

A Bedside Dipstick Method to Detect *Plasmodium falciparum*

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We conducted this study to determine efficacy of Parasight-F (an HRP-II antigen dipstick method to detect *P. falciparum*) in children. A total of 30 children were enrolled in the age group of 2 months to 12 years whose peripheral smear showed asexual forms of *Plasmodium falciparum*. All patients were tested for presence of HRP-II antigen of *Plasmodium falciparum* in their blood by the Parasight-F dipstick test by either an EDTA sample or a finger prick blood sample. The sensitivity of Parasight-F was 83.3%. However, the sensitivity of Parasight-F to detect *Plasmodium falciparum* in case of mixed *Plasmodium* (*Vivax* + *falciparum*) infection was only 25%. Also, all patients less than 6 months of age had a negative Parasight-F test. Parasitic index, prior treatment with antimalarials or severity of *falciparum* malaria have no effect on the sensitivity of Parasight-F test. We conclude that Parasight-F is an effective tool for diagnosis of *Plasmodium falciparum* malaria in children.

Keywords: HRP-II antigen, Parasight-F, *Plasmodium falciparum*.

Plasmodium falciparum is the most dangerous type of malaria, left untreated it can lead to fatal cerebral malaria(1). Rapid detection of *Plasmodium falciparum* parasite in a patient's blood is required for prompt treatment. To detect peripheral parasitemia on microscopic examination of the blood smear requires observer expertise and depends on the parasitic index and the timing of collection of blood. Therefore, a test that is bedside, rapid and not observer dependent is required for urgent diagnosis of *Plasmodium falciparum* infection. This study was thus undertaken to detect the sensitivity of Parasight-F (a dipstick qualitative test to detect histidine rich protein II-HRP II antigen of *P. falciparum*) in *P. falciparum* infected children.

Subjects and Methods

Thirty children in the age group of 2 months to 12 years with fever, splenomegaly and a positive peripheral smear showing

asexual forms of *Plasmodium falciparum* were prospectively evaluated for presence of *Plasmodium falciparum* histidine rich protein II antigen in their blood by the Parasight-F dipstick test. Patients whose peripheral smear showed gametocytes of *Plasmodium falciparum* were excluded from the study as the test fails to detect *Plasmodium falciparum* infections with only gametocytes in the blood(2). Parasitic index was determined by counting 1000 RBCs on thin peripheral smear and reporting the number of RBCs infected per hundred RBCs counted. Either an EDTA sample or a finger prick blood sample was collected for the dipstick test. As the HRP II antigen from the blood adsorbs to the antibody immobilized on the strip, a solid pink line on the test strip is formed suggesting a positive test. Efficacy of Parasight-F to detect *Plasmodium falciparum* malaria in children, in different age groups, in presence of mixed *Plasmodium* (*Vivax* + *falciparum*) infection,

with different ranges of parasitic index and prior treatment with antimalarials was evaluated.

Results

Out of 30 patients with microscopic falciparum parasitemia, 25 patients had a positive HRP-II antigen detection dipstick test. Thus the sensitivity of Parasight-F test was 83.33%. Four patients had presence of mixed Plasmodium infection (Vivax + falciparum) on the peripheral smear of which 3 patients (75%) had a negative HRP II antigen dipstick test. Of the 30 patients, 3 patients were below 6 months of age with parasitic index ranging from 1% to 8% (mean = 3.3%). All 3 of them (100%) had a negative HRP-II antigen dipstick test. However, of these 3 patients below 6 months of age, 2 patients (66.66%) also had presence of mixed Plasmodium infection (*Table I*).

There was no significant difference in the sensitivity of Parasight-F test in children above 6 months of age and gender. Eleven patients in the study had received chloroquine prior to testing. However, all 11 patients (100%) had a positive HRP II dipstick test and *Plasmodium falciparum* parasitemia on peripheral smear. Eleven patients had severe malaria including 9 patients with cerebral malaria and the HRP II antigen test was positive in 9 patients (81.81%) with severe

malaria including 8 patients (88.88%) with cerebral malaria.

The parasitic index ranged from 1% to 20% with mean parasitic index being 3.1%. Two patients (6.6%) with a parasitic index of 1%, 2 patients (6.6%) with a parasitic index of 2% and 1 patient (3.3%) with a parasitic index of 8% had a negative Parasight-F test. Parasitic Index had no statistical significance on the Parasight-F test.

Discussion

Plasmodium falciparum malaria is seen predominantly in Africa, India, Brazil, Afghanistan, Sri Lanka, Thailand, Indonesia, Vietnam, Cambodia and China(1). A significant number of malarial patients may have a negative peripheral smear for Plasmodium parasite leading to delayed diagnosis and treatment(3).

Other tests such as polymerase chain reaction (PCR) with a sensitivity of 95% and specificity of 99%(4) and ELISA for detection of serum IgM & IgG against *Plasmodium falciparum* with a sensitivity of 78.1% and specificity of 94.9%(5) are available. However, they are expensive, time consuming and available only in specific laboratories.

Parasight-F is a rapid, bedside qualitative dipstick test that detects the HRP II antigen of *Plasmodium falciparum* on the RBCs. It does

TABLE I—Sensitivity of Parasight-F test in children.

Age	Total no. of patients	Mean parasitic index	Range of parasitic index	Positive Parasight-F
2-6 months	3	3.7%	1-8%	0 (0%)
6 month-1 year	2	1.6%	1.2-4%	2 (100%)
1 year-5 years	13	2.8%	1-8%	12 (92.3%)
5 years-10 years	8	4.8%	1-20%	7 (87.5%)
10 years-12 years	4	1.5%	1-2%	4 (100%)

Key Messages

- Parasight-F is a sensitive, rapid, easy to use bedside test for detection of *Plasmodium falciparum* infection in children.
- Effectiveness of Parasight-F in *Plasmodium falciparum* infected children below 6 months of age needs further evaluation.

not require any instrumentation or expertise. Studies in adults have found the sensitivity ranging from 88.96% to 96.5% and specificity ranging from 97% to 99.1%(3,6-8). Our study also showed a sensitivity of 83.33%. However, there were no studies available to exclusively depict the efficiency of Parasight-F in pediatric population. Utility of Parasight-F is not reliable in patients less than 6 months of age and needs to be further analyzed. Also, whether presence of fetal hemoglobin or maternal antibodies has a confounding effect on the test needs to be determined.

Though Parasight-F is antigen specific for *Plasmodium falciparum* and there is no cross-reactivity with *Plasmodium vivax*(9), we found the efficiency of Parasight-F would drop in presence of mixed *Plasmodium* infection though Banchongaksorn, *et al.*(10) found the test positive in 41 patients with mixed infection. One may suspect human error in species identification during smear examination. However, since 2 (50%) of these patients were also below 6 months of age, whether mixed infection actually has an effect of Parasight-F sensitivity needs further evaluation.

Parasight-F test may remain positive for 7-10 days even after treatment with antimalarials(6,11). All our patients who were treated with chloroquine prior to testing had a positive HRP-II antigen test but they also had peripheral parasitemia. Thus, HRP-II antigen

dipstick test may not be useful to assess response of antimalarial therapy, as it is a qualitative test.

Though Parasight-F test has been found to have high sensitivity when parasitemia is more than 30-40 parasites/mL(12,13), it is also noted that sometimes high levels of parasitemia (>1000 parasites/microliter) also give false negative results but the underlying reason is not known(7). In our study, we found that parasitic index had no effect on the sensitivity of the test. Also, severity of malaria does not affect the sensitivity of the test.

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