ORIGINAL ARTICLE

ABO groups as a risk factor for myocardial infarction in the population of Bosnia and Herzegovina

Ermina Mujičić[1], Nermir Granov[1], Armin Šljivo[2], Amina Selimović[3]

[1]Department of Cardiovascular surgery, Clinical Centre of the University of Sarajevo, [2]School of Medicine, University of Sarajevo, [3]Department of Paediatrics, Clinical Centre of the University of Sarajevo; Sarajevo, Bosnia and Herzegovina

Corresponding author:

Ermina Mujičić

Department of Cardiovascular Surgery,
Clinical Centre of the University of
Sarajevo

Bolnička 25, 71 000 Sarajevo,
Bosnia and Herzegovina

Telephone number: +387 33 297 941;

Fax: +387 33 298 522;

E-mail: erminamujicic@hotmail.com

ORCID ID: https://orcid.org/0000-0002-2995-4719

ABSTRACT

Aim To investigate the association of ABO blood types and appearance of myocardial infarction (MI) among the population in Bosnia and Herzegovina.

Methods This was a cross sectional study conducted at the Department for Cardiovascular Surgery at the Clinical Centre of the University of Sarajevo from January 1st to December 31st 2019. Patients were divided into two groups, defined by their blood type, A (N=91) and non-A (N=109). ABO blood groups were determined using standard agglutination techniques. Information regarding history of MI was taken from their medical documentation during the preparation for surgery.

Results In total 200 patients were involved in this study. The study sample consisted of 151 (74.5%) males and 49 (25.5%) females. Mean age was 62.98 ± 7.73. Various risk factors associated with myocardial infarction were tobacco 92 (46.0%) and alcohol 54 (27.0%) consumption, obesity 77 (38.5%), diabetes mellitus 47 (23.5%) and hypertension 91 (45.3%). Being A blood type (OR=3.308; 95% Cl 1.317-8.311; p=0.011) and being male and having hypertension (OR=3.086; 95% Cl 1.262-7.545; p=0.013) significantly increased the risk for the development of MI among young adults. Patients with A blood type were significantly younger [median 58.0 *vs.* 63.0; U = 2738.5; p =0.027] when they developed MI compared to non-A blood type.

Conclusion The age of myocardial infarction occurrence in the population of Bosnia and Herzegovina is lower in patients with blood group A compared to non-A blood types.

Key words: acute myocardial infarction, A blood type, ABO blood groups, coronary artery disease, risk factors

INTRODUCTION

The development of myocardial infarction (MI) is associated with various risk factors such as tobacco and alcohol consumption, high lipid concentration, patient-reported hypertension, obesity, poor diet, lack of physical activity and some psychological factors (1). Among these, a lot of studies (2-5) in the last decade have shown a significant, yet also controversial association of ABO blood types with MI. Blood is an individual and unchangeable risk factor for coronary heart disease and development of MI. Some studies (3,5,6) suggest that non-O type blood groups, with the highest prevalence among A blood type, are associated with the increased risk of MI. The coronary arteriosclerosis plaques of O type blood group were exhibited to be more stable compared with non-O type blood group. Moreover, the non-O type blood groups have more serious coronary artery stenosis than O type blood group (7). The possible pathophysiological mechanism of these findings lays in genetic variations of rs495828 gene, which could be responsible for higher platelet aggregation and high levels of arachidonic acid and collagen (8). More studies are needed to investigate various genetic and pathophysiological mechanism for ABO blood types contribution to the development of MI.

To our knowledge, this is the first study assessing relation between ABO blood types and MI in Bosnia and Herzegovina. This research is needed in order to prove that not only lifestyle, but also genetic predispositions which define ABO blood types contribute to MI in our population.

The aim of this study was to investigate the association of ABO blood types and appearance of MI among adults in Bosnia and Herzegovina.

PATIENTS AND METHODS

Patients and study design

This cross sectional study was conducted at the Clinic for Cardiovascular Surgery of the Clinical Centre, University in Sarajevo, Bosnia and Herzegovina, from January 1st to December 31st 2019. All patients were hospitalized at the Clinic and were prepared for coronary artery bypass grafting (CABG) surgery.

Patients were divided into two groups, defined by their blood type: A (N=91) and non-A (N=109). ABO blood groups were determined using standard agglutination techniques. Information regarding other risk factors and history of MI was taken from their medical documentation during the preparation for surgery.

Methods

Data collected from patients documentation consisted of the risk factors: age, gender, history or ongoing tobacco and alcohol consumption, body mass index (BMI), ongoing diabetes mellitus and hypertension. Young patients were considered below the age of 55 years (9). Tobacco consumption was defined as an adult who has smoked minimum 100 cigarettes in his or her life and who currently smokes cigarettes (10). Unhealthy alcohol consumption was defined as drinking more than seven standard glasses of wine or beer each week (11). Diabetes mellitus was defined as having fasting plasma glucose above 7 mmol/L on at least two occasions or HbA1c above 6.5%, or history or ongoing use of hypoglycemic medications (12). Hypertension was defined as having blood pressure greater than 140 mmHg/90 mmHg on several measures, or history of diagnosed and/or treated with medication or non-pharmacological treatment (13).

Statistical analysis

In order to summarize the data, descriptive statistics were run and results were displayed in frequencies and percentages. In order to define independent predictors for the development of MI, binary logistic regression was conducted. Mann Whitney U test was used to show significant association between different variables.

RESULTS

In total 200 patients who underwent CABG surgery in the Clinic for Cardio Surgery of the Clinical Centre, University in Sarajevo, were included in the study. The sample consisted of mainly males, 151 (74.5%). Mean age was 62.98 ±7.73 (range 41-81) years.

The patients were divided in two groups according to their blood groups, 91 (45.5%) patients were A blood type group and 109 (54.5%) patients were non-A [60 (30.0%) O, 32 (16.0%) B, 17 (8.5%) AB].

Out of 200 patients, 92 (46.0%) reported to be current smokers, of whom 43 (46.7 %) in A blood group and 49 (43.3 %) in non-A blood group; 108

(54.0%) were non-smokers. Among 92 smokers, 45 (48. 9%) patients had more than 10 years of smoking history, e.g. 22 (48.9%) in A blood group and 23 (51.1%) in non-A (p>0.05). Alcohol consumption was found among 54 (27.0%) patients with drinking more than seven standard glasses of wine or beer each week, of which 29 (53.7%) in A blood group and 25 (46.3%) in non-A (p>0.05).

The BMI ranged from 21.1 to 44.3 kg/m^2, with a median value of 29.0 kg/m^2. Most of the patients were overweight, 97 (48.5%) of whom 43 (44.3%) in A and 54 (55.7%) in non-A blood group (BMI 25-29.9), followed by 77 (38.5%) obese patients (BMI >30), 32 (41.5%) in A and 45 (58.5%) in non-A blood group, and only 26 (13.0%) patients had BMI within the normal range (18.5-24.9), 16 (61.5%) in A and 10 (38.5 %) in non-A blood group. (p>0.05).

Diabetes mellitus was found in 47 (23.5%) patients, of whom the majority 10 (21.1%) used oral hypoglycemic medications. Hypertension was recorded among 91 (45.3%) patients. (Table 1).

Table 1. Risk factors associated with myocardial infarction according to the blood types

Risk factor	No (%) of patients in the blood type group				p
	A	Non-A			
		B	AB	O	
No of patients	91	32	17	60	>0.001
Sex (male)	69 (75.8)	22 (20.2)	14 (12.8)	46 (42.2)	>0.001
Age (>55 years)	73 (80.2)	29 (26.6)	12 (11.0)	53 (48.6)	>0.001
Smoking	43 (47.2)	15 (13.8)	9 (8.2)	25 (22.9)	>0.001
Alcohol consumption	29 (31.9)	7 (6.4)	8 (7.4)	10 (9.2)	>0.001
BMI > 30	32 (35.2)	17 (15.6)	13 (11.9)	15 (13.8)	>0.001
Diabetes mellitus	25 (27.5)	9 (8.2)	5 (4.9)	8 (7.3)	>0.001
Hypertension	37 (40. 6)	17 (15.6)	9 (8.2)	28 (25.7)	>0.001

BMI, body mass index;

Out of 200 patients, 91 (45.5%) patients were A, 60 (30.0%) O, 32 (16.0%) B and 17 (8.5%) patients were AB blood type.

When age of MI development was compared between the patients who were A blood type and those who were not, a statistical significance was found (median 58.0 and 63.0 years (p =0.027). Patients with A blood type were significantly younger when they developed MI compared to non-A blood type (Table 2).

Table 2. Distribution of myocardial infarction (MI) according to the age

Variable	Blood type				p
	A	Non-A			
		B	AB	O	
No of patients	91	32	17	60	
Mean age (±) (years)	62.8 ±7.9	64.0 ±6.4	60.7 ±10.7	63.3 ±7.1	
Age of the first MI (median) (years)	58	64	63	63	0.027

Binary logistic regression of independent predictors for the development of MI showed no statistical significance (p=0.534). It explained 58.9% (Nagelkerke R^2) of the variance, and correctly classified 87.9% of cases. Being A blood type (OR=3.308; 95% Cl 1.317-8.311; p=0.011), male, and having hypertension (OR=3.086; 95% Cl 1.262-7.545; p=0.013) significantly increased the risk for the development of MI among young adults. The model also explained that being younger (OR=0.755; 95% Cl 0.694-0.822; p<0.001) decreased the risk of the development of MI among young adults.

DISCUSSION

To our knowledge this is the first study regarding the association between ABO blood types and the development of MI in Bosnia and Herzegovina, as well as in this region. The majority of our patients had positive history of smoking and obesity. A blood type was identified as an independent predictor for MI and patients with the same blood type were significantly younger when they developed MI compared to non-A blood types.

Because of the lack of national screening programs, we could not compare distribution of ABO blood types to the national data. Studies which assessed the association between ABO blood types and various entities conducted in Croatia (14-16) and studies regarding the association of ABO blood types and MI (3,6,17) in other countries showed similar distribution of ABO blood types among the population. Our study sample consisted in majority of males (74.5%) similar to Turkish (80.3%) (6) and Canadian study (100%) (17), and it is different from the Taiwanese study (49.8%) (3). When comparing different risk factors associated with MI, our results showed a higher prevalence of obesity, hypertension and diabetes mellitus than other studies (3,6,17) and a lower prevalence of smokers than the Turkish study (6). A blood type was identified as a predictor for the development

of MI, which was shown in Taiwanese (3) and Canadian (14) studies, and it was significantly at younger age, which was also shown in the Turkish study (6). This research confirms that the patients with A blood type, male and having hypertension significantly increased the risk for the development MI among young adults (less than 55 years).

Our study had several limitations. Firstly, the study design was cross-sectional, which makes it difficult to infer causality between various factors. Secondly, we analysed the patients who were supposed to have coronary bypass grafting surgery, e.g. not all patients with IM from the population. Additionally, limited data in patients' histories made our

study limited to several risk factors. Future studies should also include detailed genotype information of the ABO alleles, as well as other risk factors and comorbidities that contribute to MI.

In conclusion, the age of MI occurrence in the population of Bosnia and Herzegovina was lower in patients with blood group A compared to non-A blood types.

FUNDING

No funding was received for this study.

TRANSPARENCY DECLARATION

Competing interests: None to declare

REFERENCES

1. Lisowska A, Makarewicz-Wujec M, Filipiak KJ. Risk factors, prognosis, and secondary prevention of myocardial infarction in young adults in Poland. Kardiol Pol 2016; 74:1148-53.
2. Hu X, Qiao S, Qiu H, Ye S, Feng L, Song L. Association between ABO blood group and acute myocardial infarction. Zhonghua Xin Xue Guan Bing Za Zhi 2015; 43:785-7.
3. Lee HF, Lin YC, Lin CP, Wang CL, Chang CJ, Hsu LA. Association of blood group A with coronary artery disease in young adults in Taiwan. Intern Med 2012; 51:1815-20.
4. Dentali F, Sironi AP, Ageno W, Crestani S, Franchini M. ABO blood group and vascular disease: an update. Semin Thromb Hemost 2014; 40:49-59.
5. Zhou B, Wu N, Zhu C, Gao Y, Guo Y, Qing P, Li X, Wang Y, Dong Q, Li J. ABO blood group is a risk factor for coronary artery disease in patients with poor blood pressure control. Clin Exp Hypertens 2017; 39:366-70.
6. Sari I, Ozer O, Davutoglu V, Gorgulu S, Eren M, Aksoy M. ABO blood group distribution and major cardiovascular risk factors in patients with acute myocardial infarction. Blood Coagul Fibrinolysis 2008; 19:231-4.
7. Huang X, Zou Y, Li L, Chen S, Hou J, Yu B. Relation of ABO blood groups to the plaque characteristic of coronary atherosclerosis. Biomed Res Int 2017; 2017:2674726.
8. Christiansen MK, Larsen SB, Nyegaard M, Neergaard-Peterson S, Würtz M, Grove EL, Hvas AM, Jensen HK, Kristensen SD. The ABO locus is associated with increased platelet aggregation in patients with stable coronary artery disease. Int J Cardiol 2019; 286:152-8.
9. Awad-lkarim AA, Bagger JP, Albers CJ, Skinner JS, Adams PC, Hall RJ. A prospective study of long term prognosis in young myocardial infarction survivors: the prognostic value of angiography and exercise testing. Heart 2003; 89:843-7.
10. Kim HN, Shin MA, Roh JH, Han MK, Won YM, Cho IR, Park HJ, Lee TK, Park TK, Ha HM, Yang SW, Min SH, Lee SY, Lee SH, Kim JH, Kwon SJ, Lee YS, Ko YW, Kim IH, Kwak JH, Jung TG, Jeon JW, Oh KR, Ha HS, kim MS, Kim YM, Kim MJ, Kim TY, Chin JH. Association between cigarette smoking frequency and health factors among Korean adults. Iran J Public Health 2018; 47(Suppl 1):19-26.
11. Department of Health. Alcohol Guidelines Review - Report from the Guidelines development group to the UK Chief Medical Officers. HM Government. 2016. https://www.gov.uk/government/consultations/health-risks-from-alcohol-new-guidelines (28 April 2020)
12. Kharroubi AT, Darwish HM. Diabetes mellitus: the epidemic of the century. World J Diabetes 2015; 6:850-67
13. Schwartz CL, Mcmanus RJ. What is the evidence base for diagnosing hypertension and for subsequent blood pressure treatment targets in the prevention of cardiovascular disease? BMC Med 2015;13:256.
14. Pisk SV, Vuk T, Ivezić E, Jukić I, Bingulac-Popović J, Filipčić I. ABO blood groups and psychiatric disorders: Croatian study. Blood Transfus 2019; 17:66-71.
15. Jukic I, Bingulac-Popovic J, Dogic V, Babic I, Culej J, Tomicic M, Vuk T, Sarlija D, Balija M. ABO blood groups and genetic risk factors for thrombosis in Croatian population. Croat Med J 2009; 50:550-8-16.
16. Karabuva S, Carević V, Radić M, Fabijanić D. The association of ABO blood groups with extent of coronary atherosclerosis in Croatian patients suffering from chronic coronary artery disease. Biochem Med (Zagreb) 2013; 23:351-9.
17. Capuso E, Bonfanti C, Fratitini F, Montorosi P, Turdo R, Previdi MG, Turriri E, Franchini M. The relationship between ABO blood group and cardiovascular disease: results from the Cardiorisk program. Ann Transi Med 2016; 4:189-93.