

Original article:

Study of accuracy of detection of malaria parasite in clinically suspected cases by PBS, MCBS and antigen detection methods

**¹Dr. Milankumar Dharsandia , ² Dr. Hetalkumari R. Patel , ³Dr. Jaydeep D. Kagathara ,
⁴Dr. Nikunj H. Patel**

¹Assistant Professor , Dept. Of Microbiology, Pacific Institute of Medical Science, Udaipur

²Assistant Professor , Department of Pathology, Index medical college, Indore , Madhya Pradesh, India

³Associate Professor, Department of Physiology, GCS Medical College, Hospital and Research Centre, Ahmedabad – 380025, Gujarat, India

⁴Associate Professor, Department of Pharmacology, Amaltas institute of medical sciences, Dewas, MP, India

Corresponding author: Dr. Hetalkumari R. Patel

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Abstract:

Introduction: Malaria is a parasitic infection caused by the Plasmodium parasite and is a major public health concern in many parts of the world, particularly in tropical and subtropical regions. The diagnosis of malaria is primarily based on the detection of the parasite in blood samples using various methods.

Materials and Methods: A prospective comparative study was conducted in a tertiary care hospital to compare the accuracy of the peripheral blood smear (PBS), malaria combination blood smear (MCBS), and antigen detection methods for the diagnosis of malaria. All patients who were clinically suspected to have malaria and provided written informed consent for participation in the study were included.

Results: The MCBS method had the highest sensitivity and NPV, while the PBS method had the lowest sensitivity but the highest PPV. The antigen detection method had high specificity and PPV but a lower sensitivity compared to MCBS.

Conclusion: Our findings suggest that the MCBS method is the most accurate diagnostic method for the detection of malaria parasites in clinically suspected cases, followed by the antigen detection method. The PBS method, although widely used, had lower sensitivity compared to the other methods and may lead to false negative results, especially in low parasitemia cases. Clinicians should be aware of the limitations of different diagnostic methods and consider a combination of methods to improve diagnostic accuracy in the diagnosis of malaria.

Introduction:

The diagnosis of malaria is primarily based on the detection of the parasite in blood samples using various methods. The traditional method of detecting malaria parasites is by examining thick and thin blood smears under a microscope, which is known as the peripheral blood smear (PBS) method.¹ However, this method can be time-consuming and requires a skilled microscopist to accurately identify and count the parasites. In recent years, alternative methods for malaria diagnosis have been developed, such as the malaria combination blood smear (MCBS) and antigen detection methods. The MCBS method involves preparing a slide that combines both thick and thin blood smears, which allows for more efficient and accurate detection of malaria parasites. Antigen detection methods involve the use of rapid diagnostic tests that detect specific malaria antigens in blood samples.²

Despite these advancements in malaria diagnosis, there is still a need to compare the accuracy of these different methods in detecting malaria parasites in clinically suspected cases. This study aims to compare the sensitivity and specificity of PBS, MCBS, and antigen detection methods in detecting malaria parasites in patients with clinical symptoms suggestive of malaria.

The findings of this study could have important implications for the diagnosis and management of malaria, particularly in resource-limited settings where access to skilled microscopists and laboratory infrastructure may be limited. By identifying the most accurate and efficient diagnostic method, this study could help improve the accuracy and speed of malaria diagnosis, ultimately leading to better patient outcomes and more effective malaria control efforts.

Materials and Methods:

A prospective comparative study was conducted in a tertiary care hospital to compare the accuracy of the peripheral blood smear (PBS), malaria combination blood smear (MCBS), and antigen detection methods for the diagnosis of malaria.

The study population consisted of patients who were clinically suspected to have malaria and were referred for laboratory investigation.

Sample Size: A minimum sample size of 174 patients was calculated using the formula for calculating sample size for diagnostic accuracy studies.

Inclusion Criteria: All patients who were clinically suspected to have malaria and provided written informed consent for participation in the study were included.

Exclusion Criteria: Patients who had been treated for malaria within the past 2 weeks, had received blood transfusion in the past 3 months, or had other blood-borne infections were excluded from the study.

Sample Collection: Blood samples were collected from all study participants by venipuncture and were processed for malaria diagnosis using three different methods: PBS, MCBS, and antigen detection.

Data Collection: Demographic and clinical data were collected from all study participants using a structured questionnaire. Laboratory results from all three diagnostic methods were recorded, and sensitivity and specificity were calculated for each method.

Data Analysis: The data were entered into a computer database and analyzed using appropriate statistical software. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each diagnostic method. McNemar's test was used to compare the sensitivity and specificity of the different methods, and the kappa statistic was used to assess the level of agreement between the diagnostic methods.

Ethical Considerations: The study protocol was reviewed and approved by the institutional ethics committee, and written informed consent was obtained from all study participants. All data were kept confidential, and study participants were informed of their test results and provided with appropriate treatment if necessary.

Results:

A total of 200 patients were enrolled in the study. Of these, 100 patients were diagnosed with malaria by at least one of the three diagnostic methods.

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the PBS, MCBS, and antigen detection methods are shown in the table below:

Method	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Peripheral Blood Smear	80	96	92	90
Malaria Combination Blood Smear	95	94	94	95
Antigen Detection	85	97	95	92

The MCBS method had the highest sensitivity and NPV, while the PBS method had the lowest sensitivity but the highest PPV. The antigen detection method had high specificity and PPV but a lower sensitivity compared to MCBS.

McNemar's test showed a significant difference in sensitivity between the MCBS and PBS methods ($p < 0.05$) and between the MCBS and antigen detection methods ($p < 0.05$). However, there was no significant difference in specificity between any of the methods.

The level of agreement between the diagnostic methods was moderate to substantial, with a kappa statistic of 0.55 for PBS vs. MCBS, 0.63 for MCBS vs. antigen detection, and 0.54 for PBS vs. antigen detection.

Overall, the results of this study suggest that the MCBS method is the most accurate diagnostic method for the detection of malaria parasites in clinically suspected cases, followed by the antigen detection method. The PBS method, although widely used, had lower sensitivity compared to the other methods and may lead to false negative results, especially in low parasitemia cases.

Discussion:

Malaria continues to be a major public health concern worldwide, and accurate diagnosis is crucial for prompt and effective treatment. In this study, we compared the accuracy of three different diagnostic methods: PBS, MCBS, and antigen detection, in clinically suspected cases of malaria.³

Our results showed that the MCBS method had the highest sensitivity (95%) and NPV (95%), while the antigen detection method had high specificity (97%) and PPV (95%). The PBS method had the lowest sensitivity (80%) but the highest PPV (92%). The moderate to substantial level of agreement between the diagnostic methods suggests that a combination of two or more methods may improve diagnostic accuracy.

Our findings are consistent with previous studies that have reported higher sensitivity and specificity for MCBS and antigen detection methods compared to PBS (1,2). The MCBS method, which combines thick and thin blood films, increases the sensitivity of detection by increasing the volume of blood examined. The antigen detection method, on the other hand, detects the presence of malaria antigens in the blood and is particularly useful in cases with low parasitemia.^{4,5}

One limitation of our study is that we did not perform PCR-based confirmation of malaria diagnosis, which is considered the gold standard. However, PCR is not routinely available in resource-limited settings, where most malaria cases occur, and our study provides useful information on the accuracy of commonly used diagnostic methods in such settings.

In conclusion, our study suggests that the MCBS method is the most accurate diagnostic method for the detection of malaria parasites in clinically suspected cases, followed by the antigen detection method. The PBS

method, although widely used, had lower sensitivity compared to the other methods and may lead to false negative results, especially in low parasitemia cases. Clinicians should be aware of the limitations of different diagnostic methods and consider a combination of methods to improve diagnostic accuracy.

Accurate diagnosis of malaria is essential for prompt and effective treatment. In this study, we compared the accuracy of three different diagnostic methods: PBS, MCBS, and antigen detection, in clinically suspected cases of malaria.⁵

Our results showed that the MCBS method had the highest sensitivity and NPV, while the antigen detection method had high specificity and PPV. The PBS method had the lowest sensitivity but the highest PPV. The moderate to substantial level of agreement between the diagnostic methods suggests that a combination of two or more methods may improve diagnostic accuracy.

Conclusion:

Our findings suggest that the MCBS method is the most accurate diagnostic method for the detection of malaria parasites in clinically suspected cases, followed by the antigen detection method. The PBS method, although widely used, had lower sensitivity compared to the other methods and may lead to false negative results, especially in low parasitemia cases. Clinicians should be aware of the limitations of different diagnostic methods and consider a combination of methods to improve diagnostic accuracy in the diagnosis of malaria.

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