ORIGINAL ARTICLE

DETERMINING THE DIAGNOSTIC ACCURACY OF IMMUNE CHROMATOGRAPHIC TECHNIQUE (ICT) IN DIAGNOSIS OF MALARIA

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ABSTRACT

Objective: To determine the diagnostic accuracy of immune chromatographic technique (ICT) in diagnosis of malaria keeping microscopy as gold standard.

Material and Methods: This study was conducted at Medical Ward, Nowshera Teaching Hospital, Nowshera. Study design was cross-sectional validation study and the duration of the study was from April 2015 to October 2015 in which a total of 161 patients were observed by taking the prevalence of malaria calculator of sensitivity and specificity 37%, sensitivity of 92.12% and margin of error 7%, specificity of 96.5% and margin of error 3% and 95% confidence interval. Sample collection was done through non-probability consecutive sampling technique.

Results: This study shows that 29% patients in the age range of 16-25 years, 31% patients of age range of 26-35 years, 21% patients in the age range of 36-45 years, 10% patients in the age range of 46-55 years and 9% patients in the age range of 56-65 years. Patients mean age was 29.76±10.85 years. Fifty-six percent patients were male and 44% patients were female. Diagnostic accuracy of ICT was analyzed as the sensitivity was 99%, specificity was 58%, positive predictive value was 93%, negative predictive value was 88% and the diagnostic accuracy was 93%.

Conclusion: The accuracy of ICT was more in the diagnosis of malaria in our region. More over it is rapid and cost effective method as compared to microscopy which needs expert personal and technique.

Key Words: Immune Chromatographic Technique (ICT), Malaria, Microscopy.

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INTRODUCTION

Malaria sometimes known to be the King of Diseases. It is caused by protozoan parasite of the genus Plasmodium. Plasmodium falciparum causes the most serious and sometimes fatal type of disease. The other malarial species i.e., P. vivax, P. ovale, P. malarie and sometimes P. knowlasi can cause acute, severe illness with low mortality rates. People suffering from malarial infection is estimated to be over 500 million annually which leads to about 1-2 million deaths, of whom 90% are sub-Saharan African children[1]. Roughly 60% of Pakistan's population, live in malaria-endemic regions[2]. In Pakistan 500,000 malarial infectios and 50,000 malaria-attributable deaths occur every year despite of well-established malaria control programme[2], with approximately 37% of cases to occur in Tribal Areas, followed by Balochistan and Khyber Pakhtunkhwa Provinces[3].

P. Falciparum is notoriously famous for causing severe and complicated malaria. Same is observed increasingly with P. vivax malaria. The documented severe manifestations include cerebral malaria, hepatic dysfunction, renal dysfunction, severe anemia, ARDS, shock, pulmonary edema, hemoglobinuria, and multiple organ involvement[4].

Many tests forming the cornerstone of the modern microbiology laboratory are based on very old and tiresome technologies such as microscopy for malaria[5] the gold standard for malaria diagnosis is conventional microscopic examination of peripheral thick and thin blood smears[1]. The accuracy of the test mainly depends on the expertise of the pathologist and smear's quality. Unfortunately, microscopy quality varies significantly, and is often unreliable. Importantly , it is hard to maintain the quality of microscopy in remote areas where malaria commonly occurs[6]. Today's world

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need is more quick investigations without sacrificing sensitivity, value-added tests and point-of-care tests for both high-and low-resource settings[5]. The rapid diagnostic tests (RDTs) have becoming famous to improve diagnostic accuracy in areas where population are at risk of malaria[6].

The rationale of the study is to figure the diagnostic accuracy of ICT in diagnosis of malaria in our region because it is rapid and cost effective method as compared to microscopy which needs expert personnel and technique. The burden of malaria in our region is very huge and the expert personnel are not readily available for microscopic detection of malarial parasite and also for proper thick and thin blood slide preparation. As already mentioned above the diagnostic accuracy of ICT is comparable with microscopy so by doing this study we will be able to determine the diagnostic accuracy of ICT malaria in our setup. This will help us to diagnose and manage malaria early and will prevent the complication of malaria and will lessen the morbidity and mortality especially in a low resource setting.

MATERIAL AND METHODS

This study was done on a Cross Sectional Validation Study at Medical Ward, Nowshera Teaching Hospital, Nowshera from April 2015 to October 2015. A total of 161 patients were selected on Non-probability Consective Sampling technique by using 37% prevalence of malaria by Sajid's calculator of sensitivity and specificity sensitivity of 92.12% and margin of error 7%, specificity of 96.5% and margin of error of 3% and a confidence interval of 95%. All male and female patients aged 16 to 60years (as medical unit deals with adults), fever history in last 24 hours or Temperature of 37.5°C with rigors and chills from axilla were included in the study. Patient already diagnosed smear positive for malaria over the last 1 month because ICT was false positive in these patients, patients who have evidence of other common causes of fever like pharyngitis, tonsillitis, urinary tract infection (UTI) and sinusitis were excluded.

The study was conducted after approval from the hospital ethical and research committee. After Informed consent all patients fulfilling the inclusion and exclusion criteria who present to Medical unit Nowshera Teaching Hospital through OPD, emergency or admitted in ward was included in study. Detailed history and physical examination was conducted. After that a base line venous blood sample of 3cc was taken from patient and was sent to Hematology lab HMC/PGMI (the lab personnel would be kept blind regarding the ICT kit result) for thick and thin smear preparation and microscopic confirmation of Plasmodium parasite. A drop of whole blood was added to the pad of ICT kit SD Bioline p.f/p.v (Bio standard diagnostic, Korea) followed by lysis reagent and was interpreted in 10 minutes. The data along with demographic information was recorded on pre designed proforma for statistical analysis.

The data was gathered and interpreted by SPSS version 16. Study variables were age, microscopy and immune chromatography. Mean standard deviation was calculated for continuous data like age of patient. Sensitivity, Specificity, positive predictive value (PPV), negative predictive value (NPV) which was determined by taking microscopy as gold standard.

RESULTS

Age distribution was analyzed and is shown in Table 1. Gender distribution was analyzed as 90(56%) patients were male and 71(44%) patients were female. Microscopic findings were analyzed as malaria was positive in 137(85%) patients and was negative in 24(15%) patients. ICT findings were analyzed as malaria was positive in 145(90%) patients and was negative in 16(10%) patients. Diagnostic accuracy of ICT was analyzed and is shown in Table 2.

Table 1: Age distribution

Age in years	Frequency & Percentage
16-25	47(29%)
26-35	50(31%)
36-45	34(21%)
46-55	16(10%)
55-65	14(9%)
Total	161(100%)

Mean age was 29 years with SD ± 13.18

Table 2: diagnostic accuracy of ICT

		Microscopic findings		Total
		Yes	No	
ICT findings	Yes	A135(93%)	B10(7%)	145(90%)
	No	C2(13%)	D14(87%)	16(10%)
	Total	137(89%)	24(11%)	161(100%)

DISCUSSION

In humans, the intraerythrocytic protozoa of genus Plasmodium (i-e P. falciparum, P. vivax, P. malariae, P. ovale) causes malaria. Malaria caused by Falciparum and Vivax are big health issues in Pakistan. In the last decade, falciparum malaria has increased six folds, which now covers 42% of all the malaria cases documented by National Malaria Control Program, Pakistan[9]. Pakistan is a tropical and agricultural country with urbanized population of 35%. 65% of its population is living in rural areas with widespread irrigation system. Annual floods in the rivers coupled with monsoon season and inadequate waste disposal all over the country, offer a suitable scenario for malaria transmission[10-11].

In a study performed by Hetal K Panchal and pratibha B Desai with a sample size of 897 out of which

198 were diagnosed as positive and 699 as negative by ICT (parahit RDT), the sensitivity and specificity of the investigation found was also high about 92.12% and 98.41% respectively[7]. Another study conducted by Juan Yan et al in China Compared to microscopy, the sensitivity of the Pf/Pan device and Pv/Pf device for detection of P. falciparum was 87.5% and 91.7%, respectively; and for detection of P. vivax was 72.0% and 73.8%, respectively. The specificity of the Pf/Pan device and Pv/Pf device was 94.3% and 96.5%, respectively[8]. Our study shows that mean age was 29.76 years with SD±10.85. Fifty six percent patients were male and 44% patients were female. Diagnostic accuracy of ICT was analyzed as the sensitivity was 99%, specificity was 58%, positive predictive value was 93%, negative predictive value was 88% and the diagnostic accuracy was 93%. In a study performed by Hetal K Panchal and pratibha B Desai with a sample size of 897 out of which 198 were diagnosed as positive and 699 as negative by ICT (parahit RDT), the sensitivity and specificity of the test found was also high about 92.12% and 98.41% respectively[12]. Another study conducted by Endeshaw T et al in China compared to microscopy, the sensitivity of the Pf/Pan device and Pv/Pf device for detection of P. falciparum was 87.5%and 91.7%, respectively; and for detection of P. vivax was 72.0% and 73.8%, respectively. The specificity of the Pf/Pan device and Pv/Pf device was 94.3% and 96.5%, respectively[8].

In another study the diagnostic accuracy of ICT was analyzed as the sensitivity was 97%, specificity was 60%, positive predictive value was 94%, negative predictive value was 75% and the diagnostic accuracy was 92% and Kappa Test value was =0.872[13]. The RDT had 97% sensitivity compared with 85% for the blood smear microscopy keeping PCR as the gold standard[14]. In another study conducted at Uganda the sensitivity and specificity of an RDT was 75% and 90.6% respectively in the low transmission setting while in the high transmission setting the sensitivity reached to 93.5% and specificity dropped to 78.1%[15]. In the study conducted at the China-Myanmar border area, the sensitivity of the RDT (pf/pan device) was 88.6% for plasmodium falciparum and 69.9% for plasmodium vivax[16]. In another study conducted in North West Ethiopia, the RDT malaria showed good sensitivity and specificity with an excellent agreement to the reference light microscopy with kappa value of 0.849. There was also a very good agreement between RDT and Light microscopy in detecting different species of plasmodium. Kappa value of 0.853 for plasmodium falciparum or mixed infection and kappa value of 0.849 for non-falciparum species.

Similarly another study held in the urban and rural areas of Quetta district showed an incidence of plasmodium falciparum 55.55% and 65.82% respectively, and that of plasmodium vivax at 44.44% and 34.17% respectively[17-18]. An incidence of plasmodium vivax infections of 24%, 30.7%, and 45% were observed in other studies conducted in Pakistan, United States and Afghanistan respectively[19-20]. In contrast to all these results in a study in Dr. George Mukhari Hospital, South Africa, out of 59 patients evaluated, 98% had acquired plasmodium infection in Sub-Saharan Africa[21]. In Sudan plasmodium falciparum is the prevalent specie, accounting for more than 95% of all malaria cases, with anopheles arabinosis, anopheles gambiae and anopheles funestus as the main disease vectors[22]. While in another recent study in Romania plasmodium falciparum was documented in 75% of the cases[23].

In our study it was noticed that malaria was present in bulk of patients (68%) belonging to plain areas as correlated to hilly areas of KP, which is in contrast to a study in which 24% of patients were from plain areas of KP[24]. This may be due to the fact that our place of study was Nowshera and most of the malarial patients included in this study were either from Nowshera or other close districts. Another study conducted in Papua New Guinea showed that the malaria epidemiology in south Simbu province was more similar to the lowlands than to other highland areas[25]. Prevalence of anemia secondary to malaria in endemic areas of the American continents has been poorly considered. In another study, uncomplicated malaria was diagnosed by thick blood smear in 150 Colombian patients. Plasmodium falciparum and vivax was found in identical proportion and anemia was found in 50% of the patients[26].

CONCLUSION

Immune chromatographic technique (ICT) was more accurate than microscopy in the diagnosis of malaria in our region. Moreover, it is rapid and cost effective method as compared to microscopy which needs expert personal and technique.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

Khan MN: Idea & bibliography.
Hanan A: data collection and typing.
Tahir M: Bibliography Statistics.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.