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To study the correlation between blood groups and malaria

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Abstract

Background: Malaria is a major national health problem with considerable morbidity & mortality & has long been eluding our efforts for an effective control. The clinical features of malaria vary from mild to severe & complicated according to species of parasite present & patient's immunity. Malaria continues to pose major public health threat in India, particularly due to Plasmodium falciparum which is prone to complications.

Objectives

- To know whether there is a correlation between A, B, O blood groups and malaria, also to study the particular blood group frequencies in malaria patients.
- To determine if any particular blood group confers some degree of protection against malaria or its complications and also to look for any sex predilection.

Materials and Methods: 150 patients admitted to MVJ Medical College and Research Hospital, Bangalore, clinically suspected to have malaria were confirmed with relevant investigations, fulfilling the study criteria were analysed. statistically. the duration of the study was from October 2017 to September 2018.

Results: Out of 150 patients, 92 (61.3%) were males and 55 (38.7%) were females with maximum incidence 15-34 years 'B' (39 patients 26%) was commonest blood group in all types of malaria. Vivax malaria was common in all blood groups.

Falciparum cases were more in blood group 'O' (21.4%).

Blood group A had maximum number of complicated cases (45.5%).

Blood group 'B' had maximum number of recurrent attacks.

Interpretation and conclusion: Malaria was more common in middle aged males, maximum complications were seen in blood group A. Vivax malaria was the commonest in all blood groups. Maximum number of malaria patients were in blood group B.

Keywords: Blood group, malaria, prevalence

Introduction

Malaria is the oldest disease known to mankind that has had profound impact on our history. It continues to be a huge social, economical and health problem, particularly in the tropical countries. Malaria is caused by protozoan parasites of Plasmodium and is transmitted to human by Anopheles species mosquitoes. There are five species of Plasmodium that cause disease in man; P. falciparum, P. Vivax, P. malariae, P. ovale and P. knowlesi^[1]. Every year 300 million to 500 million people suffer from this disease (90% of them in sub-Saharan Africa, two thirds of the remaining cases occur in six countries-India, Brazil, Sri Lanka, and Vietnam. Colombia and Solomon Islands). About 1.5 million to 3 million people die of malaria every year. Malaria ranks third among the major infectious diseases in causing deaths after pneumococcal acute respiratory infections and tuberculosis. It accounts for 2.6 percent of the total disease burden of the world. It is responsible for the loss of more than 35 million disability-adjusted life-years each year. Although erythrocytes have traditionally been considered relatively inert containers of Hemoglobin, mounting evidence suggests that they in fact bear numerous surface molecules that are active in microbial attachment processes. Various host receptors on the surface of the uninfected RBC have been proposed including ABO blood group antigens. Also, the severity of malaria and its association with the ABO blood groups and the protective effects of blood group antibodies have been highlighted in various studies.

The identification of the ABO antigens as receptors or coreceptors responsible for invasion by the malarial parasite brings in the possibility of receptor blockade for anti-malarial therapy as a potential therapeutic tool. The genetic makeup of individuals may cause a considerable variation in their reaction to malarial infection and blood groups being an expression of genetic constitution are likely to indicate an individual's susceptibility. It was therefore thought worthwhile to conduct a study on the relationship between the ABO blood groups and malaria infection in our set up.

2. Objectives

- To know whether there is a correlation between A, B, O blood groups and malaria, also to study the particular blood group frequencies in malaria patients.
- To determine if any particular blood group confers some degree of protection against malaria or its complications and also to look for any sex predilection.

3. Methodology - The study was carried out on patients with fever and who were diagnosed to have malaria by

- **Peripheral smear examination for malarial parasites:** It is the gold-standard confirming the diagnosis of malaria. Thick and thin smears prepared from the peripheral blood are used for the purpose. The peripheral blood smear provides comprehensive information on the species, the stages, and the density of parasitemia with a sensitivity of 5 to 10 parasites/pl. of blood for an experienced laboratory professional. The efficiency of the test depends on the quality of the equipment and reagents, the type and quality of the smear, skill of the technician, the parasite density, and the time spent on reading the smear.
- **Thick smear:** The thick smear of correct thickness is the one through which newsprint is barely visible. It is dried for 30 minutes and not fixed with methanol this allows the red blood cells to be haemolysed and leukocytes and malaria parasites present will be the only detectable elements. However, due to the haemolysis and slow drying, the plasmodia morphology can get distorted making differentiation of species difficult. Thick smears are therefore used to detect infection, and to estimate parasite concentration. Infected erythrocytes are counted in relation to a predetermined number of WBCs and an average of 8000/pl is taken as standard. 200 leucocytes are counted in 100 fields (0.25 ul of blood). All parasite species and forms including both sexual and asexual forms are counted together.
- **Thin smear:** Air dry the thin smear for 10 minutes. After drying, the thin smear should be fixed in methanol. This can be done by either dipping the thin smear into methanol for 5 seconds or by dabbing the thin smear with a methanol-soaked cotton ball. While fixing the thin smear, all care should be taken to avoid exposure of the thick smear to methanol. Determining the percentage of parasitemia percentage of will be essential for *P. falciparum*. The number of infected red cells (and not number of parasites) in 1000 RBCS is converted to percentage.

+ = 1-10 per 100 thick fields

++ = 11-100 per 100 thick fields.

+++ = 1-10 per thick field.

+++ =>10 per thick field.

- **Staining:** Number of Romanowsky stains like Fields, Giemsa, Wright's and Leishman's are suitable for staining the smears.
- **Quantitative buffy coat test:** It involves staining of the centrifuged and compressed red cell layer with acridine orange animation under UV light source.
- **Method:** The OBC tube is a high-precision glass hematocrit tube, pre-coated internally with acridine orange stain and potassium oxalate. It is filled with 55-65 microliters of blood from a finger, ear or heel puncture. A clear plastic closure is then attached. A precisely made cylindrical float, designed to be seeded in the packed red blood cells. is le blood inserted. The tube is centrifuged at 12,000 rpm for 5 minutes. The components of the buffy coat separate according to their densities, forming discrete bands. Because the float occupies 90% of the internal lumen of the tube, the leukocyte and the thrombocyte cell band widths and the top-most area of red cells are enlarged to 10 times normal. The QBC tube is placed on the tube holder and examined using a standard white light microscope equipped with the UV microscope adapter, an epi-illuminated microscope objective. Fluorescing parasites are then observed at the red blood cell/white blood cell interface. Red cells containing Plasmodia are less dense than normal ones and concentrate just below the leukocytes, at the top of the erythrocyte column. The float forces all the surrounding red cells into the 40 micron space between its outside circumference and the inside of the tube. Since the parasites contain DNA which takes up the acridine orange stain, they appear as bright specks of light among the non-fluorescing red cells.
- **Rapid diagnostic tests: Immunochromatographic Tests for Malaria Antigens** - Immunochromatographic tests are based on the capture of the parasite antibodies antigens from the peripheral blood using either monoclonal or polyclonal against the parasite antigen targets currently immunochromatographic tests can target the histidine-rich protein 2 of *P. falciparum*, A pan-malarial Plasmodium aldolase and Parasite specific lactate dehydrogenase.

Sensitivity: Rapid diagnostic tests for the diagnosis of *P. Falciparum* generally achieve a sensitivity of >90% at densities above 100 parasites per micro litre blood and the sensitivity decreases markedly below that level of parasite density. For the diagnosis of *P. vivax* malaria, the PfHRP2/PMA test has a lower sensitivity compared to that for *P. falciparum* malaria; however, the p LDH test has an equal or better sensitivity for *P. vivax* malaria compared to *P. falciparum* malaria.

- **Other tests: Polymerase Chain Reaction (PCR):** Using the non-isotopically labelled probe following PCR amplification, it is possible to detect malaria parasites. The PCR test is reportedly 10-fold more sensitive than microscopy. The study group consisted of 150 patients. The control series was formed by

determining the baseline distribution of ABO blood groups of 150 individuals from the general population. The cases taken were from MVJMC & RH, Bangalore and the duration of the study was from October 2017 to September 2018.

Inclusion criteria: Patients who are diagnosed to have malaria and are above 18 years of age

Exclusion criteria:

1. Cases who have undergone treatment before giving a blood sample.
2. Patients with hematological malignancies.
3. Patients with known renal disease.
4. Patients with known liver disease.

ABO blood grouping was done using the slide agglutination method and the correlation between the blood groups and malaria was studied.

Complicated malaria (WHO criteria)

1. Impaired consciousness (but arousable).
2. Prostration and extreme weakness
3. Jaundice
4. Cerebral malaria (unrous able coma not attributable to any other cause in patient with falciparum malaria).
5. Generalized convulsions
6. Normocytic anemia
7. Renal failure
8. Hypoglycemia
9. Fluid, electrolyte, acid base disturbances
10. Pulmonary oedema
11. Circulatory collapse and shock (algid malaria)
12. DIC
13. Hyperpyrexia
14. Hyperparasitemia
15. Malarial hemoglobinuria

Mild malaria: Acute febrile illness but no features of severe malaria.

Moderate malaria: Did not fulfill the criteria of severe malaria.

Severe malaria

1. Those with cerebral brain malaria (in coma and unable to localize a painful stimulus)
2. Fully conscious either prostrated (unable to maintain a sitting posture) or in respiratory distress - abnormally deep breathing with intercostal or subcostal recession.

Statistical methods: Diagrammatic representation & Chi-square test.

4. Results

4.1 Sex predominance: The study group was comprised of a total of 150 malaria patients. More malaria cases were found among males (92 patients 1.3%) than females (58 patients 38.7%).

4.2 Age wise distribution: The study group was divided into groups based on age. Malaria was found to be most common moon in the 35 - 44 age group followed by those between 15-34 years of age. Incidence was less above the age of 54 years

Table 1: Age wise distribution

Age group (years)	No. of cases	Percent
15-24	36	24.0
25-34	34	22.7
35-44	4	28.0
45-54	20	13.3
55-64	11	7.3
65-74	6	4.0
75-95	1	0.7
Total	150	100.0

4.3 Comparison between Baseline population and study group

The following table shows the blood group prevalence in the baseline population and in patients with malaria. In the baseline population O was the commonest blood group whereas in the study group B was the commonest; but this was not statistically significant.

Table 2: Comparison between Baseline population and study group

Blood group	Baseline Population		Patients with Malaria	
	No. of Subjects	Percent	No. of cases	Percent
O	61	41	42	28.0
A	41	27	33	22.0
B	39	26	52	34.7
AB	9	6	23	15.3
Total	150	100	150	100.0

Chi square test: 12.35, p=0.21 not significant

The following table show the number of vivax and falciparum infected patients those with mixed infection. Vivax malaria was the commonest in all the blood groups. Falciparum cases were more in blood group O. Mixed infection was seen predominantly in blood group B; but this was statistically not significant.

Table 3: Blood groups and malaria type

Blood groups/ malaria type	Type of malaria			Total
	Vivax positive cases	Falciparum positive cases	Mixed infections	
O	27 (64.3%)	9 (21.4%)	6 (14.3%)	42 (100%)
A	20 (60.6%)	8 (24.2%)	5 (15.2%)	33 (100%)
B	34 (65.4%)	6 (11.5%)	12 (23.1%)	53 (100%)
AB	16 (69.6%)	4 (17.4%)	3 (13.0%)	23 (100%)
Total	97 (64.7%)	27 (18.0%)	26 (17.3%)	150 (100%)

Chi-Square 6.82, P value=0.34, NS

4.5 Blood groups complications

The following table and graph show the number of complicated cases in each blood group. A had the maximum number of complicated cases (45.5%) but statistically not significant.

Table 4: Blood groups complications

Blood groups	Complications		Total
	No	Yes	
O	29 (69.0%)	13 (31.0%)	42 (100%)
A	18 (54.5%)	15 (45.5%)	33 (100%)
B	38 (73.1%)	14 (26.9%)	52 (100%)
AB	14 (60.9%)	9 (39.1%)	23 (100%)
Total	99 (66.0%)	51 (34.0%)	150 (100%)

Chi-Square 3.53, P value-0.32, NS

The following table and graph show the number of patients who repeatedly get malaria in each blood group category. Blood group B had the Aximum of each blood group category. Blood group B had the number attacks (28.8%) but this was statistically not significant.

Table 5: Blood groups Attacks

Blood groups	Attacks		Total
	Repeated	Single	
O	10 (23.8%)	32 (76.2%)	42 (100%)
A	9 (27.3%)	24 (72.7%)	33 (100%)
B	15 (28.8%)	37 (71.2%)	52 (100%)
AB	2 (8.7%)	21 (91.3%)	23 (100%)
Total	36 (24.0%)	114 (76.0%)	150 (100%)

Chi-Square-3.82, P value - 0.28, NS

Table 6: Severity of malaria in relation to blood groups

Blood groups Severity	Attacks			Total
	Mild	Moderate	Severe	
O	33 (78.6%)	5 (11.9%)	4 (9.5%)	42 (100%)
A	26 (78.8%)	1 (3.0%)	6 (18.2%)	33 (100%)
B	43 (82.7%)	5 (9.6%)	4 (7.7%)	52 (100%)
AB	20 (87.0%)	2 (8.7%)	1 (4.3%)	23 (100%)
Total	122 (81.3%)	13 (8.7%)	15 (10.0%)	150 (100%)

Chi-Square-5.17, P value-0.52, NS

The study group had been divided into three groups, those with mild, Moderate and severe malaria. Mean Hb level in the severe group was 6.6 g/dl.

Table 7: Blood groups and severity of malaria

Blood group	No. of severe cases	Percentage
A	6	18.2
B	5	7.7
AB	2	4.3
O	4	9.8

This table shows the number of severe cases of malaria in each of the blood groups. Blood group A had the maximum number of severe cases.

5. Discussion

Malaria has been emerging as a health problem with effective control considerable morbidity and mortality has long been eluding our efforts for an effective control. Since blood groups are an expression of genetic constitution, it was vided to study their influence on susceptibility to malaria.

In the 150 cases studied, more infected cases were found among males (61.3%). It was also found that most of the cases were in the 35-44 age group (28%).

The baseline distribution of blood groups in the normal population was established by taking samples from 150 individuals. Blood group O (41.0%) was the commonest in this population. Chowdhuri *et al.* found blood group B as commonest in the study group in the patients with malaria but this was not statistically significant P = 0.21^[2].

Vivax malaria was found to be the commonest in all blood groups. This is comparable with the findings of Chaudhari *et al* ^[2]. P. falciparum malaria was seen predominantly in blood group O (21.4%) in this study

Patients with blood group A were found to have more complications in the form of hypotension, anemia,

thrombocytopenia, cerebral malaria, pyrexia, and hypoglycemia. DIC. pulmonary oedema, renal failure and generalized convulsions.

This could be due to blood group A being a co-receptor in plasmodium falciparum rosetting. As various studies have found that antigens equivalent to the blood group antigens A and B and the Anti-A titre of group O subjects often had repeated attack of P. vivax and P. falciparum malaria greater than in control group O subjects ^[3].

The anti B titre was also raised but not to the same extent as for anti A.

Consequently, if malarial infection is to any extent combated by anti A, it would be more severe in those subjects unable to elaborate this antibody i.e. Group A subjects.

Also our study shows kind of protection for complications in blood group AB suffering from malaria which is not accordance with Fiseher *et.al* who reported-favourable outcomes for blood group O ^[4].

Repeated attacks were found to be more in blood groups B. An interesting finding by was the selective feeding of Anopheles Gambiae with a preference for blood group O. The basis for this recognition and selection is not obvious although ABH blood group substances do occur on skin cells and have been reported in sweat ^[5].

In this study, cases of severe malaria had a mean hemoglobin level of 6.62/dl which was comparable to other similar studies.

The trends noted in this study have however not been found to be statistically significant. This study could have been more informative if Duffy blood group testing could have been done as well as testing for RBC rosette formation.

6. Conclusion

1. Malaria is predominantly found in the 35 - 44 years age group.
2. Malaria is more common in males.
3. The maximum number of malaria patients were in blood group B in this study.
4. The baseline population showed a predominance of blood group O.
5. Falciparum cases were predominantly seen in blood group O.
6. Vivax malaria was the commonest type in all blood groups.
7. Repeated attacks were seen mainly in blood groups B.
8. Complications were more in blood group A.
9. The mean haemoglobin level in patients with severe malaria was 6.6g/dl.
10. The maximum number of severe cases of malaria was seen in patients with blood group A.

7. Summary

The present study shows that malaria is more common in patients with Blood group B' Patients with blood group A' were more prone for complications. Hence patients with blood group A may need stringent monitoring in hospital setup to avoid any overt complications. Patients with blood group AB offers some amount of protection to complications as least number of patients in this blood group developed complications. Males were more prone for malaria.

8. Reference

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