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Original Article

Parascreen as an alternative diagnostic tool for falciparum malaria

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Abstract

Background Malaria is a parasitic disease with high morbidity and mortality. Rapid immunochromatographic are emerging to detect specific antigens of human plasmodia.

Objective To determine the sensitivity and specificity of Parascreen for the detection of *Plasmodium falciparum* in children.

Methods A diagnostic test study was performed in Mandailing Natal District, Penyabungan, North Sumatera. Subjects were public health center and hospital patients with symptoms of fever, pallor, headache, and diarrhea. Blood specimens were obtained for Parascreen testing. Microscopy of Giemsa-stained blood samples served as the gold standard.

Results One hundred and four subjects were studied. The sensitivity and specificity of Parascreen were 76% and 100%, respectively. Positive and negative predictive values of the test were 100% and 49%, respectively. Likelihood ratio was infinite for a positive test and 0.23% for a negative test.

Conclusion Parascreen is a useful and highly specific diagnostic tool for *P. falciparum* malaria **[Paediatr Indones 2008;48:220-3]**.

Keywords*: malaria, Plasmodium falciparum, Parascreen, sensitivity, specificity*

Malaria remains a major health problem for children in tropical areas of the world, including Indonesia.[1,2] Every year, 200 million people are infected with malaria, resulting in two million deaths.[3,4] Most malarial deaths occur in infants and young children.[5,6] Malaria is caused by one or more of the four plasmodium species that infect humans: *Plasmodium falciparum*, *Plasmodium vivax, Plasmodium ovale*, and *Plasmodium malariae*.[7,8] Malaria due to P. falciparum is the most common and most dangerous due to its ability to cause fatal cerebral malaria.[9-11]

Malaria presents a diagnostic challenge to laboratories in most countries.[12] Prompt and accurate diagnosis is the key to effective disease management; therefore, it is one of the main interventions of the global malaria control strategy.[13,14] Considered as the gold standard, microscopic examination of Giemsa-stained blood films is widely used because of its efficiency and low cost.[15-17] However, it is time consuming and requires proper equipment and trained personnel.[16] The World Health Organization has recognized the need to overcome problems concerning diagnostic microscopy and supports the development of non-microscopic alternatives.[11,16] Several diagnostic methods have been developed for detection of the *P. falciparum* malaria disease process.

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Immunological methods for this purpose have been found to be convenient and easy.[10] Parascreen is an immunochromatographic test (ICT) used for the rapid diagnosis of malaria which has been marketed for several years.[18] However, the performance of this test in the detection of P. *falciparum* malaria in Indonesian children has not been established. This study aims to determine the sensitivity and specificity of Parascreen for the detection of *P. falciparum* in children in Mandailing Natal District, Penyabungan, North Sumatera.

Methods

A diagnostic test study was conducted in Mandailing Natal District, Penyabungan, North Sumatera from October to November 2006. The study was approved by the Health Reseatch Ethics Committee of the Medical School, University of North Sumatera.

The required number of subjects based on the sample size formula for a diagnostic test was 104. We included patients who came to the public health center or hospital with symptoms of fever, pallor, headache, and diarrhea. Patients with history of receiving any antimalarial drug within one week prior to commencement of the study and those who refused examination were excluded.

The Parascreen test were done on all samples. Microscopy of Giemsa-stained thick and thin blood films were considered the gold standard. Parascreen testing as well as blood film preparation was performed directly from finger-pricked blood samples. Blood films were stained with 10% Giemsa solution and examined at a magnification of 1,000x by an expert microscopist. The microscopist was unaware of the patient's diagnosis or Parascreen test result. The initial thick and thin films were considered positive if parasites were seen in at least 100 high-power fields.

Parascreen Pan/Pf test (Zephyr Biomedical Systems, Verna, Goa, India) with 15 μl of finger-pricked capillary blood was performed according to the manufacturer's instructions by well-trained personnel. The results were read by designated physicians who were blinded to the microscopy results. The test was considered positive if the control line was visible in accordance with the specific histidine-rich protein-2 (HRP-2) and/or pan-malarial antigen line. A diagnosis of *P. falciparum* was made if the HRP-2 line was visible, with or without the pan-malarial antigen line.

Data was analyzed using SPSS 13.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The performance of the Parascreen test for detection of P. *falciparum* was determined by calculating the sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios of this test. Test accuracy was defined as the proportion of subjects with a correct Parascreen result, calculated as the sum of true positives and true negatives divided by the total number of subjects.[19]

Results

One hundred and four subjects were recruited in this study. Fifty-five percent of the subjects were female. Most subjects (90%) were 6-12 years of age. The most common complaint was pallor (85%) and the most common physical finding was splenomegaly (7%). Subject characteristics are shown in **Table 1**.

Table 1. Subject characteristic

	n	%
Sex		
Female	57	55
Male	47	45
Age (years)		
6 - 12	94	90
> 12 - 15	8	8
> 15 - 18	2	2
Complaints		
Pallor	88	85
Fever	14	13
Headache	50	8
Diarrhea	7	7
Physical findings		
Jaundice	4	4
Hepatomegaly	5	5
Splenomegaly	7	7

Results of the Parascreen test and blood slide microscopy were used to construct a 2x2 table (**Table 2**). Based on microscopy results, the prevalence of *P. falciparum* malaria was 82%. The sensitivity, specificity, PPV, and NPV of the Parascreen test to detect P. falciparum were 76%, 100%, 100%, and 49%, respectively. The accuracy of the test was 81%. The likelihood ratio was infinite for a positive test and 0.23 for a negative test.

Table 2. Comparison between Parascreen and microscopy results

		Microscopy		n
		Positive	Negative	
Parascreen	Positive	65	0	65
	Negative	20	19	39
n		85	19	104

We calculated the sensitivity of the Parascreen test at different levels of P. falciparum parasitemia (**Table 3**). The test was not sensitive for parasitemia less than 100/μl. Sensitivity increased with increasing levels of parasitemia, and reached 100% at parasitemia above 400/μl.

Table 3. Sensitivity of the Parascreen test at different levels of P. falciparum parasitemia

Level of parasitemia (number of parasites per μL blood)	n	Number of positive Parascreen tests	Sensitivity
1 – 100	11	0	0
101 - 200	32	26	81%
201 – 400	24	21	87%
401 – 600	18	18	100%

Discussion

Of the 104 patients who met the case definition for clinical malaria, 55% were female. The age range was 6 to 18 years; most subjects were 6 to 12 years old. In Nias, North Sumatera, Marletta *et al*[20] found malaria to be most prevalent in the age group of 5-14 years. The difference in malaria morbidity rates across gender and age groups is caused by factors such as occupation, education, environment, population migration, and immunity.[9]

The diagnosis of malaria is based on anamnesis, physical examination, and laboratory findings. The gold standard for laboratory diagnosis of malaria is detection of parasites on microscopic examination of thick and thin blood smears. However, this method has several shortcomings, such as the need of a light microscope and a trained examiner. According to a recent survey of laboratories in West Nusa Tenggara, Indonesia, only 79% of the analysts evaluated were able to read the blood smear properly.[21]

In this study, false negative results were mostly found in subjects with low parasitemia levels (<100/μL), similar to the findings of Kakkilaya.[22] A study by Aslan *et al*[4] showed that the colour intensity of a rapid diagnostic test dipstick is induced by the parasitemia level.

In this study, we found that the Parascreen test had a sensitivity of 76% and specificity of 100%. In India, Singh[23] found that ICT malaria Pf/Pv, another rapid diagnostic test for malaria, had a sensitivity of 97% and specificity of 88%. Palmer[17] similarly evaluated the OptiMAL test, which had a sensitivity of 94% and specificity of 100%. In Sumba, Indonesia, Tjitra[16] found the sensitivity and specificity of ICT malaria Pf/Pv to be 95.5% and 89.8%, respectively. In the same district as the present study, Desrinawati[24] evaluated ICT malaria Pf/Pv and found a sensitivity of 76% and specificity of 69%. Jelinek[25] compared OptiMAL with ICT malaria Pf using PCR as the gold standard; this study found a sensitivity of 92% and specificity of 98% for ICT malaria Pf and a sensitivity of 89% and specificity of 99% for OptiMAL. In West Nusa Tenggara, Arum *et al*[21] found the sensitivity and specificity of ICT malaria Pf/Pv to be 100% and 97%, respectively.

In this study, we found an increase of sensitivity with increasing parasitemia levels, reaching 100% in parasitemia >400/μl. In Thailand, Coleman *et al*[26] reported that the sensitivity of ICT malaria Pf/Pv was 100% in parasitemia ≥500/μl, but only 23.3% in parasitemia <500/μl. Tjitra *et al*[16] obtained a sensitivity of 96% in parasitemia >500/μl, but only 29% in parasitemia <500/μl.

Sensitivity and specificity are constant indices of diagnostic test performance uninfluenced by disease prevalence and are used to derive likelihood ratios.[19] In this study, the Parascreen test had a reasonably good sensitivity and a high specificity, resulting in an infinite likelihood ratio for a positive test.

We conclude that, with a sensitivity of 76% and specificity of 100%, Parascreen can be used as an alternative diagnostic tool for P. *falciparum* malaria.

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