MALARIA

- Malaria is an acute and chronic illness characterized by paroxysms of fever,chills,sweats,fatigue,anaemia and splenomegaly.
- Causes more than 1 million deaths each year.(most malarial deaths occur amoung infants and young children.)
- Physicians in non endemic areas consider diagnosis of malaria in any febrile child who has returned from malaria endemic area within previous year.

ETIOLOGY

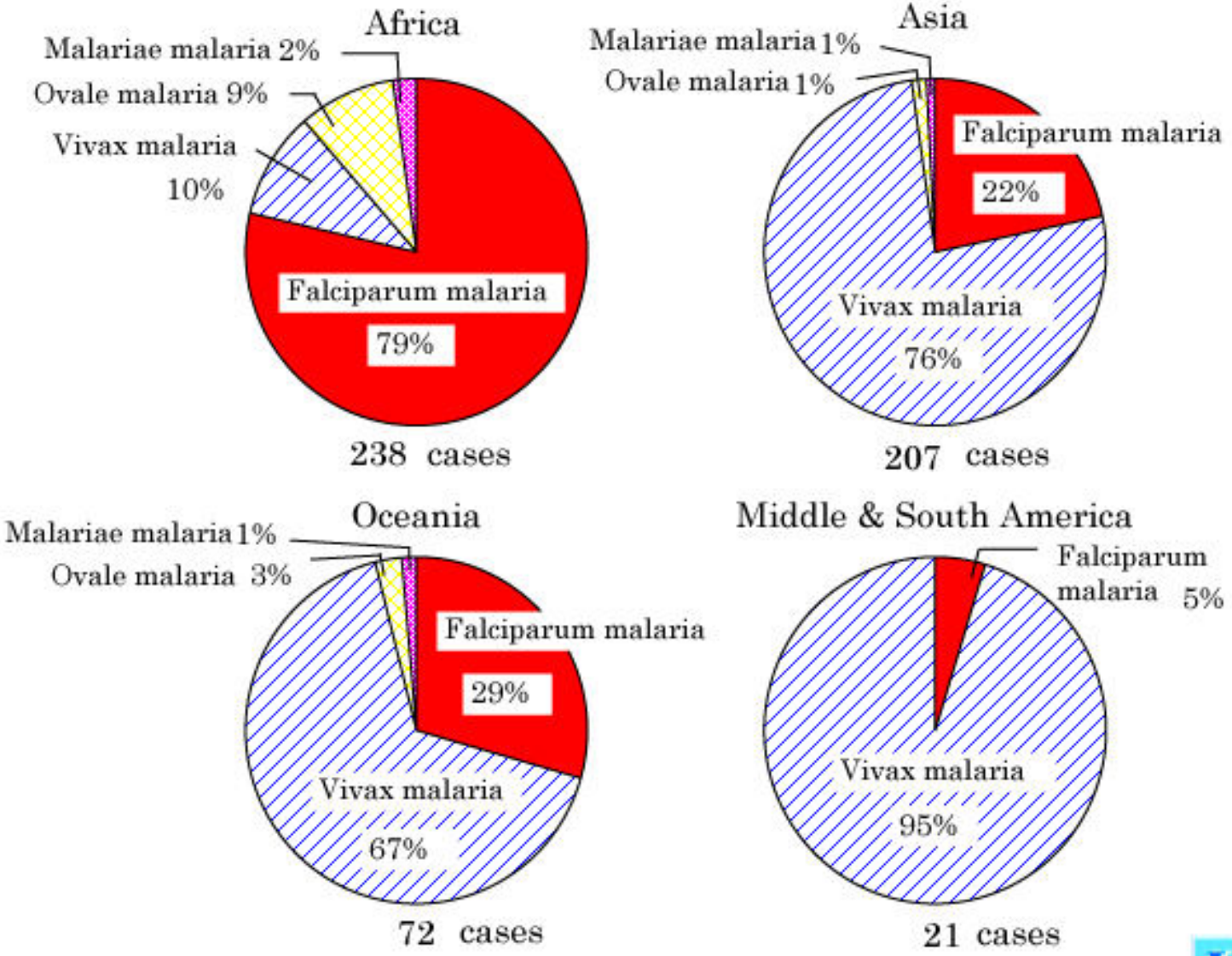
- Causative organism : Plasmodium
- Prior to 2004 : P.falciparum,P.malariae,P.vivax,P.ovale
- In 2004: P.knowlesi (Malasia,Indonasia,Singapore and Phillipines)
- Transmissiion : by female anopheles mosquitoes blood transfusion,use of contaminated needles and transplacentally

- P.vivax and P.ovale: benign tertian malaria
- P.falciparum: malignant tertian malaria
- P.malariae: benign quartan malaria

EPIDEMIOLOGY

- Principle areas of transmission: Africa,Asia and South America.
  P.falciparum:Africa,Haiti and New Guinea.
  P.vivax:Bangladesh,Central America,India,Pakistan and Sri Lanka.
  P.vivax and P.falciparum:Southeast Asia,South America and Oceania.
  P.ovale:Africa

Figure 3. Reported cases of malaria by suspected area of infection, April 1999-December 2005, Japan



(National Epidemiological Surveillance of Infectious Diseases: Data based on the reports received before January 9, 2007)

IASR
Infectious Agents Surveillance Report

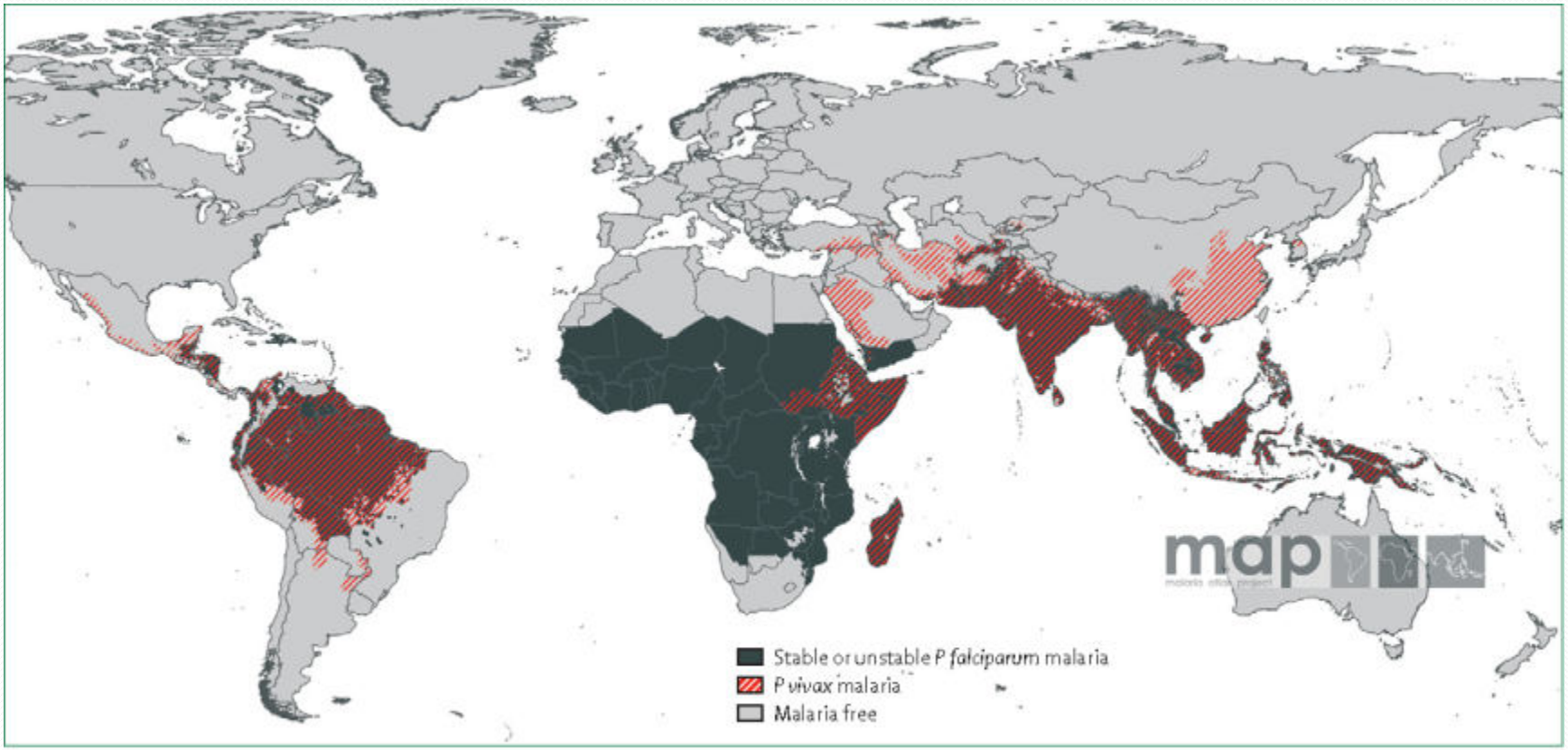


Figure 1: Global spatial distribution of *Plasmodium falciparum* malaria in 2007 and preliminary global distribution of *Plasmodium vivax* malaria

Epidemiology in india

- In India, wide distribution of nine anopheline vectors transmitting three Plasmodial species: *P. falciparum, P. vivax,* and *P. malariae.*
- *Anopheles culicifacies* is widely distributed and is the principal vector of rural malaria.
- *An. stephensi* is the primary urban vector,

Distribution of Malaria in Different States of India

- The annual parasite incidence (API) is a malariometric index to express malaria cases per thousand population.
- in most of India, the API was < 2
- , whereas 2–5 API was in scattered regions,
- and regions with > 5 API were scattered in the states of Rajasthan, Gujarat, Karnataka, Goa, Southern Madhya Pradesh, Chhattisgarh, Jharkhand, and Orissa and in northeastern states

- The proportion of *P. vivax* and *P. falciparum* varies in different parts of India.
- Although mostly indo-gangatic plains and northern hilly states, northwestern India and southern Tamil Nadu state have < 10% *P. falciparum,* and the rest are *P. vivax* infections
- In the forested areas inhabited by ethnic tribes, the situation is reversed, and the *P. falciparum* proportion is 30–90%, and in the remaining areas, it is between 10% and 30%.

LIFE CYCLE

- Definitive host and vector: female Anopheles mosquito.
- Intermediiate host: human
- Infective form:sporozoites

HUMAN CYCLE(SCHIZOGONY)

PRE ERYTHROCYTIC

- sporozoites(spindle)enters liver > become rounded
- Multiply > meront/schizont
- Merozoites (ruture of hepatocytes)
- Micro merozoites > RBC
- Macro merozoites > liver

ERYTHROCYTIC

- Receptor (glocophorin)
- Merozoites > ring form
- Enlarged to trphozoites
- Mitosis>mature schizonts
- Burst to release merozoites
- Parasite feeds on Hb > haemozoin
- Merozoite > gametocytes

SPOROGONIC CYCLE

- Mosquito takes gametocytes
- Exflagellated microgametocyte + macrogametocyte
- Zygote>ookinate >oocyst
- Oocyst contains sporozoites
- Enter salivary gland

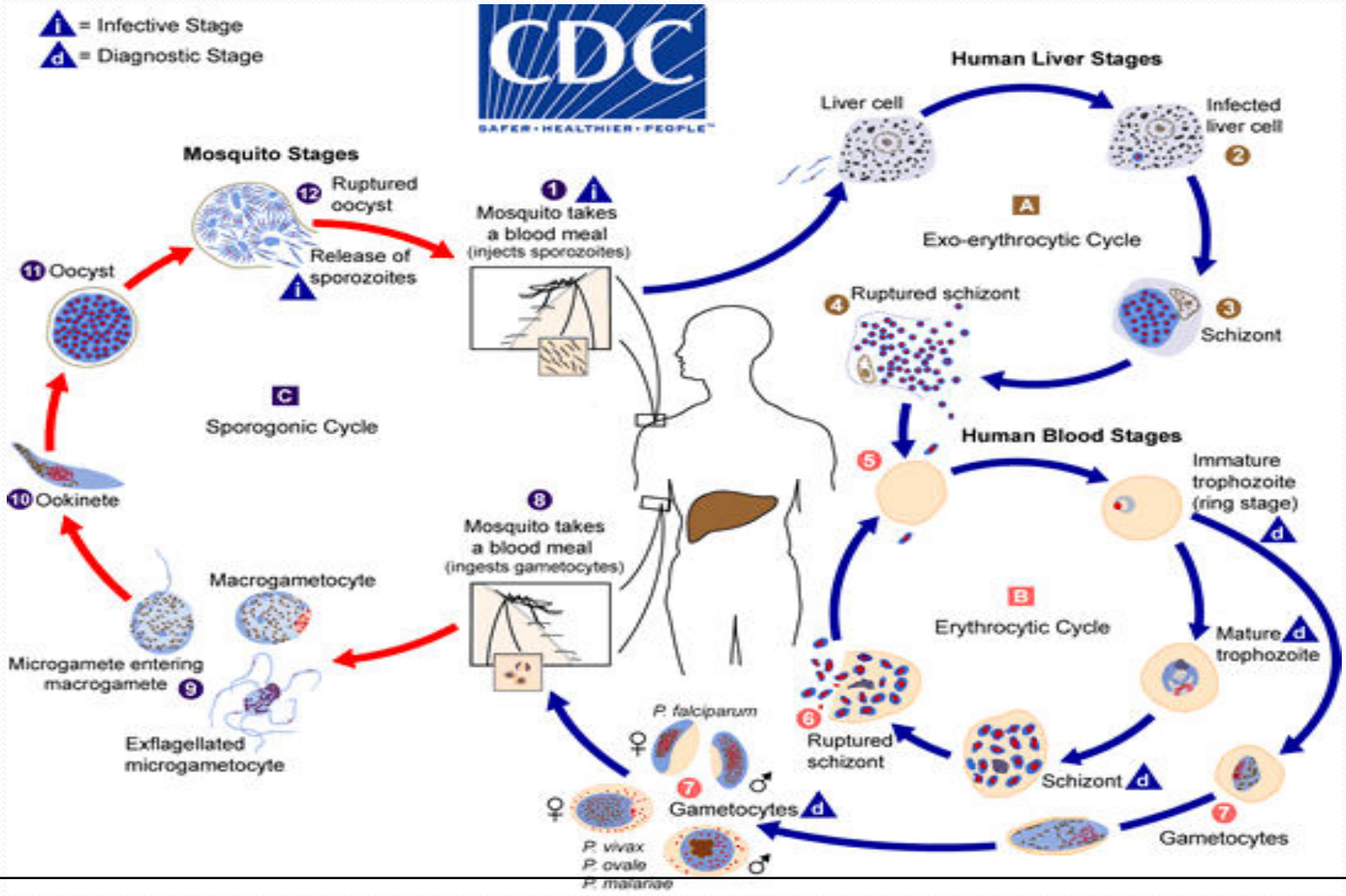
- **EROTHROCYTIC STAGE**

P.falciparum infect RBC of all age

P.vivax – only young RBC

LATENT STAGE

- In P.vivax and ovale :
  2 types of sporozoites present.
  Some infect hepatocytes.
  Others in resting form(hypnozoites)>later activated>CLINICAL RELAPSE
- In P.falciparum and malariae:
  no hypnozoites only some erythrocytic parasites persists in blood and multiply > SHORT TERM RELAPSE/RECRUDESCENCE.



PATHOGENESIS

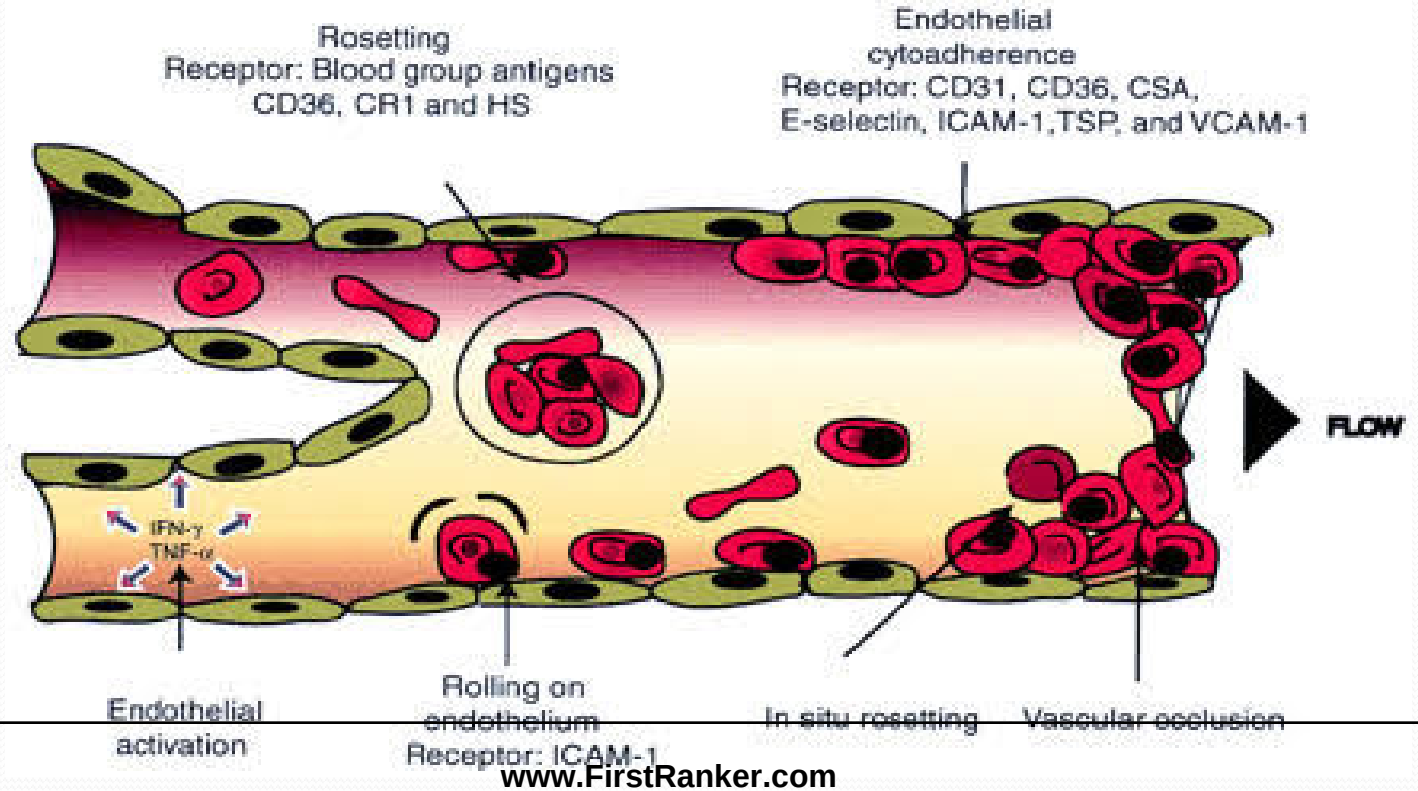
- FEVER - due to release of cytokines
- ANEMIA- hemolysis
  sequestration of RBC in spleen
  bone marrow suppression
- IMMUNOPATHOLOGIC EVENTS -
  increased production of proinflammatory cytokines
- TISSUE ANOXIA-

PATHOGENESIS

- Due to local/systemic response to parasite.
- Brain:congested with multiple punctiform haemorrhages
- Tissue hypoxia: due to obstruction of blood flow.
- Liver: enlarged and congested , fatty degeneration and centrilobal necrosis.
- Spleen:enlarged and congested,hard with thick capsule.
- Kidney:enlaarged and congested tubules
- Aeamia:decreased erythropoetin levels and increased haemolysis.

Complicated malaria

- Cytoadherence



Trophozoites in peripheral circulation
Cell invasion
Formation of knobs(from mature schizonts) and protruberances on RBC surface – act as neoantigens causing immune stimulation and vascular stickiness
-Block cappilaries > complication
-Agglutinates

- Rosseting

- Cytoadherence causes obstruction of blood flow and capillary damage

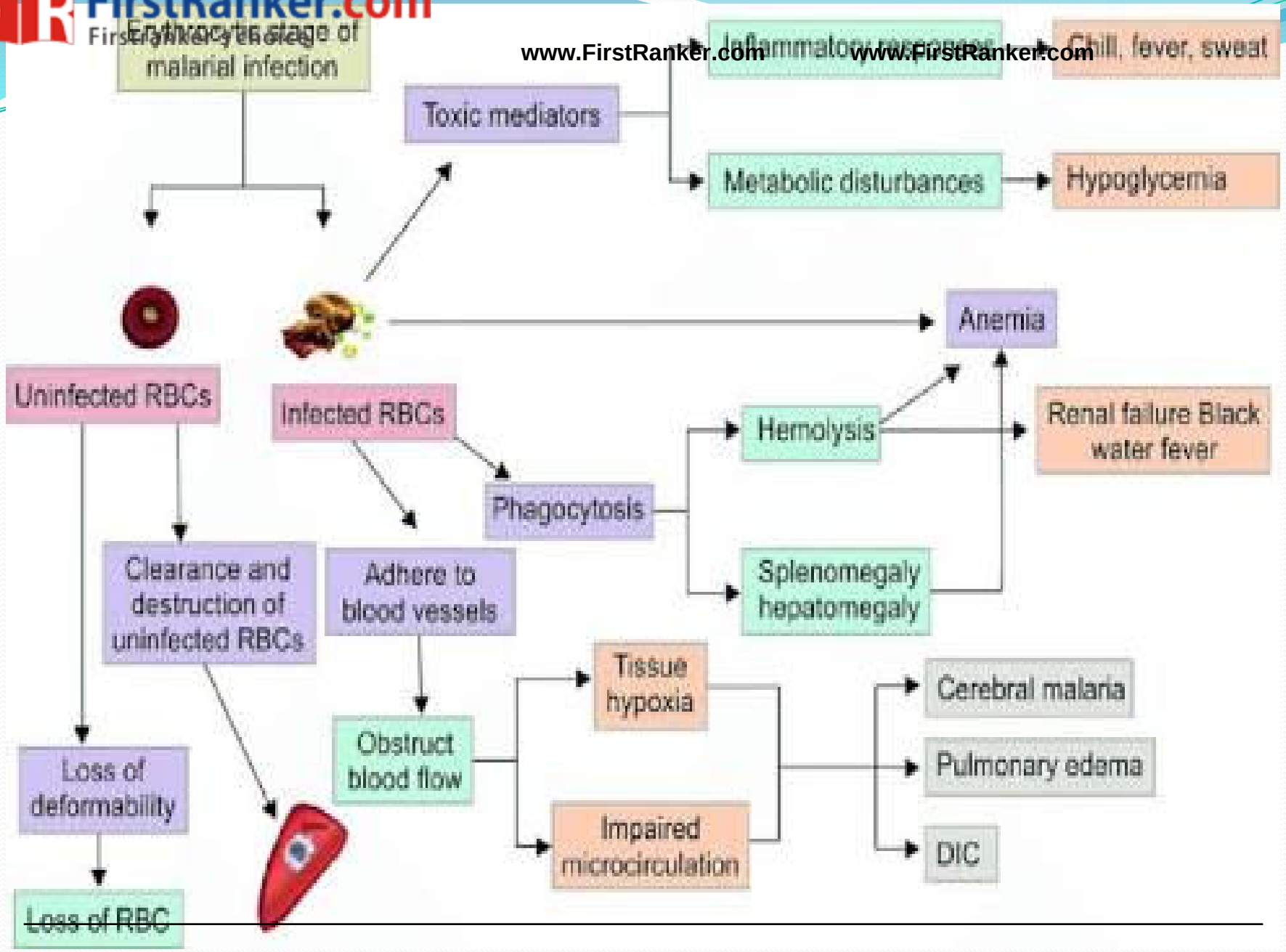
↓

vascular leakage

↓

TISSUE ANOXIA

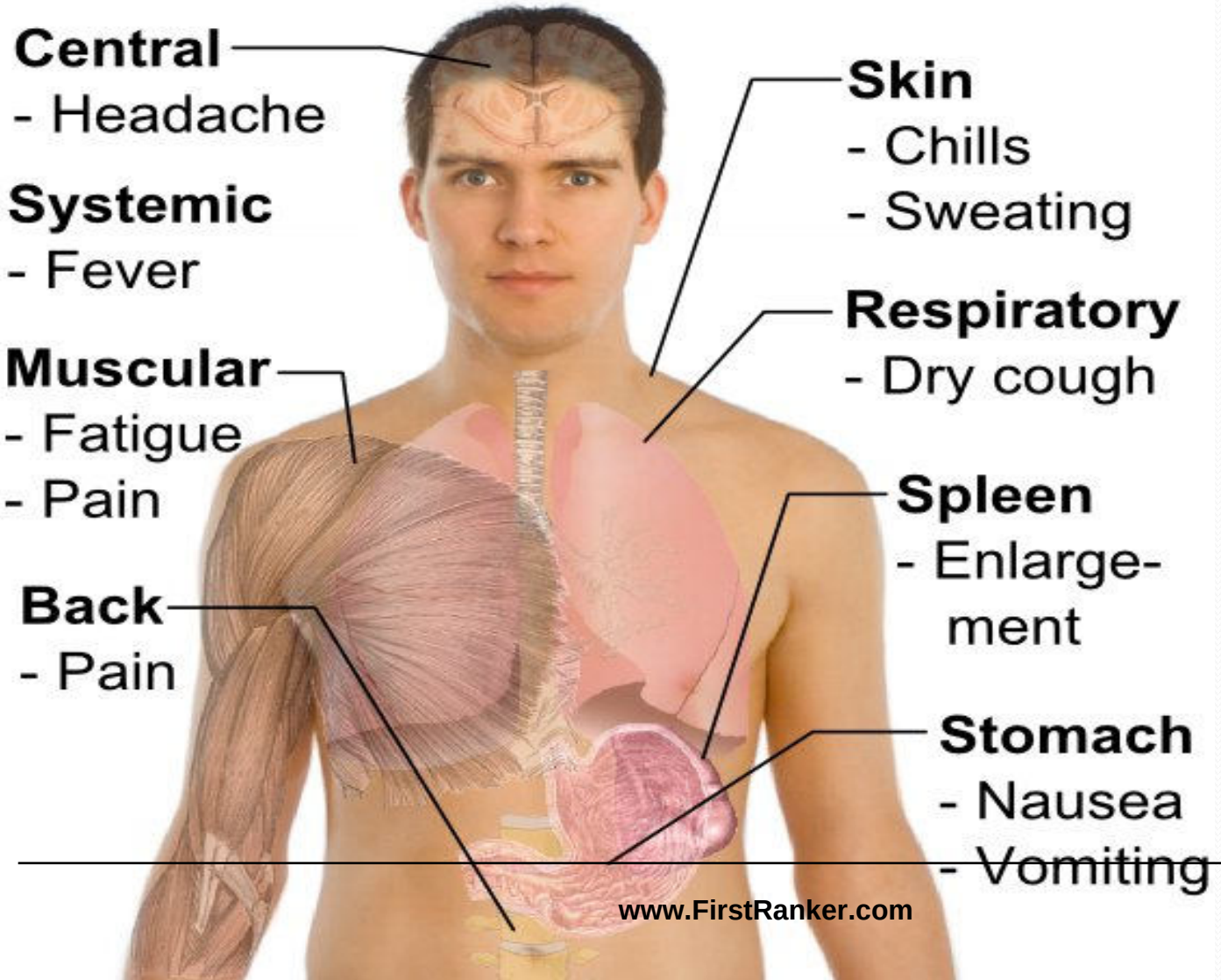
- Tissue anoxia leads to complications like cerebral malaria and acute tubular necrosis
- Hypoxia leads to anaerobic metabolism – increased lactate production



CLINICAL FEATURES

SPECIES	INCUBATION PERION
P.falciparum	9-14
P.vivax	12-17
P.ovale	16-18
P.malariae	18-40

Symptoms of Malaria



Central
- Headache

Systemic
- Fever

Muscular
- Fatigue
- Pain

Back
- Pain

Skin
- Chills
- Sweating

Respiratory
- Dry cough

Spleen
- Enlarge-ment

Stomach
- Nausea
- Vomiting

- Initial phase: asymptomatic
- Classical presentation: paroxysms of fever alternating with periods of fatigue.
- Febrile paroxysms characterized by high fever, sweats, and head ache , myalgia, back pain, abdominal pain, nausea, vomiting diarrhea, pallor, and jaundice.

- P.vivax and ovale : paroxysms coincide with ruture of shizonts that occue every 48 hours > fever spikes every 2 nd day
- P. falciparum : periodicity less apparent
- P.malariae : rupture occurs every 72 hrs>fever spikes every 3 rd or 4 th day

- Children with malaria lack paroxysms
- Non specific symptoms
  low grade fever , head ache , anorexia , nausea , vomiting , and diarrhea.
- Distinctive physical signs : splenomegaly , hepatomegaly , and pallor.

BENIGN MALARIA

- Fever with rigor followed by anaemia and spenomegaly
- Febrile paroxysms: 3 stages
- 1.cold stage: 15-60 mins>intense cold with shivering
- 2.hot stage:2-6 hrs> patient feels intense hot temp(>or equal to 41 degree celsius)
- 3.sweating stage: profuse sweating temperature drops rapidly.

- P.falciparum : most severe
- Complications unique to it
  cerebral malaria , acute renal failure , respiratory distress , algid malaria , beeding diathesis.
- Parasitaemia : high (infect both mature an immature RBC)

MALIGNANT MALARIA

- Cerebral malaria:
  occurs in non immune untreated person.
  head ache ,hyperpyrexia,paralysis,confusion may b present.(RBC aggregration)
- Algid malaria:
  Peripheral circulatory failure,rapid thready pulse,low Bp and cold skin

- Septicemic malaria:
  High continuous fever with multi organ failure
- Black water fever(malarial haemoglobinuria):
  bilious vomiting,passage of dark red/blackish urine (intravascular hemolysis by anti-erythrocute antibody)

WHO Criteria for severe malaria

- Impaired conciousness
- Prostration
- Respiratory distress
- Multiple seizures
- Jaundice
- Haemoglobinuria
- Abnormal bleeding
- Severe anaemia
- Circulatory colapse
- Pulmonary oedema

MEROZOITE INDUCED MALARIA

SEEN IN

- Transfusion malaria
- Congenital
- Renal transplantation
- Shared syringes

- Shorter incubation period and no relapse.

Congenital Malaria

- Prenatally\pernatally.
- In endemic areas important causeof abortions,miscarriages,stllbirths,premature births,IUGR and neonatal deaths.
- Even in absense of transmission from mather to baby ill effects observed.
- Signs and symptoms : fever,restlessness,drowsiness,pallor,jaundice,poor feeding,vomiting,diahrrea,cyanosis and hepatosplenomegaly.

Clinical Manifestations of Malaria

Infected Mosquito

Infected Human

Acute febrile illness

Severe illness

- Hypoglycemia
- Anemia
- Respiratory distress
- Cerebral malaria

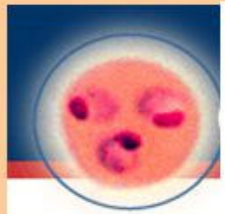
Death

Chronic effects

- Anemia
- Neurologic/ cognitive
- Developmental

Impaired growth and development

Malnutrition



Pregnancy

- Fetus → Low birth weight → Infant mortality
- Maternal
  - Acute illness
  - Anemia

Impaired productivity

Table 1. Age-specific clinical manifestations of malaria (adapted from)[10]

Congenital malaria	Infants and toddlers	Older children
Fever (without paroxysm) Irritability Listlessness Anaemia Jaundice Poor feeding Vomiting Regurgitation Loose stools Splenomegaly Hepatosplenomegaly Cyanosis (in severe cases)	Fever (irregular or continuous) Irritability Anaemia Poor feeding Vomiting Lethargy Jaundice Splenomegaly Hepatosplenomegaly	Fever (intermittent or continuous) Chills/rigor Diaphoresis Headache Backache Myalgia Abdominal pain Nausea/vomiting/ diarrhea Fatigue Anaemia Seizures Decreased mental status Hepatosplenomegaly

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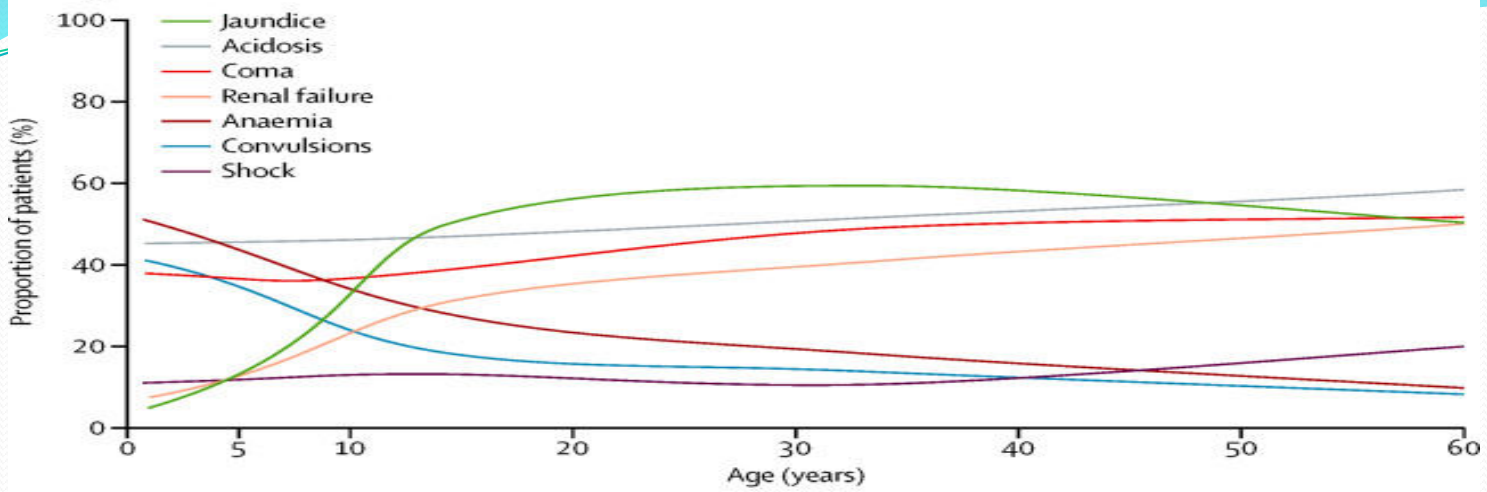

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