

FIGURE 1

Right half of the colon showing the extent and thickness of the lesions

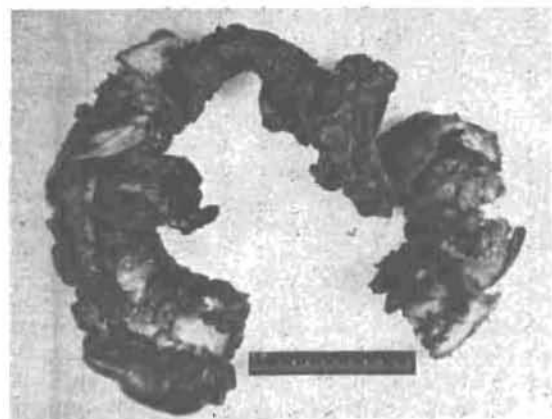


FIGURE 2

A colony of actinomyces surrounded by an abscess

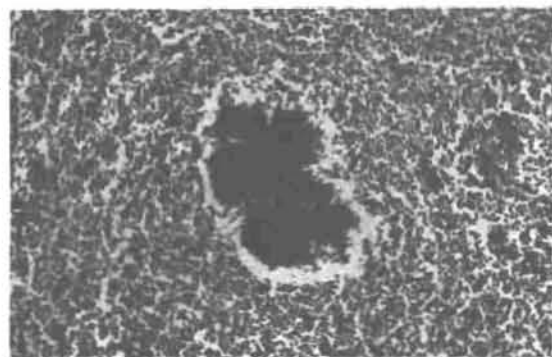
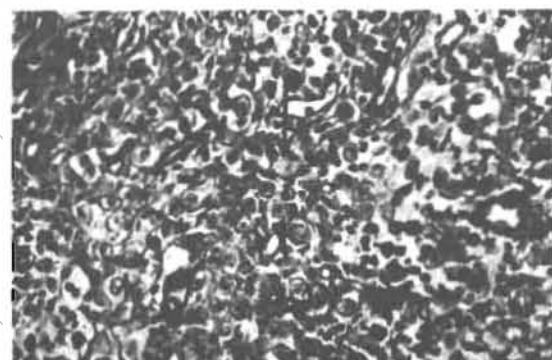


FIGURE 3

Arrow points to one of the many trophozoites of *E. histolytica*



is not uncommon. However, on review of the literature we failed to find a case report of concomitant infection of the bowel by both these organisms. It is surprising to see these common commensals of the gastrointestinal tract to invade the gut at the same time. It is possible that due to some local changes in the bowel or some change in the virulence of the amoeba, it invaded the colon first and infection by actinomyces was secondary. It is also conceivable that a transient acute immune deficiency state in the patient led both these organisms to invade the gut simultaneously. With absence of discharging sinuses and repeated negative stool examinations, the diagnosis was possible only at histology.

Management of abdominal actinomycosis is debatable. Duncan¹ suggests radical surgery whilst Davis and Keddie² advocate a limited form of surgery and prolonged chemotherapy for the same. As for amoeboma, it is generally agreed that with antiamoebic chemotherapy there is a rapid remission of the lesion. Padilla y Padilla and Padilla³ observe that if an amoeboma is treated surgically the results are disastrous. We did not encounter any post-operative problem as a result of infection of the bowel by both these organisms.

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Preliminary Investigation of the Relationship Between Malaria, Anaemia, Parasite Density, Malaria Specific Antibody and Syphilis Reactivity in Ndola Central Hospital — Zambia

by

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Abstract

A total of 165 adult Zambians aged between 12 and 65 years with symptoms suggestive of acute malarial infection were studied. Sixty-two (37.5%) were blood slide positive for malaria.

There was no significant differences in haemoglobin level between blood slide positive and blood slide negative individuals. Although the male population studied had significantly higher haemoglobin than the rural population of Kampumbu, this was significantly lower than the value for the normal urban blood donor population of Ndola. The female patients whether blood slide positive or negative had significantly lower haemoglobin than their male counterparts but their haemoglobin values did not differ significantly from the Kampumbu rural female values. Using 12G/dl to designate significant anaemia, 25% and 27% of the blood slide positive and negative patients respectively were anaemic.

Blood slide positive individuals had significantly higher malaria antibody titre as measured by the indirect immunofluorescent (IFA) test than blood slide negative patients. There was concordance between parasitological and IFA positivity. However, there was no correlation between parasite density, anaemia or specific antibody titre.

At presentation, about 20% of patients had taken either antimalarials or some other drugs containing organic bases as measured by the Dill-Glazko eosin colour urine test. There was a significant association between a positive Dill-Glazko test and a negative blood slide for malaria.

Treponema pallidum haemagglutination test was positive in 19% of 117 patients. Our observations do not confirm the putative cross-reactivity between *Plasmodium* and *Treponema* species as there was no significant differences in reactivity between those who were positive or negative for malaria. This may be due to wide-spread exposure to *Treponema* antigens in the population studied.

INTRODUCTION

Malaria, in the non-immune, classically presents with fever, chills, headache, myalgia, diarrhoea and vomiting. In the semi-immune living in endemic areas these classic symptoms are less prominent. However, in both the non-immune and semi-immune individuals, haematologic complications of anaemia and splenomegaly are frequently observed. These haematologic disorders are so common that malaria is at times classified as a haematopoietic disease. Splenic rates, for instance, is often taken as a measure of endemicity in the age groups 2-9 years in holoendemic areas while idiopathic tropical splenomegaly syndrome is thought to be aetiologically related to chronic malaria.

The development of anaemia is dependent on several factors prominent among which are: the immune state of the individual, the presence of haemoglobinopathies like the sickle cell gene, the red cell enzymatic defect such as glucose-6-phosphate dehydrogenase deficiency, intercurrent infection and nutritional state of the patient.

Mosquito vector control programme in some parts of Zambia, especially the urban areas of the Copperbelt Province, was excellent at time of political independence some 20 years ago. There were therefore pockets of probable hypoendemicity in a country that could generally be regarded as hyperendemic for malaria. Vector control is no longer as rigorous as it used to be and malaria has become a common medical problem with prevalence rates approaching epidemic proportions in some urban centres during the rainy seasons. In 1981, for instance, malaria accounted for more than 50% of all medical admissions at Ndola Central Hospital (NCH). Most of the patients seen at NCH with malaria present with acute symptoms expected in the non-immune peoples.

The objectives of this study were:-

- 1) To determine the parasite rate in patients presenting at NCH with symptoms suggestive of acute malaria;
- 2) To determine the prevalence of significant anaemia in patients presenting with symptoms suggestive of acute malaria;
- 3) To determine the proportion of individuals seen at NCH with symptoms of acute malaria who have taken antimalarials at presentation;
- 4) To ascertain the relationship, if any, between malaria parasite density, anaemia, specific antibody and syphilis serologic reactivity.

MATERIAL AND METHODS

All patients aged 12 years and above attending NCH with symptoms suggestive of malaria between 14th December, 1982 and 13th January, 1983 were included in the study. The symptoms included fever, chills, headache, joint pains, myalgia, diarrhoea and vomiting. Children below 12 years are normally admitted in another hospital 5 km away.

Significant anaemia was defined as anybody with haemoglobin (HB) level of less than 12G/dl. The figure of 12G/dl was chosen for the following reasons:-

Anaemia is known to impair maximum work capacity and since there is a direct relationship between HB concentration and work capacity as measured by the Havard Step test¹, significant anaemia was considered to be that level which would reduce the work capacity score by 50%.

According to the observations made by Viteri and Torum on Guatemalan sugar cane cutters, the score of 50% coincided roughly with a HB concentration of 12G/dl². Two population groups whose haematologic profile are available were taken for comparison. These were the urban male blood donor population of Ndola with a mean HB of 15,39G/dl standard deviation (SD) 1,56 and the rural population of Kampumbu in Zambia with a mean HB level of 12,3G/dl and SD of 2,1³. Haemoglobin values for both the study population and controls were estimated in the same laboratory using the same cyanomethaemoglobin method. No attempt was made to exclude other causes of anaemia.

To estimate the parasite density thick blood films from each patient were stained with Giemsa and examined by an experienced microscopist. A slide was declared negative if after 200 thick-film fields (usually 10-15 minutes) had been scrutinised using an oil-immersion objective and no asexual parasites are detected. When trophozoites were encountered they were counted against 200 white blood cells. In order to arrive at the approximate trophozoite count per mm³ of blood, the number of trophozoites counted was multiplied by 30, assuming the normal white cell count for adult Zambians to be approximately 6000/mm³.

Malaria antibody titre was measured using the indirect immunofluorescent antibody (IFA) technique suggested by WHO⁴. *P. falciparum* antigen slides were the gift of Dr Wernsdorfer, WHO Geneva. Antigen slides were stored frozen at -20°C until needed. Prior to use the slides were thawed and brought to room temperature in a desiccator. Based on previous experience in other and our own laboratories, sera that gave titre readings of $\geq 1/20$ were considered positive⁴.

Syphilitic serology was done using the Wellcome Treponema Pallidum Haemagglutination (TPHA) kit.

Urine was collected from each patient in casualty and tested for chloroquine and other compounds containing organic bases using the Dill-Glazko eosin colour test⁵. Drugs commonly prescribed at the casualty department of NCH to patients with symptoms suggestive of malaria (antimalarials, antipyretics and/or antibiotics) were obtained from NCH pharmacy and tested *in-vitro* for their reaction in the Dill-Glazko test.

Statistical analysis of the data was done using the Standard Normal Deviate (SND) for large samples and in some instances using student 't' test or the X² test.

RESULTS

There were 165 patients with symptoms suggestive of malaria seen during the study period; in actuality 14 working days. One hundred and sixteen of these were males and 49 were females giving a male:female ratio of 2,4:1. Sixty-two of 165 (37,5%) were positive for *P. falciparum*. Only one patient had a mixed *P. falciparum/P. malariae* infection.

Table I

Haemoglobin Values in Patients with Symptoms Suggestive of Acute Malaria at NCH — Compared with Normal Urban and Rural Populations in Zambia

	Study Group BS+VE Males	Study Group BS-VE Males	Study Group BX+VE Females
Nos Studied	46	66	14
Mean HB Values (G/dl)	13.43	13.89	11.52
Std. Deviation	1.69	1.75	1.31

	Study Group BS-VE Females	Ndola Urban Males	Kampumbu Rural Males	Kampumbu Rural Females
Nos Studied	30	120	273	260
Mean HB Values (G/d)	11.58	15.39	12.9	11.8
Std. Deviation	1.61	1.56	2.3	1.7

BS = Blood Slide

+VE = Positive

-VE = Negative

STD = Standard

HB values were available for 60 blood slide (BS) positive and 96 BS negative patients (Table 1). The mean HB for BS positive individuals is 13,0G/dl and this is not significantly different from the mean HB of 13,13G/dl for the BS negative group. The study whether BS positive or negative had significantly higher HB than the normal rural Kampumbu population (SND=2,84; $p \leq 0,01$). Male patients who are BS positive have significantly higher HB than normal rural Kampumbu population (SND=4,26; $p \leq 0,01$), but have a significantly lower HB than normal donor male population of urban Ndola (SND=6,8; $p \leq 0,001$). Similarly symptomatic males who are BS negative have significantly higher HB than the Kampumbu population (SND=4,67; $p \leq 0,01$), while they have a significantly lower HB than the normal urban Ndola donor population (SND=7,75; $p \leq 0,001$). On the other hand, female patients whether BS positive or not had significantly lower HB than their male counterparts ($t=4,44$

and 6.33 respectively; $p \leq 0.001$). The mean HB for BS positive females does not differ significantly from the mean value for rural Kampumbu females ($t=0.80$; $p \geq 0.05$). In like manner the mean HB for BS negative symptomatic females does not differ significantly from rural Kampumbu females ($t=0.72$; $p \geq 0.05$). Comparison between symptomatic females and Ndola urban donors could not be carried out since all the donors were males.

Taking the cut-off point of 12 G/dl to indicate significant anaemia, 15 out of 60 BS positive individuals (25%) were anaemic. Of the 14 BS positive females seven (50%) were anaemic and of the 46 BS positive males eight (17%) were regarded as anaemic. On the other hand 26 out of 96 BS negative group (27%) were anaemic. The corresponding figures for the BS negative males and females were 11 out of 66 (16.6%) and 15 out of 30 (50%) respectively. A breakdown of HB levels by the various age groups revealed no significant difference between BS positive and BS negative individuals for all ages except for the under 15 where the difference tended to approach significance at the 5% level.

Fifty-seven BS positive and 93 BS negative patients had malaria antibody titres available. Only three (5.3%) of BS positive had antibody titre $\leq 1:20$ (false negative IFA), and none of these three had a positive Dill-Glazko test. On the other hand 27 (29%) of BS negative individuals had antibody titre $\leq 1:20$ and eight of these 27 had positive Dill-Glazko urine test. BS positive individuals have a significantly higher malaria antibody titre than BS negative patients ($t=4.27$; $p \leq 0.001$ D.F. 121). When the two sexes are considered separately, females who are BS positive had significantly higher antibody titre than BS negative females ($t=3.36$; $p \leq 0.002$ D.F. 33). The difference between BS positive males and BS negative males did not differ significantly ($t=2.9$; $p \geq 0.05$ D.F. 87). No significant differences were observed in malaria antibody titre between BS positive and BS negative individuals at the various age groups. Comparing males and females who are BS positive there was no significant difference in their malaria antibody titre ($t=1.2$; $p \geq 0.05$, D.F. 42). Similarly for the BS negative group of males and females, there was no significant difference in their malaria antibody titre ($t=0.79$; $p \geq 0.05$, D.F. 76).

Table II shows the various drugs that gave positive and negative Dill-Glazko *in-vitro* test respectively. The drugs giving positive reactions were mainly antimalarials and some

Table II

(A) Drugs giving Positive Dill-Glazko Reaction

Ampicillin*
Ampiclox* (Ampicillin + Cloxacillin)
Camoquin (amodiaquine dihydrochloride)
Chlorophenicol*
Chloroquine sulphate
Co-trimoxazole
Mepacrine dihydrochloride
Metronidazole
Malidixic acid*
Paludrine (proguanil hydrochloride)
Paracetamol
Penicillin
Primoquine
Pyrimethamine

* Weak positive reaction

(B) Drugs giving Negative Dill-Glazko Reaction

Asprin
Codein
Cloxacillin
Gelucil
Nitrofurantoin
Sulphadimidine
Sulphamerazine
Tetracycline
Vibramycin

antibiotics. Antimalarials gave definite positive reactions whereas the majority of antibiotics gave weak positive reactions. One hundred and sixty patients with symptoms suggestive of acute malaria had the Dill-Glazko urine test performed. Of these 31 (19%) were positive. There is a significant correlation between a positive Dill-Glazko urine test and a negative BS for malaria ($X^2 = 7.14$; $p \leq 0.01$). In other words, patients who have Dill-Glazko urine test positive are unlikely to have a positive BS for malaria (Table III). There was, however, no correlation between malaria parasitemia, Dill-Glazko test and HB.

Table III

Malaria Parasitemia and Dill-Glazko Test

Urine Test	Blood Slide + VE	Blood Slide - VE	Total
Positive	5	26	31
Negative	57	72	129
Total	62	98	160

($X^2 = 7.14$ $p < 0.01$)

TPHA was performed in 117 patients (60 BS positive and 57 BS negative), and it was found positive in 22 (18.8%). There was no significant difference in TPHA positivity between BS

positive patients and BS negative individuals ($X^2 = 0.33$; $p > 0.05$; Table IV).

Table IV
Malaria Parasitemia and TPHA

TPHA	Blood Slide		Total
	Positive	Negative	
Positive	13	6	22
Negative	47	48	95
Total	60	57	117

($X^2 = 0.33$ $p > 0.05$ D.F. 1 N.S.)

NS = Not significant

No correlation was observed between malaria parasite density and both HB level or specific malaria antibody titre. There was near correlation in the case of parasite density and malaria antibody titre for the female patients but the sample size was small.

DISCUSSION

Of the 165 patients with symptoms suggestive of malaria, only 62 (37.5%) were BS positive for malaria. The remaining 103 (62.5%) were negative. Negative BS could be due to several reasons. Firstly, it is possible some of the patients had taken antimalarials before reporting to NCH. This is corroborated by the fact that 19% had a positive Dill-Glazko urine test, and there was a significant correlation between a positive Dill-Glazko test and a negative BS. Secondly, it is possible some patients had malaria but the parasite density was too low to be detected by the current microscopic method available. With time some of these, if not treated, the parasites would multiply and eventually would have positive BS. Although attempts have been made to develop immunological methods for detection of malaria antigens in patients with very low parasitemia, the simple parasitological blood examination remains the diagnostic method of choice for individual cases. Lastly, it is also possible that a number of these patients did not have malaria and their symptomatology was due to some other agent or agents such as bacterial or viral infections. Some of the symptomatic BS negative patients probably had either urinary tract infection or pelvic inflammatory disease both of which commonly present with symptoms of fever, chills, diarrhoea and vomiting.

It is interesting to note that while the prevalence in symptomatic individuals attending hospital is only 37.5%, the prevalence for the

rural population which is largely asymptomatic is 57-65%⁶. This would have important implications with regards endemicity and/or immunity with consequential development of severe complications of malaria notably cerebral malaria. The presentation with acute symptoms might indicate we are dealing with a non-immune population in the urban area and this might explain the high frequency of cerebral complications.

The World Health Organization experts in 1960 had laid down a set of normal HB values below which anaemia should be considered to exist. It is now accepted that this was an oversimplification of a very complex problem, and it is now recommended that each country should set out its own range of normal values as standards below which an individual should be considered anaemic. Studies performed in the rural population of Kampumbu, Zambia, revealed that the mean HB for 273 adult men was 12.9G/dl (SD of 2.3), and 11.8G/dl (SD 1.7) for 360 adult females. For Ndola urban donor population the mean HB was 15.39G/dl (1.56). Comparing the study population with both the urban and rural populations certain differences emerge. The study population whether BS positive or negative had significantly lower HB than the normal urban group. However, the study population had a significantly higher HB than the rural population of Kampumbu. This observation underscores the need to select appropriate controls for comparison. The majority of symptomatic patients in the study group probably came from Ndola urban and its surrounding villages and therefore it could be stated that the urban population whether normal or symptomatic have a significantly higher HB than the rural population of Kampumbu. The reasons for this difference is not immediately clear but could be related to a variety of factors prominent among which are nutritional differences and the prevalence of parasitic infections like hookworm and schistosomiasis.

Eosinophil count of about 10% is observed in the rural Kampumbu population while in the urban area the figure is less than 5%. This might indirectly imply a higher helminthic infection rate in the rural area than in the urban centres.

In this study the mean HB for BS positive individuals did not differ significantly from the mean HB of BS negative patients. However, the female patients whether BS positive or negative had significantly lower HB than their male counterparts. This observation is not surprising since females are known to have lower

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HB than males. The low HB among females may be related to menstrual losses, repeated pregnancies and possibly dietary factors. Probably if pregnant women were studied separately malaria would perhaps prove to be a significant factor in the causation of anaemia. However, in a study comparing pregnant and non-pregnant women in Mali 30% of both groups were found to be anaemic. Another group deserving closer study or a larger sample are those under 15 years since the difference between the mean HB for the BS positive and BS negative tended to approach significant levels. Studies of Nigerian children aged 1-7 years confirmed the causal relationship between anaemia and malarial parasitaemia⁸.

Taking the cut off point of 12 G/dl, 15 of 60 (25%) BS positive are anaemic as compared with 26 of 96 (27%) BS negative group. Considering the male patients who are BS positive. Eight of 46 (17%) were recorded as anaemic. This figure compares favourably with the figure of 20% quoted for American soldiers in Vietnam who developed significant anaemia upon infection with *P. falciparum*⁹. Because no attempt was made to establish the mechanisms of anaemia or to look for other possible causes of anaemia the present study could be open to criticism. However, this was not the objective of the study. Since there is no significant difference between HB concentration between BS positive and BS negative patients this would suggest that malaria *per-se* may not be a major cause of anaemia in adults.

In this study there was no correlation between the parasite density and HB levels. This is at variance with the observations made by McGregor and Williams in Gambia where there was a positive correlation between the severity of anaemia and malaria parasite rates¹⁰. In another study by Sun Myint *et al.* no correlation was observed between anaemia and the parasite density in patients with low parasitemia. However, a negative correlation was found in those with high parasite counts¹¹.

The first direct evidence for humoral anti-parasitic immunity in man was provided by Cohen *et al* when they transferred immunoglobulins of adult West Africans to children with *P. falciparum* parasitemia and induced a reduction in the number of circulating parasites¹². They suggested that the immune serum blocked invasion of new red cells by merozoites. Antibody production is dependent on the age of the patient, the intensity of infection, previous experience with parasites and the duration of infection at the time when serum is

collected. The presence of antibody proves experience of malaria but does not differentiate between present and past infection¹³. It must be borne in mind that immunodiagnostic and serologic tests are not able as yet to replace microscopic diagnosis of malaria in individual cases. Of the existing tests, IFA is at present the test of choice. This is because IFA technique utilises the whole parasite antigen and it is species — specific.

Using the IFA to detect malaria antibody 94.7% of patients who were BS positive had titre of $\geq 1/20$. ($\leq 1/20$ being taken as negative by the sensitivity of the method used). Thus only 5.3% of BS positive patients had false negative IFA test. This compares favourably with the false negative IFA of 11.7% in 800 BS positive patients in El Salvador¹⁴. There was thus concordance between IFA test and microscopic diagnosis in this study. Similar agreement was observed by Thomas and Pak Leng in their study involving 86 serum samples from patients who were BS positive for *P. falciparum*¹⁵.

In this study there was no correlation between parasite density and malaria antibody titre even at various age groups, although for the female a correlation coefficient r of 0.25 was observed. The sample size was small and it might be worthwhile pursuing this with a large sample size. This, however, confirms an earlier observation noted in male patients participating in the Mefloquine phase II trial at our Centre where again no correlation was evident between parasite density and specific malaria antibody titre. This may be a reflection of the complexity of immunopathological pathways in malaria infection.

It is not immediately clear why the females who are BS positive have a higher malaria antibody titre than BS negative females. It would appear the female patients respond more vigorously to repeated *P. falciparum* infections. It can, however, be said that the malaria cases studied were sufficiently immunocompetent to the malaria antigen as measured by the IFA; indicating in most cases a booster-like reaction in the BS positive individuals. In case of the BS negative group perhaps prior treatment with antimalarials in some led to an early abortive infection with a consequential poor immune response.

The Dill-Glazko test on the various drugs revealed that all the antimalarials gave strong positive reactions. A number of antibiotics including penicillin and chloramphenicol gave positive reactions, albeit weak ones. Since

these were *in vitro* tests, it is not possible to say whether they would still give positive reactions after *in vivo* metabolism of the same drugs. Studies involving 332 urine samples in India, gave no false positive Dill-Glazko results and 331 reacted within 24 hours with only one having a delayed reaction up to 72 hours. The study concluded that the Dill-Glazko test for chloroquine is a simple and reliable test¹⁶. The finding of correlation between a positive Dill-Glazko urine test and a negative BS would suggest that the majority of BS negative patients had probably taken chloroquine or some other antimalarial containing an organic base within 24-72 hours prior to admission.

The finding of an 18% TPHA positive individuals was surprising especially when there was no significant difference between those who are BS positive or negative. Although we set out to search for biological false positives we were taken aback at finding this high figure in both malarious and non-malarious individuals. TPHA utilizes a treponemal antigen and as such it is both a sensitive and a fairly specific test. This would mean that about 18% of the population studied had been in contact with a treponemal antigen at one time or another, and since Bejel, Pinta and Yaws are relatively rare in East and Central Africa the treponemal antigen in question is most probably syphilitic. This observation clearly calls for more detailed study of the Zambian population groups. A preliminary analysis of cord blood and maternal blood at the time of delivery at our Centre reveals an equally high positivity TPHA rate.

In summary from this study it can be concluded:-

- 1) That the parasite rate in symptomatic individuals attending NCH is only 37%;
- 2) That malaria *per-se* is probably not a major cause of significant anaemia among male adults seen at NCH;
- 3) That about 19% of symptomatic individuals will have taken either antimalarials or other drugs containing organic bases;
- 4) That there is apparently no correlation between parasite density, anaemia and specific antibody titre and this may merely reflect the complexity of the immunopathological pathways in malaria infection;
- 5) That about 18% of individuals tested are TPHA positive whether BS positive or not.

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