



TEAM443
MICROBIOLOGY

Malaria

Dr. Mona & Dr. Ibrahim



Objectives

NO objectives were found

Better for your eye:

- ○ = Male slides
- ○ = Female slides



Video from Dr. Mona

Any future corrections will be in the editing file, so please check it frequently

Color Index:

Main text

Important

Doctor Notes

Males slide

Females slide

Extra



Malaria

Introduction	<ul style="list-style-type: none">● Malaria is a life threatening disease.● It is the most important of all tropical parasitic disease; causes death and debility.● Malaria is a Mosquito-borne febrile disease caused by Malaria parasites● Malaria (in Italians Mal means bad and aria means air) is a protozoal infection caused by genus Plasmodium, a wide spread of sporozoans that parasites affect the human liver and red blood cells
Epidemiology	<ul style="list-style-type: none">● It is endemic in several parts of the world (throughout the tropics & subtropics)● The African Region contributes most malaria cases (93%) followed by south east Asia(3.4%), & the Eastern Mediterranean region 2%.
Transmission	<ul style="list-style-type: none">● Humans are infected with Plasmodium protozoa ★ via the bite of a infected female Anopheles mosquito vector, which occurs mainly between dusk and dawn. The mosquito will release anticoagulant substance to keep sucking your blood● Other rare mechanisms for transmission include: congenitally acquired disease, blood transfusion, sharing of contaminated needles, organ transplantation and nosocomial transmission. very rare

Main symptoms & sign may appear within weeks to months or even years



*Periodic fever



Anorexia

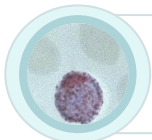


Anemia

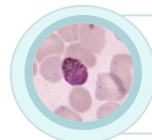


Headache

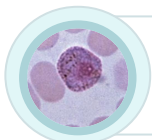
Five species of malaria infect human:



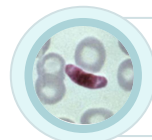
Plasmodium ovale
(★Relapse, Tertian)



Plasmodium malariae
(Quartan)



Plasmodium vivax
(★Relapse, Tertian)

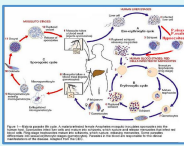



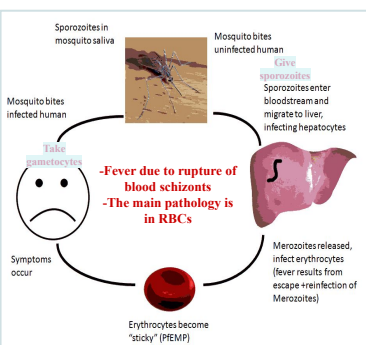
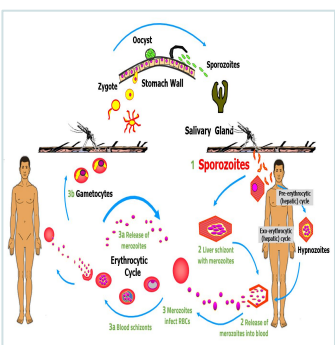
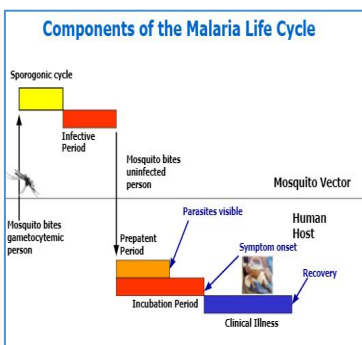
Plasmodium falciparum
(★malignant tertian) (1, 2)



Plasmodium knowlesi (rare)



<p>Female Slides</p> <p>Life cycle (3, 4, 5)</p> 	<p>Asexual stage in human</p>	<ul style="list-style-type: none"> ★ sporozoites (infective stage for human) are injected by an infected Anopheles Mosquito into the blood of human then sporozoites enter liver cells to become schizonts (large cell filled with Merozoites) when these schizonts rupture in the peripheral circulation, it release thousands of Merozoites (Ring stage) which invade RBCs. On maturation inside RBCs, the merozoites transformed to become trophozoite then trophozoites transformed to become schizogony contains thousands of daughter merozoites which rupture and release thousands of merozoites to infect other RBCs, some of these merozoites become ★ gametocytes male & female (the infective stage to mosquito)
	<p>Sexual stage in female Anopheles mosquito</p>	<ul style="list-style-type: none"> Gametocytes which taken up from the blood of an infected human during mosquito's meal In the gut of the mosquito the Gametocyte (male & female), become a zygote, Further sexual development takes place in the mosquito gut to produce SPOROZOITES.
<p>Female Slides</p> <p>Pathogenesis</p> 	<p>★ Hemolysis of RBCs: with release of metabolites and pigments from Malaria parasite which lead to severe hemolysis and anemia the main pathology of malaria. Parasites reduce red cell membrane deformability. resulting in hemolysis and accelerated splenic clearance, which may contribute to anemia and lead to enlargement of the spleen and liver.</p> <p>◇ Plugging of capillaries by parasitized erythrocytes: In cerebral malaria there is sequestration of parasites in several organs capillaries, as example if in central nervous system capillaries can lead to coma, if in kidney can lead to renal failure. caused by Plasmodium falciparum</p> <p>◇ Relapse in Malaria (Plasmodium ovale & vivax): Relapse is when symptoms of malaria reappear after the parasite have been eliminated from circulation, but the parasite remain dormant hypnozoites in the liver, usually occur 8-24 weeks after first attack</p>	
<p>Male Slides</p> <p>Clinical symptom</p>	<p>General</p>	<ul style="list-style-type: none"> •Prepatent period. •Flu-like initially. •Intermittent fever. •Recurrence. •Coma/death. •Chronic infection. •Relapses
	<p>Cold stage(chills) 1hr</p>	<ul style="list-style-type: none"> •Feeling of intense cold. ◇Vigorous shivering. •Lasts 15-60 minutes. •Headache. •Weak pulse
	<p>Hot stage (fever) 6hrs *Fever in all species every 48 hrs except P. malariae every 72 hrs* (6)</p>	<ul style="list-style-type: none"> ★*Due to rupture of blood (RBCs) schizonts (NOT liver schizonts). •Intense heat. •Throbbing headache. •Dry burning skin. •Lasts 2-6 hours. •Nausea. •Thirst. •Distress
	<p>Sweating (stage) 4hrs</p>	<ul style="list-style-type: none"> • Profuse sweating. • Declining temperature • Exhausted and weak → sleep • Lasts 2-4 hours.
<p>Clinical picture</p>	<p>Acute disease</p>	<ul style="list-style-type: none"> ◇Non-severe Acute Febrile disease ◇Severe malaria e.g. Cerebral Malaria (P. falciparum) ◇Death
	<p>Chronic disease</p>	<ul style="list-style-type: none"> ◇Chronic Asymptomatic Infection -Anemia -Developmental Disorders; Transfusions; Death ◇Infection During Pregnancy -Placental Malaria -Low Birth weight -Increased Infant Mortality



442 notes

Acute disease (immediately after exposure) is usually associated with *P. falciparum* (malignant malaria), and it can lead cerebral malaria & death.

Chronic disease (more common than acute) is usually associated with *P. ovale* & *P. vivax*. It is mostly asymptomatic (mild infection & anemia goes on and off). However, when a woman gets the infection during pregnancy, it can be transmitted to placenta & baby and lead to infant mortality.

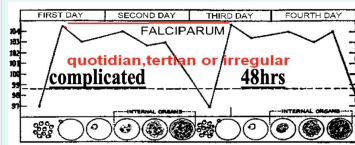


Complications

Same as we mentioned before

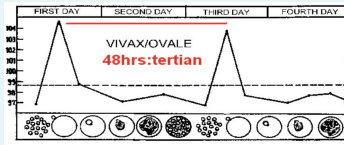
Periodic fever in Malaria

Plasmodium Falciparum
(Malignant, irregular, complicated malaria)
(fever every 48h)



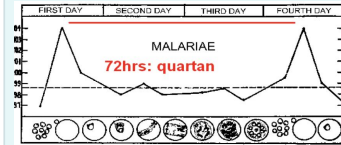
Plasmodium vivax
Plasmodium ovale

(Relapse, tertian = fever every 48h)



Plasmodium malariae

(Quartan = fever every 72h)



Complications of Severe Malaria

★ Severe Malaria Mainly *P. falciparum* (malignant tertian malaria) ★ (7)

○ Definition: Symptomatic malaria in a patient with *P. falciparum* with one or more of the following

1★ Cerebral malaria is an encephalopathy that presents with impaired consciousness, delirium, and/or seizures. (unrousable coma not attributable to other causes).



2★ Acute renal failure (urine <400 ml/24 h in adults; 12 ml/kg/24 h in children) (blackwater fever):
- Hemoglobinuria associated with malaria (blackwater fever) is Uncommon and usually presents in adults as severe disease with anemia and renal failure.
- The pathogenesis of renal failure may be related to erythrocyte sequestration interfering with renal microcirculatory flow and metabolism. Other potential factors include hypovolemia and hemolysis.



3★ Hypoglycemia (blood glucose < 2.2 mmol/l or 40 mg/dl) & pulmonary edema in pregnancy can lead to abortion and stillbirth, seen in Tropical Africa



4 Abnormal bleeding severe haemolytic anemia & child with malaria anemia in conjunction with Metabolic acidosis and respiratory distress (arterial pH <7.35 or bicarbonate < 15 mmol/l).

5 Hyperparasitaemia (>10% in non-immune; >20% in semi-immune).

6 Acute pulmonary edema and adult respiratory distress syndrome.

7 Circulatory collapse, shock, septicaemia (algid malaria).

8 Generalized convulsions (>2 episodes within 24 hours)

9 Severe normocytic anaemia (Ht<15% or Hb< 5 g/dl)

10 Fluid & electrolyte disturbances

11 Tropical splenomegaly

12 Jaundice



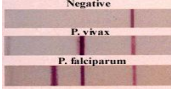
Uncomplicated malaria

- Uncomplicated malaria is defined as Symptomatic infection with malaria parasitemia without signs of severity and/or evidence of vital organ dysfunction.
- Malaria should be suspected in patients with any febrile illness if they have had exposure to a region where malaria is endemic. The initial symptoms of malaria are nonspecific and may also include tachycardia, tachypnea, chills, malaise, fatigue, sweating, headache, cough, anorexia, nausea, vomiting, abdominal pain, diarrhea, arthralgias, and myalgias. Physical findings may include manifestations of anemia and an enlarged spleen.

All types except *P. falciparum* are uncomplicated.

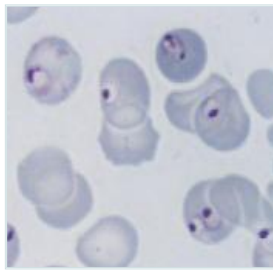


Diagnosis

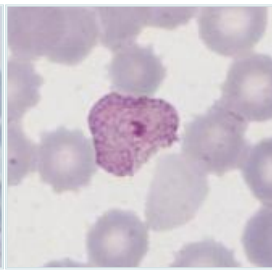
<p>★ 1- Light microscopy (The GOLD standard)</p>	<p>★ 2- Rapid diagnostic tests (RDTs) : detect malaria antigens *for screening*</p>
<p>1. Thin smear: Gimsa stain Maintains the morphology of erythrocytes so that parasites are visible within red blood cells. Thin smears allow identification of the infecting parasite species and can be used to measure parasite density, and also monitoring response of treatment.</p>	<p>★By taking a blood sample and screening it by Ag-Ab reaction (detects malaria antigens not the parasite itself)</p> <p>The product comes in a number of formats:</p> <ul style="list-style-type: none"> 1- Plastic Cassette 2- Card 3- Dipstick 4- Hybrid Cassette-dipsticks
<p>2. Thick smears: Gimsa stain allow the microscopist to review a relatively large quantity of blood and are typically used to screen for presence or absence of parasites and to estimate parasite density. <i>we do this type when we have large number of people to check if they have malaria or not, the stage is not important here</i></p>	<p>Useful in areas endemic for malaria (where we need a fast detection /screening method).</p> <div style="display: flex; justify-content: space-around;">    </div>

The malaria parasite

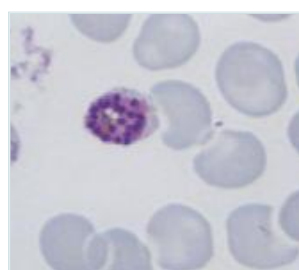
◆ Three developmental stages seen in blood films:



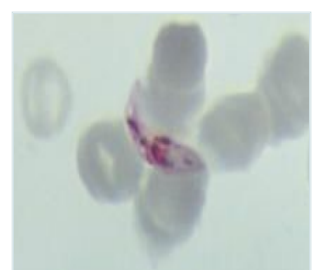
Trophozoites, merozoite ring stage



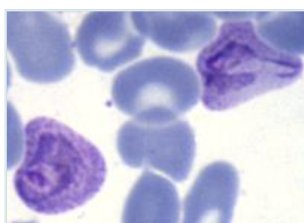
Schizonts (blood)



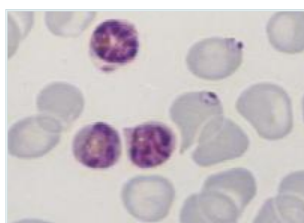
Gametocyte
male and female



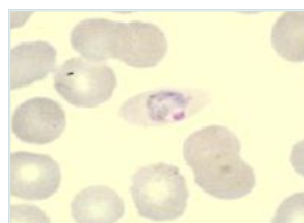
◆ Microscopy is the gold standard for diagnosis of malaria:
Parasite Density, Species diagnoses, Monitoring response to treatment.



Plasmodium vivax



Plasmodium falciparum



Plasmodium ovale



Plasmodium malariae



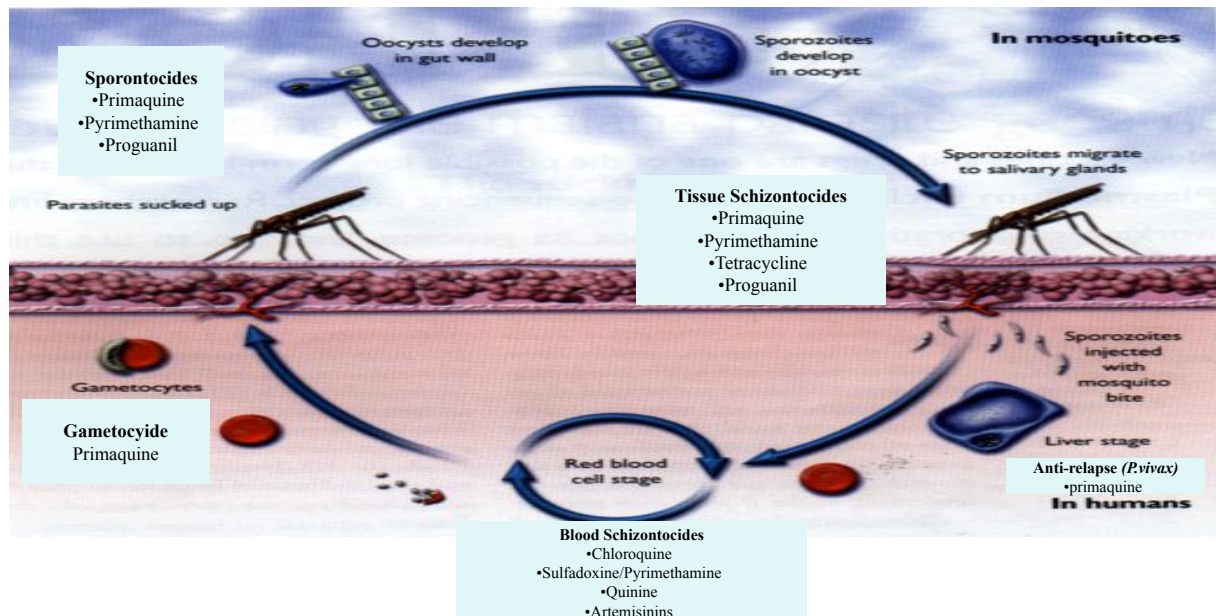
Treatment

Picture in both F & M slide

Preventive measure, treatment and prophylaxis of malaria

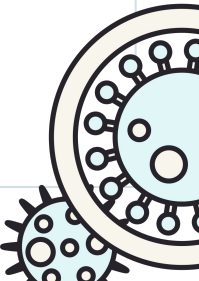
<p>Preventive measure</p>	<ul style="list-style-type: none"> ○ To lower your chance of getting malaria, you should ○ Apply mosquito repellent with DEET (diethyltolumide) to exposed skin. ○ Drape mosquito netting over beds, put screens on windows and doors ,treat clothing ,mosquito nets , sleeping bags with an insect repellent called permethrin.
<p>treatment and prophylaxis of malaria</p>	<ul style="list-style-type: none"> ○ Anti-malarial drugs that act on the liver stage of the parasite are known as causal prophylactics and prevent the parasite from progressing to infect the RBCs . ○ The combination medication of Atovaquone/proguanil (Malarone) is an example of causal prophylactic preventing the development of liver schizont , this combination it has to be started 2 days before traveling to malarial area and to be continued 7 days after leaving the area . ○ Plasmodium ovale and plasmodium vivax relapse: ○ Primaquine can affect the dormant hypnozoite of the liver stage to prevent relapse. ○ Antimalarial drugs that directed against Red blood cells stage are known as Suppressive prophylactics ○ Mefloquine, Chloroquine and Doxycycline are example of suppressive prophylactics and destroyed the parasite once it is relive to the blood. ○ The duration of the liver stage delays the appearance of the malarial parasite in the blood and that's why the suppressive prophylactics must be taken for 4 weeks after you leaving the malarial area
<p>The treatment course of malaria in Saudi Arabia</p>	<ul style="list-style-type: none"> ○ The combination of pyrimethamine/sulfadoxine/artesunate ○ Is the first line of treatment of uncomplicated malaria ○ Lumefantrine /artemether is used as second option ○ The treatment of severe malaria reset on the use of quinine or artesunate. ○ How long is the course ? 7 days ○ What type of malaria in Saudi Arabia? Falciparum infection ,in southwestern part of the country ,in Aseer and Jazan regions.

Action of antimalarial drugs in the different life stages of the malaria parasite





1. any question in the exam cam with complication (e.g. convulsion, coma, renal failure) of malaria, immediately know that they talk about **Plasmodium falciparum**
2. The onset of the disease symptoms start one week after one week -fast- of the entrance of **sporozoites**, while the other species start after one month
3. **In summary:**
infected Anopheles **Mosquito** will inject **sporozoites** into the blood → go to the liver cells → become **schizonts** (large cell filled with **Merozoites**) → liver cell will rupture → release **Merozoites** into the circulation → **invade RBCs** and transformed inside it to **trophozoite** → transformed again to become **schizogony** (contains thousands of daughter merozoites) → RBCs ruptur & release thousands of **merozoites** to infect other RBCs → some of them will become **gametocytes (male & female)** → **NON-infected mosquito** (ما قد تزوجت) came to suck the **infected human** blood → **gametocytes** will be sucked with the blood → go to the gut of the mosquito → become a **zygote** (تتزوج) → Further sexual development → produce **sporozoites** → the cycle continues to repeat)
4. **Why الله سبحانه وتعالى make the sexual proliferation happened in Mosquito not human?**
To save the species from disappearing, because human can take anti-malarial drugs and killed the species which prevent their proliferation forever. So, to avoid that, when they enter RBCs some of them will stay silent and convert to gametocytes -instead of schizogony- in order to go to a new non-infected Mosquito and proliferate there
5. **Infective stage for Human: sporozoites**
Infective stage for Mosquito: gametocytes
Definitive host of malaria: female Anopheles mosquito
6. Blood schizonts rupture every 48h in (P. falciparum + P. vivax + P. ovale), and every 72h in (P. malariae) causing periodic fever.
7. Any complication in malaria is ALWAYS associated with **P. falciparum**, if we ask you in SAQs about the complications you have to mention first that these complications are seen with P. falciparum. The most important complications are: coma (due to CNS involvement), black water fever and pulmonary edema.

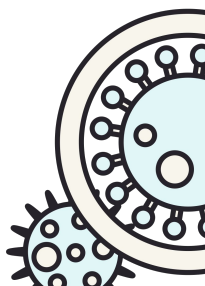




Summary

Malaria

5 Species can infect human	<ul style="list-style-type: none"> ○ Plasmodium ovale & Plasmodium vivax → ★ Relapse (fever every 48h) ○ Plasmodium malariae → Quartan (fever every 72h) ○ Plasmodium falciparum → ★ malignant, complicated malaria (fever every 48h)
Life cycle	<ul style="list-style-type: none"> ○ ★ Vector (Transmission): via the bite of infected female Anopheles mosquito ○ Asexual stage in human: <ul style="list-style-type: none"> → Infective stage for human → ★ sporozoites → Infective stage for mosquito → ★ gametocytes (male & female) → Definitive host of malaria → female Anopheles mosquito → Merozoites invade RBCs ○ In summary: infected Anopheles Mosquito will inject sporozoites into the blood → go to the liver cells → become schizonts (large cell filled with Merozoites) → liver cell will rupture → release Merozoites into the circulation → invade RBCs and transformed inside it to trophozoite → transformed again to become schizogony (contains thousands of daughter merozoites) → RBCs rupture & release thousands of merozoites to infect other RBCs → some of them will become gametocytes (male & female) → NON-infected mosquito (ماقد تزوجت) came to suck the infected human blood → gametocytes will be sucked with the blood → go to the gut of the mosquito → become a zygote (نتزوج) → Further sexual development → produce sporozoites → the cycle continues to repeat)
Pathogenesis	<ul style="list-style-type: none"> ○ ★ Hemolysis of RBCs → severe hemolysis & anemia (main pathology of malaria) ○ ★★ Relapse in Malaria (Plasmodium ovale & vivax): is when symptoms of malaria reappear after the parasite have been eliminated from circulation, but the parasite remain dormant hypnozoites in the liver, usually occur 8-24 weeks after first attack
Clinical Symptom	<ul style="list-style-type: none"> ○ Hot stage (periodic fever) due to rupture of blood (RBCs) schizonts (NOT liver schizonts) ○ This stage is in all species every 48 hrs except P. malariae every 72 hrs, and it's
Complications of Severe Malaria	<ul style="list-style-type: none"> ★ Severe Malaria = mainly <i>P. falciparum</i> (malignant tertian malaria): <ol style="list-style-type: none"> 1. Cerebral malaria → coma 2. Acute renal failure (blackwater fever) 3. Hypoglycemia & pulmonary edema in pregnancy → abortion & stillbirth, seen in Tropical Africa
Diagnosis	<ol style="list-style-type: none"> 1. Light microscopy (The GOLD standard): <ul style="list-style-type: none"> ○ Thin smear Gimsa stain → allow identification of the species ○ Thick smears Gimsa stain → used to screen for presence or absence of parasites 2. Rapid diagnostic tests (RDTs): <ul style="list-style-type: none"> ○ Detect malaria antigens for screening : ★ By taking a blood sample and screening it by Ag-Ab reaction (detects malaria antigens not the parasite itself)





MCQs

Q1. Periodic fever in malaria is due to?

- A. Rupture of liver schizonts B. Rupture of blood schizonts C. Merozoites infecting RBCs D. Gematocytes

Q2. Which of the following species of malaria that cause quartan fever?

- A. Plasmodium ovale & vivax B. Plasmodium malariae C. Plasmodium falciparum D. Plasmodium knowlesi

Q3. Blackwater fever is seen in which disease?

- A. Leishmania major B. Trypanosomiasis C. Plasmodium malariae D. Plasmodium falciparum

Q4. How Malaria is transmitted?

- A. female sandflies bites B. fecal-oral route C. female anopheles mosquito bites D. eating undercooked beef

Q5. Which of the following species of malaria that always relapse?

- A. Plasmodium ovale & vivax B. Plasmodium malariae C. Plasmodium falciparum D. Plasmodium knowlesi

Q6. A 32-year-old man named Sultan came with renal failure and slipped into a coma. What could be the possible cause of his condition?

- A. Plasmodium ovale & vivax B. Plasmodium malariae C. Plasmodium falciparum D. Plasmodium knowlesi

Q7 . In malaria, what is the infective stage for Human?

- A. sporozoites B. schizonts C. trophozoite D. gametocytes

Q8 . In malaria, what is the infective stage for Anopheles?

- A. sporozoites B. schizonts C. trophozoite D. gametocytes

Q9 .What is the main part of the body that get destroyed by malaria?

- A. Liver B. Bone marrow C. RBCs D. Large intestine

Q10. which of the following is a test that used for identification of malaria?

- A. Thick smear B. Thin smear C. RDT D. Both A&C

Q11. which of the following is a test that used for screening of malaria?

- A. Thick smear B. Thin smear C. RDT D. Both A&C

Q12. Rapid diagnostic tests is used detect which of the following?

- A. Malaria Antigen B. Malaria Antibody C. Sporozoites D. Malaria Genome



SAQ

1

What do we mean by “Relapse” in malaria?

- Relapse is when symptoms of malaria reappear after the parasite have been eliminated from circulation, but the parasite remain dormant hypnozoites in the liver, usually occur 8-24 weeks after first attack
- It caused by Plasmodium ovale and Plasmodium vivax

2

What is the complication in severe malaria?

1. severe malaria it Mainly due to *P. falciparum* (malignant tertian malaria) ★ (you should mention the etiology)
2. The complication include:
 - Cerebral malaria which lead to coma,
 - Hypoglycemia & pulmonary edema pregnancy
 - Abnormal bleeding & severe anemia
 - Acute renal failure

3

How to diagnose malaria?

1. Light microscope (the gold standard):
 - A. Thin smear: used for identification & monitoring response of treatment
 - B. Thick smear: to screen for the present of absent of the parasite
2. Rapid diagnostic tests (RDTs): detect malaria antigens and used for screening



TEAM 443
MICROBIOLOGY

Team leaders

Aishah Boureggah Aroub Almahmoud Maryam Alghannam Nazmi M Alqutub

Team Members

Mohammd Alqutub

Raghad Almuslih

Khalid Alsobei

Afnan Alahmari

Lama Alotabi

Wajd Almutairi

Sultan Albaqami

Zahra Alhazmi

Nourah Alarifi

Moath Alhudaif

Almas Almutari

Sarah Alajaji


Aban Basfar

Reema Almotairi

Alhawraa Alawami

Mohammed Alarfaj

Reema Algarni

 Shahad Alzaid

Faris Alzahrani

Farah Abukhalaf

 Danah Almuhausen

Abdulrahman Almusallam

Remaz Almahmoud

Areej Alquraini

Zeyad Alotaibi

Aleen Alkulyah

Layan Al-Ruwaili

Luay Alhudaithy

Rafan Alhazzani

Haya Alzeer

Nazmi A Alqutub

Reuf Alahmari

Raseel Almutairi

Rahaf Alshowihi

Reena Alsadoni