ASSESSMENT OF NEUROLOGICAL COMPLICATIONS IN CHILDREN PRESENTING WITH PLASMODIUM VIVAX MALARIA

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ABSTRACT

Objective: To assess neurological complications in children presenting with Plasmodium vivax malaria at a Tertiary Care Hospital of Peshawar.

Methodology: This descriptive cross sectional study was carried out in the Pediatric Department, Hayatabad Medical Complex, Peshawar from April 2021 to September 2021. A total of 183 patients were enrolled using convenient sampling from outpatient department with high grade fever, nausea, diarrhea, and headache, duly confirmed for Plasmodium vivax mono-infection microscopically. A pre-designed performa was used to extract information regarding demographics, laboratory investigations, and neurological complications. SPSS (version 21.0) was used to check the statistics,

Results: Out of 183 cases 71.6% were male. The mean age of the patients was 6.44±2.46 years, while mean weight was 12.76±4.56 kg. In mean duration of disease, it was recorded to be as 6.14±2.18 days. The laboratory investigations showed, low level of hemoglobin and platelets count in 38.8% and 42.2% respectively. Neurological complications were detected in 15.8% of children and were non-significantly associated with gender, age group and duration of disease (stratified), and was significantly associated with the stratification of hemoglobin, hematocrit levels and platelets count.

Conclusion: A less frequent number children reported to have neurological complications when diagnosed with P. vivax. Furthermore, these complications are associated significantly with the stratification of hemoglobin, hematocrit levels and platelets count.

Keywords: Malaria; Plasmodium vivax; Neurological Complications.

INTRODUCTION

Malaria is one of the major global health issue causing morbidity and mortality worldwide. Out of 212 million clinical cases reported, around 429,000 are deaths. The incidence of malaria have been curtailed to 41% globally and deaths have been reduced to 62% between 2000 and 2015 by preventive measures but still 3.2 billion people are at risk to suffer from malaria. Pakistan has reported 202,013 confirmed malaria cases in 2015. This contributed to 10% of the cases and 11% of deaths worldwide due to P. vivax.[1] In 2019, 229 million cases of malaria resulted in 409000 deaths majority in African continent.[2] The prevalence of Plasmodium vivax is increasing in comparison to Plasmodium falciparum over the last few years in many countries including Pakistan. Malarial burden in Pakistan due to P. vivax , P. falciparum and mixed species was 81.3%,14.7% and 4% respectively.[3]

Four species within the Plasmodium genus are known to infect humans. Notably, P. vivax stands out as the most prevalent species, potentially afflicting over a third of the global population. This prevalence is attributed to the protozoan's dormant phase within the liver, resulting in a broader geographical distribution. In 2017, the World Health Organization (WHO) reported that a staggering 74.1% of P. vivax malaria cases occurred within the Americas. For the invasion of red blood cells by P. vivax, the presence of the Duffy antigen is a prerequisite. However, individuals of African descent are generally Duffy antigen-negative.[4-7] Comparatively, the morbidity associated with P. vivax tends to outweigh mortality, especially when contrasted with P. falciparum infections.[8] Recent research conducted across diverse regions, including Indonesia, Papua New Guinea, Brazil, India, and Pakistan, has unveiled that P. vivax either as a sole infection or in conjunction with other Plasmodium species can lead to severe, and in some cases, fatal adverse effects. Intriguingly, P.

vivax mono-infections have been associated with complications such as anemia, severe jaundice, renal failure, hemodynamic shock, thrombocytopenia, and even non-cardiogenic pulmonary edema/acute respiratory distress.[9-12]

P. vivax has caused Cerebral malaria in children along with various other documented neurological adverse effects.[14] Risk factors associated with severe malaria are young children (under 5 years), pregnancy and lack of immunity. Immunity to P.vivax develops rapidly as a result children in endemic regions suffer more from neurological sequelae and morbidities in comparison to adults who acquire immunity due to repeated malarial infections.[7] The rational of the present study is to determine the presence of any neurological complications that are specifically associated with P.vivax malaria in children and observe its association with demographic and laboratory parameters.

METHODOLOGY

This descriptive Cross-Sectional Study was conducted in Department of Pediatrics, Hayatabad Medical Complex, Peshawar using consecutive (non-probability) sampling technique to enroll the patients. A Sample size of 183 using 8.3% proportions of neurological complications in children with P.vivax malaria,[20] 95% confidence level and 4% absolute precision using following formula for sample size calculations, was calculated. Any patient of any gender between 2 to 11 years, presented with High grade fever with vomiting, headache and neurological features like drowsiness, coma, seizures and paresis confirmed microscopically for P. vivax mono-infection were included in this study, while patients with other type of infections, other neurological symptoms, hematological diseases and chronic diseases were excluded from this study. After approval from hospitals ethical and research committee and explaining purpose and benefits of the study,all the children following the inclusion criteria were assessed for further workup. The blood was drawn from these patients under strict aseptic techniques and was sent to hospital laboratory for measuring platelets count, hemoglobin and hematocrit level. Additionally, the children were subjected to detailed history followed by clinical examination. A pre-designed performa was used to extract the information regarding demographic, clinical and laboratory characteristics along with the neurological complications, including seizures, altered mental status, coma, headaches, psychosis, agitation, loss of consciousness and loss of reflexes of the children. All the collected data was analyzed through SPSS version 21,descriptive statistics were calculated for both numerical and categorical variable. For inferential analysis, neurological complications/features were stratified with regards to age, gender, and duration of disease by using chi square test while keeping p value of < 0.05 as significant.

RESULTS

After analysis, results showed that majority of the population was male (71.6%) compared to female. Mean age of the total population was 6.44±2.46 years, while-mean weight and height were recorded to be a 12.76±4.56 kg and 92.40±12.10 cm respectively. Mean duration of disease was recorded as 6.14±2.18 days. As per laboratory findings, low level of hemoglobin and platelets counts were found to be as 38.8% and 42.2% respectively. About, 15.8% of children had neurological complications, wherein 12.02% were males. Neurological

Table 1: Stratification of Neurological complications with Different Variables

Variables		Neurological complications		P-Value
		Yes	No	
Gender	Female	07	45	0.58
	Male	22	109	
Age	2-6 years	14	75	0.97
	7-11 years	15	79	
Duration of Disease	0-5 days	12	70	0.69
	6-10 days	17	84	
Hemoglobin	Normal	0	112	<0.001
	Low	29	42	
Hematocrit	Normal	2	112	<0.001
	Low	27	42	
Platelet Count	Normal	0	106	<0.001
	Low	29	48	

Table 2: Biochemical Parameters of Subject (N=183)

Variables		Descriptive analysis
Mean hemoglobin (g/dl)		11.45±2.59
Hemoglobin level	Normal	112 (61.2)
	Low	71 (38.8)
Mean hematocrit L/L		39.01±5.41
Hematocrit level	Normal	114 (62.29)
	Low	69 (37.71)
Mean platelets count (109/L)		192.9±91.09
Platelets count	Normal	106 (57.9)
	Low	77 (42.1)

Table 3: Prevalence of Neurologicalcomplications in Studied Population (N=183)

Variables		Frequency (%)
Neurological Complications	Yes	29 (15.8)
	No	154 (84.2)
Seizures	Yes	20 (10.9)
	No	163(89.1)
Drowsiness	Yes	27 (14.8)
	No	156(85.2)
Loss of consciousness	Yes	17(9.3)
	No	166(90.7)
Uncontrolled moments	Yes	14(7.7)
	No	169(92.3)

complicationswere non-significantly associated with gender, age group and duration of disease (stratified), and was significantly associated with the stratification of hemoglobin, hematocrit levels and platelets count.

DISCUSSION

Malaria is a fairly widespread illness that often manifests as a febrile illness with a wide range of non-neurological symptoms. Neurological symptoms caused by Plasmodia are frequently severe. According to the literature, P. vivax has been linked to thalamic bleeding, acute scattered encephalomyelitis, bilateral facial palsies, and facial diplegia.[12,16–20], P. vivax can cause harm to multiple organs[9,10,13]. P. vivax has a significant role in the development of severe malaria and other malarial diseases. An inadequate healthcare system would be further burdened by severe malaria with neurological consequences brought on by P. vivax, which would result in higher morbidity and mortality rates..

Severe P. vivax infection reported in 77 studies. A total of 42 had cerebral malaria[9] and 13 children with cerebral malaria due to P. vivax mono-infection have been have been reported in the pediatric age group.[14] Another study conducted in adult population has revealed 7 patients with plasmodium vivax mono infection to suffer from neurological complications, male gender had predominance.[15] Cerebral malaria was documented in 8.3% of the patients suffering from P.vivax.[21]

In the present study 15.8% of studied population had neurological complications.. In a prior study, 6.5% of malaria-infected adults and 13.6% of all children and adolescents experienced cerebral symptoms. While still presenting with unconsciousness, seizures were present in 40.3% and 65.1% of adults and children, respectively.[21] Neurological manifestations like seizures 42%, drowsiness 28%, loss of consciousness 28% and uncontrolled movements 14% were documented by A Akhlak. [15] which contrasts current studies. Low hemoglobin levels and thrombocytopenia have been significantly associated with neurological complications in present study which is comparable with severe anemia and severe thrombocytopenia of <50,000/mm^3 reported in 77 studies with severe P vivax infection, pooled prevalence of these signs were 4% and 8.6% respectively. [9]

According to another study, patients with P. vivax infections had lower platelet counts than those with mixed infections this finding is consistent with earlier research.[22] Mean haemoglobin and hematocrit levels were same among etiological groups, however the majority of patients with vivax cerebral malaria received platelet transfusions since approximately a third of them had severe thrombocytopenia.

CONCLUSION

A sizable number of the children evaluated in this study had neurological sequelae from malaria linked to P. vivax.Previos studies also support that P. vivax induces serious malaria complications therefore it shouldn,t be considered benign benign. Therefore, it is advised that early detection of infected cases and the adoption of proper treatment will minimise malaria-related mortality and morbidity in the future.

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Author's Contribution

RK conceived the idea and drafted the manuscript and performed data analysis. JKA, SM and MBZ drafted the manuscript and checked for technical issues manuscript. SN and MA helped in designing and data collection for the study and drafting of the manuscript. 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.

Conflict of Interest

Authors declared no conflict of interest

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None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.