco-oral	*Oral through saliva and droplet
Pathology to human	**Female;** vaginitis, leucorrhea(Discharge of white mucous material from the vagina), dyspareunia **Male**; very often asymptomatic	*Colitis *Sometimes diarrhea	*Gingivitis
Reservoir	Human	Human	Human
Laboratory exam	**Female**; vaginal swab, uretral drop, ECBU **Male;** urethral drop	Direct exam of the stool	Sample from the gum (gencive)

- **TREATMENT**

  METRONIDAZOLE (Flagyl) or TINIDAZOLE

III.7 SCHISTOSOMIASIS OR BILHARZIASIS

DEFINITION

Schistosomiasis or Bilharziasis, widespread disease caused by the infestation of the human body by (flukes) commonly called blood flukes, of the genus *Schistosoma.*

AETIOLOGY

Three species produce serious diseases. These are ***S. hematobium, S. mansoni,*** **and** ***S. japonicum****,* found in the Tropics and in the Orient. About eight other species are known to produce irritations of the skin, commonly called swimmer's itch, of bathers in the lakes of the north-central U.S., especially Michigan and Wisconsin, and of Canada, especially Manitoba. Only those species that produce serious disease are described here.

TRANSMISSION AND PATHOGENESIS

The Egyptian blood fluke, *S. hematobium,* was first described by the German physician **Theodor Bilharz** in 1851. The cercariae of the Egyptian blood fluke pierce the skin or mucous membranes when a human bathes in infested water.Eventually the flukes reach the venules and capillaries of the bladder. They mate and deposit eggs that, acting as foreign proteins, give rise to a severe inflammatory reaction in the walls of the bladder and find their way to the interior of the bladder; during their course, hemorrhages are produced, causing **bloody urine** and **pain** during urination. Eggs can be found in the urine on microscopic examination. The rectal blood fluke, *S. mansoni,* and the Japanese blood fluke, *S. japonicum,* concentrate in the blood vessels of the large intestine and liver. Some are carried up the portal veins to the liver where they cause inflammation and scarring, with enlargement of liver and spleen. Because of obstruction to blood flow through the liver, enlargement of veins ensues, particularly in the esophagus (esophageal varices). These veins often rupture, causing serious **hemorrhage**.Untreated schistosomiasis often results in death.

Clinical features of schistosomiasis

Symptoms
Hematuria, painful and frequency of micturition for s.heamatobium
Referred pain to hinder part for s.haem.
Cardiac disturbances and mental weakness
Abdominal pain for s. Mansoni and s. japonicum
affection of anus and rectum for s. Manson and s. japonicum
Diarrhea and sanguinous stools for Mansoni and japonicum

DIAGNOSIS

Urine and stool examinations

TREATMENT

Praziquantel (*BIltricide) is the drud of choice.* PRAZIQUANTEL is active against all schistosomal species. The current recommendation is 2 Oral Doses of 40 mg/kg in 1 day for either *S. haematobium* or *S. mansoni*. Surgery when the treatment unresponsive for s.heamatobium.

PREVENTION

The first line of attack is preventive, including proper sanitation and extermination of snails.

- **NB *URINARY SCHISTOSOMIASIS***

Is due to S . Haematobium worm pairs dwell principally in the perivesical venous plexus in humans and cause urinary schistosomiasis. There, they produce eggs which travel the urinary bladder wall to be found in the urine. *S. haematobium* has been a scourge of the Middle East and Africa for millennia and is still a major cause of disease and death in these areas.

PATHOGENESIS

Egg laying (oviposition) by adult *S. haematobium* normally occurs in vesical and pelvic venules; these vessels are tributaries of the caval system but are connected to the portal venous system through hemorrhoidal collateral vessels. They produce and deposit approximately 200 to 500 eggs per day. Thus, during its estimated mean life span of 3 to 6 years, a single worm pair spawns 250,000 to 600,000 eggs; moreover, occasional worm pairs may persist as long as 30 years. They mate and deposit eggs that, acting as foreign proteins, give rise to a severe inflammatory reaction in the walls of the bladder and find their way to the interior of the bladder; during their course, hemorrhages are produced, causing **bloody urine** and **pain** during urinationThe spectrum of serious disease ascribed to *S . haematobium* results from the interaction of 4 factors: intensity,duration, activity and focality

CLINICAL MANIFESTATIONS

Schistosomiasis haematobia progresses through 3 clinical stages:

*1.**Swimmers' itch*** (schistosomal dermatitis), which relates to cercarial skin penetration

2.**Acute schistosomiasis** (also known as Katayama fever), which relates to the onset of oviposition; hypogastric pain, pollakiuria, haematuria and pain when urinating (mictalgia)

3.**Chronic urinary** schistosomiasis.

*CHRONIC URINARY SCHISTOZOMIASIS

The infection enters a patient "active" stage, in which eggs are deposited in tissues, traverse the bladder or rectosigmoid mucosa, and are excreted in the urine (and less regularly in the feces). This prepatent period is usually 2 to 3 months but may last over 7 months. The classic clinical presentation of "active" schistosomiasis, *hematuria* and *terminal dysuria,* has been recognized for over 3000 years. After some years, egg deposition and excretion continue at a lower rate and symptoms are diminished. Over 30% of light infections "resolve" spontaneously in some endemic areas. However, although symptoms are absent, silent obstructive uropathy develops throughout this phase, as sandy patches and fibrosis replace polypoid patches and the bladder and ureters undergo irreversible damage. Patients finally enter a *chronic inactive* phase, in which *viable* eggs are no longer detected in urine or tissues. Signs and symptoms at this stage are caused by Sequelae & Complications rather than by the schistosomal infection itself. Inactive urinary schistosomiasis, which occurs after adult worms have died, is characterized by the absence of viable eggs in tissues or urine and the presence of "sandy patches"

DIAGNOSIS:-Urine exam to detect eggs

-Blood eosinophilie

COMPLICATIONS

Cystitis

Bladder ulcers

Bladder stones

Carcinoma of ureter

Contracted bladder.

- **INTESTINAL BILHARZIASIS:** It is caused by **Schistosoma mansoni and Schistosoma intercalatum.** Schistosoma mansoni live in mesenteric veins where they produce eggs. The eggs travel the intestinal wall and invade the intestinal lumen and faeces. Sometimes the eggs can reach the liver through blood circulation.

CLINIC: In state phase, there is

+Dysenteria

+Abdominal pain

+Diarrhea

+Hepatosplenomegally

+Cholecystitis

For Schistosoma intercalatum: they live in peri-rectal veins and can complicate in hepatosplenic bilharziasis which ressemble to hepatic cirrhosis.

COMPLICATIONS

- Intestinal obstruction
- Hematemesis; vomiting of blood
- Liver cirrhosis

DIAGNOSIS:

-Stool exam to detect eggs

-Sometimes the biopsy of the rectum serves to the diagnosis

III.8 TRYPANOSOMIASIS

INTRODUCTION AND EPIDEMIOLOGY

Trypanosomiasis, also sleeping sickness, endemic, and sometimes epidemic, chronic disease caused by a protozoan blood parasite, genus *Trypanosoma.* In cattle and other animals, which serve as the reservoir for the protozoa, the disease is called nagana. Two variations of the disease occur in central and western Africa, both of them transmitted in the salivary glands of infected tsetse flies. The most common is caused by *T. brucei gambiense,* whereas a more local version is caused by *T. brucei rhodesiense.* In South America, another version of the protozoan, *T. cruzi,* is transmitted by the triatoma bug and is called Chagas' disease.

The disease is found in two forms, depending on the parasite, either *Trypanosoma brucei gambiense* or *Trypanosoma brucei rhodesiense*. Humans are the main reservoir for *Trypanosoma brucei gambiense*, but this species can also be found in pigs and other animals. Wild game animals and cattle are the main reservoir of *T. b. rhodesiense*. *T. b. gambiense* is found in central and western Africa; it causes a chronic condition that can remain in a passive phase for months or years before symptoms emerge. *T. b. rhodesiense* is the acute form of the disease, but has a much more limited geographic range. It is found in southern and eastern Africa and symptoms of infection emerges in a few weeks and is more virulent and faster developing than *T. b. gambiense*. According to recent estimates, the disability adjusted life years (9 to 10 years) lost due to sleeping sickness are 2.0 million. Recent estimates indicate that over 60 million people living in some 250 locations are at risk of contracting the disease, and there were under 10,000 cases reported in 2009 according to WHO figures which represents a huge decrease from the estimated 300,000 new cases in 1998. The disease has been recorded as occurring in 36 countries, all in sub-Saharan Africa. It is endemic in southeast Uganda and western Kenya, and killed more than 48,000 Africans in 2008.

Horse-flies (Tabanidae) and stable flies (Muscidae) possibly play a role in transmission of nagana (the animal form of sleeping sickness) and the human disease form.

Diseases caused by *Trypanosoma* spp. parasite

Trypanosoa species	Vertebrate host	vector	disease	Epidemiology
T.bruci bruci	Horses, pigs, cattle, rodents	Glossina spp.	Nagana	Tropical Africa
T.bruci gambiense	Human, monkeys, dogs,pigs,etc ..	Glossina spp.	Sleeping sikness	West Africa
T.bruci rhodesiense	Human,pigs.	Glossina spp.	Sleeping sikness	East Africa
T.crusi	Human, domestic & wild animal.	Reduviid bugs (*Triatoma rhodnius*)	Chagas' disease	South America
T.evansi	Horses, dogs.	Tabanus spp.	Surra	India, Africa, Australia, South and central America

III. 11.1 HUMAN AFRICAN TRYPANOSOMIASIS, SLEEPING SICKNESS, AFRICAN LETHARGY, OR CONGO TRYPANOSOMIASIS

DEFINITION

Human african trypanosomiasis is a parasitic disease of people and animals, caused by protozoa of the species *Trypanosoma brucei* and transmitted by the tsetse fly.

Four major epidemics have occurred in recent history: one from 1896–1906 primarily in Uganda and the Congo Basin, two epidemics in 1920 and 1970 in several African countries, and a recent 2008 epidemic in Uganda.

ETIOLOGY

The most common is caused by *T. brucei gambiense,* whereas a more local version is caused by *T. brucei rhodesiense.* It was identified in 1903 by David Bruce

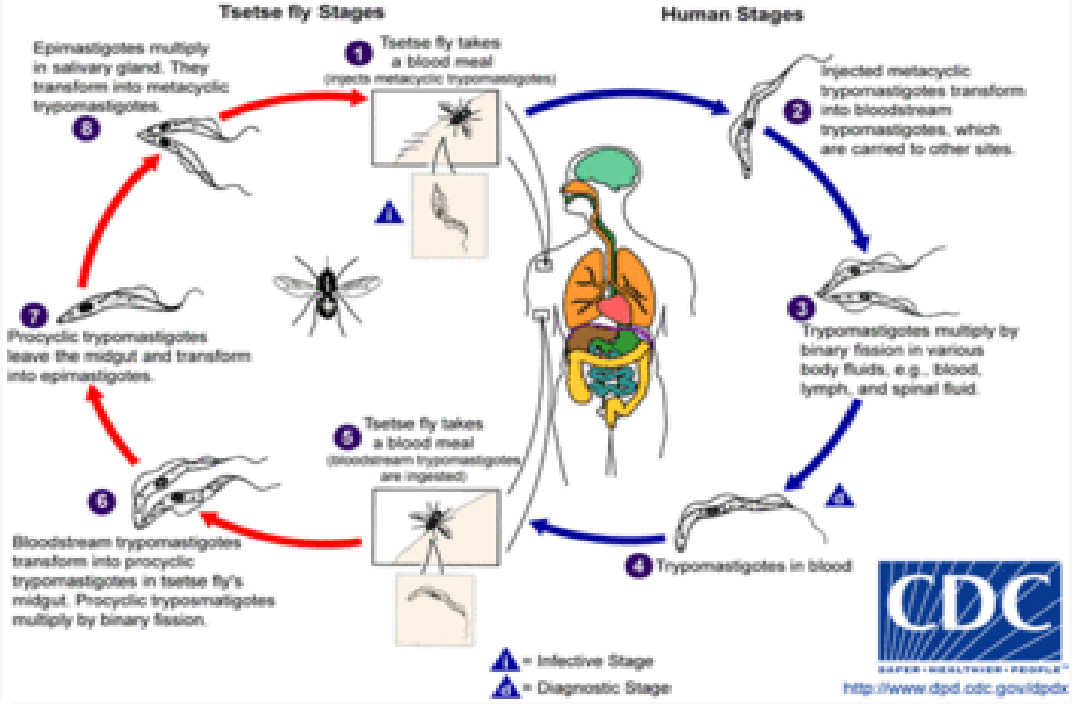
TRANSMISSION

In addition to the bite of the tsetse fly (of the genus glossina), the disease can be transmitted in the following ways:

- Mother to child infection: the trypanosome can sometimes cross the placenta and infect the fetus.
- Laboratories: accidental infections, for example, through the handling of blood of an infected person and organ transplantation, although this is uncommon.

- Blood transfusion
- Sexual contact (This may be possible)

TRYPANOSOMA LIFE CYCLE



Life cycle of the *Trypanosoma brucei* parasites. Source: CDC

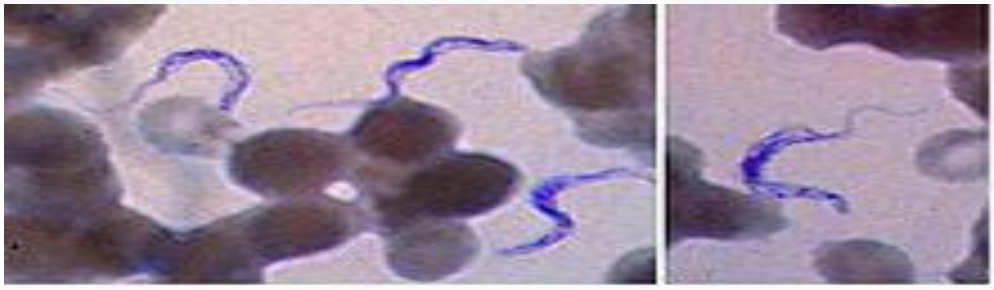
The tsetse fly (genus *Glossina*) is a large, brown biting fly that serves as both a host and vector for the Trypanosome parasites. While taking blood from a mammalian host, an infected tsetse fly injects metacyclic trypomastigotes into skin tissue. From the bite, parasites first enter the lymphatic system and then pass into the bloodstream. Inside the mammalian host, they transform into bloodstream trypomastigotes, and are carried to other sites throughout the body, reach other blood fluids (e.g., lymph, spinal fluid), and continue to replicate by binary fission.The entire life cycle of African trypanosomes is represented by extracellular stages. A tsetse fly becomes infected with bloodstream trypomastigotes when taking a blood meal on an infected mammalian host. In the fly's midgut, the parasites transform into procyclic trypomastigotes, multiply by binary fission, leave the midgut, and transform into epimastigotes. The epimastigotes reach the fly's salivary glands and continue multiplication by binary fission. The entire life cycle of the fly takes approximately 3 weeks.

SIGNS AND SYMPTOMS

African trypanosomiasis symptoms occur in two stages.

- **The first stage is known as the haemolymphatic phase** and is characterized by **fever, headaches, joint pains, and itching**. Invasion of the circulatory and lymphatic system by the parasites is associated with severe swelling of lymph nodes, often to tremendous sizes. **Winterbottom's sign**, the tell-tale swollen lymph nodes along the back of the neck, may appear. If left untreated, the disease overcomes the host's defenses and can cause more extensive damage, broadening symptoms to include anemia, endocrine, cardiac, and kidney dysfunctions.
- **The second stage, called the neurological phase**, begins when the parasite invades the central nervous system by passing through the blood-brain barrier. The term 'sleeping sickness' comes from the symptoms of the neurological phase. The symptoms include confusion, reduced coordination, and disruption of the sleep cycle, with short period of fatigue punctuated with manic periods leading to daytime slumber and night-time insomnia. Without treatment, the disease is invariably fatal, with progressive mental deterioration leading to coma and death. Damage caused in the neurological phase is irreversible. **Tryptophol** is a chemical compound that induces sleep in humans. It is produced by the trypanosomal parasite in sleeping sickness.

DIAGNOSIS



Two areas from a blood smear from a patient with African trypanosomiasis. Thin blood smear stained with Giemsa. Typical trypomastigote stages (the only stages found in patients). The two Trypanosoma brucei subspecies that cause human trypanosomiasis, T. b. gambiense and T. b. rhodesiense, are indistinguishable morphologically. The trypanosomes length range is 14 to 33 µm, Source: CDC

The gold standard for diagnosis is identification of trypanosomes in a patient sample by microscopic examination. Patient samples that can be used for diagnosis include chancre fluid, lymph node aspirates, blood, bone marrow, and, during the neurological stage, cerebrospinal fluid. Detection of trypanosome-specific antibodies can be used for diagnosis, but the sensitivity and specificity of these methods are too variable to be used alone for clinical diagnosis. Further, seroconversion occurs after the onset of clinical symptoms during a *T. b. rhodesiense* infection, and therefore is of limited diagnostic use.

TREATMENT

First line, first stage

The current standard treatment for first stage (haemolymphatic) disease is:

- Intravenous or intramuscular pentamidine (for *T.b. gambiense*); or
- Intravenous suramin (for *T.b. rhodesiense*)

According to a treatment study of Trypanosoma gambiense caused human African trypanosomiasis, use of eflornithine (DMFO) resulted in fewer adverse events than treatment with melarsoprol.

First line, second stage

The current standard treatment for second stage (neurological phase) disease is:

- Intravenous melarsoprol 2.2 mg/kg daily for 12 consecutive days.

Alternative first line therapies include:

- Intravenous melarsoprol 0.6 mg/kg on day 1, 1.2 mg/kg IV melarsoprol on day 2, and 1.2 mg/kg/day IV melarsoprol combined with oral 7.5 mg/kg nifurtimox twice a day on days 3 to 10; or
- Intravenous eflornithine 50 mg/kg every six hours for 14 days.[16]

PREVENTION

Two alternative strategies have been used in the attempts to reduce the African trypanosomiases. The primary method focuses on the eradication of the tsetse fly, which disrupts transmission rates by reducing the number of flies. Instances of sleeping sickness are being reduced by the use of the sterile insect technique. The second tactic is primarily medical or veterinary and tries to reduce spread of the parasite by monitoring, prophylaxis, treatment, and surveillance to reduce the number of people/animals that carry the disease

III.11.2 CHAGAS DISEASE OR AMERICAN TRYPANOSOMIASIS

DEFINITION AND ETIOLOGY

Chagas disease also called **American trypanosomiasis** is a tropical parasitic disease caused by the flagellate protozoan *Trypanosoma cruzi*. *T. cruzi* is commonly transmitted to humans and other mammals by an insect vector, the blood-sucking insects of the subfamily Triatominae (family Reduviidae) most commonly species belonging to the*Triatoma*, *Rhodnius*, and *Panstrongylus* genera. The disease was first identified by carlos chagas in 1909

TRANSMISSION

The disease is spread by insects but *T. cruzi* can also be transmitted through blood transfusions. With the exception of blood derivatives (such as fractionated antibodies), all blood components are infective. The parasite remains viable at 4 °C for at least 18 days or up to 250 days when kept at room temperature. It is unclear whether *T. cruzi* can be transmitted through frozen-thawed

blood components. Other modes of transmission include organ transplantation, through breast milk, and by accidental laboratory exposure. Chagas disease can also be spread congenitally (from a pregnant woman to her baby) through the placenta, and accounts for approximately 13% of stillborn deaths in parts of Brazil. In 1991, farm workers in the state of Paraíba, Brazil, were infected by eating contaminated food; transmission has also occurred via contaminated açaí palm fruit juice and sugar cane juice. A 2007 outbreak in 103 Venezuelan school children was attributed to contaminated guava juice.

The insects that spread the disease are known by various local names, including *vinchuca* in Argentina, Bolivia, Chile and Paraguay, *barbeiro* (the barber) in Brazil, *pito* in Colombia, *chinche* in Central America, *chipo* in Venezuela, *chupança,chinchorro*, and "the kissing bug".

Rhodnius prolixus is the principal vector in Colombia, Venezuela, Guatemala, Honduras and some parts of Nicaragua and El Salvador.

PATHOGENESIS

In Chagas-endemic areas, the main mode of transmission is through an insect vector called a triatomine bug. A triatomine becomes infected with *T. cruzi* by feeding on the blood of an infected person or animal. During the day, triatomines hide in crevices in the walls and roofs. The bugs emerge at night, when the inhabitants are sleeping. Because they tend to feed on people's faces, triatomine bugs are also known as "kissing bugs." After they bite and ingest blood, they defecate on the person. Triatomines pass *T. cruzi* parasites (called trypomastigotes) in feces left near the site of the bite wound. Scratching the site of the bite causes the trypomastigotes to enter the host through the wound, or through intact mucous membranes, such as the conjunctiva. Once inside the host, the trypomastigotes invade cells, where they differentiate into intracellular amastigotes. The amastigotes multiply by binary fission and differentiate into trypomastigotes, which are then released into the bloodstream. This cycle is repeated in each newly infected cell. Replication resumes only when the parasites enter another cell or are ingested by another vector.

SIGNS AND SYMPTOMS

The human disease occurs in two stages: **An acute stage**, which occurs shortly after an initial infection, and **a chronic stage** that develops over many years.

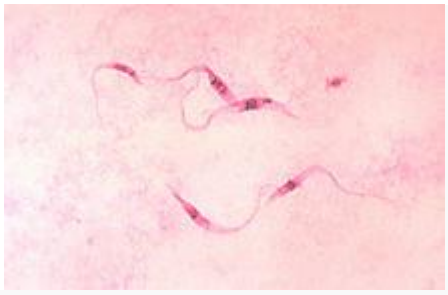
The acute phase lasts for the first few weeks or months of infection. It usually occurs unnoticed because it is symptom free or exhibits only mild symptoms that are not unique to Chagas disease. These can include fever, fatigue, body aches, headache, rash, loss of appetite, diarrhea, and vomiting. The signs on physical examination can include mild enlargement of the liver or spleen, swollen glands, and local swelling **(a chagoma)** where the parasite entered the body. The most recognized marker of acute Chagas disease is called **Romaña's sign**, which includes swelling of the eyelids on the side of the face near the bite wound or where the bug feces were deposited or accidentally rubbed into the eye. Rarely, young children, or adults may die from the acute disease due to severe inflammation/infection of the heart muscle (myocarditis) or brain (meningoencephalitis). The acute phase also can be severe in people with weakened immune systems.

If symptoms develop during the acute phase, they usually resolve spontaneously within 3–8 weeks in approximately 90% of individuals. Although the symptoms resolve, even with treatment the infection persists and enters a chronic phase. Of individuals with chronic Chagas disease, 60–80% will never develop symptoms (called *indeterminate* chronic Chagas disease), while the remaining 20–40% will develop life-threatening heart and/or digestive disorders during their lifetime (called *determinate* chronic Chagas disease). In 10% of individuals the disease progresses directly from the acute form to a symptomatic clinical form of chronic Chagas disease.

The symptomatic (determinate) chronic stage affects the nervous system, digestive system and heart. About two thirds of people with chronic symptoms have cardiac damage, including dilated cardiomyopathy, which causes heart rhythm abnormalities and may result in sudden death. About one third of patients go on to develop digestive system damage, resulting in dilation of the digestive tract (megacolon and megaesophagus), accompanied by severe weight loss. Swallowing difficulties (secondary achalasia) may be the first symptom of digestive disturbances and may lead to malnutrition. Twenty to fifty percent of individuals with intestinal involvement also exhibit cardiac involvement. Up to 10% of chronically infected individuals develop neuritis that results in altered tendon reflexes and sensory impairment. Isolated cases exhibit central nervous system involvement, including dementia, confusion, chronic encephalopathyand sensitivity and motor deficits.

The clinical manifestations of Chagas disease are due to cell death in the target tissues that occurs during the infective cycle, by sequentially inducing an inflammatory response, cellular lesions, and fibrosis. For example, intracellular amastigotes destroy the intramural neurons of the autonomic nervous system in the intestine and heart, leading to megaintestine and heart aneurysms, respectively. If left untreated, Chagas disease can be fatal, in most cases due to heart muscle damage.

DIAGNOSIS



Photomicrograph of Giemsa-stained*Trypanosoma cruzi* (CDC)

The presence of *T. cruzi* is diagnostic of Chagas disease. It can be detected by microscopic examination of fresh anticoagulated blood, or its buffy coat, for motile parasites; or by preparation of thin and thick blood smears stained with Giemsa, for direct visualization of parasites. Microscopically, *T. cruzi* can be confused with *Trypanosoma rangeli*, which is not known to be pathogenic in humans. Immunoassay tests include: detecting complement fixation, indirect hemagglutination, indirect fluorescence assays, radioimmunoassays, and ELISA. Alternatively, diagnosis and strain identification can be made using polymerase chain reaction (PCR).

PREVENTION

There is currently no vaccine against Chagas disease and prevention is generally focused on fighting the vector *Triatoma* by using sprays and paints containing insecticides (synthetic pyrethroids), and improving housing and sanitary conditions in rural areas. For urban dwellers, spending vacations and camping out in the wilderness or sleeping at hostels or dirt houses in endemic areas can be dangerous; a mosquito net is recommended. Some stepstones of vector control include:

Blood transfusion was formerly the second most common mode of transmission for Chagas disease, but the development and implementation of blood bankscreening tests has dramatically reduced this risk in the last decade

TREATMENT

There are two approaches to treating Chagas disease, antiparasitic treatment, to kill the parasite; and symptomatic treatment, to manage the symptoms and signs of infection.

Medication

Antiparasitic treatment is most effective early in the course of infection, but is not limited to cases in the acute phase. Drugs of choice include azole or nitro derivatives such as benznidazole or nifurtimox. Both agents are limited in their capacity to effect parasitologic cure (a complete elimination of *T. cruzi* from the body), especially in chronically infected patients, and resistance to these drugs has been reported

Treatment of chronic infection in women prior to or during pregnancy does not appear to reduce the probability the disease will be passed on to the infant. Likewise, it is unclear whether prophylactic treatment of chronic infection is beneficial in persons who will undergo

immunosuppression (for example,, organ transplant recipients) or in persons who are already immunosuppressed (for example,, those with HIV infection).

COMPLICATIONS

In the chronic stage, treatment involves managing the clinical manifestations of the disease. For example, pacemakers and medications for irregular heartbeats, such as the anti-arrhythmia drug amiodarone, may be life saving for some patients with **chronic cardiac disease**, while surgery may be required for **megaintestine**. The disease cannot be cured in this phase, however. **Chronic heart disease** caused by Chagas disease is now a common reason for heart transplantation surgery. Until recently, however, Chagas disease was considered a contraindication for the procedure, since the heart damage could reocccur as the parasite was expected to seize the opportunity provided by the immunosuppression that follows surgery.

III.9 TAPEWORM OR "TAENIASIS"

DEFINITION:

Teniasis; Pork tapeworm; Beef tapeworm; Tapeworm; is tapeworm infection

ETIOLOGY

Tapeworm infection is caused by eating the raw or undercooked meat of infected animals. Beef generally carry *Taenia saginata* (*T. saginata*). Pigs carry *Taenia solium (T. solium)* from the cestodes. Cestodes include the following:

- ***Taenia solium***
- ***Taenia saginata***
- *Taenia asiatica*
- *Diphyllobothrium*
- *Hymenolepis*
- *Dipylidium caninum*
- ***Echinococcus***
- *Spirometra*
- *Taenia multiceps*

The following figure shows cestodes and their hosts;

Cestode	**Primary Host**	**Intermediate Host**
T solium	**Humans**	**Pigs, humans, dogs, cats, sheep**
T saginata	**Humans**	**Cattle**

Diphyllobothrium	**Humans**	**Fish**
Hymenolepis	**Humans**	***Hymenolepis nana*: None; *Hymenolepis diminuta*: Rodents**
D caninum	**Humans, dogs, cats**	**Fleas on dogs/cats**
Echinococcus	**Dogs**	**Humans, sheep, cattle, goats, horses, camel**
Spirometra	**Humans**	
T multiceps		**Hares, rabbits, squirrels, humans (rarely)**

TRANSMISSION

Tapeworms have many segments. Each segment is able to produce eggs. Eggs are spread individually or in groups, and can pass out with the stool or through the anus. Adults and children with pork tapeworm can infect themselves if they have poor hygiene. They can ingest eggs from tapeworm they pick up on their hands while wiping or scratching their anus or the surrounding skin. Those who are infected can expose other people to *T. solium* eggs, usually through food handling.

RISK FACTORS

Factors that may put you at greater risk of tapeworm infection include:

- **Poor hygiene.** Infrequent washing and bathing increases the risk of accidental transfer of contaminated matter to your mouth.
- **Exposure to livestock.** This is especially problematic in areas where human and animal feces are not disposed of properly.
- **Frequent travel to developing countries.** Infection occurs more frequently in areas with poor sanitation practices.
- **Eating raw or undercooked meats.** Improper cooking may fail to kill tapeworm eggs and larvae contained in contaminated pork or beef.

PATHOGENESIS

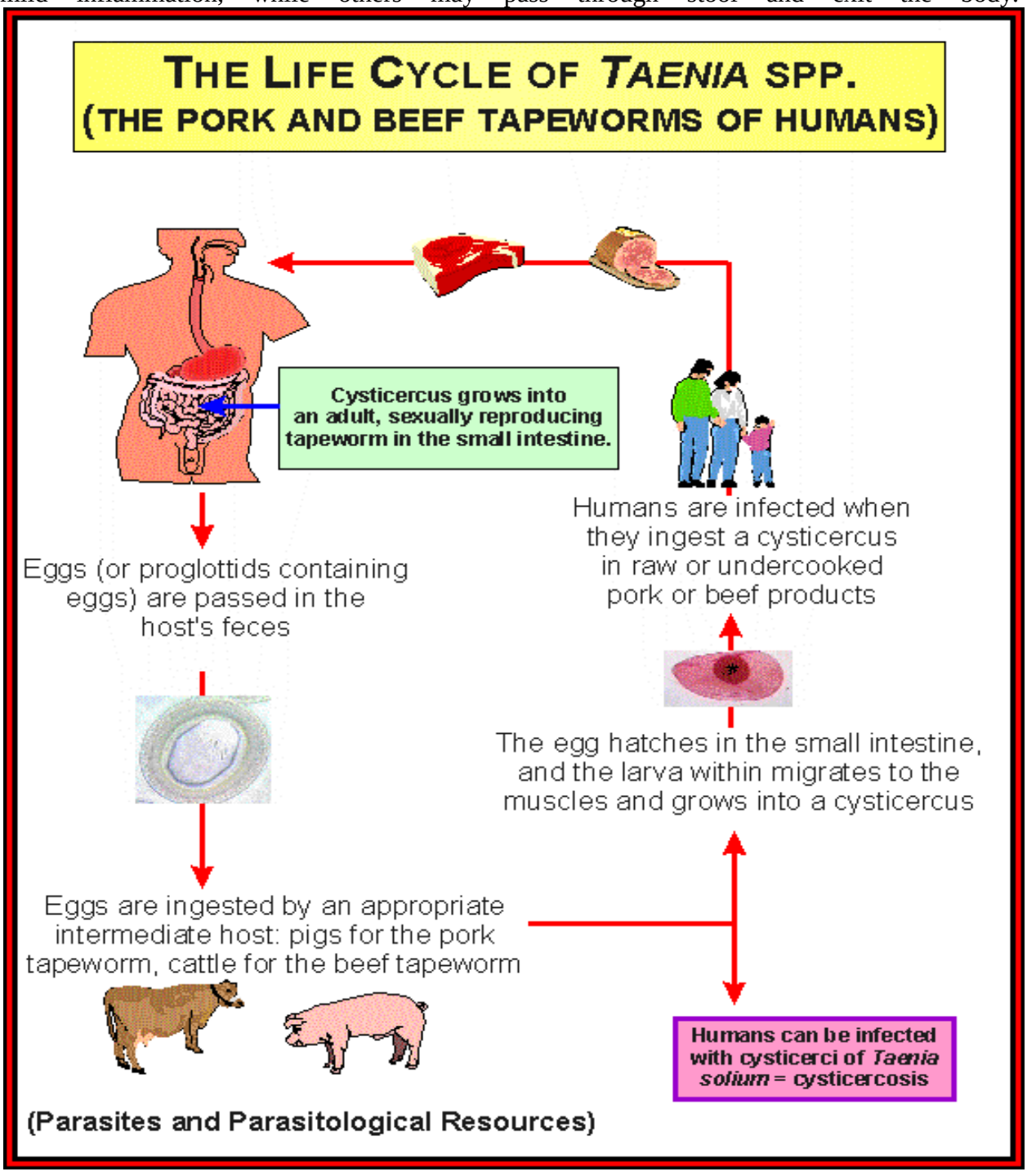
In most cestode infestations (ie, *T solium*, *T saginata*, *Diphyllobothrium*species, *Hymenolepis* species, and *D caninum*), humans are the primary hosts. Adult worms survive inside their human hosts, where they are limited to the intestinal tract. Human fecal contamination of the environment is needed to sustain these life cycles. In the

remaining cestodes (ie, *Echinococcus* species, *Spirometra* species, and *T multiceps*), humans function as the intermediate hosts. Larvae exist within the tissues and migrate through different organ systems. *Hymenolepis* species and *T solium* are the only cestodes for which humans can function as both primary hosts and intermediate hosts. *Hymenolepis diminuta* is primarily a cestode of rodents, although humans can be a rare and accidental hosts in the life cycle. Humans are infected by swallowing insects that contain cysticercoid larvae, most often by ingesting mealworms or grain beetles that infest dried grains, cereals, flour, and dried fruit. A tapeworm infection starts after ingestion of tapeworm eggs or larvae.

- **Ingestion of eggs.** If you eat food or drink water contaminated with feces from a person or animal with tapeworm, you are ingesting microscopic tapeworm eggs. For example, a pig infected with tapeworm will pass tapeworm eggs in its feces, which gets into the soil. If this same soil comes in contact with a food or water source, it becomes contaminated. You can then be infected when you eat or drink something from the contaminated source. Once inside your intestine, the eggs develop into larvae. At this stage, the larvae become mobile. If they migrate out of your intestines, they form cysts in other tissues such as your lungs or liver. Invasive tapeworm infection is more common with pork tapeworm than with the other kinds.
- **Ingestion of larvae cysts in meat or muscle tissue.** When an animal has a tapeworm infection, it has tapeworm larvae in its muscle tissue. If you eat raw or undercooked meat from an infected animal, you ingest the larvae, which then develop into adult tapeworms in your intestines.

Adult tapeworms can measure up to 50 feet long and can survive as long as 20 years in a host. Some tapeworms attach themselves to the walls of the intestine, where they cause irritation or

mild inflammation, while others may pass through stool and exit the body.



PATHOPHYSIOLOGY

Tissue cysticerci develop over a period of three to eight weeks following ingestion of T. solium eggs shed in the stool of a human tapeworm carrier. Cysticerci can develop at one or multiple sites; during the initial viable phase, cysticerci do not cause much inflammation in surrounding

tissues. This phase of infection is usually asymptomatic and cysticerci typically remain in this stage for many years. Taenia parasites have sophisticated means of evading destruction, and a number of mechanisms for host immune tolerance have been postulated. Metacestodes elaborate a variety of substances, including taeniaestatin (a parasite serine proteinase inhibitor), paramyosin, sulfated polysaccharides, and secretory proteases, that inhibit or divert host inflammatory responses .Taeniaestatin may also interfere with lymphocyte proliferation and macrophage function, thereby inhibiting normal cellular immune defenses . Secreted proteases degrade host molecules including cytokines. In addition, humoral antibodies do not kill the mature metacestode.

Eventually (after a variable number of years) the cysts degenerate and lose their ability to modulate the host immune response.Host immune and inflammatory cells attack the cysticercus, which leads to the appearance of edema and/or contrast enhancement on imaging studies. This inflammatory response is associated with onset of seizures. Host inflammatory molecules such as Substance P may be key mediators of seizures

SYMPTOMS

Tapeworm infection usually does not cause any symptoms. People often realize they are infected when they pass segments of the worm in their stool, especially if the segments are moving. Invasive tapeworm infection symptoms vary depending on where the larvae have migrated.

Intestinal infection

Signs and symptoms of intestinal infection include:

- ✓ Nausea
- ✓ Weakness
- ✓ Loss of appetite
- ✓ Abdominal pain
- ✓ Diarrhea
- ✓ Weight loss and inadequate absorption of nutrients from food

Invasive infection

If tapeworm larvae have migrated out of your intestines and formed cysts in other tissues, they can eventually cause organ and tissue damage, resulting in:

- ✓ Seizures
- ✓ Fever
- ✓ Cystic masses or lumps

- ✓ Allergic reactions to the larvae
- ✓ Bacterial infections
- ✓ Neurological symptoms or seizures

COMPLICATIONS

The consequences of tapeworm infection can vary, depending on what species of tapeworm someone is infected with.

- ✓ **Intestinal infection complications**

  Generally, intestinal tapeworm infections have little or no complications. But if the tapeworms grow large enough, they **can block your bile duct, appendix or pancreatic duct**, causing problems for those organs.

- ✓ **Invasive infection complications**

  Invasive infections have a greater likelihood of developing complications, including:

  Brain and central nervous system impairment. Called neurocysticercosis, this especially dangerous complication of invasive pork tapeworm infection can result in headaches and visual impairment, as well as seizures, **meningitis, hydrocephalus or dementia**. Death can occur in severe cases of infection.

  Organ function disruption. When larvae migrate to tissues or organs in the body, they develop into lesions or cysts. Over time, they grow larger, and sometimes their size can disrupt organ function, or they can grow so large that they rupture. In other cases, cysts put pressure on nearby blood vessels, hindering circulation or causing **blood vessels to rupture**. Surgery or organ transplantation may be needed in severe cases.

DIAGNOSIS

- ✓ **Intestinal infections**

  When there is an intestinal tapeworm infection, eggs and sometimes tapeworm segments are passed in the stool, where they can be identified as a tapeworm infection. However, they are released irregularly and the segments may be broken down by the time they pass through the digestive system. A laboratory may use microscopic identification techniques to check for eggs or tapeworm segments in the feces.

- ✓ **Invasive infections**

  For tissue-invasive infections, test the blood for antibodies. Certain types of imaging, such as **CT or MRI scans, X-rays or ultrasounds of cysts**, also may suggest the diagnosis.

TREATMENT

Medications for intestinal tapeworm
The most common treatment for tapeworm infection involves oral medications that are toxic to the tapeworm. The drug of choice is ***niclozamide***(yomesan) ,praziquantel (Biltricide),and Albendazole (Albenza) are sometimes used

Treatments for invasive tapeworm infection
Treating an invasive infection depends on the location and effects of the infection.

- ✓ **Anthelmintic drugs.** Niclosamide , Albendazole (Albenza) can shrink some tapeworm cysts.
- ✓ **Anti-inflammatories.** If tapeworm cysts are causing swelling or inflammation in the tissues or organs, an anti-inflammatory medication can help.
- ✓ **Anti-epileptic therapy.** If the disease is causing seizures, anti-epileptic medications can stop them.
- ✓ **Shunt placement.** One type of invasive infection can cause too much fluid on the brain, called hydrocephalus. The doctor may recommend placing a permanent shunt, or tube, in the head to drain the fluid.
- ✓ **Surgery.** Whether cysts can be removed surgically depends on their location and symptoms. Those that develop in the liver, lungs and eyes are typically removed, since they can eventually threaten organ function.

PREVENTION
To prevent tapeworm infection:

- ✓ Wash hands with soap and water before eating or handling food and after using the toilet.
- ✓ When traveling in areas where tapeworm is more common, wash and cook all fruits and vegetables with safe water before eating.
- ✓ Eliminate livestock exposure to tapeworm eggs by properly disposing of animal and human feces.
- ✓ Thoroughly cook meat at temperatures of at least 125 F (52 C) to kill tapeworm eggs or larvae.
- ✓ Freeze meat for at least 12 hours and fish for at least 24 hours to kill tapeworm eggs and larvae.
- ✓ Avoid eating raw or undercooked pork, beef and fish.
- ✓ Promptly treat dogs infected with tapeworm.

III.10 FILARIASIS

a. Introduction

Filarial worms are nematodes that inhabit in the subcutaneous tissues and the lymphatics. Eight filarial species infect humans; of these, four ***Wuchereria bancrofti, Brugia malayi***, ***Onchocerca volvulus***, and ***Loa loa*** are responsible for most serious filarial infections. Filarial parasites are transmitted to human by certain **insects** (specific species of mosquitoes or other arthropods) and have a complex life cycle including infective larval stages carried by insects and adult worms that reside in either lymphatic or subcutaneous tissues of humans.

The Filariasis are classified into 2 groups according to the residence of adult worms(macrofilaria)

- **Lymphatic filariasis;** they are caused by

-Wuchereria bancrofti

-Brugia malayi

- **Dermic filariasis;** they are caused by

-Loa-loa

-Onchocerca volvulus

-Drancunculus medinensis

b.Characteristic of Filariae

Organism	**Periodicity**	**Distribution**	**Vector**	**Location of Adult**	**Microfilarial Location**
Wuchereria bancrofti	Nocturnal	Cosmopolitan areas worldwide, including South America and Africa	*Culex* (mosquitoes)	Lymphatic tissue	Blood
		Mainly India	*Anopheles* (mosquitoes)		
		China, Indonesia	*Aedes* (mosquitoes)		
Brugia malayi	Nocturnal	Southeast Asia, Indonesia.	*Mansonia*, *Anopheles*	Lymphatic tissue	Blood

		India	(mosquitoes)		
Loa loa	Diurnal	West and Central Africa	*Chrysops* (deerflies)	Subcutaneous tissue	Blood
Onchocerca volvulus	None	South and Central America, Africa	*Simulium* (blackflies)	Subcutaneous tissue	Skin, eye

c.Wuchereriasis or Lymphatic Filariasis of Bancrofti

-CLINIC; Clinical signs are due to the presence of live or dead adult worms in lymphatic vessels. This results in lymphatic stasis which is also accompanied by secondary infection.

Then the following will occur;

- Lymphangitis which is manifested by sensible and palpable lymphatic cord, erythematous and hot, often accompanied by fever. This lymphangitis is frequent on lower limb. Later, lymphatic varices can occur
- Obstruction of lymphatic vessels (especially for lower limbs and genital organs) often results in **lymphoedema.** This lymphoedema is localized at the level of subcutaneous tissue and causes a firm edema which becomes chronic and creates **elephantiasis.** The edema can creates **hydrocele** which contains a liquid in which the microfilariae can be identified. Deep lymphatic vessels obstruction often leads to **ascitis.**
- The rupture of lymphatic vessels in urinary tract leads to **lymphuria**

N.B. ELEPHANTIASIS; is the thickening of the skin and tissue, its frequent localization is ; lower limbs and genital organs (scrotum for males, labia majora for females)

-DIAGNOSIS

*** Nocturnal blood smear** because the microfilaria have nocturnal blood periodicity (22h00 to 2h00)

*Examine fluids from hydrocele and ascite

*Hypereosinophilia

*Identification of antifilarian antibodies

d.Loasis

It is caused by Loa-loa. The adults worms actively circulate in subcutaneous tissues

-CLINIC

- **Oedema of Calabar**;are subcutaneous oedema, itchy and migrate
- **Intense itching**; resulting in lesions due to scratching
- **Superficial migration of adult worm** which can be seen where the mucus is less adherent and where the adipose tissue is reduced, especially at the conjunctiva (conjonctive bulbaire). There is irritation of the conjunctiva but without causing blindness

-Complications;
*** Cardiac and ocular**; they are benign
***Neurologic**; in form of filarian encephalopathy with the presence of microfilaria in CSF. This complication is very severe. It can also happen as allergic accident during the treatment due to abrupt lysis of microfilaria in case of intense microfilaremia.

-DIAGNOSIS

* Diurnal blood smear because the microfilaria have diurnal blood periodicity

*Hypereosinophilia

e. Onchocerciasis

Onchocerciasis is caused by the filarial nematode ***O. volvulus***, which infects an estimated 13 million individuals.Onchocerciasis is the second leading cause of infectious blindness worldwide.

Onchocerciasis primarily affects the skin, eyes, and lymph nodes.

-Clinical Features

The adult worms live in subcutaneous tissue where they form the nodules.

*Skin; Pruritus and rash are the most frequent manifestations of onchocerciasis. The pruritus can be debilitating; the rash is typically a papular eruption that is generalized rather than localized to a particular region of the body.

*Superficial subcutaneous nodules **(Onchocercomata);** These are subcutaneous nodules, which

can be palpable and/or visible, contain the adult worm. Nodules tend to develop preferentially in the upper part of the body (at the thorax) and can also be localized at the pubic symphysis.

*Ocular lesions; they occur very late but they make the gravity of the disease because they lead to **decreased visual acuity** and finally to **blindness.** The reason why onchocericiasis is called [**river blindness**]. The disease is transmitted by small black flies called **SIMULIUM** which live near the rivers.

*Lymph Nodes; Mild to moderate lymphadenopathy is common, particularly in the inguinal and femoral areas, where the enlarged nodes may hang down in response to gravity ("hanging groin").

*Systemic Manifestations; Some heavily infected individuals develop cachexia with loss of adipose tissue and muscle mass.

-Diagnosis

Definitive diagnosis depends on the detection of an adult worm in an **excised nodule** or, more commonly, of microfilariae in **a skin snip (**dans le suc dermique).

Eosinophilia and elevated serum IgE levels are common but, because they occur in many parasitic infections, are not diagnostic in themselve.

*TREATMENT OF FILARIASIS

-Old drug; DIETHYL CARBAMAZINE or Carbilazine

-Actual drug; IVERMECTINE (Mectizan); a single dose

-Associate also with; a corticoide or antihistamine

*PREVENTION AND CONTROL

-Avoidance of mosquito bites. Impregnated bednets have a salutary effect.

-DIETHYL CARBAMAZINE (DEC) can kill developing forms of filarial parasites and is useful as a prophylactic agent in humans.

-Community-based intervention is the current approach to elimination of lymphatic filariasis as a public health problem: Mass annual distribution of antimicrofilarial chemotherapy by albendazole with either DEC or ivermectin

-Community education and clinical care for persons already suffering from the chronic sequelae of lymphatic filariasis are important components of filariasis control and elimination

III. 11 TRICHURIASIS

a.Etiology

It is caused by ***Trichuris trichiura***

Most infections with the *Trichuris trichiura* are asymptomatic, but heavy infections may cause gastrointestinal symptoms. Like the other soil-transmitted helminths, whipworm is distributed globally in the tropics and subtropics and is most common among poor children from resource-poor regions of the world.

The adults worms live in coecum and produce eggs that can be seen in faeces. These eggs embryonate in external environment and contaminate water and food in which they can be ingested with.

b. Life Cycle

Adult *Trichuris* worms reside in the colon and coecum. Thousands of eggs laid daily by adult female worms pass with the feces and mature or embryonate in the soil and contaminate water and food in which they can be ingested with. After ingestion, infective eggs hatch in the duodenum, releasing larvae that mature before migrating to the large bowel. The entire cycle takes 3 months, and adult worms may live for several years.

c. Clinical Features

Most infected individuals have no symptoms or eosinophilia.

-Heavy infections may result in abdominal pain, anorexia, and bloody or mucoid diarrhea resembling inflammatory bowel disease.

-Rectal prolapse can result from massive infections in children, who often suffer from malnourishment and other diarrheal illnesses.

-Moderately heavy *Trichuris* burden also contribute to growth retardation.

d. Diagnosis

Direct exam of the stool; Trichuris* eggs are readily detected on stool examination.

*Adult worms are occasionally seen on proctoscopy.

e. Treatment

-**Albendazole (ZENTEL);** 400mg as a single dose

-**Vermox** 100mg; 1tablet twice a day/ 3days

f. Prevention

-Use of latrines -Early detection and treatment

-Hand, food and water hygiene

III.12 ENTEROBIASIS (PINWORM) OR OXYUROSIS

a.Etiology

It is caused by the worm called oxyure or **Enterobius vermicularis**. The adults worms (males and females) live in small intestines where they fertilize. Fertilized females migrate to

the rectum and during the night they come and fix to the skin around the anus where they produce eggs. These eggs are infectious and permit immediate auto-infestation by hands. They are resistant to external environment.

b.Life Cycle and Epidemiology

Enterobius adult worms are 1 cm long and inhabit in the coecum. Gravid female worms migrate nocturnally into the perianal region and release up to 10,000 immature eggs each. The eggs become infective within hours and are transmitted by hand-to-mouth passage. From ingested eggs, larvae hatch and mature into adults. This life cycle takes 1 month, and adult worms survive for 2 months. Self-infection results from perianal scratching and transport of infective eggs on the hands or under the nails to the mouth. Because of the ease of person-to-person spread, pinworm infections are common among family members.

c.Clinical Features

Most pinworm infections are asymptomatic and often attack children

-Perianal pruritus is the cardinal symptom.

The itching, which is often worse at night as a result of the nocturnal migration of the female worms, may lead to excoriation and bacterial surinfection.

-Heavy infections have been claimed to cause abdominal pain, intermittent diarrhea and weight loss.

-On rare occasions, pinworms invade the female genital tract, causing vulvovaginitis.

d.Diagnosis

- Since pinworm eggs are not released in feces. Eggs are detected by the application of clear cellulose acetate tape to the perianal region in the morning. After the tape is transferred to a slide, microscopic examination will detect pinworm eggs
- See the worm itself on the faeces (adult female worm was discovered in diarrheic stool)

N.B. The eggs are rare in the faeces.

e.Treatment

-**ALBENDAZOL (Zentel)** 400mg as a single dose

-**MEBENDAZOL(Vermox)** 100 mg

-Treatment of household members is advocated to eliminate asymptomatic reservoirs of potential reinfection.

f. Prevention

* Treat family members

*Repeat the treatment after 8 days

*Hand hygiene and hygiene of the bed sheets