

Exemplification of ABO Blood Groups in Patients with Diabetes Mellitus

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ABSTRACT

INTRODUCTION: Diabetes Mellitus and blood groups are interrelated. The relationship between ABO blood groups and disease susceptibility has generated a concern. The identification of a positive relationship between DM and blood groups could indicate higher susceptibility to diabetes and a negative relationship could indicate protection from diabetes. Therefore, the objective of the study was designed to exemplify ABO blood groups in Patients with Diabetes Mellitus. **MATERIALS AND METHODS:** The study was conducted at Ram Janaki Hospital and Swastika Health Care Hospital, Janakpurdham from September 2017 to March 2018. The record of the patients from the medicine OPD in both the hospitals was identified and relevant data were extracted. The data was recorded from the reports of the patients with confirmed DM patients attending Medicine department. **RESULTS:** The majority of the 579 diabetic patients were in the 40-60 year old age group. The most predominant blood group was B (251; 43.4 %), followed by AB (137; 23.7 %), O (125; 21.5 %), and A (66; 11.4 %) respectively. In comparison to male diabetics, less than half (44.1%) of female diabetics had blood group B. (42.7%). Similarly, males (13.0 %) were found to have more blood group A than females (9.8%). In diabetic individuals, the relationship between blood group and age ($p=0.652$) and sex ($p=0.659$) was shown to be insignificant. The majority of the patients (94.3%) had Rh positive blood groups, whereas the other had Rh negative blood types (5.7%). There was no correlation between blood group Rh factor and age group ($p=0.817$) or as well as with sex ($p=0.333$) among diabetic patients. **CONCLUSIONS:** Diabetic patients were more likely to have blood type B, while diabetics were less likely to have blood group A. It implies that diabetes is linked to ABO blood types, and that those with Group-B are more likely to develop the condition. Blood group could be a risk factor, and knowing it can aid with disease evaluation and screening.

Keywords: Blood groups, Diabetes mellitus, Rh factor

INTRODUCTION

The phenotypic ABO blood groups are inherited polymorphic antigenic substances found on the surface of red blood cells and other tissues [1]. The term "blood group" refers to the entire blood group system, which consists of antigens found on red blood cells (RBCs), the specificity of which is determined by a series of genes that can be allelic or

closely linked on the same chromosome [2]. Karl Landsteiner was the first to discover the "ABO" blood group in 1900. The antigens "ABO" and "Rhesus" are major human blood group system antigens that play a critical role in transfusion medicine [1]. The blood type of an individual defined by small carbohydrate epitopes depends on the presence or absence of genes "A" and "B". The

gene is positioned on chromosome 9q34 and consists of 7 exons spread over 18kb called "ABO" blood groups [3].

Since the discovery of ABO system by Karl Landsteiner in 1900, many researchers took their interest to conduct their own research studies to find out any association of ABO blood group with diseases [4]. Gastric and duodenal ulcer [5], hepatitis B1, vascular diseases [6], abdominal aortic aneurism [7], and cancers has been associated with the "ABO" blood group [8,9]. Peptic ulcer is much higher in blood group O [10] whereas stomach cancer [11], tumors of salivary glands [12] are more frequent in blood group A individuals. Many reports have appeared in recent years suggesting an association between blood groups and diabetes mellitus [13]. The incidence of diabetes mellitus has shattered all previous records. Diabetic patients currently number 382 million worldwide, with the number expected to rise to 592 million by 2035. Furthermore, approximately 183 million people are completely unaware that they have diabetes [14]. The etiology of diabetes mellitus is complex and appears to involve interactions of genetic, immunological and environmental factors [15]. In fact, human chromosome 1q21-q23 showed well replicated linkage to type-2 diabetes mellitus [16]. The ABO blood group genes are mapped at 9q34 [17] region in which genetic alteration is common [18].

Some epidemiological studies demonstrated significant association between the "ABO" blood group and the risk of diabetes mellitus. According to Barbalic et al. [19], blood group B is associated with a lower risk of diabetes than blood group O. Blood group AB was a protective factor against gestational DM in pregnant Chinese women [20]. On the other hand, Fagherazziet al. [21] introduced O blood group as protective factor against type 2 DM. However, some studies did not find any relationship between blood group and DM [22]. In 1955, McConnell proposed that diabetic patients have a higher frequency of blood group A [23]. In Copenhagen, male diabetics had a significant excess of blood group O [24]. The prevalence of blood group B among diabetics was found to be higher in Italy [25] and Trinidad [26], Germany [27], Glasgow [28], Bangladesh [29]. Other recent studies found no link between type 2 diabetes and blood group in diabetics studied [30].

Genetic research has established that some inherited factors play a role in the development of Diabetes Mellitus (DM). Scientific evidences proved that ABO/Rh blood systems are genetically determined and diabetes mellitus and ABO/Rh blood systems both have a common association/linkage with genetic integrations & both have their respective genetic factors/ genes [31]. Although some epidemiological studies found a link between the "ABO" blood group and the risk of type 2 diabetes mellitus (DM), the findings were inconsistent and unclear [32]. Diabetes Mellitus and ABO-RH blood groups would facilitate our understanding of the genetic basis of the disease. Because the disease is polygenic and multifactorial, early screening of patients with susceptible blood groups could benefit in the primary prevention of diabetes and delay the progression and complications of DM. So far, there haven't been many studies on the pattern of blood groups in diabetics in Nepal. To the best of our knowledge, this is the first study conducted in Nepal's Madhesh Province. Therefore, the objective of the study was designed to exemplify ABO blood groups in Patients with Diabetes Mellitus.

MATERIALS AND METHODS

Study design, Settings and participants

The hospital based cross sectional study was conducted at two private hospitals Ram Janaki Hospital and Swastika Health care Hospital located at Janakpurdham, Dhanusha, Nepal from September 2017 to March 2018.

Procedures of data collection

The record of the patients from the medicine OPD in both the hospitals was identified and five hundred seventy nine diabetic patient's data were extracted. The data was recorded from the reports of the patients with confirmed DM patients attending Medicine department. The patient was confirmed by laboratory investigations report prescribed by physician in Medicine OPD. Gestational diabetes was excluded.

Statistical analysis and data management

Data were expressed in frequencies and percentage. Chi-square test was used to compare frequencies between two or more than two categories. The level $p < 0.05$ was considered as the cut-off value for significance.

Ethical considerations

The study was approved by institutional review committee of Janaki Medical College Teaching Hospital, Tribhuvan University, Nepal (Ref: IRC/07/2074-075). Additionally, the permission letter were also obtained from Ram Janaki Hospital and Swastika Health care Hospital, Janakpurdham.

RESULTS

Out of 579 diabetic patients, majority of the patients were found in age group 40-60 years. Blood group B was the most common (251; 43.4%) followed by group AB (137; 23.7%), group O (125; 21.5%) and group A (66; 11.4%) respectively. Among ABO blood groups, group B (132; 46.5%) was most prevalent in age 40-60 years in patients with Diabetes type 2. Blood group B (39.8%; 46.5%; 40.6%), group AB (22.6%; 22.5%;25.7%), group O (24.7%; 21.5%;20.3%) and group A (12.9%;9.5%;13.4%) was found in patients in age groups less than 40 years, 40-60 years, more than 60 years respectively. Less than half (44.1 %) female

diabetics had blood group B compared to male diabetics (42.7%). Likewise, blood group A was found more in male (13.0%) compared to females (9.8%). However, blood group AB, B and O were more in females (23.7%; 42.7%;20.8%) compared to male (23.5%; 42.7%; 20.8%) respectively. The association of blood group were found to be insignificant with age group ($p=0.652$) as well as with sex ($p=0.659$) among diabetic patients as shown in Table 1. Table 2 describes age and sex distribution of diabetic patients according to Rh factor. Majority of the patients had blood groups Rh positive (94.3%) and remaining had Rh negative (5.7%). Around 5 % patients had blood groups Rh negative across the age group in age groups less than 40 years(4.3%), 40-60 years(6.0%), more than 60 years (5.9%) respectively and as well as across the sex i.e male (4.8%) and female (6.6%). There was no association of blood group Rh factor with age group ($p=0.817$) as well as with sex ($p=0.333$) among diabetic patients.

Table 1 | Age and Sex distribution of diabetic patients according to blood groups

Age Group (Years)	Blood Groups				Total	P-value
	A	AB	B	O		
<40	12(12.9%)	21(22.6%)	37(39.8%)	23(24.7%)	93 (100)	0.652
40-60	27(9.5%)	64(22.5%)	132(46.5%)	61(21.5%)	284 (100)	
>60	27(13.4%)	52(25.7%)	82(40.6%)	41(20.3%)	202(100)	
Sex						0.679
Male	38 (13.0%)	69(23.5%)	125(42.7%)	61(20.8%)	293(100)	
Female	28(9.8%)	68(23.8%)	126 (44.1%)	64(22.4%)	286(100)	
Total	66(11.4%)	137(23.7%)	251(42.7%)	125 (20.8%)	579(100)	

DISCUSSION

The "ABO" blood group system is associated with some diseases including gastric and duodenal ulcer, hepatitis B1, vascular diseases, abdominal aortic aneurism, and cancers. Some epidemiological studies demonstrated the linkage among the "ABO" blood group and the risk of type 2 diabetes mellitus (DM) [32]. Out of 579 diabetic patients, majority of the patients were found in age group 40-60 years. According to our findings, diabetics with blood group B have the highest frequency (42.7%), followed by blood group AB (23.7%), O (21.5%), and A (11.4%) respectively. In the line with this

Table 2: Age and Sex distribution of diabetic patients according to Rh factor

Age group	Rh-factor		Total	P-value
	Positive	Negative		
<40	89(95.7%)	4(4.3%)	93(100)	0.817
40-60	267(94.0%)	17(6.0%)	284(100)	
>60	190(94.1%)	12(5.9%)	202(100)	
Total	546(94.3%)	33(5.7%)	579(100)	
Sex				0.333
Male	279(95.2%)	14(4.8%)	293(100)	
Female	267(93.4%)	19(6.6%)	286(100)	
Total	546(94.3%)	33(5.7%)	579(100)	

study, Bener and Yousafzai[33] reported that blood group B (25.7%) was significantly more common among diabetics in a study carried out among diabetic outpatient clinics and donors visiting blood bank of the Hamad Medical Corporation (HMC), Doha Qatar. Two other studies from Malaysia [34] and India [35] found that diabetic patients have a higher frequency of blood group B. Furthermore, Quershi and Bhatti from Pakistan explored the interrelationships between diabetes and ABO blood groups with highest distribution of blood group B in diabetes [36]. In addition, Kamil et al. reported that patients with DM type 2 had a high frequency of B blood group (25; 35.71 %), followed by O blood group (24; 34.28 %) [34]. Similarly, most of the patients in diabetic group were blood group B (41%) followed by blood group O(26%), A(23%) and AB(10%) [4].

The results of these studies are consistent with our findings. Oner C et al.[33] also showed that B blood group was more often in diabetics comparing with non-diabetics. In contrast, a research published in Uttar Pradesh, India, reported a decreased association between diabetes and blood group B [32]. This finding was similar to Qi et al [37] but different from Kamil et al. [34], Bener and Yousafzai [33], Hadeal and Ali [38], Moinzadeh et al. [39]. Previous scientific literatures reveals that the frequency of the ABO blood group varies by population [17,40]. Authors from different countries found out diversified relationship between frequency of ABO blood groups and diabetes mellitus. It could be caused by the distribution of blood groups in the population of these countries.

In addition, there are studies that showed no association between ABO blood groups and DM [34]. In our study, the prevalence of blood group O (20.8 %) was lower than that of blood groups B and AB among diabetics. Bener and Yousafzai [33] found that blood group O was significantly less common in diabetic patients in Qatar, which matched our findings. Agrawal et al. [32] conducted a similar study that showed blood group O (34.61 %) among diabetics, which is almost identical to our findings. Agrawal et al. [32] conducted a similar study that showed blood group O (34.61%) among diabetics, which is almost identical to our findings. However, it has been reported that blood group O has the highest prevalence among diabetics in Pakistan [40], Algeria [30], Iraq [41], and Japan [42].

Additionally, the increased association of blood group O with DM has previously been reported [32]. Karagoz et al. [9] Zhang et al. [14] found increased association, but Kamil et al. [34] Fagherazzi et al. [21], Bener and Yousafzai [33], Qureshi and Bhati [36], and Jassim et al. [41] did not. According to our results, diabetic patients had the lowest frequency of blood group A (11.4%). However, Oner et al. reported a blood group was significantly frequent in type-2 DM patients [43]. Another Nigerian study also found a strong link between blood group A and diabetes [44]. In terms of ABO blood group distribution in diabetics, blood group A was higher in diabetic population of Iraq (35.98%), Japan (33.7%). However, Malaysia (35.7%) and India (38.6%) had higher blood group B [33]. In comparison to male diabetics, less than half (44.1%) of female diabetics had blood group B. (42.7%) in our study. Similarly, males (13.0%) were found to have more blood group A than females (9.8%). Females had higher rates of blood groups AB, B, and O (23.7 %, 42.7 %, and 20.8 %) than males (23.5 %, 42.7 %, and 20.8 %) respectively.

In a study of 1633 diabetic patients conducted in Doha, Katar, the frequency of blood group B was significantly higher among male diabetics, while the frequency of both blood groups A and B was significantly higher among female diabetics [33]. Diabetic females (40.54 %) had the most blood groups B, while diabetic males had the most blood group O (39.4 %). The gender distribution in the control group ($P=0.764$) and the patients group ($P=0.069$) was not significantly different [34]. Bener and Yousafzai found that blood group O (38.2%) was significantly less common in male diabetic patients.

Diabetic women were significantly more likely to have blood group A (29.7%), followed by blood group B (25.5%). However, blood group B was more common in male diabetic patients (25.8%) [33]. Other population studies revealed no significant differences between male and female in both groups, with the exception of a study from Algeria [30], which found that blood groups O and AB were significantly higher in diabetic males. In both males and females, the blood group AB has a similar distribution (6.8% and 6.5%) respectively [33]. Blood group O was found to be significantly less common in both male and female diabetics [33]. The majority of the patients in our study (94.3%) had Rh positive blood groups, while the rest had Rh

negative blood groups (5.7%). Rh positive was found in 95.2 % and 93.4 % of females, while Rh negative was found in 4.8% of males and 6.6 % of females. Around 5% of patients had Rh negative blood groups, which were divided into age groups of less than 40 years (4.3%), 40-60 years (6.0%), and more than 60 years (5.9%), as well as for male (4.8%) and female (6.6%). The relationship between blood group and age group ($p=0.652$) as well as sex ($p=0.659$) among diabetic patients was found to be insignificant. The association between blood group ABO and diabetes was statistically significant ($P=0.04$) in a study conducted in Uttar Pradesh, India, and found an increased frequency of Rh+ blood group (96.15 % vs. 95.54 %) in diabetics. But, no statistically significant association between Rh blood group and DM ($P=0.88$) [32]. A cross-sectional study in Type I diabetics in Arar, Northern Saudi Arabia, found no significant relationships between ABO blood group, gender, diabetes, or type of diabetes. The relationship between DM and (Rh) blood group was highly significant, whereas the relationship between gender and type of DM and (Rh) blood group was insignificant [45].

Recent advances in molecular genetic/genomic analysis of the ABO system have acknowledged that antigens A and B can also be expressed on epithelial cells and endothelial cells, in addition to red blood cells (RBCs), depending on the blood types of the individuals. The A and B oligosaccharide antigens of the ABO blood group system are produced from the common precursor, H substance, by enzymatic reactions catalyzed by A and B glycosyltransferases (AT and BT) encoded by

functional A and B alleles at the ABO genetic locus, respectively [46]. Several studies have evaluated the possible link between diabetes and the Rh blood group; however, the populations studied vary, and the results are inconsistent and inconclusive [33]. Racial and geographical differences could play a role in the genetic expression of the disease, which could explain the contradictory results regarding the association between ABO blood groups and diabetes. Furthermore, the majority of studies in this area have a small sample size. A solution to this quandary will most likely come from larger-scale studies and a meta-analysis of previous work.

CONCLUSIONS

The findings revealed that diabetic patients were more likely to have blood group B, while diabetics were less likely to have blood group A. Majority of the patients had blood groups Rh positive and remaining had Rh negative. It suggests that diabetes has a link to ABO blood groups, and that people with Group-B have a higher risk of developing the disease. However, there was no association of blood group Rh factor with age group as well as with sex. Blood group might be a risk factor and it can be helpful for the evaluation and screening of the disease. These findings, however, are insufficient to draw a firm conclusion. Other genetic factors could be involved, which would necessitate a more extensive and in-depth investigation. Large-scale study with full investigations of DM and ABO and (Rh) blood groups is recommended.

ADDITIONAL INFORMATION AND DECLARATIONS

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Data Availability: Data will be available upon request to corresponding authors after valid reason.

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