ORIGINAL ARTICLE

Distribution of ABO blood groups in the patients with intracranial aneurysm and association of different risk factors with particular blood type

Shyamal Chandra Bir, Papireddy Bollam, Anil Nanda

Department of Neurosurgery, LSU Health-Shreveport, 1501 Kings Highway, Shreveport, LA 71130-3932, USA

ABSTRACT

Introduction: The association between ABO blood groups and intracranial aneurysms is not well-known. Many co-morbid factors are associated with intracranial aneurysms. Our objective was to assess the prevalence of different blood group in patients with intracranial aneurysm and to look for associations between risk factors and these groups.

Materials and Methods: This retrospective study includes 1,491 cases who underwent surgical operations for intracranial aneurysms from 1993-2014. We have evaluated the information related to clinical history, ABO blood groups and associated risk factors in the patients both ruptured and unruptured intracranial aneurysms by chart review of the cases.

Results: In our study, out of 1,491 cases, the most common ABO blood groups were group O (668 cases, 44.80%) and Group A (603 cases, 40.44%), and Rh(+) in 1,319 (88.4%) and Rh(-) in 147 (11.6%). Blood Group A (43% vs. 36%) and Group B (16.2% vs. 8.6%) were significantly higher in Caucasian and African Americans respectively. However, in general population, there was no significant difference in blood groups between Caucasians and African Americans. Rh(-) factor was significantly higher in Caucasians compared to African Americans. Incidence of smoking was significantly higher in aneurysm patients with O group compared to others. In addition, incidence of hypercholesterolemia was significantly higher in aneurysm patients with A group compared to others.

Conclusion: The racial disparity in the distribution of blood groups, and risk factor association with blood groups in the development of intracranial aneurysm needs to be considered. The findings from our study may be useful in identifying patients at increased risk. Further study may be required to establish the risks from multiple centers studies around the world.

Key words: ABO blood type, intracranial aneurysm, risk factors

Introduction

Intracranial aneurysm is a very serious condition since it may result in life-threatening intracranial hemorrhage.[1] Although current treatment modalities reduce the mortality rate of this fatal condition, there remains high morbidity from postoperative complications.[1,2] Therefore, establishing the risk factors for cerebral aneurysm formation plays an important role in identifying patients at increased risk and to determine the candidates for cerebral aneurysm screening. Extensive data evaluation revealed that many risk factors are involved in cerebral aneurysm formation including female gender, congenital syndromes, smoking, high blood pressure, atherosclerosis, diabetes, high alcohol consumption, Autosomal Dominant Polycystic Kidney disease, and infection or trauma.[1,3,4] ABO blood groups are identified as one of the major prognostic factors for various diseases including cancers and vascular diseases.[5-7] It is well-established that patients with blood Group A has a strong association with gastric cancer.[6] Similarly, patients with blood Group B with long-standing diabetes have a significant risk of developing pancreatic cancer.[7] Importantly, recent evidence suggested that abdominal aortic aneurysm patients with blood Group A have a higher risk of complications and morality.[8,9] In 1967, there was a report showing that B, AB, O, but not A blood group is a potential risk for intracranial arteriovenous malformation.[10] However, there is no report about association between blood

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Address for correspondence:
Dr. Anil Nanda, Department of Neurosurgery, LSU Health-Shreveport, 1501 Kings Highway, Shreveport, LA 71130-3932, USA.
E-mail: ananda@lsuhsc.edu

groups and the prevalence of intracranial aneurysms. All of the above observations in different articles related to association between ABO blood types and vascular conditions acted as a drive for us to investigate the present study. In this study, we have aimed at investigating the prevalence of blood groups, and association of blood groups with major risk factors among different population with already diagnosed intracranial aneurysm that will help in developing the screening, and preventive strategies for intracranial aneurysm.

Materials and Methods

A total of 1,491 patients with cerebral aneurysm were included in the present study to investigate any association between blood type, Rh factor and risk factors of intracranial aneurysms. This retrospective study is a review of the clinical record of patients who presented to the neurosurgery service and underwent treatment between 1993 to 2014 at LSU Health, Shreveport. We retrospectively reviewed the case records to obtain information on blood groups, and studied the significant association between blood groups and intracranial aneurysms. Information on age, sex ethnicity and major risk factors were also obtained on the patients to determine if these factors have a significant impact on intracranial aneurysm in association with blood groups. Charts reviewed and collected data for ABO blood groups, and risk factors were analyzed using SPSS 21.0 version (IBM Corp., Armonk, NY). Univariate and multivariate analysis were performed to investigate the association of ABO blood groups with risk factors in the patients with intracranial aneurysm. Chi-square test was used to demonstrate (1) the racial disparity in ABO blood types, and (2) relation between specific blood group and risk factor in the patients with intracranial aneurysm. A 5% level of significance was used for all statistical tests of association.

Results

Of the 1,491 patients, 461 were males and 1030bwere females. Table 1 shows the distribution of different variables observed on the study population. Distribution of blood group in the patients with intracranial aneurysms showed that the blood group O was in 668 (44.80%), group A in 603 (40.44%) group B in 173 (11.6%) and group AB in 47 (3.15%) patients [Table 1 and Figure 1]. There was no significant difference in distribution of blood group in these patients and was distributed same as in general population. Figure 1 (pie chart) shows the distribution of blood group in intracranial aneurism. Blood Group A (43% vs. 6.4% patients) and Group B (16.2% vs. 8.6% patients) were significantly higher in Caucasians and African Americans with intracranial aneurysm respectively [Table 2]. However, in general population, there was no significant difference in blood groups between Caucasians and African Americans. Rh factor distribution was as follows; Rh(+)ve in 1,319 (88.4%) and Rh(-)ve in 172 (11.6%) patients. In addition, Rh (-)ve factor was significantly higher in Caucasians compared to African Americans [Table 2].

Table 1: Patient's epidemics

Variables	Mean±SD or number (%)
Total cases of aneurysm	1,491
Total surgeries	2,639
Age	53±14
Gender (%)	
Male	461 (30.9)
Female	1030 (69.1)
Ethnicity (%)	
Caucasians	905 (60.6)
African Americans	564 (37.8)
Other	22 (1.4)
Location of aneurysms (%)	
Anteriorcerebral circulation	1,267 (85)
Posteriorcerebral circulation	180 (12)
Both anterior and posterior circulation	44 (2.98)
Blood type	
A	603
B	173
AB	47
O	668
Rh factor (%)	
Positive	1,319 (88.4)
Negative	172 (11.6)

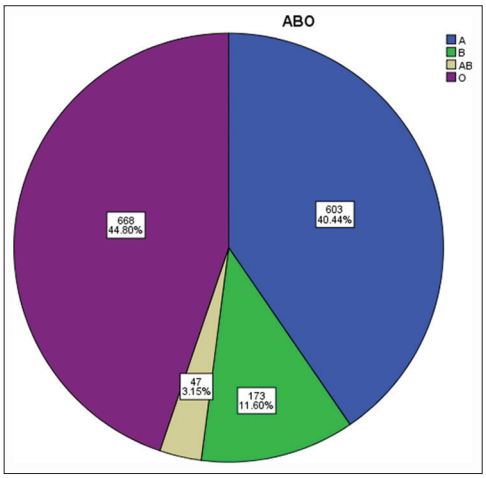

Figure 1: Pie chart showing the distribution (%) of ABO blood groups in the patients with intracranial aneurisms. Blood Group O has the highest distribution (43.51%) followed by A (42.07%), B (11.38%) and AB (3.04%). There was no significance difference in blood group distribution compared to general population. Not significant at 5% level ($P > 0.05$)

Age group and sex distribution are separately shown in the figure 2. Data represents that aneurysm is most commonly seen in between the ages of 30 and 70 years in both males and females, with a peak incidence in 5th and 6th decades. In addition, intracranial aneurysms were more common in females (69% vs. 31%). Table 1 and Figure 3 report the distribution of location of aneurysm in all patients and indicate that 1,267 (85%) patients had aneurysm in anterior cerebral

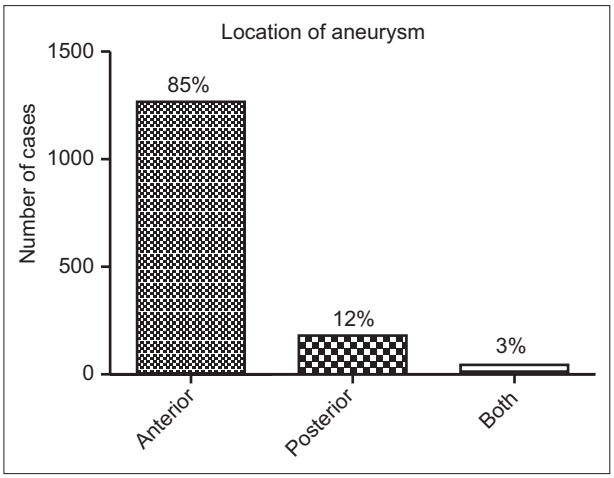

Figure 2: Age and sex distribution in study population with intracranial aneurysm showing peak distribution in fifth and sixth decades in both males and females. Females have higher incidence rate compared to males

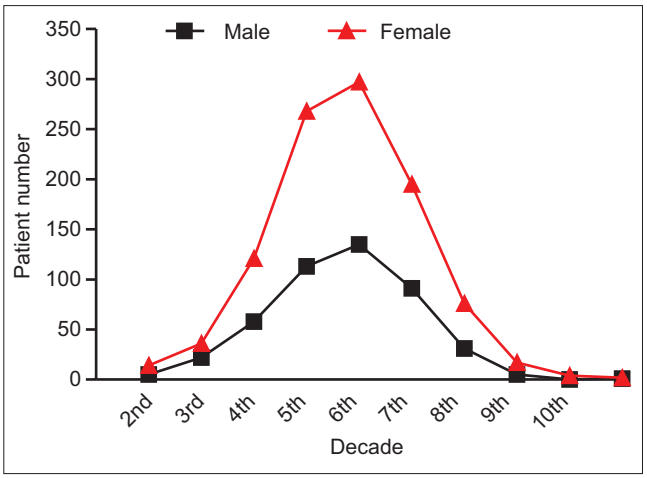

Figure 3: Anatomical distribution of intracranial aneurysms showing highest in anterior circulation (86% of patients) with multiple sites (25%), anterior communicating artery (22%), posterior communicating artery (14%) and middle cerebral artery (13%). internal carotid artery and it branches (11%). Aneurysm in posterior cerebral circulation was in 11% patients and both anterior and posterior cerebral circulation in 3% patients

circulation including anterior communicating artery (22%), posterior communicating artery (14%), middle cerebral artery (13%), internal carotid artery and it's branches (11%), and 180 (12%) patients had aneurysms in posterior cerebral circulation, and 44 (3%) patients have aneurysms in both anterior and posterior cerebral circulation [Figure 2].

Literature-based evidence has revealed that different variables including ethnicity, age, sex, smoking, hypertension, diabetes, alcoholism, hypercholesterolemia past history of cerebrovascular accident and obesity are related to intracranial aneurysms. Multivariate analysis from our data revealed that ethnicity and age have no significant effect on aneurysm, but gender is significantly related to aneurysm with females having significantly higher aneurysm rate compared to males [Figure 3 and Table 3]. Table 3 also shows that there are significant effects of smoking, hypertension, diabetes, alcoholism, hypercholesterolemia, and obesity on formation of intracranial aneurysms.

Multivariate analysis also showed that ABO blood group has a significant association with different risk factors. Ethnicity and age have a significant effect on aneurysms in relation to ABO blood group [Table 4]. Univariate analysis showed the same results with significance in association of smoking with ABO blood group. Incidence of smoking was significantly higher in aneurysm patients with O Group compared to others groups [Table 5]. In addition, an incidence of hypercholesterolemia was significantly higher in aneurysms patients with A Group compared to others [Table 5].

Table 2: Disparity of distribution of blood group in different ethnicity

Parameters	Odd ratio	95%CI for OR	*P* value
Blood Group A			
Caucasians vs. African Americans	0.42	0.24-0.75	0.004
Blood group B			
African Americans vs. Caucasians	2.5	1.8-4.0	0.0001
Rh (-)ve factor			
Caucasians vs. African Americans	1.6	1.15-2.34	0.006

Table 3: Common risk factors for intracranial aneurysms

Risk factors	*P* value
Gender	0.0005*
Age	0.10
Ethnicity	0.85
Hypertension	0.0005*
Diabetes	0.032*
Alcoholism	0.0005*
Hypercholesterolemia	0.034*
Smoking	0.0005*
Obesity	0.024*

Discussion

ABO blood group is a major determinant of hemostasis having consequences on other risk factors involved in hemorrhage or thrombosis.[11,12] The association between ABO blood groups and the prevalence of intracranial aneurysms is not well-understood, and this topic deserves additional investigation particularly to explain the relation of blood group and risk factors in respect to intracranial aneurysm. In the present study, we have attempted to investigate the impact of ABO blood type in a large volume of patients with intracranial aneurysm. The present study revealed that the most common blood group in intracranial aneurysm is O followed by A, B and AB, which reflects a similar pattern of distribution

Table 4: Risk factors of intracranial aneurysm related to ABO blood group

Risk factors	*P* value
Multivariate analysis	
Gender	0.52
Age	0.001*
Ethnicity	0.0005*
Hypertension	0.28
Diabetes	0.45
Alcoholism	0.44
Hypercholesterolemia	0.10
Smoking	0.070*
Obesity	0.35
Univariate analysis	
Age	0.032*
Ethnicity	0.050*
Smoking	0.007*

Table 5: Risk factors of intracranial aneurysm related to ABO blood group

Risk factors	Odd ratio	95%CI for OR	*P* value
Hypercholesterolemia			
Blood group A vs. others	1.53	1.10-2.10	0.006*
Smoking			
Blood group O vs. others	1.320	1.04-1.66	0.010*

of blood group in the general population. Studies showed that non-O blood group is associated with abdominal aortic aneurysm, peripheral arterial disease, angina, myocardial infarction, cerebral ischemia, and venous thromboembolism.[5] However, partially supporting our findings, one recent study in a large volume of patients showed that blood group has no impact on the development of coronary artery disease.[13] Although our data did not show any significant difference in distribution of blood groups in overall study population, but there was an association of blood type A in Caucasians and blood type B in African Americans ethnicity. Research-based evidence suggested that African Americans with non-O blood group has a higher risk of venous thromboembolism which partly favors our finding.[14] Therefore, racial disparity of blood group distribution in intracranial aneurysm is quite possible. Rh factor is also a determinant of cardiovascular diseases including hemolytic diseases. Recent evidence has suggested that Rh negative children with intraventricular hemorrhage have higher mortality rate.[15] Our data has suggested that Caucasians with Rh negative blood group has a higher rate of intracranial aneurysm than that in African Americans. Thus, racial disparity in ABO and Rh blood groups may have importance in screening the patients with intracranial aneurysms in different ethnicity.

Age and sex distribution has a significant impact in any disease population. Our finding is in partial agreement with the previous report showing the higher incidence of intracranial aneurysms in fifth or sixth decade in female patients.[16] Multiple risk factors including gender, hypertension, smoking, hypercholesterolemia, alcohol, and diabetes are involved in the formation of intracranial aneurysm.[16,17] Our finding is a partial agreement with previous publications showing that there is a positive association between gender, hypertension, alcoholism, hypercholesterolemia, smoking, obesity, and formation of intracranial aneurysm.

Before this study, there was not a single study showing association between ABO blood groups and major risk factors with respect to intracranial aneurysm formation, and that remained to be elucidated. Multivariate and univariate analysis of our data indicate that ethnicity, age, and smoking have a positive association with ABO blood group in respect to aneurysm formation. Importantly, smoking is one of the most common risk factors for cardiovascular disorders.[18] We have found that smokers with O blood group have significantly higher chance of intracranial aneurysm formation. Recent study has shown that O blood group has an association with smoking in the patient with chronic heart disease which partially supports our finding.[19] Similarly, hypercholesterolemia is also a common risk factor for intracranial aneurysm and treatment with statins can reduce the risk of intracranial aneurysm.[20] Our data indicate that hypercholesterolemia patients with blood Group A have significantly higher chance of developing intracranial aneurysm. Literature-based evidence also suggested that there is a positive association of A blood group and serum cholesterol in respect to coronary heart disease.[21,22] Therefore, current finding of the association between blood Group O with smoking and Group A with hypercholesterolemia may be used as predictive factors for intracranial aneurysms.

Conclusion

To the best of our knowledge, this is the first study on the distribution of ABO blood groups and association of risk factors in the patients with intracranial aneurysms. The racial disparity in the distribution of ABO and Rh blood groups and association of risk factors with the blood groups need to be considered to understand the individual patient's risk. However, information from a prospective study of intracranial aneurysm is required to refine the risk observed in our study. In addition, future identification of genetic and environment factors among different ethnicity would provide some insights into our observed data and advance opportunities to better understand the control and development of intracranial aneurysms.

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