

To Investigate the Patterns and Prevalence of Distinct ABO Blood Types in Dengue, as well as the Relationship between ABO Blood Groups and Dengue Severity

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Abstract

Aim: To analyze the patterns and prevalence of different ABO blood groups in dengue and to find an association between ABO blood groups and severity of dengue. **Methods:** This prospective observational study was done in the Department of Pediatrics, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, from January 2020 to December 2020. Children between 0-12 years of age were included. All patients with serological confirmation of Dengue (NS1, IgM/IgG positivity) by Rapid Card Methods with hematology data were included. Blood groups (by Forward Blood grouping -Slide method with Anti-A, Anti-B sera from Tulip diagnostics) were also recorded. The severity of dengue was graded according to World Health Organization guidelines. **Results:** Of the 115 patients who presented with dengue fever without warning signs, 66(57.39%), 19(16.52%), 27 (23.48%) and 3 (2.61%) had blood groups O, A, B, AB respectively. When compared with general population, this was statistically significant. Of the 31 patients with dengue fever with warning signs, 15 (48.39%), 5 (16.13%), 10 (32.26%) and 1 (3.22%) had blood groups O, A, B, AB respectively, which was statistically significant. Among the 14 patients with Severe dengue, 5 (35.71%), 2 (14.29%), 6(42.86%) and 1 (7.14%) had blood groups O, A, B and AB respectively. When compared with general population, this was statistically significant. 20% of this was blood group AB as compared with 7.14% of AB blood group in general population. This also indicated that AB blood group predisposes to severe dengue. **Conclusion:** The incidence of dengue fever is higher in children with blood group O, AB blood group is associated with severe forms of dengue, especially in secondary infections.

Keywords: AB blood group, Blood group, Dengue, Severity

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Introduction

Dengue fever (DF) is endemic in more than 100 countries, with most cases reported from the American, Southeast Asian, and Western Pacific regions of WHO. Dengue is endemic in almost all

states in India and is the leading cause of hospitalization [1]. It has been estimated that there would be 390 million dengue infections per year (95% credible interval: 284–528 million), of which 96 million (67–136 million) manifest clinically (with

any severity of disease) [2]. In 2017, India has recorded 188,401 dengue cases and 325 deaths. There is a sudden upsurge of dengue cases in the Union territory of Puducherry, from 490 (2016) to 4568 and seven deaths in 2017 [3]. DF may result in complications such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) [4]. Coinfection with more than one serotype of dengue virus (DENV) is attributed to increased incidence of complications [5]. The predisposition to DHF or DSS is determined by human leukocyte antigen (HLA) haplotype which has been proposed by several researchers; no clear, specific polymorphisms have been unequivocally described [6]. The ABO blood group is part of innate immunity, and it has been described that individuals with different ABO blood groups differ in their susceptibility or resistance to viral and bacterial infections and diseases [7,8]. A relationship between blood groups and disease was first hypothesized by Kaipainen and Vuorinen during 1960] and the gene involved in ABO blood groups was discovered in 1990 [9]. The ABO blood group plays a considerable role in making a person susceptible or resistant to diseases such as malaria [10], cholera [11], *Helicobacter pylori* [12] and chikungunya [13] infections. A study conducted by Kalayanarooj et al. found that blood group AB was associated with more severe dengue disease with dengue serotypes 2, 3, and 4 than with dengue serotype-1[14]. A study conducted in Karnataka observed that dengue infections were higher in individuals with O-positive blood group (42.8%) when compared with controls (32%) [15].

However, reports are varied among the different studies, none of which have correlated the blood group with each of the hematological parameters which are

affected in dengue. Our study focuses on the association of blood group and dengue, its prevalence and severity as knowledge of risk factors can prove to be vital for prevention and management. The aim of our study was to analyse patterns and prevalence of different ABO blood groups in dengue and to find an association between ABO blood groups and severity of dengue.

Material and methods

This prospective observational study was done the Department of Pediatrics, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, from January 2020 to December 2020.

Methodology

After taking informed consent detailed history was taken from the patient or relatives. Children between 0-12 years of age were included.

All patients with serological confirmation of Dengue (NS1, IgM/IgG positivity) by Rapid Card Method (Standard Diagnostics-BiolineAlera) with hematology data (obtained by hematology automated analyzer Sysmex 1800c) were included. Blood groups (by Forward Blood grouping -Slide method with Anti-A, Anti-B sera from Tulip diagnostics) were also recorded. The severity of dengue was graded according to World Health Organization guidelines.

100 samples of random patients admitted in our hospital were tested for blood group and this was taken as control group for blood group distribution in the particular area.

All details were entered in Microsoft Excel, and the data was analyzed. Patients with concomitant infections like Malaria and Typhoid were excluded from the study.

Table 1: Frequency of ABO blood group among dengue cases and controls).

Blood group	Cases	Controls
O	110	43
A	32	20
B	50	30
AB	8	7
Total	200	100

Of the 200 cases, 110 were blood group O, 32 were blood group A, 50 were blood group B and 8 were blood group AB (Table 1).

Table 2: Distribution of blood group among controls

Blood group	O	A	B	AB	Total
Distribution	43(43%)	20 (20%)	30 (30%)	7 (7%)	100

The control group for blood group distribution was determined by assessment of blood groups of 100 random patient's blood sample (Table 2).

Table 3: Distribution of blood groups in primary dengue cases

Dengue severity	O	A	B	AB	Total
Dengue fever without warning signs	66	19	27	3	115
Dengue fever with warning signs	15	5	10	1	31
Severe dengue	5	2	6	1	14
Total	86	26	43	5	160

In patients with primary infection, it was observed that the distribution of blood groups between dengue infection cases and general population were statistically significant ($\chi^2=40.63$, degrees of freedom=5.5, $p=0.0000011$). Of the 115 patients who presented with dengue fever without warning signs, 66(57.39 %), 19(16.52%), 27 (23.48%) and 3 (2.61%) had blood groups O, A, B, AB respectively (Table 3). When compared with general population, this was statistically significant ($\chi^2=53.15$, degrees of freedom=3, $p=10.55 \times 10^{-11}$).

Of the 31 patients with dengue fever with warning signs, 15 (48.39%), 5 (16.13%), 10 (32.26%) and 1 (3.22%) had blood groups O, A, B, AB respectively, which was statistically significant ($\chi^2=30.17$, degrees of freedom=4, $p=1.21 \times 10^{-7}$). Among the 14 patients with Severe dengue, 5 (35.71%), 2 (14.29%), 6(42.86%) and 1 (7.14%) had blood groups O, A, B and AB respectively ($\chi^2=27.72$, degrees of freedom=3, $p=6.65 \times 10^{-6}$). This showed that a higher percentage of AB blood group presented as severe forms of dengue as compared with general population (7.14%). (Table 3).

Table 4: Distribution of blood groups in secondary dengue cases

Dengue severity	O	A	B	AB	Total
Dengue fever without warning signs	15	2	2	0	19
Dengue fever with warning signs	7	3	4	2	16
Severe dengue	2	1	1	1	5
Total	24	6	7	3	40

In our study, it was found that the distribution of blood groups between dengue infection cases and general population was statistically significant ($\chi^2=22.97$, degrees of freedom=6, $p=0.00059$) even in secondary cases of dengue. Of the 19 patients who presented with dengue fever without warning signs, 15 (78.95%), 2 (10.53%), 2 (10.53%) and 0 (0%) had blood groups O, A, B, AB respectively (Table 4).

Results

When compared with general population, this was statistically significant ($\chi^2=30.14$, degrees of freedom=4, $p=2.57 \times 10^{-6}$). It was observed that no cases of AB blood group presenting as with secondary dengue had mild symptoms and always presented with warning signs (0% incidence).

Of the 16 patients with dengue fever with warning signs, 7 (43.75%), 3 (18.75%), 4 (25%) and 2 (12.5%) had blood groups O, A, B, AB respectively, which was statistically significant ($\chi^2=11.87$, degrees of freedom=3, $p=0.017$). Among the 5 patients with Severe dengue, 2 (40%), 1 (20%), 1 (20%) and 1 (20%) had blood groups O, A, B and AB respectively ($\chi^2=11.22$, degrees of freedom =3, $p=0.027$). 20% of this was blood group AB as compared with 7.14% of AB blood group in general population. This also indicated that AB blood group predisposes to severe dengue.

Discussion

In our study, an analysis of blood group patterns, in dengue, has been studied. It was observed that although blood group distribution was in concordance with that of control, blood group O was associated in higher percentages with incidence of dengue disease. This was in agreement with a study by Khode et al, which suggested that blood group O is possibly a risk factor predisposing for dengue disease [16]. The present study suggests that blood group AB is associated with severe dengue disease when compared to the control group and was statistically significant, which supported the results of the study by Kalayanarooj et al., which stated that AB blood group, was probably a risk factor predisposing to severe dengue disease [14]. Furthermore, this association for noticed more with secondary infections, where majority of patients progressed to severe dengue. The human innate immune system, consisting of mast cells, NK cells, dendritic cells, macrophages, antibody

producing B cells, the complement system, and the host genetic factors-clearly plays a role in the immunity against viral infections [17]. Among these factors, the genetic factors play a significant role in determining the predisposition of an individual to be susceptible or resistant to certain phenotypes of an infection and also the magnitude of their clinical manifestations. Two genetic factors namely HLA and ABO blood groups have been shown to play a crucial role in resistance to infectious diseases [18]. The blood group antigens are biochemically carbohydrates. The A blood group has N-acetyl-dgalactosamine as its immunodominant sugar while the B antigen is d-galactose. Galactosyl transferases is the common enzyme involved in the synthesis of both these determinants [18]. These antigens stimulate an IgM response [19]. The glycosylated dengue viral protein produces an immune response which also consists of IgM antibodies which probably cross-react with the blood group antigen. Although a correlation between HLA typing and dengue disease has been previously researched, a specific polymorphism which affects the severity has not been identified yet [8]. This study does not study the severity amongst the different serotypes of dengue infection (DENV 1, DENV 2, DENV 3, DENV 4 and forms a limitation of the study.

Conclusion

The prevalence of dengue infection is high all over India. Most cases are asymptomatic or mild but severe cases have high fatality. Hence an understanding of investigations that help predicting progress to severity is crucial. This study concludes that although the incidence of dengue fever is higher in children with blood group O, AB blood group is associated with severe forms of dengue. Moreover, AB blood groups when associated with secondary infection more commonly progress to severe forms of

dengue. Further studies are needed to determine whether HLA, and ABO are independent variables and whether some blood subgroups are associated with a particularly high risk of DENV infection itself.

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