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A Review: Malaria

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Abstract: ***One of the biggest threats to world health is still malaria, especially in tropical and subtropical areas. Herbal treatments have long been used to cure malaria, particularly in areas with limited access to contemporary medical care. Herbal medications have garnered scientific recognition when Artemisinin was discovered in Artemisia annua. On the other hand, the mainstay of malaria therapy has been allopathic medications like primaquine, chloroquine, and artemisinin-based combination treatments (ACTs). However, interest in plant-based substitutes has increased due to the emergence of drug-resistant strains. The aetiology, pathophysiology, diagnosis, and treatment of malaria are highlighted in this overview, with a comparison of allopathic and herbal methods. In comparison to traditional antimalarial medications, it seeks to investigate the effectiveness, safety, drawbacks, and prospects of herbal formulations. With scientific backing, the use of herbal medicine into contemporary treatment may present novel approaches to the long-term management and control of malaria.***

Keywords: Malaria, Herbal treatment, Allopathic drugs, Artemisinin, Drug resistance, **Plasmodium,** ***ACTs, Antimalarial herbs, Traditional medicine, Phytotherapy.***

I. INTRODUCTION

One of the biggest public health issues facing the globe today is malaria, particularly in tropical and subtropical areas. Humans can get this potentially fatal parasite illness by being bitten by female Anopheles mosquitoes carrying the infection. Every year, hundreds of millions of people worldwide suffer from malaria, which is mostly caused by five species of the Plasmodium parasite: Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, Plasmodium malariae, and Plasmodium knowlesi. The most common of these are Plasmodium falciparum and Plasmodium vivax, with the former being the most lethal kind of the illness[1-2].

Malaria is said to have plagued people for thousands of years, thus it has a lengthy history. In reference to the old notion that the disease was brought on by miasmas, or filthy air from marshes, the name "malaria" is derived from the Italian words mal (bad) and aria (air). However, it was not until the late 1800s that the true perpetrator was identified. An important turning point in our knowledge and management of malaria was reached in 1897 when Sir Ronald Ross discovered that mosquitoes are the disease's vector [3-4].

II. EPIDEMIOLOGY AND GLOBAL BURDEN

The World Health Organization (WHO) estimates that there were 241 million malaria infections globally in 2020, leading to about 627,000 fatalities, with sub-Saharan Africa bearing a disproportionately high impact. The bulk of malaria-related fatalities occur in children under five, making them especially vulnerable. Pregnant women, visitors to endemic areas, and those with compromised immune systems are additional high-risk categories. In certain regions of Africa, South Asia, Southeast Asia, Latin America, and Oceania, malaria is endemic. More than 90% of all malaria infections and fatalities occur in Africa alone. The illness still causes a great deal of morbidity, financial damage, and stress on healthcare systems in spite of continuous eradication attempts. Malaria transmission and prevalence are influenced by environmental variables, migratory patterns, vector control measures, and environmental conditions [5-6].

III. CAUSATIVE ORGANISMS AND LIFE CYCLE

Humans and Anopheles mosquitoes are the two hosts in the complicated life cycle of the Plasmodium species that cause malaria. Human asexual reproduction and mosquito sexual reproduction are the two primary stages of the life cycle [7].

Sporozites are injected into a person's bloodstream via an infected mosquito bite. After maturing into schizonts in the liver, these Sporozites burst, releasing merozoites into the circulation.

The typical fever and chills of malaria are brought on by the merozoites' infection, multiplication, and rupture of red blood cells. The cycle is continued when mosquitoes consume the gametocytes—sexual stages of certain parasites—during a blood meal [8].

Relapses may result from the latent liver stage (hypnozoites) of Plasmodium vivax and P. ovale reactivating weeks or months later. This makes it very difficult to eradicate these species completely [9].

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IV. GLOBAL MALARIA CONTROL INITIATIVES

The global community has made considerable progress in malaria control through coordinated initiatives like:

1) Roll Back Malaria (RBM) Partnership
2) President's Malaria Initiative (PMI)
3) The Global Fund to Fight AIDS, Tuberculosis and Malaria
4) WHO's Global Technical Strategy for Malaria 2016–2030

These programs focus on expanding diagnostic access, distributing bed nets, improving access to ACTs, and strengthening health systems. However, funding gaps, political instability, climate change, and public health emergencies (e.g., COVID-19) continue to challenge malaria eradication goals [10-11].

V. ETIOLOGY

Plasmodium protozoan parasites are the cause of malaria. Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae, Plasmodium ovale, and Plasmodium knowlesi are the five species that infect humans. While P. vivax is known to induce relapses, P. falciparum is the most deadly of them. The bite of an infected female Anopheles mosquito spreads the illness. As Sporozites, the parasite enters the human circulation and proceeds to grow in the liver. In addition to insect bites, sharing needles, organ transplants, and blood transfusions can all spread malaria. Although uncommon, congenital transmission from mother to foetus is also conceivable [12-13].

VI. PATHOPHYSIOLOGY

Plasmodium Sporozites enter the circulation through the mosquito and go to the liver, where they develop and proliferate within hepatocytes. The erythrocyte cycle is started by these liver-stage parasites when their schizonts burst and release merozoites into the blood. Merozoites cause symptoms including fever, chills, and anemia by invading red blood cells, multiplying, and then destroying them. Cyclic fever is caused by the coordinated bursting of red blood cells. Certain parasites mature into gametocytes, which mosquitoes can consume when they feed on blood. Complications include brain malaria, acute respiratory distress, and organ failure may arise in severe instances, particularly when P. falciparum is involved [15-16].

VII. DIAGNOSIS

Giemsa-stained thick and thin blood smears are examined under a microscope to identify the parasite species and parasitemia level, which is the main method used to diagnose malaria. Rapid Diagnostic Tests (RDTs) are helpful in field situations because they may identify particular Plasmodium antigens and deliver findings in 15 to 30 minutes. Due to its high sensitivity and specificity, Polymerase Chain Reaction (PCR) is mostly utilized in reference or research labs for the detection of mixed infections and species confirmation. Although they are less frequently used for acute diagnosis, serological testing might help with epidemiological research. Prior to confirmation tests, clinical symptoms such chills, recurring fever, and history of travel to endemic locations all help to support the diagnosis [17-18].

VIII. TREATMENT

The Plasmodium species, medication resistance patterns, and severity of the disease all affect how malaria is treated. Artemisinin-based Combination Therapies (ACTs), such as artemether-lumefantrine or artesunate-mefloquine, are used to treat simple P. falciparum infections. To get rid of liver-stage hypnozoites, P. vivax and P. ovale need primaquine and chloroquine (if sensitive). Oral ACTs must be taken after intravenous artesunate for severe malaria, especially those caused by P. falciparum. Primaquine also kills gametocytes, which stops transmission. Medication monitoring is crucial because medication resistance makes treatment more difficult, particularly in Southeast Asia and Africa. In order to treat complications and lower malaria-associated morbidity and mortality, supportive care, antipyretics, and hydration management are essential [19-20].

IX. HERBAL DRUGS USED IN TREATMENT OF MALARIA

Traditionally utilized in endemic areas, a number of herbal treatments have shown antimalarial efficacy. Important plants include Swertia chirata, Alstonia scholaris, Andrographis paniculata, Cinchona bark (quinine), Azadirachta indica (neem), Artemisia annua (artemisinin source), and Curcuma longa (turmeric). Bioactive components found in these plants, such as flavonoids, alkaloids, and sesquiterpene lactones, disrupt the parasite's life cycle. Numerous have demonstrated encouraging antiplasmodial properties and have been professionally verified both in vitro and in vivo. Particularly in remote or resource-constrained areas, herbal medicine provides a viable and affordable substitute for synthetic medications, maybe with fewer adverse effects and improved patient tolerance [21-22].

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X. ALLOPATHIC DRUGS USED IN TREATMENT OF MALARIA

Artemisinin-based combination treatments (ACTs), the first-line treatment for uncomplicated Plasmodium falciparum malaria, are a major component of modern antimalarial therapy. Artemether-lumefantrine and artesunate-mefloquine are examples of common ACTs. In regions where resistance is absent, P. vivax is treated with chloroquine. Primaquine works well against P. vivax and P. ovale hypnozoites. Artesunate is used intravenously to treat severe malaria. Quinine, atovaquone-proguanil, doxycycline, and clindamycin (in combination treatment) are other medications. These medications work quickly and target many phases of the parasite's life cycle, but they can have negative side effects including nausea, haemolysis, or neurotoxicity, and resistance to some of them has grown to be a serious issue [23-25].

XI. COMPARATIVE ANALYSIS OF HERBAL VS ALLOPATHIC

Malaria may be treated naturally, easily, and culturally using herbal remedies, which frequently have fewer negative effects. They may have multi-targeted modes of action and are reasonably priced. But there is a lack of clinical validation, standardisation, and dose precision. Allopathic remedies, such as ACTs, on the other hand, are standardized, fast-acting, and supported by evidence; nevertheless, they can be costly, have adverse effects, and encounter growing resistance. Herbal remedies show promise for long-term integration, even though allopathic medications are still the gold standard in acute therapy. A balanced, sustainable strategy for managing malaria worldwide may be provided by combining the two systems through the development of phytopharmaceuticals, which might increase efficacy and decrease resistance [26-28].

XII. FUTURE SCOPE OF STUDY

Modern pharmacology and traditional herbal knowledge will be combined in integrated techniques to treat malaria in the future. Finding, separating, and standardizing phytoconstituents with shown anti plasmodial action should be the main goals of research. The development of innovative drug delivery methods, clinical trials of herbal formulations, and studies that work in concert with current antimalarial might all improve efficacy and get past resistance. The creation of herbal drugs may be transformed by molecular docking, AI-driven chemical screening, and delivery based on nanotechnology. Herbal research is a potential field for future medicines and public health progress since drug-resistant malaria is becoming a more serious problem and there is an urgent need for novel, safe, and economical alternatives [29-30].

XIII. CONCLUSION

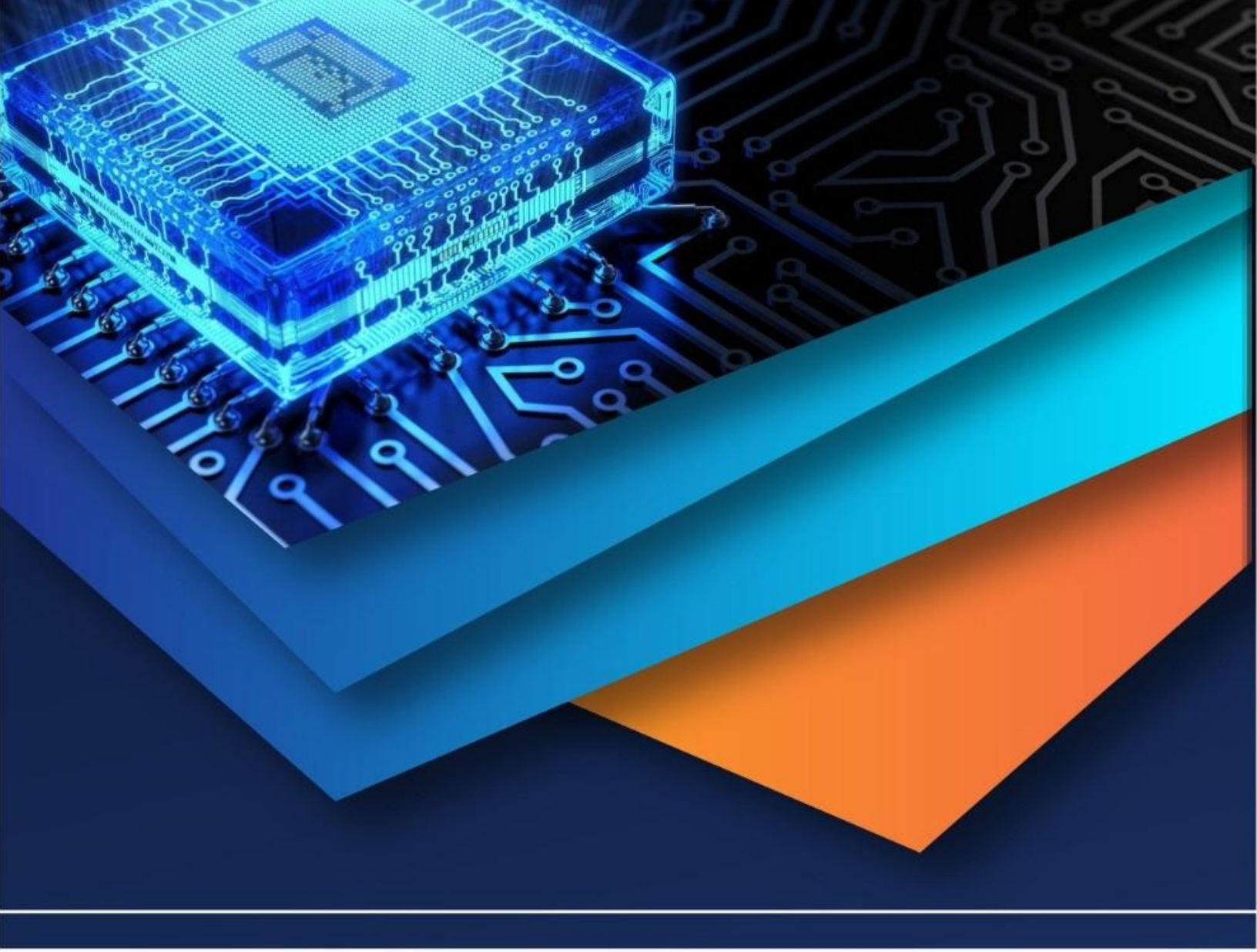
In order to effectively cure malaria, both allopathic and natural remedies are crucial. In acute care settings, allopathic medications—especially ACTs—are essential because they provide quick and consistent relief. However, the necessity for alternate or adjunct therapy is highlighted by the rising problem of medication resistance and adverse effects. Rich in bioactive components and supported by centuries of traditional usage, herbal medicines have a lot of promise, especially when scientific study validates them. Future malaria therapies might be more efficient, reasonably priced, and environmentally friendly if both systems are balanced and current science and traditional knowledge are combined.

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