A Change of Plasmodium Species Infecting Children in Karachi over the Last Decade

Pages with reference to book, From 162 To 164

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Abstract

Febrile children of both sexes, aged between 0-15 years coming to the Civil Hospital over the last 12 years had their blood tested for malarial parasite. Five hundred and twenty-six slides positive for Plasmodium were analysed for species and stage identification. Of the total 59.3% children with malaria were between 5-15 years of age. Applying the test of proportion, Plasmodium vivax was the predominant species ($P<0.01$) between 1981-1985 and plasmodium falciparum between 1986-1990. This trend persisted up to 1992. As malaria due to Plasmodium falciparum is more severe with multiple complications accurate and easier methods of its diagnosis are needed at primary health care level. (JPMA 44:162, 1994).

Introduction

In endemic areas, falciparum malaria is associated with severn anaemia, increased mortality and residual neurological deficit[1] especially in children. In some areas of Africa, falciparum malaria accounted for 50% of non-surgical hospitalization[2], while in another study 77% children admitted in coma had cerebral malaria[3]. Seventy-five percent cases of falciparum malaria are concentrated in 9 countries[4] but Pakistan is not included in this group. This study was undertaken to determine if there was a change in species of Plasmodium in children admitted with malaria.

Patients and Methods

A total of 49,509 children, agedO-15 years comingto the Paediatrics outpatient or emergency department from January 01, 1981 to December 31, 1992, with fever were screened. From January 01, 1981 to October31, 1991 was a retrospec¬tive and from November 1, 1991 to December 31, 1992 a prospective study period. Thick and thin blood smear made by puncture of the fore-finger with a sterile disposable lancet/needle were stained with geimsa stain. Thick films were seen under a microscope with a magnification of x 100, In each slide, 10 concecutive fields were examined to detect the presence of malarial parasite (MP). Thick blood films in 526 cases showed malarial parasite, therefore, their thin films were examined micro¬scopically under magnification of x 100 and species and stage identification were done. As a definite change of pattern of Plasmodium species from vivax to falciparum was observed, it was decided to retrospectively analyse the results for a period prior to November 1991.

Results

More than 59% children who had malaria were between 5 to 15 years of age, 30-40% were between into 5 years and on an avenge, less than 10% were below one year(Table I).

Table I. Age distribution of patients with malaria.

Year	Total number of children	0-1 year		1-5 years		5-15 years	
		No.	%	No.	%	No.	%
1981	88	18	20.4	33	37.5	37	42.0
1982	16	03	18.7	08	50.0	05	31.3
1983	27	01	3.7	10	37.0	16	59.3
1984	69	05	7.0	21	30.0	43	62.0
1985	28	02	7.0	12	43.0	14	50.0
1986	35	03	8.6	10	28.6	22	62.8
1987	21	01	4.8	07	33.3	13	61.9
1988	25	01	4.0	11	44.4	13	52.0
1989	55	04	7.4	16	29.0	35	63.6
1990	43	03	7.0	12	27.9	28	65.1
1991	76	01	1.3	18	23.7	57	75.0
1992	43	02	4.7	12	27.9	29	67.4

Total number of cases detected per year varied from 16 to 88, with an avenge of 43.8 patients per year. The changing species of Plasmodium seen over the last decade is shown in Table II.

Table II. Distribution of plasmodium species amongst patients.

Year	No. of patients with P. falciparum		No. of Patients with P. vivax	
	No.	% of total that year	No.	% of total that year
1981	9	10.2	79	89.8
1982	1	6.3	15	93.7
1983	9	33.3	18	66.7
1984	12	17.4	57	82.6
1985	12	42.9	16	57.1
1986	17	48.6	18	51.4
1987	10	47.6	11	52.4
1988	11	44.0	14	56.0
1989	44	80.0	11	20.0
1990	31	72.1	12	27.9
1991	58	76.3	18	23.7
1992	32	74.4	11	25.6
Total:	246		280	

There was an increase in falciparum and a decrease in vivax cases. The differences observed in the frequency of infection by P. vivax and P. falciparum were significant (Table III).

Table III. Distribution of plasmodium species amongst patients with test of proportion applied.

Year	No. of patients with P. falciparum		No. of patients with P. vivax		Significant at p level
	No	% of total	No.	% of total	
1981-85	43	19.0	185	81.0	<0.01
1986-90	113	63.0	66	37.0	<0.01
1991-92	90	75.6	29	24.4	<0.01

Dividing the twelve year period into 5 year groups, P. vivax was the predominant species from 1981-85 ($P<0.01$) and P. falciparum from 1986-90 and 1991-92. The same trend persisted up to 1993. The slides

of P. falciparum showed (Table IV)

Table IV. Stages of plasmodium falciparum identified.

Year	Slides showing ring forms		Slides showing gametocyte forms		Slide Showing ring & gametocytes	
	No.	% of total	No.	% of total	No.	% of total
1981	1	11.1	08	88.9	-	-
1982	1	100.0	-	-	-	-
1983	4	44.4	05	55.6	-	-
1984	7	58.3	05	41.7	-	-
1985	9	75.0	03	25.0	-	-
1986	7	41.2	08	47.1	2	11.8
1987	3	30.0	07	70.0	-	-
1988	6	54.5	05	45.5	-	-
1989	8	18.2	36	81.8	-	-
1990	17	54.8	14	45.2	-	-
1991	23	39.7	33	56.9	2	3.4
1992	10	31.3	22	68.7	-	-

that 7.7% cases per year had ring forms and 11.9% gametocytes. Slides showing both ring and gametocytes of P. falciparum were rare. Stages of? vivax as seen in the slide are analysed in Table V

Table V. Stage of plasmodium vivax identified.

Year	Slides showing trophozoite gametocytes & ring forms		Slides showing Trophozoite & gametocyte		Slide showing ring forms & trophozoite		Slide showing trophozoite	
	No	.% of total	No.	% of total	No.	% of total	No.	total
1981	51	64.6	28	35.4	-	-	-	-
1982	6	40.0	9	60.0	-	-	-	-
1983	10	62.5	6	37.5	-	-	-	-
1984	29	50.9	28	49.1	-	-	-	-
1985	3	18.8	13	81.2	-	-	-	-
1986	-	-	17	94.4	1	5.6	-	-
1987	-	-	11	100.0	-	-	-	-
1988	6	42.9	8	57.1	-	-	-	-
1989	-	-	11	100.0	-	-	-	-
1990	5	41.7	7	58.3	-	-	-	-
1991	10	55.6	8	44.4	-	-	-	-
1992	4	36.4	7	63.6	-	-	-	

An avenge of 42.3% cases per year showed trophozoites, ring and gametes and 56.3% only trophozoites and gametes in the same slide. Rarely (1.4%) had ring and trophozoite forms appeared together. None of the slicks showed trophozoites alone. Mixed infectionswithtwo species of plasmodium in the same patient occurred in one patient only. The slide positivity rate (S.P.R) ranged between 0.31% to 2.6 1% (Table VI)

Table VI. Slide positivity rate of malarial parasite (S.P.R).

Year	Total No. of slides seen	No. of slides positive for malarial parasite	Slide positivity rate
1981	8216	88	1.07
1982	5168	16	0.31
1983	5023	27	0.54
1984	6109	69	1.13
1985	3528	28	0.79
1986	2604	35	1.34
1987	3274	21	0.64
1988	2832	25	0.88
1989	3222	55	1.71
1990	2684	43	1.60
1991	2912	76	2.61
1992	3937	43	1.09

with an avenge of 1.06%.

Discussion

Malaria is a major public health problem in Pakistan. The geographical location, monsoon season, irrigation and agricultural methods all encourage standing pools of water, and, therefore, contribute to the malariogenic potential of the country. Malaria in children can present with fever of varying severity with or without a characteristic pattern, splenic enlargement, acute respiratory infections, gastmenteritis, or an intercurrent infection may initiate renewed activity of a quiescent malarial infection[5]. Cerebral malaria is now being seen increasingly. Our study of proven cases of malaria over the last 12 years demonstrates the emergence of P. falciparum as a major cause of this disease. The method employed was that of Passive Case Detection (PCD) as defined by the Malaria Control Programme of Sindh in which blood smears from cases of pyrexia visiting our institution were collected and analysed. The other method of surveillance involves active case detection (ACD). In this programme the Malaria supervisor has to move from house to house, to search for malaria cases, collect blood smears from fever cases and treat them with anti-malarial drugs. Preparation of thick and thin smears and its staining by Geimsa stain is done when species identification is required. Most laboratories in Karachi use aLeishniann stain for a peripheral blood smear in which the plasmodiurn can be detected but for species identification geimsa slam should be used. The method used by the Malaria Control Programme is both sensitive (less than 0.00 1% parasitaemia can be detected) [6] and

specific. However, it is time consuming and requires the services of a well-trained microscopist who unless committed to spending 20 minutes per slide, may miss a case of malaria. The method recommended by Kibukamusoke[7] is that 5 to 10 smears of blood are made on 3 visits. All the slides to be stained with Geimsa stain and 100 consecutive fields should be examined in each slide. Short of the procedure described above[7], our slide positivity rate (SPR) was 1.06% which is an acceptable average. If the practical significance of SPR is studied, most medical practitioners loathe to get blood smears for malarial parasite (M.P.) done at all, their plea being that, this is a futile exercise if only one out of 100 patients is to benefit from it. This practical aspect of SPR needs to be studied further with regard to the attitude of medical personnel. Other methods requiring less expense, less expertise and high detection rates must be explored for use at the primary health care facilities. In addition the emergence of Plasmodium falciparum as the predominant aetiological agent of malaria associated with serious complications, high morbidity and mortality make the development of improved diagnostic methods imperative. In the first five years of this study the values of the cases of Plasmodium vivax detected are statistically significant. The next S years show P. falciparum being predominant and the last 2 years again show a predominance of P. falciparum. It is anticipated that the expected result will continue to be the same or worsen till the end of 1995. The analysis of a decade shows that almost all patients with P1 vivax and about 58% with P. falcipamm showed the presence of gametocytes. All these patients would function as reservoirs of the sexual forms which would complete their life cycle in the female anopheles mosquito and pass on the infection to others. The presence of trophozoite and ring forms of plasmodium are taken as indicators of an active infection causing fever. Most of symptomatic cases of P. falciparum malaria had only gametocytes in their blood smears. This form is more easily visualised on microscopy than ring or trophozoite forms. In the presence of typical clinical features, patients showing only gametocytes of P. falciparum may be suggestive of active state of malaria infection and treated accordingly. Advance technology for detection and characterization of malarial parasite is available[8-13] but it can not be used because of expenses and expertise required for it.

Acknowledgements

The authors would like to thank the personnel of the Malaria Control Programme posted at the department of Paediatrics, Civil Hospital, Karachi; and all the medical officers of this department. The credit for the typing goes to Mr. Salim Sultan Ali Momin.

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