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Malaria And Hematological Parameters Of Feverish Patients From 2007 To 2011 At The Pasteur Institute Of Ivory Coast

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Abstract

Malaria is the leading cause of consultation and hospitalization in Côte d'Ivoire. We did a survey on blood samples from febrile patients referred to Pasteur Institute for both hematological and parasitological examinations. The aim of this study is to monitor the infection status, parasitemia and associated hematologic profile, for better care management of malaria patients with appropriate treatment. The thick and thin smear and the Complete Blood Count (CBC) documented were investigated over the period 2007 to 2011. A total 2414 samples were collected of which 343 positives smears with an average parasitemia of 3678 trophozoits per microliter of blood, and 2071 negative smears. A general plasmodic index 14.20% was then determined. Three parasite species were identified. There are 339 Plasmodium falciparum malaria cases detected, 2 cases due to Plasmodium malariae, and two by Plasmodium ovale infections. The infection index per species was 98.83% and 0.58% for the latter two species, respectively. All of the patients showed a normal white blood counted cell. An insufficient red blood counted cell was noted from a quarter of patients (26.8%). Not significant differences rate were shown in hypochromic and normocytic RBCs states. Both were associated with normocytosis with a small proportion of microcytosis (4.88%) and macrocytosis (9.77%). More than half of the population presented thrombocytopenia. This justifies the WHO recommendation in 2011, to conduct a prompt parasitological confirmation of the diagnosis by microscopic examination or by a rapid diagnostic test (RDT) before the administration of any antimalarial treatment for all suspected patients.

Key Words: Malaria, Plasmodium, Trombocytopenia, Thick smear, malariology

INTRODUCTION

Africa is by far the most affected continent with 90 % of the cases of malaria registered in its tropical and subtropical zones. Some economists estimate that the annual loss of the gross domestic product (GDP) due to malaria in Africa is more than 12 billion.[1,2] In Ivory Coast, malaria constitutes more than 80 % of the motives for consultation and for hospitalization (PNLP, 2004). Its major vector is Anopheles gambiae.[3-6] The genetic plasticity of Anopheles gambiae, the main vector of malaria in sub-Saharan Africa, allows it "to exploit" in an optimal way the environmental changes generated by human activities; development projects, particularly the construction of dams, roads and making rice fields.[7] To them, we add the natural environmental factors, (temperature, the relative humidity and the rains) which also play a fundamental role on the transmission level and the epidemiology of diseases.[2,7,8] In periods of maximum rainfall in Abidjan, the economic capital of Côte d'Ivoire, the anopheline density is very important and the most dominant is A. gambiaea s 1.[9] Unpredictably, massive population movements resulting from wars or famine may also induce unexpected malaria epidemics.

The objective of this study is to monitor the level of infection, the infection status and the hematological profile associated to a better care of malaria subjects.

MATERIALS AND METHODS

Presentation of the framework of the study

This study was conducted at the Institut Pasteur of Côte d'Ivoire (IPCI) in Abidjan which is an institution built on two sites: the site of Cocody and the Adiopodoumé site. The Institut Pasteur of Côte d'Ivoire is an Ivorian public institution created in 1972. It joined the International Network of Pasteur Institutes in 1989. It is directly under the tutelage of the Ministry of Higher Education and Scientific Research. In the context of the fight against transmissible diseases, it houses the National Reference Centers (NRC) which has several missions among which, there is the biological expertise of infectious agents, including the contribution to the epidemiological and microbiological surveillance of infectious agents. The research on malaria is one of the several axes provided in the domain of research [10]. The study was carried out on the site of Cocody, a commune located in the East of Abidjan, which occupies about 20.8% of the total area of the ten communes of Abidjan. Cocody covers an area of 132? km2, bounded in the North by the district of Abobo, in the south by the Ebrié lagoon, in the East by the sub-prefecture of Bingerville, and in the West by the communes of Adjamé and Plateau. According to the 1998 census, the population of Cocody is estimated at 251 000 [11] for a density of 3,241 inhabitants per km2.

Ethical consideration

The survey has been performed in accordance with the ethical requirements in force in Ivory Coast.

Statistical Analysis

Analyzes were performed using XLSTAT 7.5 software. The proportions of positive thick blood smear individuals were determined as well as the proportions of the thick film negative individuals. A Z-test comparison (bilateral test) of the two proportions was performed at alpha (5%).

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Table 1: Parasitic portage

YEARS	Echantillons de sang		
	Receive	Positives	Negatives
2007	305	63	242
2008	479	52	427
2009	399	54	345
2010	639	99	540
2011	592	75	517
T0TAL (5 Years)	2414	343	2071

Table 2: Distribution of patients according to the parasitic density.

pa rasitic de nsity (tr ophoz oits/µ l)	pa tie nts num ber s	%
[5 - 200 [	27	7,91
[200 - 2000 [	214	70,67
[2000 - 5000 [	40	11,73
[5000 - 10000 [	16	4,69
[10000 - 25000 [	23	6,74
[25000 - 50000 [	10	2,93
> 50 000	1	0,29
total	341	100

Table 3: Parasitic portage of the patients according to the seasons

Se asons (n= 5 ye ar s)	P ar asitic porta ge (n= 343)	%
Big se ason of r ain)	110	32,06
Sm all dr y sea son	64	18,65
Sm all se ason of ra in	65	18,95
Big dr y sea son	104	30,32

Table 4: Parasitic portage of the patients according to age.

	YEAR					
Age group	2007	2008	2009	2010	2011	TOTAL
[0 to 5 ans]	6	7	8	10	24	55
]5 to 15 ans [	10	11	11	20	15	67
]15 to + [	47	34	35	69	36	221
TOTAL	63	52	54	99	75	343

Patients

The patients concerned with the study are of all ages and both sexes. They were sent to the Institut Pasteur in Côte d'Ivoire (IPCI) by healthcare facilities to achieve parasitological examinations after having a fever. These patients should regularly be documented. The list of positive cases in the thick film and blood smear derived from records from 2007 to 2011 of the Malariology Unit (MU), crossed with the databases of the Clinical Biochemistry and hemobiology Unit (CBHU) of Medical and fundamental biochemistry (MBF) department to bring out the patients' hematological profiles. Excluded patients are patients referred for a second time checkup. The registers contain the registration number of the patient, the date, the patient's sex, age and the results of the thick film and blood smear.

RESULTS

We collected 2414 samples with 343 positive thick and thin blood smear with an average parasitemia of 3678 trophozoites / µl of blood and 2071 negative (Table 1) (P-value < 0.0001). This allowed us to determine a general plasmodial index of 14.20%. We observed a variation of the parasite density in patients whose GE / FS is positive (Table 2). We noticed that this pathology was the rampant form of stable malaria which is endemic with seasonal variations (Table 3). The distribution of the disease according to age groups was 55 patients from 0 to5 years old, 67 patients between 5 and 15 years old, and 221 patients were more than 15 years old (Table 4). Three parasite species were identified. And 339 cases of malaria were related to Plasmodium falciparum, 2 cases were due to Plasmodium malariae, and 2 other cases were related to oval Plasmodium with an index of infection of respective species estimated at 98.83% and 0.58% for the last two species. Hematological parameters showed a variable profile depending on the subject. In the whole the rate of white blood cell is normal in patients over 15 years, but we noticed in other patients for lower rates (19.51%) and relatively higher rates (7.32%). An insufficient rate of red blood cell (RBC) was noted in more than a quarter of patients (26.8%). Almost half of the population showed anemia (48.78%). Red blood cells showed normocytic and hypochromic states and with approximately equal rates, both associated with a normocytose with a small proportion of microcytosis (4.88%) and macrocytosis (9.77%). More than half of the population showed thrombocytopenia (Table 5).

Table 5: Haematological parameters of malarial subjects aged 15 years and over

WBC : White Blood Cell; RBC : Red Blood Cell; HGB : Hémoglobine ; MCV : Mean Corpuscular Volume; MCH : Mean Corpuscular Heamoglobin; PLT : Blood Platelet
I : Lower of the normal ; N : Normal ; S : Above to the normal

haematological Parameters	normal Value	Units	patients Profiles	Mean Value	Subjects Number (%)
WBC	[4-10]	$10^3/\mu L$	I N S	3,18 ± 0,57 5,93 ± 1,48 23,8 ± 20,9	19,51 73,2 7,32
RBC	[3,8-6]	$10^6/\mu L$	I N S	2,81 ± 0,63 4,58 ± 0,49 -	26,8 73,17 -
Hb	[11,5-18]	g/dL	I N S	9,19 ± 2,09 13,2 ± 1,06 -	48,78 51,2 -
MCV	[80-95]	fL	I N S	79,3 ± 0,42 84,7 ± 6,48 99,1 ± 1,87	4,88 85,4 9,76
MCH	[32-36]	g/dL	I N S	30,09 ± 0,93 32,9 ± 0,73 -	46,3 51,2 -
PLT	[150-400]	$10^3/\mu L$	I N S	91,7 ± 39,4 240 ± 85,8 -	53,7 43,9 -

DISCUSSION

The significant difference observed between collected febrile patients and patients actually sufferering from malaria has enabled us to understand the importance of calling for biological diagnostics tests for all febrile patients. One can not say with certainty that the feverish states are true cases of malaria. Febrile subjects treated as real malaria patients on the basis of a presumptive diagnosis may actually suffer from other viral or bacterial diseases [12]. So, this assumption confirms one of the additional recommendations of the second edition of the 2010 directives, [13] which argues that any suspect patient must confirm the diagnosis by microscopy or by a rapid diagnostic test (RDT) before administering any treatment. The variation in parasitic density could be explained by individual variations in protection for patients who depend on their natural immune. It has long been known that acquired clinical immunity to P. falciparum against infections depends on the duration of exposure to the parasite and the repetition of infections which would predispose subjects to react differently or not against the infectious agent. The percentage of infection (98.83%) caused by Plasmodium falciparum. is close to the one determined by which was 98%. Today, this species remains the pertaining species that poses enormous difficulties for malaria treatment matters. And the presence of Plasmodium malariae, though at a low rate (0.58%), remains worrying on the territory because of its involvement in irreversible chronic kidney damage.[15] The work showed anopheline density, with a particular importance for An. gambiae s.l. in periods of maximum rainfall in Abidjan. Females of Funestus group are abundant in the dry season, causing an intensity of malaria transmission during the rainy season and a high transmission at the beginning of the dry season.[14,16]

Pediatrics is generally reserved to professionals working in specialized health centers. That would justify the low number of febrile children from 0 to 5 years old and from 6 to 14 years old referred to the IPCI. The acquired immunity against malaria is associated with low levels of parasitemia and clinical episodes of the disease throughout life.[17] Indeed, recent studies in non-parasitic systems have shown the existence of a family of proteins encoded by the germline (Toll Like Receptors or TLRs), which is important for the host's innate defense.[18] In mammals, the activation of macrophages through TLRs leads to the induction of effector genes that control and execute the innate defense in a great number of varieties of bacterial and viral systems.[19] The low rate of white blood cells observed in some patients may have infectious origin (viral infection), but also a nutritional origin, knowing the major impact of micronutrients in the activation of the immune system.[20] The hemolysis of red blood cells and the decreased production of red blood cells are mechanisms by which malaria leads to anemia.[21,22] Iron is an essential element needed by Plasmodium falciparum to achieve its metabolism, causing its penetration inside the red blood cell for the digestion of hemoglobin.[23] Thus, P. falciparum could get this iron before the formation of the host's immune function. This situation would explain the anemic states, but also the observed low rates of white blood cells whose action would be worsened by micronutrient deficiency, which would thus disrupt erythropoiesis or the immune system.[24,25] The digestion of hemoglobin and the use of iron by the parasite inside the red blood corpuscle for its cellular differentiation and its growth, would also lead to a defect in coloring and/or conformation of these cells, favoring the hypochromic and microcytic states as observed in some patients. Normochromic and normocytic anemic states as well as the decrease in the production of red blood cells in some patients would depend on inflammatory anemia. Moreover, the causes of anemia, generally of nutritional and infectious origin [26, 27], could be attributable to the hereditary abnormalities such as hemoglobinopathies (sickle cell disease, thalassemias) and erythrocyte enzymopathies due to G6PD deficiency.

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