Malaria in Children

Natasha M. Kafai, BS[a], Audrey R. Odom John, MD, PhD[b,c,*]

KEYWORDS

• Malaria • Travel medicine • Fever • Diagnostics • Antiparasitic therapy
• Chemoprophylaxis

KEY POINTS

- Malaria is common worldwide and travel to malaria-endemic destinations is increasing.
- Travel history should be obtained for all children presenting with fever.
- Antigen-based malaria tests can provide rapid malaria diagnosis, although blood smears are still necessary.
- Treatment of malaria depends on severity of illness, species of malaria parasite, and epidemiologic likelihood of drug resistance.

INTRODUCTION

A century ago, malaria was a major public health threat in the United States, with ongoing transmission in 13 Southeastern states as late as the 1930s.[1] Although extensive efforts ultimately eliminated local malaria in North America, this mosquito-borne infection remains endemic throughout much of the world. Indeed, more than half of the children on our planet live in malaria-endemic countries. Despite continued success in malaria control, there are more than 200 million new infections each year and nearly half a million deaths, mostly in infants and children younger than 5 years old.[2] Importantly, in our increasingly global society, malaria and other imported infectious diseases remain of particular concern to the North American traveler, with nearly all American malaria cases acquired abroad.[3–6]

This article offers a brief overview of the *Plasmodium* parasite responsible for malaria, the epidemiology of infection, clinical features associated with uncomplicated

Disclosures: Research funding: NIH/NIAID (AI103280, AI123808), Bill and Melinda Gates Foundation, Children's Discovery Institute, and Dr A.R.O. John is a Burroughs Wellcome Fund Investigator in the Pathogenesis of Infectious Disease. Scientific advisory board member, Pluton Biosciences LLC (A.R.O. John).

[a] Medical Scientist Training Program, Washington University School of Medicine, 660 S. Euclid Avenue, Campus Box 8226, St Louis, MO 63110, USA; [b] Department of Pediatrics, Washington University School of Medicine, 660 South Euclid Avenue, Campus Box 8208, St Louis, MO 63110, USA; [c] Department of Molecular Microbiology, Washington University School of Medicine, 660 South Euclid Avenue, Campus Box 8208, St Louis, MO 63110, USA
* Corresponding author.
E-mail address: aodom@wustl.edu

Infect Dis Clin N Am ■ (2017) ■–■
https://doi.org/10.1016/j.idc.2017.10.008 **id.theclinics.com**

and severe malaria presentations, preventative measures for travelers, and current treatment strategies for childhood malaria infections.

DESCRIPTION OF THE PATHOGEN

Malaria is caused by infection with intracellular protozoan parasites of the genus *Plasmodium*, transmitted by the bite of a female *Anopheles* spp mosquito.[7,8] While feeding, the infected mosquito leaves behind sporozoites, the infectious motile form of the parasite. Sporozoites then migrate to the liver, asymptomatically invade hepatocytes, and amplify infection through the release of tens of thousands of daughter parasites. This release initiates the asexual erythrocytic replication stage of the parasite life cycle, the stage of parasite responsible for the malaria pathogenesis. Two species of *Plasmodium*, *P vivax* and *P ovale*, uniquely develop dormant parasite forms called hypnozoites, which may remain in the liver for months or years after primary infection before causing relapse and recurrent symptomatic disease.[9,10]

The clinical symptoms of malaria are due to cycles of asexual replication within red blood cells (**Fig. 1**). Fever is a hallmark symptom, triggered by erythrocyte rupture and parasite release every 2 to 3 days, depending on *Plasmodium* species.[7] Severe, life-threatening malaria may result from high parasite burdens, causing hemolysis and severe anemia, or from end-organ damage due to vascular adherence of infected erythrocytes and microocclusion.[11,12] Person-to-person transmission is mediated by mosquitoes, in which the sexual form of the parasite (gametocytes) infects a feeding mosquito to thus complete the parasite's complex life cycle.[7,8]

EPIDEMIOLOGY

More than half the world's population lives in areas where malaria transmission occurs, and the disease continues to cause a major public health burden to populations in areas of Africa, Asia, and Central and South America (**Fig. 2**).[2] In 2015, more than 200 million

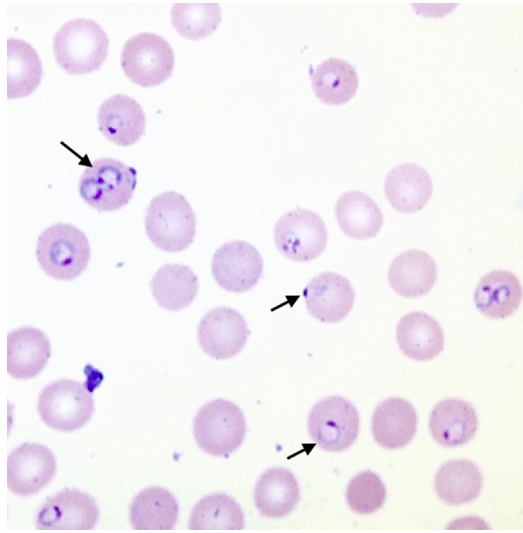

Fig. 1. Blood smear from patient with *P falciparum* malaria. Intraerythrocytic parasite forms are visible in nearly 20% of red blood cells, some of which are doubly-infected. Arrows: typical signet ring, headphones, and appliqué forms of the parasite. (*Courtesy of* Amruta Padhye MD, Columbia, MO.)