

Examine the Diagnostic Evaluation of Rapid Diagnostic Test for Diagnosing Malaria in Children

SAJID SHAMIM¹, ANILA FARHAT², KHYALMUHAMMAD³, ALLAH NAWAZ SULTAN³

¹Senior Registrar, Paediatric Department Frontier Medical College Abbottabad

²Assistant Professor, Paediatric Department Frontier Medical College Abbottabad

³Junior Consultant, Paediatrics A Unit Ayub Teaching Hospital Abbottabad

⁴Assistant Professor, Paediatrics Sharif Medical City Hospital Lahore

Correspondence to: Dr. Sajid Shamim, Email: drsajidshamim@yahoo.com, Cell No: +923335038390

ABSTRACT

Objective: To determine the diagnostic accuracy of rapid diagnostic test for diagnosing malaria in children clinically suspected to have malaria. Microscopy was taken as a gold standard.

Study Design: Cross-sectional/Observational

Place and Duration: Conducted in Paediatrics Department of King Abdullah Hospital Mansehra for six months duration from 1st July 2018 to 31st December, 2018.

Methods: One hundred and forty patients of both genders clinically suspected to have malaria with ages up to 12 years were enrolled in this study. Detailed demographics including age, sex, and symptoms were recorded. Rapid diagnostic test was performed and compare the findings with microscopic examination. Microscopy was taken as a gold standard Sensitivity, specificity, PPV, NPV and diagnostic accuracy of Rapid diagnostic test were examined. Data was analyzed by SPSS 24.0.

Results: There were 85 (60.71%) male and 55 (39.29%) female patients. 62 (44.29%) patients were ages 0 to 6 years while 78 (55.41%) were ages 7 to 12 years. 80 (57.14%) patients showed positive for malaria by microscopic examination and by rapid diagnostic test 83 (58.57%) had malaria positive. By comparing RDT findings with microscopy the sensitivity, specificity, PPV, and NPV were 96.25%, 90%, 92.77% and 94.74%. The positive likelihood ratio was 9.63 (4.50-20.59). The diagnostic accuracy of RDT was 93.57%.

Conclusion: Rapid diagnostic test is very useful diagnostic tool for diagnosing malaria in children and can be used as an alternate to the microscopic examination.

Keywords: Malaria, Microscopy, Rapid Diagnostic Test, Diagnostic Accuracy.

INTRODUCTION

Malaria caused by parasites such as Plasmodium falciparum (Pf), Plasmodium vivax (Pv), Plasmodium knowlesi (Pk), Plasmodium malariae (Pm), and Plasmodium ovale (Po), of which P. falciparum and P. vivax are the most prevalent, but life-threatening diseases, is a preventive but life-threatening disorder [1,2]. In 2017, there were approximately 219 million malaria cases in the world and nearly 435 thousand attributable deaths[3]. In particular, children under the age of 5 constitute 61% of all malaria deaths in the world, making them the most vulnerable population affected by malaria[3,4]. In comparison to adults, children are more vulnerable to infectious conditions and faster differential diagnosis is required between malaria and non-malaria fever to minimise mortality and serious cases.

All reported cases of malaria must be screened in a parasitological way to validate diagnostics using either microscopic or malaria rapid diagnostic tests (RDTs) [5], according to the World Health Organisation (WHO). The goal of this strategy is to reduce the excessive use of ART and avoid possible drug resistance[6]. It can also enhance the diagnosis of other febrile diseases that are not malaria. Blood slide microscopy is considered to be the "gold standard" for malaria diagnosis, but it takes time and requires well-trained staff and ample laboratory equipment, which is difficult to maintain in most endemic areas [7,8]. Specific antigens formed by Plasmodium, including histidine-rich protein-2 (HRP2), lactate dehydrogenase (LDH), and aldolase, may be detected from RDTs in individual blood. HRP2 is P. falciparum specific, whereas

aldolase is present in all organisms (pan-specific). Three types of LDH: Pf-specific, Pv-specific and pan-specific can be divided. Antibodies against these antigens can be combined to detect various Plasmodium species in one form of RDT[9,10]. We have carried out the present study to assess the accuracy of a fast diagnostic test for the diagnosis and microscopy of malaria in children.

MATERIALS AND METHODS

This cross-sectional study was conducted in Paediatrics Department of King Abdullah Hospital, Mansehra for six months duration from 1st July 2018 to 31st December, 2018. Total 140 children of both genders clinically suspected to have malaria with ages up to 12 years were enrolled in this study. Patients detailed demographic including age, sex and symptoms were recorded after taking informed consent form parents/attendants of the children. Already confirmed cases and those on anti-malaria drugs and without consent patients were excluded.

3 ml blood sample was taken from all the patients and sent to laboratory for examination. By microscopic examination thick and thin smears of blood were examined for the detection of plasmodium. Paracheck-Pf RDT kits were used for detection of malaria with the help of guideline provided by the manufacturer. Results obtained from microscopy and RDTs were recorded and compare the findings between both procedures. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of RDT were examined. Microscopic examination was taken as gold standard. All the data was analyzed by SPSS 24.0. Frequency and percentages were

recorded in tabulation form. Chi-square test was done to compare the findings between two methods. P-value <0.05 was considered as significant.

RESULTS

There were 85 (60.71%) male and 55 (39.29%) female patients. (Figure 1)

62 (44.29%) patients were ages 0 to 6 years while 78 (55.41%) were ages 7 to 12 years. (Figure 2)

Figure No 1. Gender wise distribution

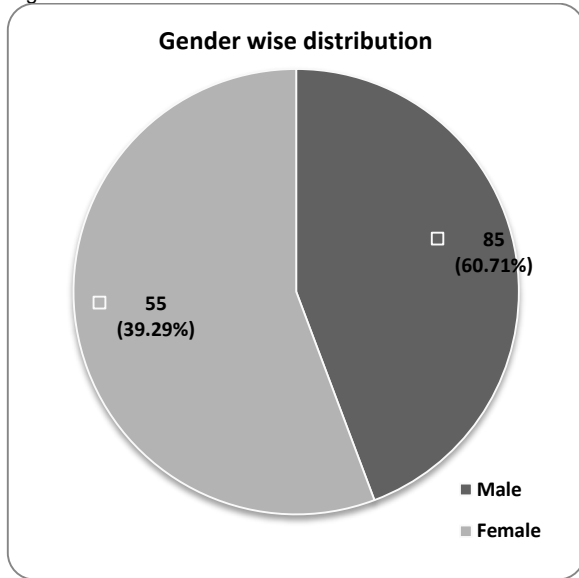
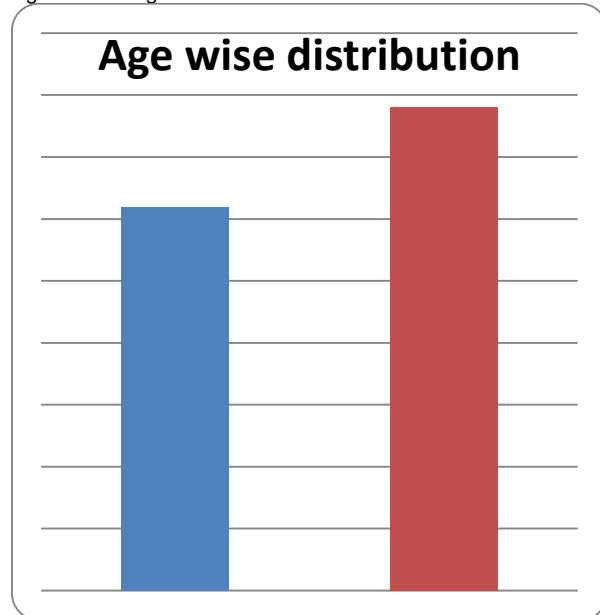


Figure No 2: Age wise distribution



80 (57.14%) patients showed positive and 60 (42.86%) showed negative for malaria by microscopic examination and by rapid diagnostic test 83 (58.57%) had malaria positive while 57 (40.71%) had negative for malaria. By comparing the findings between both

procedures, 77 (55%) were true positive, 6 (4.29%) false positive, 3 (2.14%) were false negative and 54 (38.57%) were true negative. The sensitivity, specificity, PPV, and NPV of RDT were 96.25%, 90%, 92.77% and 94.74%. The positive likelihood ratio was 9.63 (4.50-20.59). The diagnostic accuracy of RDT was 93.57%.

Table 1: Findings of RDT and microscopy and its association

RDT	Microscopy		Total
	Positive	Negative	
Positive	77	6	83
Negative	3	54	57
Total	80	60	140

Statistic	Value	95% CI
Sensitivity	96.25%	89.43% to 99.22%
Specificity	90.00%	79.49% to 96.24%
Positive Likelihood Ratio	9.63	4.50 to 20.59
Negative Likelihood Ratio	0.04	0.01 to 0.13
Disease prevalence (*)	57.14%	48.51% to 65.47%
Positive Predictive Value (*)	92.77%	85.71% to 96.49%
Negative Predictive Value(*)	94.74%	85.53% to 98.21%
Accuracy (*)	93.57%	88.15% to 97.02%

DISCUSSION

Globally, malaria is the commonest edisease among children and associated with higher complications and mortality, especially in developing countries due to lack of resources and unawareness the prevalence of malaria is quite high [11-12]. Accurate diagnosis may helps to reduce the complications and mortality associated with malaria. Many of diagnostic procedures have been used for detection of malaria but microscopic examination remains as a gold standard procedure [13]. We conducted present study to examine the diagnostic accuracy of rapid diagnostic test (RDT) for detection of malaria and taking microscopy as a gold standard. In this regard 140 children were enrolled. Majority of patients 60.71% in our study were males while 39.29% were females. 62 (44.29%) patients were ages 0 to 6 years while 78 (55.41%) were ages 7 to 12 years. These results were comparable to many of previous studies in which males were predominant and the average age of children was 8 years [14-15].

In present study 80 (57.14%) patients showed positive and 60 (42.86%) showed negative for malaria by microscopic examination and by rapid diagnostic test 83 (58.57%) had malaria positive while 57 (40.71%) had negative for malaria. The frequency of malaria in our study was 57.14%. A study conducted by Afzal MF et al [16] reported in their study that out of 125 malaria suspected children 32.8% children had positive findings by microscopic examination. Another study by Acheampong, Desmond et al [17] reported that 18.6% patients was confirmed malaria cases by microscopic examination. Khan A et al [18] reported that among 17035 suspected cases of malaria 7.83% patients showed positive for malaria in Khyber pakhtunkhwa Pakistan.

In our study, 77 (55%) were true positive, 6 (4.29%) false positive, 3 (2.14%) were false negative and 54 (38.57%) were true negative. The sensitivity, specificity, PPV, and NPV of RDT were 96.25%, 90%, 92.77% and 94.74%. The positive likelihood ratio was 9.63 (4.50-20.59). The diagnostic accuracy of RDT was 93.57%. A study by

Nkenfou CN et al [19] reported that the sensitivity, specificity, positive and negative predictive values compared to microscopy were: 75; 48.8; 39, and 81.6%.

Afzal MF et al. [16] showed that the sensitivity, specificities and diagnostic accuracy of PVV of RDT was 97.56%, 98.81%, 97.56% and 98.81%, respectively. These findings were identical to the results of our analysis.

In its analysis, Mahende C et al [20] stated that malarial RDT results were 88.9% and 75.3% respectively sensitive and positive (PPV) predictive value compared to microscopy results. Another study by Iwuafor AA et al [21] RDT study had a sensitivity of 51.4% and a specificity of 73.2%. The false-positive rate was 26.8%, while the false-negative rate was 48.6%. The predictive positive was 58.1% while the predictive negative (NPV) was 67.6%. The RDT also had a 1.92 positive probability (LR) ratio and a 0.67 negative LR. The precision of the RDT test was 64.1 percent.

CONCLUSION

We find that the rapid diagnostic test is a very useful method for diagnosing malaria in children and can be used as a substitute for the microscopic test.

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