

Association between ABO blood group and severity of coronary artery disease in unstable angina

Negar Omidi⁽¹⁾, Mohammad Rafie Khorgami⁽²⁾, Mohammad Effatpanah⁽³⁾, Farnaz Khatami⁽⁴⁾, Mehrpouya Mashhadizadeh⁽⁵⁾, Arash Jalali⁽⁶⁾, Hamidreza Hekmat⁽⁷⁾

Original Article

Abstract

BACKGROUND: ABO blood groups are genetically transmitted through chromosome 9 at locus 9q34. It is supposed that there is a locus on 9p21, which has a role in developing coronary artery disease.

METHODS: Our study population consisted of 309 patients with unstable angina admitted to the Ziaieian Hospital, Tehran, Iran, who underwent coronary angiography. The association between types of blood group (O and non-O) with the severity of coronary artery disease was investigated.

RESULTS: Compared to the non-O groups, the O group had more severe coronary artery involvement ($P = 0.004$).

CONCLUSION: Our study supports recent suggestions on the association between blood group and coronary artery disease. Further studies are needed to evaluate the effect of blood group on atherosclerosis.

Keywords: ABO Blood Group System, Blood Group, Coronary Artery Disease, Unstable Angina, Acute Coronary Syndrome, Myocardial Ischemia, Angina Pectoris, Atherosclerosis

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Introduction

Coronary artery disease (CAD) is the major cause of death all over the world and has multiple major risk factors such as aging, gender, dyslipidemia, hypertension and diabetes, smoking, and family history.¹ The high prevalence of a particular blood group in a community or geographical area may affect the incidence of the diseases.² The ABO system occurs because of polymorphism of complex carbohydrate with different antigenic structures of glycoproteins and glycol lipids at the surface of erythrocytes, as glycan units of mucin glycol proteins.^{1,2} H-antigen precursor converts by A and B glycosyl transferase into A or B determinants. These transferase enzymes have no function in group O and they express H-antigen.^{3,4} ABO blood groups are genetically transmitted through chromosomes 9 at locus 9q34.^{5,6} The ATP-binding cassette 2 [ABCA2]

gene is also located on locus 9q34 which has some role in the cholesterol balance and lipid homeostasis.⁷ A locus on 9p21 is supposed to have a role in developing CAD.^{8,9} ABO (H) carbohydrate antigenic determinants expressed on the N-linked glycan chains of circulating plasma von Willebrand factor (VWF). High levels of VWF and factor VIII are associated with risk of thrombosis and an ABO relationship has been suggested.⁶ The role of ABO blood group as a risk factor of venous thrombosis and ischemic heart disease had been recognized from 1960, and it has been postulated that it is due to the relation between the ABO group and level of pro-coagulant factor VIII and VWF. VWF levels are 25 percent higher in non-O groups, compared with group O.⁹ Previous studies showed controversial results about the relation of ABO blood groups and ischemic heart disease in Italy, Iran and India.^{10,11} We

1- Assistant Professor, Cardiac Primary Prevention Research Center, Tehran Heart Center AND Department of Cardiology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

2- Assistant Professor, Rajaie Heart Center AND Department of Pediatric Cardiology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

3- Assistant Professor, Department of Psychiatry, School of Medicine, Ziaieian Hospital, International Campus, Tehran University of Medical Sciences, Tehran, Iran

4- Assistant Professor, Department of Community Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

5- Student of Medicine, Department of Cardiology, School of Medicine International Campus, Tehran University of Medical Sciences, Tehran, Iran

6- Assistant Professor, Tehran Heart Center AND Department of Research, Tehran University of Medical Sciences, Tehran, Iran

7- Assistant Professor, Department of Cardiology, School of Medicine, Ziaieian Hospital, Tehran University of Medical Sciences, Tehran, Iran

Correspondence to: Mohammad Rafie-Khorgami, Email: rafikhorgami@gmail.com

aimed to investigate whether ABO blood groups were associated with the severity of CAD and major cardiovascular risk factors in Iranian patients with moderate to high risk unstable angina.

Materials and Methods

The study was conducted on patients admitted to the coronary care unit of the Ziaeeian Hospital affiliated to Tehran University of Medical Sciences, Tehran, Iran, from June 2014 to April 2015. Total of 309 patients with moderate to high-risk unstable angina according to thrombolysis in myocardial infarction (TIMI) risk score were consecutively included into this cross sectional study. We used convenient sampling method regardless of patient blood groups. Exclusion criteria were clinically significant heart failure, significant valvular heart disease and severe renal failure. Informed consent was obtained from all participants and the study protocol was approved by the ethic committee. Baseline clinical and demographic data including age, hypertension, diabetes mellitus, dyslipidemia, smoking habits and family history were recorded. Hypertension was defined as systolic blood pressure equal or more than 140 mm Hg, diastolic blood pressure equal or more than 90 mm Hg or history of anti-hypertensive medications. Diabetes mellitus was defined as previous history of diabetes and history of medical treatment. Dyslipidemia was defined as total cholesterol > 200 mg/dl or low-density lipoprotein cholesterol (LDL-C) >130 mg/dl or history of medical treatment. Smoking was defined as person who currently smokes. Family history was defined as history of myocardial infarction or coronary artery disease in the first degree relatives in men < 45 and in women < 55

years of age. Blood sampling for lipid profile study [triglyceride, cholesterol, LDL-C, high-density lipoprotein cholesterol (HDL-C)] was done after 12 hours fasting and checked using proper kit. Coronary angiography was performed in the standard manner with angiography system Artis Zee Multipurpose (SIEMENS) and the results were assessed by two cardiologists separately. Severity of coronary artery stenosis according to the severity categorization of Jones et al.¹² was defined as mild (< 50%), moderate (50%-70%) and severe (> 70%) stenosis of coronary lumen. According to the previous studies, blood groups were divided in two groups, O and non-O.¹³

Results are presented as mean \pm standard deviation (SD) for quantitative variables. Categorical variables are shown as frequencies and percent. Chi-square test was used for categorical variables. To evaluate the adjusted effect of blood group on severity of CAD, the unconditional logistic regression method was used and presented as odds ratio (OR) and 95% confidence interval (CI). Statistical significance was determined as a P-value of ≤ 0.05 . All statistical analysis were performed using SPSS software (version 19.0, SPSS Inc., Chicago, IL, USA).

Results

Totally, 309 patients [mean age 59.6 ± 11.7 years, 60% (185) men and 40% (124) women] with coronary artery involvement were assessed. The distribution of blood groups were as follows: O 53.1% (164), A 30.1% (93), B 11% (34), AB 5.8% (18). Table 1 presents the characteristics of study population and also compares the patients by blood group O versus non-O.

Table 1. Clinical and laboratory characteristics of the patients with O and non-O blood groups

Variables	Total [n = 309 (100%)]	Blood group O [n = 164 (53.1%)]	Blood group non-O [n = 145 (46.9%)]	P
Age (mean \pm SD)	59.6 \pm 11.7	60.3 \pm 11.8	58.8 \pm 11.5	0.274
BMI (mean \pm SD)	27.5 \pm 4.1	27.8 \pm 4.2	27.3 \pm 3.9	0.292
Triglyceride (mean \pm SD)	162.9 \pm 80.3	162.3 \pm 88.6	163.7 \pm 69.9	0.879
Cholesterol (mean \pm SD)	204.2 \pm 50.5	204.8 \pm 47.1	203.6 \pm 54.3	0.836
HDL-C (mean \pm SD)	44.6 \pm 12.9	43.1 \pm 13.8	46.1 \pm 11.8	0.035
LDL-C (mean \pm SD)	130.6 \pm 40.1	130.3 \pm 38.7	130.1 \pm 41.8	0.836
Smoking [n (%)]	146 (47.2)	77 (52.7)	69 (47.3)	0.911
Diabetes [n (%)]	154 (49.8)	89 (57.8)	65 (42.2)	0.098
Hypertension [n (%)]	175 (56.6)	95 (54.3)	80 (45.7)	0.626
History of MI or admission in CCU [n (%)]	92 (29.8)	46 (50.0)	46 (50.0)	0.481
History of HPL [n (%)]	73 (23.6)	36 (49.3)	37 (50.7)	0.461
Family history of CAD [n (%)]	135 (43.7)	67 (49.6)	68 (50.4)	0.285
Severity of CAD				0.004
Mild and Moderate	187 (60.5)	87 (46.5)	100 (53.5)	
Severe	122 (39.5)	77 (63.1)	45 (36.9)	

SD: Standard deviation; BMI: Body mass index; MI: Myocardial infarction; CCU: Coronary care unit; HDL-C: High-density lipoprotein cholesterol; LDL-C: Low-density lipoprotein cholesterol; HPL: Hyperlipidemia; CAD: Coronary artery disease

Table 2. Adjusted and unadjusted effect of blood group on the severity of coronary artery disease

Effect	OR (95% CI)	P
Severity of coronary artery disease (unadjusted)	1.967 (1.23-3.13)	0.005
Severity of coronary artery disease (adjusted)*	1.968 (1.22-3.15)	0.005

*Adjusted for high-density lipoprotein cholesterol and diabetes
Hosmer and Lemeshow goodness of fit test, P = 0.675
OR: Odds ratio; CI: Confidence interval

Regarding cardiovascular risk factors, 49.8% had diabetes mellitus, 56.6% had hypertension and 43.7% had family history of premature coronary artery disease. In order to assess the severity of coronary artery involvement in different blood groups, they were classified into two categories, O and non-O.

There was no statistically significant difference between blood group O (n = 164, 53.1%) and non-O blood groups (n = 145, 46.9%) in terms of diabetes mellitus, history of myocardial infarction or smoking. HDL-C showed statistically significant difference between O and non-O blood groups (P = 0.035, effect size = 0.23). There was a statistically significant difference between mild, moderate and severe coronary artery involvement with O and non-O blood groups (P = 0.004). Variables with P-value < 0.200 in O and non-O blood groups in table 1 were included in adjusted model to eliminate the potential confounder effect. Table 2 represents the adjusted and unadjusted effect of blood group on severity of CAD.

Discussion

CAD is the leading cause of death all over the world, so evaluation of all aspects that may predispose to CAD is important.

Our study agree with the recent suggestions on the association of blood groups with CAD. In our study, patients with blood group O had more severe form of coronary involvement. Carpeggiani et al. reported that mortality of ischemic heart disease was more common in non-O blood group which is opposed to our result.¹⁰ In the study of Amirzadegan et al., there was no significant difference between frequency of ABO blood group in patients with CAD in an Iranian population.¹¹ As shown by Biswas et al. in a Bengali Asian-Indian population, AB blood group decreased the risk of CAD and the O blood group was more frequent in CAD which is the same as our result.¹⁴ In the study of Dodiya et al. on 256 patients with CAD, a significant association was observed between ABO blood group and CAD. Early onset of CAD was more common in blood group O and A compared with B and AB.¹⁵ In the study by Sujirachato et al.,

patients with coronary atherosclerosis and blood group O had increased sudden cardiac deaths that were more common in women.¹⁶ As shown by Whincup et al.¹⁷ in British men and McKeigue et al.¹⁸ in Asians in northwest London, blood group A was more frequent in patients with CAD, which was opposed to our study. Biswas et al.¹⁴ showed that blood group O was associated with low HDL-C level, which was the same as our result. Although HDL-C showed statistically significant difference between the O and non-O groups, but the difference was not clinically significant.

Controversies between the association of blood group and CAD can be due to several confounding factors such as diabetes mellitus, hypertension and smoking. Other important factor is the rule of race and genetic which may have different impact on relationship between blood groups and coronary artery involvement among Asian and European. In addition, socioeconomic condition, environmental and Life style may have some effect on correlation of ABO and CAD.

The limitation of this study was study design, which was cross sectional. the causality could not be confirmed in a cohort study. In this study, the majority of patients were men and we recommend a gender specific population study.

Conclusion

ABO blood group seems to have an impact on the risk of coronary artery involvement and the type of blood group effects on severity of CAD. There may be different responses to usual medications used in the CAD. Identifying the specific target of ABO blood group, which plays a role in thrombosis and atherosclerosis, can lead to development of targeted therapeutic medications.

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Conflict of Interests

Authors have no conflict of interests.

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