A Review on Malarial Parasite

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Abstract: Malaria is a mosquito borne infectious disease caused by protozoan parasite of the genus Plasmodium. There are four species of plasmodium i.e. P. vivax, P. falciparum, P. ovale and P. malariae. In Pakistan, two species are common Plasmodium vivax (74%) and P. falciparum (26%) the most dangerous. The primary vector species are Anopheles culicifacies, A. stephensi and A. arabiensis is considered as a major malaria vector and is widely distributed. Pathogenesis of malaria is P. malariae exhibits a 72 hour periodicity, whereas the other three species exhibit 48 hour cycles. Treatment of malaria is Artemisinin (Qingnasou) and Chloroquine is very active against P. falciparum rings as well as the later stages of the parasite. It is given orally or by rectal suppository and should only be used for treatment but not for prophylaxis. It is concluded that P. vivax is the most common pathogen of malaria in Pakistan. Prevention requires awareness of risk, bite avoidance, chemoprophylaxis (Taking preventive medicines if you are travelling to or requires awareness) and diagnosis made promptly with early treatment of an infected case.

Key words: Plasmodium vivax • P. falciparum • P. ovale • P. malariae

INTRODUCTION

Malaria is a mosquito borne infectious disease caused by protozoan parasite of the genus Plasmodium [1]. Malaria parasite (Plasmodium) is primarily transmitted by the bite of an infected female Anopheles mosquito, but infections can also occur due to introduction of infected blood Products (Transfusion malaria) and by inborn transmission [2]. The primary vector species are Anopheles culicifacies and A. stephensi considered as a major malaria vector and is widely distributed [3]. In Pakistan, two species is common; Plasmodium vivax (74%), the most prevalent and P. falciparum (26%) the most dangerous [4, 5].

Pakistan is listed among moderately endemic countries for malaria. Malaria also considerably affects the health of children [6]. The establishment and spread of malaria within a geographical area can vary greatly between villages and households [7]. In many developing nations located in diverse ecological regions of the world, malaria is still a large cause of human mortality and controlling it not only requires case detection and treatment, but control of mosquito vectors and their habitats [8]. In Pakistan; P. falciparum is an important public health problem, which annually causing at least ½ million cases of malaria [9].

Malaria is present in endemic form in about 103 countries of the world. Every year more than one billion persons in the world suffer from this disease. It kills about 1-3 million people in the world every year [10]. There is evidence in the medical writings found in China and India indicating that Malaria has existed at least since 2700 BC. The Roman involvement in drainage works especially of marshy land around 26 BC was probably motivated by malarial concerns as well [11]. But, despite centuries of awareness about the disease and breakthrough in understanding what causes malaria and how it can be transmitted among humans in the late 19th Century we have not been able to domesticated either the insect or the parasite that it carries [12]. Part of the reason for the inability to bring malaria under control has to do with the ability of the malaria-causing Anopheles mosquito to breed in even a small amount of stagnant water. Preventing the formation of such breeding grounds in poor agrarian societies lacking the infrastructure to enable drainage of excess water is difficult. Further, the Anopheles mosquitoes tend to become resistant to insecticides such as DDT (Dichlorodiphenyltrichloroethane) and the parasite to drugs like chloroquine [13].

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Classification of Malarial Vectors: mosquitoes belong to the family Culicidae in the order Diptera; class Insect, Phylum Arthropoda [14]. Culicidae is divided into three subfamilies Anophelinae, Culicinae and Toxorhynchitinae and comprise about 3450 recognized species of mosquitoes in 38 genera. The 34 genera are in the subfamily Culicinae, 3 in Anophelinae and only 1 in Toxorhynchitinae. About 460 species of Anopheles mosquitoes have been identified throughout the world, many of which are species complexes. Only about 80 species are capable of transmitting malaria, 70 species are vectors of malaria under natural conditions and approximately 45 are of major significance [15].

Species of Plasmodium: Malaria is caused by obligate intracellular protozoan parasite of the genus plasmodium. Commonly there are four types of malarial parasite. Four species of Plasmodium are involved in the spread of malaria i.e.

- *Plasmodium falciparum, P. vivax, P. ovale, P. malariae*: The most dangerous and common species is *P. falciparum* [16]. In Pakistan there are only two species are common. One is *P. falciparum* and the second one is *P. vivax*.

*Plasmodium vivax* (Benign tertian or vivax malaria) is wide spread in the tropical, subtropical and in some temperate regions [17].

*Plasmodium falciparum* (Malignant tertian) malaria is normally found in warm climates in southern and Eastern Europe and in most parts of tropical Africa and also occurs in the Middle East, India, Pakistan, South-east Asia, North, Australia and Central America [18].

*Plasmodium ovale* (Ovaletertian) malaria is uncommon and occurs in scattered areas of East, West and Central Africa and South America.

*Plasmodium malarial* (Quartan) this type of malaria occurs widely in the tropics, especially in Africa, India and Ceylon.

Malarial Parasite in Pakistan: In Pakistan two species are very common *P. vivax* and *P. falciparum*.

*Plasmodium vivax*: The term “benign tertian malaria” means, *vivax* malaria is usually a simple disease that runs a benign course and is rarely lethal. This medical paradigm has been challenged recently [19]. The incubation period is generally 12-20 days. In the last few days of this period, prodormal symptoms of headache, severe backache, nausea, limb pains, anorexia and vomiting. At start of the chief attack is associated with a rise of temperature to 101° F or higher, usually accompanied by shivering. For the first week, the fever is irregularly remittent or intermittent, with peaks of 103° to 105° F, but without clear periodicity. Without treatment, periodic, intermittent fever continues for 2 to 3 months. The bursts of fever and the associated signs and symptoms are called paroxysms. These occur more commonly in the day than at night and for some reason occur in the afternoons than the mornings. There are typically three stages, cold, hot and sweating [20].

*Plasmodium falciparum*: This is deadly type of jungle fever, which can kill a non-insusceptible individual inside of a week, or two of an essential assault, unless fitting treatment is given in time. Preerythrocytes' schizonts of *P. falciparum* discharge more merozoites than those of other species influencing man. It in this way items, for a given measurements of sporozoites conveyed by a mosquito, a far bigger number of agamic blood frames than alternate species, which might to some extent clarify why it is so much the most hazardous disease. The brooding period is around 8 to 12 days. Plasmodium falciparum will be capable for one of the most serious structure of the sickness, the neurological disorder cerebral jungle fever [21].

Clinical Symptoms of Malaria: The first symptom of the disease, the fever pattern resembles that seen in early stages of many other bacterial, viral and parasitic diseases. The first three species (*P. vivax, P. malariae*and *P. ovale*) may cause severe illness, but they are hardly fatal. However, the fourth specie (*P. falciparum*) causes much more serious and progressive illness, besides it sometimes leads to coma and death within a few days of infection [22].

This parasite has been identified by many names: autumnal fever, malignant tertian malaria and cerebral malaria. The incubation period is usually 7 to 14 days. It is the most serious malaria infection which has fever (In non-immune patients it exceeds 40°C), chills, sweats, cough, diarrhea, respiratory distress, headache, shock, renal and liver failure, pulmonary and cerebral edema, coma and death. Case fatality rates among untreated children and non-immune adults exceed 10 % [23].

Diagnosis and Treatment: The diagnosis of malaria should be confirmed by microscopy of stained thin and thick blood films, at a magnification of 1000. The intraerythrocytic parasites have to be identified and counted. In severe malaria, the developmental stage of the
parasites and the percentage of neutrophils containing malarial pigment should also be noted, since these have prognostic significance [24]. The mainstay of the treatment of severe and cerebral malaria is the immediate start of parenteral antimalarial treatment. Available drugs are injectable artemesunate, quinine and artemether. Intravenous chloroquine has become obsolete in Asia and almost the whole rest of the world because of widespread resistance of the parasite to this once so successful drug. Artesunate belongs to the group of the artemisins, which are currently the most rapidly acting and potent available antimalarial drugs. Unlike quinine they not only act on the mature form of the parasite, but also on the younger ring forms, preventing their maturation and sequestration [25].

Global Burden of Malaria: Bruce-Chwatt [26] reported that Malaria vectors belong to the genera Anopheles (Cellia) Myzomyia and their worldwide distribution has been recognized in six zoological geographical regions; Palaearctic, Oriental, Australasian, Afro-tropical, Neotropical and Neotropical regions. According to Diuk-Waser et al. [27] Malaria is one of the most common vector-borne infectious diseases affecting human populations. Hays et al. [28] reported that Malaria exists its greatest toll in most sub-Saharan African countries where about 70% of the population resides in areas infested with potential malaria vectors. Hay et al. [29] Studied Malaria is the most prevalent tropical disease in the world today. Each year, it causes disease in approximately 650 million people and kills between one and three million, most of them, young children in Sub-Saharan Africa. WHO [30] reported 28 million cases and 38,000 deaths in 2010 in which P. falciparum (61%) and P. vivax are most common and 95% reported cases and deaths are from India, Indonesia and Myanmar. WHO [31] reported 51 malaria-endemic countries outside of Africa had an estimated 34 million malaria cases in 2010 and approximately 46,000 related deaths. This report focuses on countries in Asia, the Pacific, Americas, Middle East and Europe. According to wersdorfer [32] over 80% of population of Africa and, Asia and a significant proportion of Amricans and Europeans were originally exposed to malaria risk, while Australia was largely free of the disease. Breman et al. [33] reported that Africa has 60% of themorbidity and 90% of themortality rates attributable to the disease. Neoh et al. [34]. Reported that around 250 million of malaria cases and one million deaths caused by malaria are reported around the world and in most South East Asia countries; malaria remains a serious threat to public health.

Khalili et al. [35] reported the malaria among 4482 cases, 4257(95%) were male and 225(5%) female. 77.3% of patients were Afghan immigrants, 20.8% Iranian and 1.9% with other nationality. Data showed that 85.2% of isolated species were P. vivax, 13.7% P. falciparum, 0.1% P. malaria and mixed species. Results revealed that Yazd is not an endemic area and 80% of imported cases are immigrant from other area mainly Afghanistan [36].

Malaria is comparatively common in Pakistan. It is more serious in children under five year of age, pregnant women and non-immune people. Abassi and Shaikh [37]. Four species of plasmodium are known to parasites of human being, but two species i.e. P. vivax and p. falciparum are found in Pakistan. Jan and Kiani [38] reported malaria 7% slide observed positivity with P. vivax 6.3% and P. falciparum 0.67% among the Kashmiri refugees settled in Muzaffarabad.

Ghanchi et al. [39] reported incidence of malaria has markedly increased during the last ten years and the relative rate of recurrence of P. falciparum has increased from 45% in 1995 to 68% in 2006 amongst malaria infections. Bano and Mufti [40] reported P. ovaleis completely absent while P. malariais rare. Yasinzi and Kakarsulemankhel [41]. Observed that in Pakistan about ¼ million cases of malaria infection estimated each year. Ahmad et al. [42]. Type of malaria infections that were seen included P. falciparum 46(57%), mixed infection 26(32%) and P. vivax 9(11%). Yasinza et al. [43]. Reported that out of 5598 suspected cases of malaria, 2432 (43.44%) were found to be positive for malaria parasite in blood smear slides. Out of positive cases, 2157(88.69%) were P. vivax 6.3% and P. falciparum 0.67% among the Kashmiri refugees settled in Muzaffarabad.

Saleem et al. [45] in the study of malaria in KPK it was observed that cerebral malaria was more common in males (64%) and most vulnerable group was pregnant women. Afridi et al. [46] at Akhunabad, Peshawar 10.4% incidence rate of malaria out of 2500 suspected cases were noted. Mohammad and Hussan [47] reported 70 individual (6.86%) were positive for Plasmodium vivax. The Plasmodium species found were P. vivax (5.78%) and P. falciparum (1.08%) with not a single case of mixed infection. Incidence was higher in male (7.10%) as compare to female (6.52%) in general population in District Buner. Awan et al. [48] studied these 581 individuals, (3.61%) were found positive only for Plasmodium vivax. No other species of Plasmodium was detected in District Buno. Idris et al. [49] Plasmodium vivax was seen in the majority (72.47%).
Plasmodium falciparum was the second common species detected in 24.1% cases. Mixed infection was seen in 3.44% cases while Plasmodium malariae and ovale was not seen in any patient at Ayub teaching hospital Abbottabad. Shah at al. [50] reported that a total of 795 school children were examined, 4 cases (0.5%) were found positive for malarial parasite.

CONCLUSION

Malaria is a common health problem in world. Both P. vivax and P. falciparum exist in Pakistan. It is concluded that P. vivax is the most common pathogen of malaria in Pakistan and the children below ten years of age are most commonly infected which is because of poorly developed immune system and poor hygienic conditions. The commonly used anti-malarial drug chlororquine, Quinine in the case of vivax and Quinine or Artemethere in falciparum malaria are helpful in more cases.

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