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Is type 1 diabetes mellitus associated with ABO & Rh blood groups? A cross-sectional study

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Abstract

Background: This study was conducted to determine whether type 1 diabetes mellitus (T1DM) is associated with ABO & Rhesus (Rh) blood groups.

Materials and Methods: This analytical cross sectional study was carried out on 77 patients suffering from T1DM and 96 healthy children less than 18 years old referring to Yazd Diabetes Research Center from April 2018 to May 2019. The ABO blood group and Rh factor in both groups were determined. Fasting blood sugar (FBS) and hemoglobin A1C (HbA1c) were measured at baseline, 12 weeks, and 24 weeks in these patients, and the mean of FBS and HbA1C in three-time assessments were considered as the FBS and HbA1C variables. The statistical analysis was performed by SPSS software version 22.

Results: About 46.8% in T1DM and 36.5% in the control groups were male. There was a significant difference between groups regarding blood groups (p-value: 0.042). Although the frequency of B+ was 33.8% and 19.8% in the T1DM and controls, respectively, AB+ and O+ were more prevalent in the controls. The mean of FBS was significantly different between groups (p-value: 0.023).

Conclusions: The findings revealed that patients with blood group B are more likely to develop T1DM whereas those with blood group O showed a lower tendency towards diabetes.

Keywords: Blood Group Antigens, Child, Diabetes Mellitus, Rh-Hr Blood-Group System

Introduction

The most general and largest classification of blood group, the ABO and Rh system which is based on the presence or absence of antigens A and B on red blood cells and are expressed in many body tissues (1, 2). These genetic factors are significantly different in geographical, ethnic, and socio-economic groups in several parts of the world (3). Several studies have reported that blood group antigens play a vital role in genetics and creating, preventing, and exacerbating various diseases such as gastric cancer, thyroid disorders, coronary artery disease, and diabetes, especially type 2 diabetes (4-6).

Diabetes Mellitus (DM) is the most common metabolic disorder, which is caused by defects in secretion or insulin function and causes chronic hyperglycemia (7). The disease has involved many people around the world in developed and developing countries (3). It is estimated that the number of people with DM increased to 693 million by 2045 (8). Type 1 diabetes mellitus (T1DM) is an autoimmune disease, which is increasing globally and forms 5% of cases of diabetes (9, 10). This disease causes progressive degradation of beta pancreas cells (11). Studies have shown that more than 13 million people are affected by T1DM (10).

Although in many studies, the relationship between blood groups of ABO and Rh and diabetes has been examined in different countries, reports about the sensitivity of the ABO blood group as a risk factor for DM, especially T1DM are controversial, and such a study has not yet been carried out in Iran. Since the cause of T1DM is

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complex and several factors including genetic and environmental elements play an important role in its pathogenesis, therefore, this study was conducted to investigate the relationship between ABO and Rh blood groups and the risk of T1DM.

Materials and Methods

Patients

The present analytical cross-sectional study was accomplished on 77 patients suffering from T1DM and 96 healthy children younger than 18 years old. The subjects had referred to Yazd Diabetes Research Center from April 2018 to May 2019. In this study, 77 patients with T1DM were assigned to one group and 96 age- and sex-matched healthy subjects to control. All diabetic children had only been treated with insulin within the previous year. Moreover, they had referred to the clinic for follow-up of their disease management. Individual matching in terms of age and sex was performed for selecting the control group and 96 healthy children who were attending the clinic for the well-child visit were thus considered as the controls. Exclusion criteria for controls comprised patients with psychiatric illnesses, acute diseases, and any medical history of diabetes. The ABO blood groups and Rh factor in both groups were determined using the Standard Slide Agglutination Test. To assess biochemical variables in diabetic patients consisting of FBS and HbA1c, a 10-ml sample of the venous blood (after 12 hours fasting) was taken from each participant at baseline, 12 weeks, and 24 weeks and the mean of FBS and HbA1C in three-time assessments were indicated as the FBS and HbA1C variables. HbA1c was determined by TosohG8 HPLC Analyzer through the high-performance liquid chromatography method. FBS was also measured by an enzymatic colorimetric method (glucose oxidize-peroxides) (Biosystem kit, Spain).

Ethical consideration

This research was presented to the ethics committee of Shahid Sadoughi University of Medical Sciences and approved by the internal medicine department. The ethics committee approved the study with the number of IR.SSU.MEDICINE.REC.1394.402 on February 8, 2016. The patients were informed about the objective and nature of the study, and each participant provided written informed consent before the study.

Statistical analysis

Data were expressed in frequencies and percentages. The chi-square test was applied to estimate the probability of distribution differences occurring by chance. Also independent T-test, Fischer-Exact and ANOVA were used. Results were considered significant at p value<0.05. Moreover, SPSS-22 was applied for data analysis.

Results

This study comprised 173 participants, and the blood groups and Rh were compared between the groups consisting of 77 (44.5%) T1DM patients and 96 (55.5%) controls. The distributions of the two studied groups are illustrated in Table I. Totally, 46.8% in T1DM and 36.5% in the control groups were male. The blood group frequency between the groups was investigated for which significant difference was identified between the diabetic cases and the controls (p-value:0.042); for B+, it was 33.8% in diabetic and 19.8% in the controls but for AB+ and O+, they were more prevalent in the controls. However, there were no significant differences between Rh frequencies in the two studied groups.

The association between blood group and glycemic control in the T1DM group is shown in Table II. The ANOVA test demonstrated the mean of FBS was significantly different between the groups (p-value:0.023), and the post-hoc test revealed that the mean of FBS being statistically different between A and AB groups (p-value: 0.041). In addition, the mean of HbA1c failed to be statistically

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significant between the blood groups but it appeared to be 9.37 in B+ and 8.7 in AB+, thus being clinically significant. Power analysis represented that the statistically insignificant HbA1c can be attributed to a small sample size (power: 66%).

Table I: Two studied groups' findings

variables	Type one diabetic	Control	p-value
Age (mean ± SD)	9.72 (±3.90)	10.92 (±5.19)	0.095*
sex			0.214**
Male (%)	36 (46.8%)	35 (36.5%)	
Blood group (%)			
O+	21(27.3%)	37 (38.5%)	0.042***
B+	26(33.8%)	19(19.8%)	
A+	18(23.4%)	23(24%)	
AB+	5(6.5%)	10(10.4%)	
O-	4(5.2%)	5(5.2%)	
B-	2(2.6%)	0	
A-	1(1.3%)	2(2.1%)	
Rh Positive (%)	71 (92.2%)	89 (92.7%)	1.000**

*-Independent T-test; **chi²; ***Fischer-Exact

Table II: Blood group and glycemic control indexes

Blood groups	FBS (mean (± SD)	p-value*	HbA1c(mean ± SD)	p-value*	Power for HbA1c
O+	146.25 (65.81)	0.023	8.89 (1.53)	0.797	0.66
B+	165.96 (83.49)		9.37 (2.31)		
A+	118.16 (46.57)		8.87 (1.19)		
AB+	227.20(95.8)		8.70(0.91)		
Other	152.14(92.88)		8.23 (0.69)		

*ANOVA

Discussion

This cross-sectional study uncovered that patients with blood group B more likely tend to develop T1DM whereas those with blood group O experienced fewer chances of the disease. In addition, blood group antigens are known to play an essential role in disease susceptibility. Various data also display an association between varying diseases, notably colorectal malignancy, thyroid disorders, duodenal ulcer, ovarian tumor, and coronary heart disease with ABO blood type (12-14). T1DM is a multifactorial disorder involving both genetic and environmental factors interacting with one another. Various contradictory associations of ABO and Rh blood groups with DM have been reported in a several epidemiological and genetic studies. The possible reason for this contradiction may be explained as the result of different study designs, sample size, racial, and geographical variations affecting the distribution of ABO blood group phenotypes and disease occurrence (15, 16). Many researchers have investigated the relationship between various blood groups with the incidence of DM (6, 15, 17). The current study supported the hypothesis that DM and blood groups are somewhat interrelated. In this study, the distribution of blood group B was high among the patients with T1DM (33.8%) compared to the healthy individuals (19.8%). Also, Moinzadeh et al. identified that blood group B+ was more frequent in diabetic patients (30.8%) compared to the control group 24.9% (18). The findings of the present study were consistent with those of Bener and

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Yousafzai carried out in Qatar, that examined 1631 patients with type 2 DM and 1650 healthy control subjects (19). The researchers reported blood group B being significantly common while blood group O being significantly less usual among diabetic patients. Several other studies have reported the same results (6, 20). Meo et al. conducted a review study on 47 research and concluded that blood group B is interrelated with a high incidence of type 2 DM whereas blood type O projects the least of such association (20). Naoto Egawa et al. (21) also reported increased frequency of blood group B among diabetic patients while another study detected a negative association of blood groups AB and B and a positive association of blood groups A and O positive with diabetes (13). Additionally, another study in Iraq recognized a significantly higher occurrence of blood group O among diabetic patients (22). Still in another study by Azizi et al., it was demonstrated that blood group O+ is the most frequent whereas AB is the least frequent among blood groups investigated in the study (16). Also in a study from Malaysia Kamil unearthed a negative association between ABO blood groups A and O with type 2 DM (23). There are, however, few others who have failed to find such association of ABO and Rh blood groups with DM (24, 25). On the other hand, other investigators have found an equal distribution of ABO blood groups among diabetic and healthy people. Mandal et al., for example, discerned a higher frequency of blood group B in both diabetic and control groups (26). Furthermore, another study in Iraq demonstrated no significant association between participants' blood groups and their sex, DM, and HbA1C. This is in line with the studies conducted among other populations which failed to distinguish any significant impact of sex on diabetes, except for the research in Algeria (20) in which diabetic men showed a significantly greater proportion of blood groups O and AB compared with healthy controls (27).

The result of this study revealed that FBS level was significantly different among studied blood groups. Similar outcomes were also reported by studies in Iraq proving significant differences among blood types in terms of FBS; the participants with blood group AB showed strong relation with FBS (28). On the other hand, the research addressed by Owis et al. detected no significant relationship between ABO/Rh blood groups and FBS levels among the participants (29). Gloria-Bottini et al. indicated a relationship between the RH system and glycosylated hemoglobin level (HbA1c) in diabetes suggesting that RH proteins may affect glucose transport through the red cell membrane and/or hemoglobin glycation (30). In contrast, the findings discerned no significant association between blood groups and HbA1c. Considering Rh blood group, no association was identified between Rh blood groups and DM in our probe; this is in accordance with the result of some previous studies. In contrast, Dali et al. (27) and Waseem AG et al. (31) detected an increased frequency of Rh-negative blood groups in diabetic cases. However, their results suggested that the Rh blood system likely plays some role in the process of glucose metabolism that can impact the clinical expression of DM. Another study reported a positive association of Rh-positive blood group with DM (32). With regard to the susceptibility of various blood groups with obesity, Sukalingam et al. confirmed that individuals with blood group B and the Rh-positive are more susceptible to obesity. This could propose that people with blood group B might genetically be more prone to obesity as compared to other blood groups (33). This was consistent with another research in India which showed B to be the most common blood group associated with obesity (34). Obesity in patients with T1DM might augment diabetic complications and reduce or nullify the benefits achieved by optimizing glycaemic control. Therefore, intensive insulin

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therapy and an appropriate lifestyle are recommended for people with diabetes possessing blood group B. Further studies are needed to confirm the results.

Conclusion

The study finding revealed that patients with blood group B are more prone to develop DM whereas those with blood group O show lower chances of diabetes. In this study, the small sample size was a limitation; investigations on a larger sample are thus a prerequisite for verifying the findings obtained.

Conflict of intrests

The authors declare no conflict of interest.

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