The Relation Of Falciparum Infection With Human Blood Groups

Dr. Manish Lamoria*, Dr. K Prabhakaran, Dr. Soumi H Chaudhuri***, Dr. J M Jadeja******

* Assistant Professor,Department of Physiology, GMERS Medical College and Hospital,Dharpur, Patan, **Associate Professor, Department of Anatomy, Geetanjali medical college and Hospital, Udaipur, Rajasthan,***Ex-Assistant Professor, Department of Anesthesia, GMERS Medical College Hospital, Dharpur, Patan,****Professor and HOD, Department of Physiology, B. J. medical college, Ahmedabad, Gujarat

Abstract : **Background and Objectives**: The ABO blood group is arguably the best known, yet the most functionally mysterious, genetic polymorphism in human. A number of studies have shown the susceptibility to several infectious diseases is related to patient's blood group. Malaria is one of the diseases and Malaria remains the most complex and overwhelming health problem facing humanity especially in the vast majority of tropical and subtropical regions of the world. The resurgence of malaria is a serious public health problem in many parts of the world including India. It is therefore important to identify the factors which contribute to susceptibility of hosts. **AIM:** In order to study the distribution and correlate the incidence of ABO blood group in healthy individuals and Plasmodium falciparum malaria patients admitted in Civil Hospital, Ahmedabad with Plasmodium falciparum infection. To evaluate the morbidity and mortality associated with Plasmodium falciparum malaria infection. To figure out the correlation between ABO blood group and complications caused by Plasmodium Falciparum infection. To find out the blood group which confer some resistance against the plasmodium falciparum malaria infection. **Methods:** The study conducted from January 2009 to August-2010 (1year, 8 months) on 62 diagnosed cases of Plasmodium falciparum malaria patients admitted in Civil Hospital, Ahmadabad. Patients who were tested positive for plasmodium falciparum and treated for the same in the indoor wards of Civil Hospital, Ahmedabad were taken for study. **Observation and Results**: out of 62 cases 21 (33.80) were in blood group A, 19 (30.64) were in blood group B, 7(11.29) were in blood group AB and 15 (24.20) were in blood group O. Out of 660 controls selected 161 (24.39%) were of blood group A, 224 (33.93%) were of blood group B, 68 (10.30%) of blood group AB and 207 (31.36%) belonged to blood group O. **Conclusion:** So we see through Statistical data_that although blood group B is commonest in controls but in patients plasmodium falciparum malaria blood group A (33.80%) followed by blood group B (30.64%), blood group O was at 3rd place and AB was least common in cases. By Statistical data there is high relative risk in blood group A (1.38) followed by blood group AB (1.09). Distribution of blood group in healthy individual shows blood group B is more common in India followed by group O then group A and lastly group AB, whereas falciparum malaria incidence is highest in group A (high relative risk is present) followed by group B, then group O and least in group AB. Incidence of malaria is seen higher among young age group (below 30 years) and in male sex probably due to occupational exposure.Highest morbidity and complications are observed in group A followed by group B. Group O appears to be immune to severe complications of falciparum malaria. Mortality is seen equally in group A and B. Death is not noted in group O. As blood group O reduces plasmodium rosseting. [Lamoria M et al NJIRM 2013; 4(6) : 23-28]

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Author for correspondence: Dr. Manish Lamoria, Assistant Professor,Department of Physiology,GMERS Medical College and Hospital,Dharpur, Patan

Introduction: The ABO blood group is arguably the best known, yet the most functionally mysterious, genetic polymorphism in human. The ABO blood group system is widely credited to have been discovered by the Austrian scientist Karl Landsteiner[1], who found three different blood types in 1905. Blood group antigen represents genetic marker, which like other risk factors shows correlation with a number of diseases. No diseases are known to result from the lack of expression of ABO blood group antigens, but the susceptibility to a number of diseases has been linked with a person's ABO phenotype. A number of studies have shown the susceptibility to several infectious diseases is related to patient's blood group. Clark et al[2] and Glynn et al[3] found the rheumatic fever was more common in non group O individuals while infection with influenza virus A2 was found more frequently in persons with group O blood group. Such correlations remain controversial and include the observation that gastric cancer appears to be more common in group A individuals, whereas gastric and duodenal ulcers occur more often in group O individuals.

Malaria remains the most complex and overwhelming health problem facing humanity especially in the vast majority of tropical and subtropical regions of the world. The resurgence of malaria is a serious public health problem in many parts of the world. It is therefore important to identify the factors which contribute to susceptibility of hosts.

The disease caused by the intracellular protozoan parasite of the genus Plasmodium invades and multiplies in the liver and red blood cells during its lifecycle in man. Malaria is scourge of nations like Africa, India, Southeast Asia and South America. However about 90% of all malarial deaths in the world today occur in sub-Saharan Africa because majority of infections in the region are caused by Plasmodium falciparum, the most dangerous of the four human malarial parasites, and also because of the most effective malarial vector, Anopheles gambiae. Although infection with malarial parasites is common, only 1-2% of infections lead to severe life threatening disease characterized by a range of clinical pictures, including unarousable coma, severe anemia, metabolic acidosis and multiple organ failure.

During the past two decades, several studies[4,5] have been tried to link the ABO blood groups to the incidence of malaria parasitemia, to malaria antibody level or to the repeat attacks of malaria. But nothing solid has been contrived from the above studies.

The finding of more malaria cases in males than in females is in agreement with the finding of most malariologists. Some studies have indicated that Duffy negative erythrocytes are resistant to invasion by P. knowlesi and Duffy negative individuals are resistant to P. vivax infection. Such studies suggest that subjects with different blood group have different susceptibilities to malarial infection. The exact cause of this difference is yet to be identified but there are several possibilities. First, the genetic makeup of an individual may cause considerable variation in their reaction to malarial infection, and blood groups are merely an expression of genetic constitution. Secondly, qualitative and quantitative variation in structure and chemical composition of the receptor sites on the erythrocytic membrane of the various groups may play an important role in determining susceptibility. The variation also ascribed to the feeding qualities or habits of the vector species. Some people are more prone to the mosquito bites than others. It was also found that under laboratory conditions Anopheles gambiae seems to recognize blood groups and to feed preferentially on group O. The basis of this recognition is unknown although it may be related to the occurrence of ABO substances on skin cells and in sweat secretion.

Recent studies of the pathogenesis of malaria have shown that parasite triggered red blood cell rosette formation is associated with the severity of clinical disease and with cerebral malaria. The virulence of plasmodium falciparum is associated with the capacity of infected red blood cell (iRBC) to adhere to uninfected RBCs, a process known as rosetting. Interestingly some strains of plasmodium falciparum preferentially trigger rosette formation depending on red blood cell blood group, with A and B group cells being more likely to form rosettes.

Aims & Objectives

1. To study the distribution of ABO blood group in healthy individuals and Plasmodium falciparum malaria patients admitted in Civil Hospital, Ahmedabad with Plasmodium falciparum infection.
2. To correlate the incidence of plasmodium falciparum malaria infection in each of the ABO blood groups & to relate this incidence to the normal distribution of blood group.
3. To evaluate the morbidity and mortality associated with Plasmodium falciparum malaria infection.
4. To figure out the correlation between ABO blood group and complications caused by Plasmodium Falciparum infection.
5. To find out the blood group which confer some resistance against the plasmodium falciparum malaria infection.

Material & Methods: 62 diagnosed cases of Plasmodium falciparum malaria patients admitted in Civil Hospital, Ahmedabad (Patients who were tested positive for plasmodium falciparum and treated for the same in the indoor wards of Civil Hospital) and 660 healthy people free from disease (who voluntarily donated blood, and were registered blood donors from the blood bank of civil hospital, Ahmadabad) formed the subjects of the current study. The was study conducted from January 2009 to August-2010 (1year, 8 months)

Inclusion and Exclusion criteria: only indoor patients who tested positive for plasmodium falciparum on thick smear (with no age limit) were included under the study group in the present study. Whereas patients with mixed plasmodium infection and other associated illness were excluded from the study. 660 healthy people free from disease (who voluntarily donated blood, and were registered blood donors from the blood bank of civil hospital, Ahmadabad) were included under the control group.

Patient particulars: like name, Registration number, age, sex, Address, date of admission, date of discharge, duration of stay and cause of death were recorded.

Malaria was graded as follows: Grade 1: 1-10 parasites per 100 high power field, Grade 2: 11-100 parasites per high power field, Grade 3: 1-10 parasites in every high power field, Grade 4: more than 10 parasites in every high power field.

Following Investigations were collected: Thick smear test report, for falciparum malaria and grade of malaria, ABO blood group by slide method using Antisera, Serum hemoglobin**,** Platelet count**,** Serum Bilirubin**,** Serum Creatinine**,** Random blood sugar

Known Complications of malaria: are Coma/convulsion, Hypoglycemia, Anemia, Thrombocytopenia, Hepatic dysfunction, renal dysfunction and death

Statistical Analysis: Chi-square test was used

Method of determination of blood groups: Blood grouping was done by conventional agglutination test using Anti A serum (containing anti A agglutinin), Anti B serum (containing anti B agglutinin).

Observation And Results: out of 62 cases 21 (33.80) were in blood group A, 19 (30.64) were in blood group B, 7(11.29) were in blood group AB and 15 (24.20) were in blood group O. Out of 660 controls selected 161 (24.39%) were of blood group A, 224 (33.93%) were of blood group B, 68 (10.30%) of blood group AB and 207 (31.36%) belonged to blood group O. So we see through statistical data that although blood group B is commonest in controls but in patients plasmodium falciparum malaria blood group A (33.80%) followed by blood group B (30.64%), blood group O was at 3rd place and AB was least common in cases. By statistical data there is high relative risk in blood group A (1.38) followed by blood group AB (1.09).

Table – 1 (Distribution of Blood group among cases and normal healthy controls)

ABO blood group	Diseased people (%)	Control people (%)
A	21(33.8)	161 (24.39)
B	19 (30.64)	224 (33.93)
AB	7 (11.29)	68 (10.30)
O	15 (24.20)	207 (31.36)
Total	**62**	**660**

This table shows maximum number of plasmodium falciparum cases are seen in A blood group followed by B blood group whereas most common blood group in controlled cases is B blood group followed by O blood group.

Table – 2 (Sex distribution among the cases of Plasmodium Falciparum)

ABO Blood group	Male Positive Cases (%)	Female positive Cases
A	12 (19.35%)	9 (14.51%)
B	16 (25.8%)	3 (4.83%)
AB	4 (6.45%)	3 (4.83%)
O	8 (12.9%)	7 (11.29%)
TOTAL	**40(64.52%)**	**22(35.48%)**

This table shows that plasmodium falciparum cases are more common in male patients in comparison to female patients. In all type of blood groups male patients are more in number. In statistical analysis there is significant p value ($p<0.05$) in males compared to females.

Table – 3 (Age distribution among the cases of Plasmodium Falciparum)

Age Groups	Blood gr. A	Blood gr. B	Blood gr. AB	Blood gr. O
1-10	3	2	1	1
11-20	5	2	0	8
21-30	5	3	2	0
31-40	4	4	2	2
41-50	2	0	1	4
51-60	1	5	1	0
61-70	1	2	0	0
71-80	0	1	0	0
TOTAL	**21**	**19**	**07**	**15**

The distribution of age group in plasmodium falciparum cases showing more cases in younger age groups. Maximum numbers of cases are seen below 30 years of age. In statistical analysis there is significant p value ($p<0.05$) in all blood groups in patients of falciparum malaria having less than 30 years of age.

Table – 4 (Death occurred in cases of falciparum malaria)

ABO Blood group	No. Of patients died (%)
A	2 (40%)
B	2(40%)
AB	1(20%)
O	0(00%)
TOTAL	**5(100%)**

There are total 5 patient died out of 62 patients in which 2 patients each died in blood group A and B, one patient died in blood group AB and there is no death in Blood group O.

Table – 5 (Complication occurred in Plasmodium Falciparum cases)

ABO blood group	Coma / Convulsion	Hypoglycemia	Anemia	Thrombo cytopenia	Hepatic dysfunction	Renal dysfunction
A	3(60%)	3(50%)	6(40%)	15(37.5%)	12(44.4%)	9(39.13%)
B	2(40%)	1(16.6%)	5(33.3%)	15(37.5%)	11(40.47%)	9(39.13%)
AB	0	1(16.6%)	2(13.3%)	5(12.5%)	0	3(13.04%)
O	0	1(16.6%)	2(13.3%)	5(12.5%)	4(14.81%)	2(8.06%)
TOTAL	**5(100%)**	**6(100%)**	**15(100%)**	**40(100%)**	**27(100%)**	**23(100%)**

There are more complication seen in blood group A and B, thrombocytopenia cases are more in all groups compared to any other complication. O Blood group showing least complications.

Discussion: In India blood group B is the commonest followed by O and A while in western countries blood group O is commonest followed by A and B. This may be due to racial distribution of ABO genes. In our study we also found that out of 660 controls selected 24.39% were of blood group A, 33.93% were of blood group B, 10.30% of blood group AB and 31.36% belonged to blood group O.

So we see through statistical data that blood group B is commonest in controls. This observation is accordance with the study done by Madhu Gupta et al (1990)[4].

The present study conducted on 62 falciparum malaria patients admitted for the treatment in civil hospital ahmedabad showed that out of 62 cases blood group A had 33.8%incidence followed by blood group B which has 30.64% followed by blood group O having incidence of 24.2% and at last blood group AB with 11.2%. By strategic data there is high relative risk in blood group A (1.38) followed by blood group AB (1.09).

Demographic data: Sex: The plasmodium falciparum cases are more common in male patients in comparison to female patients and in all type of blood groups male patients are more in number as found in our study. Males have incidence of 64.52% whereas females have incidence of 35.48%. This observation is in accordance with the study done by Ashwin Kumar et al (2007)[6]

Age: The distribution of age group in plasmodium falciparum cases showing more cases in younger age groups. Maximum numbers of cases are below 30 years of age. This observation is in accordance with the study done by Ashwin Kumar et al (2007)[6]

Complications associated with malaria:

Coma: Incidence of coma in my study is only observed in group A (60%) and group B(40%). Group O and group AB shows no incidence.

Hypoglycemia: Incidence of hypoglycemia is highest in group A (50%) and equal in all other groups (16.6%).

Anaemia: Incidence of anaemia is highest in group A(40%) followed by group B(33.3%) and equal in group O and AB (13.3%).

Thrombocytopenia: Incidence of thrombocytopenia is high and equal in group A and B (37.5%); and low and equal in group AB and O (12.5%).

Hepatic dysfunction: Incidence of hepatic dysfunction is highest in group A(44.4%) followed by group B(40.47%) and then group O(14.81%). It is not observed in group AB.

Renal dysfunction: Incidence of renal dysfunction is equal in group A and B (39.13%) followed by group AB(13.04%) and group O(8.06%).

As mentioned above, it is seen that highest complication is seen in group A. Group B follows group A by only a slight margin. Group AB and group O shows minimal complications. These observations are in accordance with the studies done by Philip R. Fischer et al[5]

Death: Highest incidence of death is observed in group A and B (40%) followed by group AB (20%). No incidence of death is seen in group O. this observation is in accordance with study of Philip R. Fischer et al[5]

Conclusion: Distribution of blood group in healthy individual shows blood group B is more common in India followed by group O then group A and lastly group AB, whereas falciparum malaria incidence is highest in group A (high relative risk is present) followed by group B, then group O and least in group AB.

Incidence of malaria is seen higher among young age group (below 30 years) and in male sex probably due to occupational exposure.

Highest morbidity and complications are observed in group A followed by group B. Group O appears to be immune to severe complications of falciparum malaria.

Mortality is seen equally in group A and B. Death is not noted in group O.

So we conclude from my study that group A is associated with high incidence along with morbidity and mortality closely followed by group B whereas group O shows minimum incidence. Group O also appears to be immune from severe complications and mortality probably due to inhibition of rosetting.

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