DOWNLOAD PDF THE THREE LIVES OF PLASMODIUM

Chapter 1 : Plasmodium Life Cycle | Intellectual Ventures Laboratory

Plasmodium is a genus of unicellular eukaryotes that are obligate parasites of vertebrates and insects. The life cycles of Plasmodium species involve development in a blood-feeding insect host which then injects parasites into a vertebrate host during a blood meal.

Plasmodium of lizards and birds Subgenus Laverania Subgenus Vinckeia Hepatocystis parasites of bats Estimates for when different Plasmodium lineages diverged have differed broadly. Estimates for the diversification of the order Haemosporida range from around For this, estimated dates range from , to 2. Vertebrates[edit] Many birds, from raptors to passerines like the red-whiskered bulbul Pycnonotus jocosus , can carry malaria. Plasmodium parasites have been described in a broad array of vertebrate hosts including reptiles, birds, and mammals. Some of these can cause severe disease in primates, while others can remain in the host for prolonged periods without causing disease. Again, some species of Plasmodium can cause severe disease in some of these hosts, while many appear not to. In general each species of Plasmodium infects one to a few species of birds. Species from several subgenera of Plasmodium infect diverse reptiles. Plasmodium parasites have been described in most lizard families and, like avian parasites, are spread worldwide. Quinine was used as a frontline antimalarial from the 17th century until widespread resistance emerged in the early 20th century. In addition to a vertebrate host, all Plasmodium species also infect a bloodsucking insect host, generally a mosquito although some reptile-infecting parasites are transmitted by sandflies. Mosquitoes of the genera Culex , Anopheles , Culiseta , Mansonia and Aedes act as insect hosts for various Plasmodium species. The best studied of these are the Anopheles mosquitoes which host the Plasmodium parasites of human malaria, as well as Culex mosquitoes which host the Plasmodium species that cause malaria in birds. Only female mosquitoes are infected with Plasmodium, since only they feed on the blood of vertebrate hosts. Sometimes, insects infected with Plasmodium have reduced lifespan and reduced ability to produce offspring. This was followed by the recognition of the other two species of Plasmodium which infect humans: Plasmodium ovale and Plasmodium knowlesi identified in long-tailed macaques in ; in humans in Telford in when he reclassified Plasmodium parasites that infect reptiles, adding five subgenera. Valkiunas reclassified the bird-infecting Plasmodium species adding a fifth subgenus:

Chapter 2 : Types of malaria.

Until recently, there were four plasmodium species that were considered responsible for malaria disease in humans: P. vivax, P. falciparum, P. ovale and P. malariae. In , P. knowlesi, a species that used to infect exclusively apes of the genous Macaque, was recognised by WHO as the fifth plasmodium species that infect humans.

WHO press release, http: The incubation period varies depending on the strain of the parasite. Since these symptoms resemble the flu, malaria can be difficult to diagnose in places where it is not endemic, such as the United States. With severe malaria, caused by P. Again, these symptoms are shared with many other diseases. Consequently, the only way to diagnose malaria is to conduct laboratory tests. Diagnostic kits using a dye-labeled antibody that binds to the parasite are also available and are especially useful in the field and for rapid diagnoses. These tests are becoming more important in the diagnosis of malaria. They do not require a microscope or a skilled technician. In Africa and other countries without adequate medical infrastructure, these tests are an essential tool in detecting the parasite. Treatment of Malaria Treatment of malaria 1 depends on the species of the infecting parasite and the density of that parasite in the bloodstream. Treatment also depends on any accompanying illnesses and drug allergies. The World Health Organization suggests that treatment begin within 24 hours after symptoms appear, particularly with a Plasmodium falciparum infection because of its rapid progression towards severe malaria. If the species of parasite cannot be immediately identified, the patient should be treated as if infected with P. The drug s administered depends on the identified parasite species and drug resistance in the region where the parasite was acquired. Travel history is especially crucial in the identification and drug resistance process 3. Anti-malaria drugs can be given orally, intravenously, or as a suppository determined by the severity of the infection. Most drugs are given when the parasite has a high density in the bloodstream. For example, patients who have P. For initial treatment of P. In areas with chloroquine resistance, three different treatment options may be given: These two species become latent in the liver, but primaquine is effective in preventing the spread of the parasite into the bloodstream 4. The parasite may become active and spread into the bloodstream from the liver causing the patient to have a relapse of malaria. The most effective new drugs are the artemisinins. They are currently the most effective agents against multi-resistant malaria strains. Ironically, they are derived from compounds from the most ancient treatment known, qinghao tree annual Chinese wormwood, Artemesia annu. Artemisinins clear parasites more rapidly than quinine during the first 24 hours of treatment 5. However, these drugs are very expensive and are not yet widely available. And, as with all antibiotics, resistance has already arisen 6. Severe malaria requires a different approach because of the risk of the explosive release of parasites into the blood. There are two treatments for severe malaria: Quinidine is currently the recommended treatment in the United States, but treatment is problematic because quinidine is cardiotoxic 4. The drug is usually administered in an intensive care unit with continuous electrocardiographic and frequent blood pressure monitoring because it can cause arrhythmia. Sometimes because of the severity of malaria, a drug cannot be used at all. This is then followed by appropriate drug treatment.

Chapter 3 : Definitions and symptoms | Medicines for Malaria Venture

Plasmodium Life Cycle Plasmodium is a genus of the Apicomplexan parasite, which was described in by Ettore Marchiafava and Angelo Celli and is known to cause malaria. There are known species of Plasmodium, of which at least 11 species infect humans, while others infect other animals including reptiles, birds, rodents, and monkeys.

During pregnancy malaria can lead to premature baby delivery or delivery of a low-birth-weight baby. The infant can get the parasite from the mother and develop the disease. Central nervous system involvement cerebral malaria can cause especially in small children blindness, deafness, speech difficulty, paralyses and trouble with movements. Diagnosis Malaria is usually diagnosed by examining a blood sample under a microscope. There are also test kits that detect antigens of P. These immunologic tests are known as rapid diagnostic tests RDTs. RDTs can detect two different malaria antigens, one for P. RDTs usually show results in about 20 minutes. It is a good alternative to microscopy, when reliable microscopic diagnosis cannot be done. A negative RDT result can be followed up by microscopy. If a patient with positive RDT result is not responding to treatment, another blood sample should be taken. This time using microscopy to determine whether the medicine was appropriate for the Plasmodium species. Diagnosis can be challenging for many reasons: Some health workers in developing countries are insufficiently trained and supervised. The microscopes and reagents might be of poor quality and the supply of electricity might be unreliable. Some health workers save blood samples until a qualified person is available to perform the microscopy. This delay results sometimes as incorrect diagnosis. Many malaria endemic communities do not have the proper diagnostic tools such as microscopes and RDTs. Treatment Most malaria deaths occur in rural areas. Quick progression from illness to death can be prevented by fast and effective medication. Patients who have uncomplicated malaria can visit a nearby hospital to get treated and then go home to rest. In emergency cases rectal artesunate drug can be given as a first line treatment if they cannot be treated orally. Patients with severe malaria can be hospitalized for many days. When treating a malaria patient, the following should be taken into account: For example, chloroquine resistant strain of P. Listed below are some drugs that are usually recommended by national malaria control programs. They might not be effective in many parts of the world due to drug resistant strains.

Chapter 4 : The Survival Strategies of Malaria Parasite in the Red Blood Cell and Host Cell Polymorphisms

Five species Malaria is caused by protozoan parasites of the genus Plasmodium - single-celled organisms that cannot survive outside of their host(s). Plasmodium falciparum is responsible for the majority of malaria deaths globally and is the most prevalent species in sub-Saharan Africa.

History[edit] Malaria has been recognized since the Greek and Roman civilizations over 2, years ago, with different patterns of fever described by the early Greeks. Plasmodium falciparum , Plasmodium vivax , Plasmodium ovale curtisi , Plasmodium ovale wallikeri , Plasmodium malariae and Plasmodium knowlesi. It is widespread throughout sub-Saharan Africa , much of southeast Asia, Indonesia, on many of the islands of the western Pacific and in areas of the Amazon Basin of South America. It can be found at the following link: Role in disease[edit] P. Molecular analysis is usually required for an accurate diagnosis. Unusual characteristics of this organism in comparison to general eukaryotes include the rhoptry, micronemes, and polar rings near the apical end. The plasmodium is known best for the infection it causes, malaria. Life cycle[edit] Plasmodium malariae wiki P. Mosquito stage[edit] Similar to the other human-infecting Plasmodium parasites, Plasmodium malariae has distinct developmental cycles in the Anopheles mosquito and in the human host. The sporozoites are then carried by the circulation of the hemolymph to the salivary glands, where they become concentrated in the acinal cells. Microscopically, the parasitised red blood cell erythrocyte is never enlarged and may even appear smaller than that of normal red blood cells. The cytoplasm is not decolorized and no dots are visible on the cell surface. The food vacuole is small and the parasite is compact. Cells seldom host more than one parasite. Band forms, where the parasite forms a thick band across the width of the infected cell, are characteristic of this species and some would say is diagnostic. Large grains of malarial pigment are often seen in these parasites: Management and therapy[edit] Failure to detect some P. Although serologic tests are not specific enough for diagnostic purposes, they can be used as basic epidemiologic tools. Collins from the Center of Disease Control CDC , chloroquine is most commonly used for treatment and no evidence of resistance to this drug has been found. Public health, prevention strategies and vaccines[edit] The food vacuole is the specialized compartment that degrades hemoglobin during the asexual erythrocytic stage of the parasite. In a paper published in , Westling et al. They sought to characterize the specificity for the enzymes cloned from P. Using substrate specificity studies and inhibitor analysis, it was found that the plasmepsins for P. Unfortunately, this means that the development of a selective inhibitor for P. Six polymorphic genetic markers from P. The data showed a high level of multi-genotypic carriage in humans. William Collins doubts that anyone is currently looking for possible vaccines for P. He states that very few studies are conducted with this parasite, [12] perhaps as a result of its perceived low morbidity and prevalence. Collins cites the great restrictions of studies with chimpanzees and monkeys as a sizeable barrier. The continuing work with the plasmepsin associated with P.

Chapter 5 : Malaria - Simple English Wikipedia, the free encyclopedia

End product of plasmodium trophozoite digestion of hemoglobin. It's insoluble, not toxic to parasite. It reduces macrophage function, which aid in phagocytosing and killing merozoites, so hurts immune response.

Ecology of Malaria Factors That Determine The Occurrence of Malaria Factors that determine the occurrence of malaria are those that influence the three components of the malaria life cycle: In rare cases malaria parasites can be transmitted from one person to another without requiring passage through a mosquito from mother to child in "congenital malaria" or through transfusion, organ transplantation, or shared needles. Climate can influence all three components of the life cycle. It is thus a key determinant in the geographic distribution and the seasonality of malaria. Such breeding sites may dry up prematurely in the absence of further rainfall, or conversely they can be flushed and destroyed by excessive rains. Once adult mosquitoes have emerged, the ambient temperature, humidity, and rains will determine their chances of survival. Warmer ambient temperatures shorten the duration of the extrinsic cycle, thus increasing the chances of transmission. This explains in part why malaria transmission is greater in warmer areas of the globe tropical and semitropical areas and lower altitudes , particularly for P. Climate also determines human behaviors that may increase contact with Anopheles mosquitoes between dusk and dawn, when the Anopheles are most active. Hot weather may encourage people to sleep outdoors or discourage them from using bed nets. During harvest seasons, agricultural workers might sleep in the fields or nearby locales, without protection against mosquito bites. Anopheles Mosquitoes The types species of Anopheles present in an area at a given time will influence the intensity of malaria transmission. Some species are biologically unable to carry human malaria parasites, while others are readily infected and produce large numbers of sporozoites the parasite stage that is infective to humans. Different Anopheles species may differ in selected behavior traits, with important consequences on their abilities as malaria vectors. All other factors being equal, the anthropophilic, endophagic species will have more frequent contacts with humans and thus will be more effective malaria vectors. The anthropophilic Anopheles gambiae is an extremely effective vector and is one of the reasons why malaria is so prevalent in Africa. An important biologic factor is insecticide resistance. If the mosquitoes are resistant to the insecticide s used locally for spraying or for treating bed nets, these measures will be ineffective in curtailing transmission. Parasites Characteristics of the malaria parasite can influence the occurrence of malaria and its impact on human populations: Such relapses can result in resumption of transmission after apparently successful control efforts, or can introduce malaria in an area that was malaria-free P. Such strains are not uniformly distributed. Constant monitoring of the susceptibility of these two parasite species to drugs used locally is critical to ensure effective treatment and successful control efforts. Travelers to malaria-risk areas should use for prevention only those drugs that will be protective in the areas to be visited. Plasmodium falciparum predominates in Africa south of the Sahara, one reason why malaria is so severe in that area. Animal Reservoirs A certain species of malaria called P. Humans living in close proximity to populations of these macaques may be at risk of infection with this zoonotic parasite. However, in many of these countries including the United States Anopheles mosquitoes are still present. Thus the potential for reintroduction of active transmission of malaria exists in many non-endemic parts of the world. All patients must be diagnosed and treated promptly for their own benefit but also to prevent the reintroduction of malaria. Human Factors and Malaria Human Factors and Malaria Genetic Factors Biologic characteristics present from birth can protect against certain types of malaria. Two genetic factors, both associated with human red blood cells, have been shown to be epidemiologically important. Persons who have the sickle cell trait heterozygotes for the abnormal hemoglobin gene HbS are relatively protected against P. In general, the prevalence of hemoglobin-related disorders and other blood cell dyscrasias, such as Hemoglobin C, the thalassemias and G6PD deficiency, are more prevalent in malaria endemic areas and are thought to provide protection from malarial disease. Persons who are negative for the Duffy blood group have red blood cells that are resistant to infection by P. Since the majority of Africans are Duffy negative, P. In that area, the niche of P. Other genetic factors related to red blood cells also influence malaria, but to a lesser extent. Sickle Cell and Malaria

Acquired Immunity Acquired immunity greatly influences how malaria affects an individual and a community. After repeated attacks of malaria a person may develop a partially protective immunity. In areas with high P. As these antibodies decrease with time, these young children become vulnerable to disease and death by malaria. If they survive repeated infections to an older age years they will have reached a protective semi-immune status. Thus in high transmission areas, young children are a major risk group and are targeted preferentially by malaria control interventions. In areas with lower transmission such as Asia and Latin America , infections are less frequent and a larger proportion of the older children and adults have no protective immunity. In such areas, malaria disease can be found in all age groups, and epidemics can occur. Anemia in young children in Asembo Bay, a highly endemic area in western Kenya. Anemia occurs most between the ages of 6 and 24 months. After 24 months, it decreases because the children have built up their acquired immunity against malaria and its consequence, anemia. The mother had malaria, with infection of the placenta. Pregnancy and Malaria Pregnancy decreases immunity against many infectious diseases. Women who have developed protective immunity against P. Malaria during pregnancy is harmful not only to the mothers but also to the unborn children. The latter are at greater risk of being delivered prematurely or with low birth weight, with consequently decreased chances of survival during the early months of life. For this reason pregnant women are also targeted in addition to young children for protection by malaria control programs in endemic countries. Malaria During Pregnancy Behavioral Factors Human behavior, often dictated by social and economic reasons, can influence the risk of malaria for individuals and communities. Poor rural populations in malaria-endemic areas often cannot afford the housing and bed nets that would protect them from exposure to mosquitoes. These persons often lack the knowledge to recognize malaria and to treat it promptly and correctly. Often, cultural beliefs result in use of traditional, ineffective methods of treatment. Travelers from non-endemic areas may choose not to use insect repellent or medicines to prevent malaria. Reasons may include cost, inconvenience, or a lack of knowledge. Human activities can create breeding sites for larvae standing water in irrigation ditches, burrow pits Agricultural work such as harvesting also influenced by climate may force increased nighttime exposure to mosquito bites Raising domestic animals near the household may provide alternate sources of blood meals for Anopheles mosquitoes and thus decrease human exposure War, migrations voluntary or forced and tourism may expose non-immune individuals to an environment with high malaria transmission. Human behavior in endemic countries also determines in part how successful malaria control activities will be in their efforts to decrease transmission. The governments of malaria-endemic countries often lack financial resources. As a consequence, health workers in the public sector are often underpaid and overworked. They lack equipment, drugs, training, and supervision. The local populations are aware of such situations when they occur, and cease relying on the public sector health facilities. Conversely, the private sector suffers from its own problems. Regulatory measures often do not exist or are not enforced. This encourages private consultations by unlicensed, costly health providers, and the anarchic prescription and sale of drugs some of which are counterfeit products. Correcting this situation is a tremendous challenge that must be addressed if malaria control and ultimately elimination is to be successful. Sickle Cell Protective Effect of Sickle Cell Trait Against Malaria Only in some individuals do malaria episodes progress to severe life-threatening disease, while in the majority the episodes are self-limiting. This is partly because of host genetic factors such as the sickle cell gene. The sickle cell gene is caused by a single amino acid mutation valine instead of glutamate at the 6th position in the beta chain of the hemoglobin gene. Inheritance of this mutated gene from both parents leads to sickle cell disease and people with this disease have shorter life expectancy. On the contrary, individuals who are carriers for the sickle cell disease with one sickle gene and one normal hemoglobin gene, also known as sickle cell trait have some protective advantage against malaria. As a result, the frequencies of sickle cell carriers are high in malaria-endemic areas. Most earlier studies of the relationship between sickle cell trait and malaria were cross-sectional, and therefore some important data relevant to the protective effects of sickle cell trait were missing. Most of this protection occurs between months of life, before the onset of clinical immunity in areas with intense transmission of malaria. Those who had the sickle cell trait HbAS had a slight survival advantage over those without any sickle cell genes HbAA , with children with sickle cell disease HbSS faring the worst. Mosquitoes Anopheles

Mosquitoes Malaria is transmitted among humans by female mosquitoes of the genus Anopheles. Female mosquitoes take blood meals to carry out egg production, and such blood meals are the link between the human and the mosquito hosts in the parasite life cycle. Differently from the human host, the mosquito host does not suffer noticeably from the presence of the parasites. Diagram of Adult Female Mosquito Map of the world showing the distribution of predominant malaria vectors Anopheles freeborni mosquito pumping blood Sequential images of the mosquito taking its blood meal Life Stages Like all mosquitoes, anophelines go through four stages in their life cycle: The first three stages are aquatic and last days, depending on the species and the ambient temperature. The adult stage is when the female Anopheles mosquito acts as malaria vector. The adult females can live up to a month or more in captivity but most probably do not live more than weeks in nature. Eggs Adult females lay eggs per oviposition. Eggs are laid singly directly on water and are unique in having floats on either side. Eggs are not resistant to drying and hatch within days, although hatching may take up to weeks in colder climates. Larvae Mosquito larvae have a well-developed head with mouth brushes used for feeding, a large thorax, and a segmented abdomen. They have no legs. In contrast to other mosquitoes, Anopheles larvae lack a respiratory siphon and for this reason position themselves so that their body is parallel to the surface of the water. Larvae breathe through spiracles located on the 8th abdominal segment and therefore must come to the surface frequently. Anopheles Egg; note the lateral floats. Anopheles eggs are laid singly. The larvae spend most of their time feeding on algae, bacteria, and other microorganisms in the surface microlayer. They dive below the surface only when disturbed. Larvae swim either by jerky movements of the entire body or through propulsion with the mouth brushes. Larvae develop through 4 stages, or instars, after which they metamorphose into pupae.

Chapter 6 : exo-erythrocytic cycle â€“ calendrierdelascience.com

Introduction. Organisms that belong to the genus Plasmodium are obligate eukaryotic parasites, best known as the etiological agent of human malaria. There are four parasites that infect humans and cause malaria: P. falciparum, P. vivax, P. malariae, and P. ovale.

Plasmodium Life cycle Plasmodium species that infect humans Until recently, there were four plasmodium species that were considered responsible for malaria disease in humans: Transmission routes The main mode of transmission of the disease is by bites from infected Anopheles mosquitoes that have previously had a blood meal from an individual with parasitemia. Less common routes of transmission are via infected blood transfusion, transplantation, infected needles, and from a mother to her fetus during pregnancy. Plasmodium life cycle The life cycle Figure 1 is almost the same for all the five species that infect humans and follows three stages: I ifection of a human with sporozoites II asexual reproduction III sexual reproduction The two first stages take place exclusively into the human body, while the third one starts in the human body and is completed into the mosquito organism. Plasmodium life cycle Source: Open Course Ware The human infection begins when an infected female anopheles mosquito bites a person and injects infected with sporozoites saliva into the blood circulation. That is the first life stage of plasmodium stage of infection. The next stage in malaria life cycle is the one of asexual reproduction that is divided into different phases: Within only 60 minutes after the parasites inoculation, sporozoites find their way through blood circulation to their first target, the liver. The sporozoites enter the liver cells and start dividing leading to schizonts creation in 6-7 days. Each schizont gives birth to thousands of merozoites exoerythrocytic schizogony that are then released into the blood stream marking the end of the exoerythrocytic phase of the asexual reproductive stage. It is worth mentioning that, concerning P. The exoerythrocytic phase is not pathogenic and does not produce symptoms or signs of the disease. Its duration is not the same for all parasite species. Merozoites released into the blood stream, are directed towards their second target, the red blood cells RBCs. As they invade into the cells, they mark the beginning of the erythrocytic phase. The first stage after invasion is a ring stage that evolves into a trophozoite. The trophozoites are not able to digest the haem so they convert it in haemozoine and digest the globin that is used as a source of aminoacids for their reproduction. The next cellular stage is the erythrocytic schizont initially immature and then mature schizont. Each mature schizont gives birth to new generation merozoites erythrocytic schizogony that, after RBCs rupture, are released in the blood stream in order to invade other RBCs. This is when parasitaemia occurs and cinical manifestations appear. The liver phase occurs only once while the erythrocytic phase undergoes multiple cycles; the merozoites release after each cycle creates the febrile waves. A second scenario into the RBCs is the parasite differentiation into male and female gametocytes that is a non pathogenic form of parasite. The gametocytes, then, mature and become microgametes male and macrogametes female during a process known as gametogenesis. The time needed for the gametocytes to mature differs for each plasmodium species: In the mosquito gut, the microgamete nucleus divides three times producing eight nuclei; each nucleus fertilizes a macrogamete forming a zygote. The zygote, after the fusion of nuclei and the fertilization, becomes the so- called ookinete. The ookinete, then, penetrates the midgut wall of the mosquito, where it encysts into a formation called oocyst. Inside the oocyst, the ookinete nucleus divides to produce thousands of sporozoites sporogony. Sporogony lasts 8- 15 days. The oocyst ruptures and the sporozoites are released inside the mosquito cavity and find their way to its salivary glands but only few hundreds of sporozoites manage to enter. Thus, when the above mentioned infected mosquito takes a blood meal, it injects its infected saliva into the next victim marking the beginning of a new cycle. The duration of each above desribed phase is different for each of the plasmodia as shown in Table 1 that follows.

Chapter 7 : Plasmodium - Wikipedia

Malaria parasites are micro-organisms that belong to the genus Plasmodium. There are more than species of Plasmodium, which can infect many animal species such as reptiles, birds, and various mammals.

In he reported the presence of black pigment granules from the blood and spleen of a patient who died of malaria. He gave the scientific name Oscillaria malariae. Laveran was awarded the Nobel Prize in Physiology or Medicine in for his work. In , the Italian zoologist Giovanni Battista Grassi categorized Plasmodium species based on the timing of fever in the patient; malignant tertian malaria was caused by Laverania malariae now P. Ross discovered in that malarial parasite lived in certain mosquitoes. The next year, he demonstrated that a malarial parasite of birds could be transmitted by mosquitoes from one bird to another. Around the same time, Grassi demonstrated that P. Under controversial circumstances, only Ronald Ross was selected for the award. It was only in the International Commission on Zoological Nomenclature officially approved the binominal Plasmodium falciparum. The species name was introduced by an American physician William Henry Welch in This suggests that the origin of P. It is likely that the development of extensive agriculture increased mosquito population densities by giving rise to more breeding sites, which may have triggered the evolution and expansion of Plasmodium falciparum. Close to the center is a schizont and on the left a trophozoite. Each schizont produces merozoites, each of which is roughly 1. In the erythrocyte the merozoite form a ring-like structure, becoming a trophozoite. A trophozoites feed on the haemoglobin and forms a granular pigment called haemozoin. Unlike those of other Plasmodium species, the gametocytes of P. Mature trophozoites or schizonts in peripheral blood smears, as these are usually sequestered in the tissues. On occasion, faint, comma-shaped, red dots are seen on the erythrocyte surface. It contains secretory organelles called rhoptries and micronemes, which are vital for mobility, adhesion, host cell invasion, and parasitophorous vacuole formation. The apicoplast is involved in the synthesis of lipids and several other compounds and provides an attractive drug target. During the asexual blood stage of infection, an essential function of the apicoplast is to produce the isoprenoid precursors isopentenyl pyrophosphate IPP and dimethylallyl pyrophosphate DMAPP via the MEP non-mevalonate pathway. The genome of its mitochondrion was reported in , that of the nonphotosynthetic plastid known as the apicoplast in , [31] and the sequence of the first nuclear chromosome chromosome 2 in The sequence of chromosome 3 was reported in and the entire genome was reported on 3 October Just over 5, genes were described. Many genes involved in antigenic variation are located in the subtelomeric regions of the chromosomes. These are divided into the var, rif, and stevor families. Within the genome, there exist 59 var, rif, and 28 stevor genes, along with multiple pseudogenes and truncations. In humans[edit] Life cycle of Plasmodium Infection in humans begins with the bite of an infected female Anopheles mosquito. Out of about species of Anopheles mosquito , more than 70 species transmit falciparum malaria. The mosquito saliva contains antihemostatic and anti-inflammatory enzymes that disrupt blood clotting and inhibit the pain reaction. Typically, each infected bite contains sporozoites. But a few escape and quickly invade liver cells hepatocytes. Within the parasitophorous vacuole of the hepatocyte, it undergoes rounds of mitosis and meiosis which produce a syncytial cell coenocyte called a schizont. This process is called schizogony. A schizont contains tens of thousands of nuclei. From the surface of the schizont, tens of thousands of haploid 1n daughter cells called merozoites emerge. The liver stage can produce up to 90, merozoites, [37] which are eventually released into the bloodstream in parasite-filled vesicles called merosomes. The parasite first binds to the erythrocyte in a random orientation. It then reorients such that the apical complex is in proximity to the erythrocyte membrane. The parasite forms a parasitophorous vacuole, to allow for its development inside the erythrocyte. The clinical symptoms of malaria such as fever, anemia, and neurological disorder are produced during the blood stage. Infected erythrocytes are often sequestered in various human tissues or organs, such as the heart, liver and brain. This is caused by parasite-derived cell surface proteins being present on the erythrocyte membrane, and it is these proteins that bind to receptors on human cells. Trophozoite[edit] After invading the erythrocyte, the parasite loses its specific invasion organelles apical complex and surface coat and de-differentiates into a round trophozoite located within a

parasitophorous vacuole. The young trophozoite or "ring" stage, because of its morphology on stained blood films grows substantially before undergoing schizogony. The liberated merozoites invade fresh erythrocytes. A free merozoite is in the bloodstream for roughly 60 seconds before it enters another erythrocyte. This gives rise to the characteristic clinical manifestations of falciparum malaria, such as fever and chills, corresponding to the synchronous rupture of the infected erythrocytes. These gametocytes take roughly 7â€”15 days to reach full maturity, through the process called gametocytogenesis. These gametocytes are taken up by a female Anopheles mosquito during a blood meal. An average incubation period is 11 days, [44] but may range from 9 to 30 days. In isolated cases, prolonged incubation period as long as 2, 3 or even 8 years have been recorded. The male gametocyte undergoes a rapid nuclear division within 15 minutes, producing eight flagellated microgametes by a process called exflagellation. The zygote then develops into an ookinete. The ookinete is a motile cell, capable of invading other organs of the mosquito. It traverses the peritrophic membrane of the mosquito midgut and crosses the midgut epithelium. Once through the epithelium, the ookinete enters the basal lamina , and settles to an immotile oocyst. For several days, the oocyst undergoes 10 to 11 rounds of cell division to create a syncytial cell sporoblast containing thousands of nuclei. Meiosis takes place inside the sporoblast to produce over 3, haploid daughter cells called sporozoites on the surface of the mother cell. They migrate to the mosquito salivary glands where they undergo further development and become infective to humans. But in nature the number is generally less than The sporozoite glycoprotein specifically activates mast cells. From this stage onward the parasites produce different proteins that help in suppressing communication of the immune cells. PfEMP1 is the most important, capable of acting as both an antigen and an adhesion molecule.

Chapter 8 : Plasmodium malariae - Wikipedia

Malaria parasites are micro-organisms that belong to the genus calendrierdelascience.com are more than species of Plasmodium, which can infect many animal species such as reptiles, birds, and various mammals.

This is to make sure they do not get sicker. It also makes sure they can take the medicines by mouth. Malaria does not start to become a life-threatening disease until it has been a couple of weeks after the bite without being treated. Falciparum malaria also has more resistance to medicines. This makes it much harder to treat. Falciparum malaria is always treated with two or more medicines. Doctors choose the medicines by where in the world the person got malaria. Different places have P. The most important resistance is chloroquine-resistance. In some places in the world, P. In some places it is chloroquine-resistant. This means chloroquine does not kill it. In these places quinine can be used. Quinine is taken by mouth. How to prevent malaria[change change source] Sleeping under insecticide-treated bed nets ITNs helps reduce the risk of getting malaria. Only pyrethroid insecticides are approved for use on ITNs. These are man-made pesticides similar to the natural pesticide pyrethrum, made by chrysanthemum flowers There are three ways to prevent malaria: Control mosquitoes Keep mosquitoes from biting Take medicine to keep from getting sick after a bite, especially in those parts of the world where people get malaria. Clearing drainage ditches in Kenya Anopheles larvaeThe anopheles mosquito lays eggs in stagnant water Vector control is one way to stop malaria. Vector means an organism that carries an infectious disease to another organism. For malaria, the vector is the Anopheles mosquito. The most used method of vector control is pesticides. These are chemicals that kill the mosquito. The first pesticide used for vector control was DDT. DDT worked very well for vector control. It did not make people very sick at the time it was used. It did not cost very much money. Other chemicals for vector control had not been invented yet. In many places mosquitoes became resistant to DDT. This meant that DDT did not work anymore in these areas. Scientists worried that DDT was making people and animals sick. It killed a lot of wildlife too. DDT also stays in the environment for a long time. For these reasons, people mostly use other chemicals for vector control. Organophosphate or carbonate pesticides are used, like malathion or bendiocarb. Vector control is not the only way to stop malaria. And DDT is not the only chemical that can be used for vector control. The best way to stop malaria is to use a combination of methods. In some places, DDT may be a useful part of a program to stop malaria. This is why DDT is still allowed to be used for controlling malaria. Keeping mosquitoes from biting[change change source] The mosquito that carries malaria comes more at dawn when the sun comes up and dusk when the sun goes down. Be most careful at these times. Wear long trousers and shirts with long sleeves. Wear mosquito repellent this is a chemical that mosquitoes do not like, so they do not bite. Mosquitoes will bite through thin cloth. So repellent should be used on skin and clothes. Pesticides can be used in rooms to kill mosquitoes. When sleeping outside, people use a mosquito net. This is made from cloth that air can go through but keeps mosquitoes out. It is put over a bed where people sleep to keep mosquitoes out. Sometimes people also use it when they are not sleeping. It is best to use mosquito nets that have been treated with Permethrin, which repels and kills mosquitoes. Taking medicine to not get sick[change change source] People can take medicine when they are in a place where there is malaria. This reduces the chances that they contract malaria. This is called prophylaxis. Some people take prophylactic medicines for years. Many people in areas where there is malaria do not have the money to buy this medicine. People who live where there is no malaria usually have not had malaria. The first case malaria is usually much worse. So people from places where there is no malaria may take prophylactic medicines when they go to places where there is malaria. The kind of prophylactic medicines people take depends on where they are. This is because not all medicines work on the malaria in every place. To make them work best, prophylactic medicines have to be taken the right way. The medicine should start before going to an area with malaria. Most medicines should be taken for 4 weeks after coming home. One medicine Malarone only needs to be used for one week after coming home. Resistance to malaria[change change source] There are some children in Tanzania who are naturally immune to malaria. Researchers are using this to develop a new vaccine. Injecting a form of this antibody into mice protected the

animals from the disease. The researchers plan to do tests on primates , including humans. He isolated malaria parasites from the salivary glands of mosquitoes that had fed on infected birds. Its recommendations were used during construction of the Panama Canal. This public-health work saved the lives of thousands of workers and helped develop the methods used in future public-health campaigns against the disease. The first effective treatment for malaria came from the bark of cinchona tree , which contains quinine. This tree grows on the slopes of the Andes , mainly in Peru. The indigenous peoples of Peru made a tincture of cinchona to control malaria. The Jesuits noted the efficacy of the practice and introduced the treatment to Europe during the s, where it was rapidly accepted. The resulting fever would kill the syphilis spirochaetes , and quinine could be administered to control the malaria. Although some patients died from malaria, this was preferable to the almost-certain death from syphilis.

Chapter 9 : Plasmodium Falciparum - Malaria

Unlike those of other Plasmodium species, the gametocytes of P. falciparum are elongated and crescent-shaped, by which they are sometimes identified. A mature gametocyte is Î¼m long and Î¼m wide.

Schizogony often occurs in vessels in organs so disease severity may not correlate with parasitaemia. Various complications may arise due to ischaemic changes, including cerebral malaria comatose , bilious remittent fever hepatomegaly , dysentery malabsorption diarrhoea , algid malaria circulatory collapse and blackwater fever haemoglobinuria. Cerebral malaria occurs when capillaries are blocked by infected erythrocytes causing small haemorrhages which rapidly increase in size conspicuous in retina. Symptoms include abnormal behaviour, fits, change in level of consciousness, coma, elevated cerebrospinal fluid CSF pressure, and classic decerebrate rigidity associated with hypoglycaemia. There are often neurological sequelae, such as hemiparesis, cerebral ataxia, cortical blindness, hypotonia, mental retardation, generalized spasticity, or aphasia. The incubation period ranges from days, with vague symptoms developing for days headache, photophobia, muscle aches, anorexia followed by severe paroxysms of chills and fevers every 72 hours long chill stage, more severe symptoms during fever stage. Proteinuria is common in infected individuals and a nephrotic syndrome may develop in children. Symptoms appear days after infection and are vague for days headache, photophobia, muscle aches, anorexia , developing to steady or irregular low-grade fever then paroxysms with a regular 48 hour cycle. Splenomegaly is evident during the first few weeks of infection and leukopenia is usually present. Severe complications are rare but P. Infections are vector-borne, being transmitted by female mosquitos, mainly Anopheles spp. Although mosquito species are found worldwide, only a few are considered to be important vectors. Only the female mosquitoes feed on blood as they require high protein diets in order to reproduce and lay rafts of eggs. The mosquito is not simply a vector, it acts as the definitive host in which sexual reproduction of the parasite occurs. Gametocytes ingested during feeding undergo fertilization forming an ookinete then an oocyst which produces numerous sporozoites eventually infecting the salivary glands. Sporozoites are injected into new hosts when the mosquito next feeds as saliva has anticoagulant properties and prevents blood from clotting in the mouthparts. Once a mosquito is infected, it is infected for life and continues to transmit infections. Fluorochrome stains have also been used to detect parasites in blood samples, but the morphological features of the stages detected are often obscure. It is important that infections by individual parasite species be differentiated as it impacts on treatment and prognosis. Immunoserological tests have also been developed and several fluorescence, haemagglutination and enzyme immunoassays are being used, particularly for mass screening. Molecular biological techniques using polymerase chain reaction PCR amplification of gene fragments have also been developed and have shown great potential for the detection of drug resistance in Plasmodium. A variety of drugs have been developed for therapeutic treatment and prophylactic preventive use. While most enjoyed years of efficacy, there are now widespread problems with drug resistance amongst the parasites. The active drug quinine was isolated from the bark around and this become the mainstay for malaria treatment throughout the world, essentially based on Cinchona tree plantations in tropical colonies. Supply shortages due to the World Wars prompted research on synthetic drugs. Pamaquine, mepacrine and chloroquine were developed in the s, proguanil in the s, and pyrimethamine in the s. Chloroquine, in particular, was found to be highly effective, cheap to produce and had low toxicity. However, resistance to chloroquine emerged in the s and soon spread around the world. Sulphonamides were developed in the s, mefloquine and a series of related drugs in the s, and artemisinin was discovered in a Chinese herbal remedy in the s. A holistic and strategic approach to the treatment of infected individuals is required based on whether suppressive, radical or preventive treatment is required, and the level of drug resistance present. Antimalarial drugs of choice are primaquine, chloroquine despite the emergence of chloroquine-resistant strains , sulfadoxine, pyrimethamine, mefloquine, quinine and tetracycline. Preventive measures based on vector control programmes had many early successes including those using DDT , but the rapid emergence of insecticide resistance and the recognition of the toxicity of DDT and its prohibition have led to the resurgence of malaria in many countries. At present, the best protection is the avoidance of mosquito

bites, using screens, bed nets, insect repellants, and residual insecticide sprays.