Correlation between the Blood Pressure and Some Physiologycal Indexes of Blood According to ABO – Blood Group System

S. Baltova

Department of Anatomy and Physiology of Man, University of Plovdiv

Blood samples of 636 clinically healthy subjects (males) of Bulgarian origin from South-central and South-eastern regions of Bulgaria aged from 18 to 30 years were used in the study. ABO blood–grouping and estimation of the blood pressure were done by the conventional methods. The data were analyzed by variation and correlation analysis.

Low correlation was established between blood groups and systolic blood pressure. High correlation was established between blood group A,B,O and diastolic blood pressure. We ascertained a significant and moderate correlation between the systolyc and diastolic blood pressure and the common protein, the hemoglobin, the blood sugar – at persons with B and AB blood groups. The highest correlations were assessed in subjects with B and AB and lowest-in subjects with A and O blood groups.

Key words: blood-group systems ABO, blood pressure (systolic and diastolic).

Introduction

To the present day a vast body of knowledge of the nature and extent of the individual variability of physiological and biochemical characteristics for many populations has been amassed. The most comprehensive data refer to such indicators as basal metabolism, hemoglobin, proteins, arterial blood pressure, heart and respiration rate, the numerous hormones found in blood, glucose, cholesterol, and other lipids.

The study of the correlation between the ABO blood-group system and physiological indicators that are labile within the normal range has considerable potential for future research in which a large group of virtually healthy population is investigated.

The work on the problem followed the standard for such studies transition from individual, intra-group variability to inter-group variabi- lity. We assumed that in his evolution and differentiation human has developed adaptive complexes accentuating the individual relationships inside the organism.

In relation to the above, [3, 4] a number of investigations aimed at identifying a correlation between the ABO blood-group system and some physiological indicators – total protein, cholesterol, albumins found in blood have been carried out.

The inquiry into available literature revealed that the present subject matter has been insufficiently studied and that authors have expressed contradictory opinions [1, 2, 5].

The present paper represents only a single stage of the research into the correlation between the ABO blood-group system and some physiological indicators of blood. Its significance for further study lies in the elucidation of some differentiation characteristics. It is believed that the specificity in the donor selection process emphasizes the important fact that the above relationships are not determined by age peculiarities, historical correlation in the populations or any other factors.

Material and Methods

Blood samples of 636 clinically healthy subjects (males) of Bulgarian origin from South-central and South-eastern regions of Bulgaria aged from 18 to 30 years were used in the study. ABO blood-grouping was done by the conventional methods.

The same individuals were subjected to indirect blood pressure measurement (systolic and diastolic) over the upper arm artery (a. brachialis) with a Riva-Rocci sphygnomanometer.

We carried out the common protein and cholesterol determining by means of the colorimetric method, as we read the results on specol 11 under 540 nm respectively for the common protein and under 510 nm for the cholesterol. By means of the ortho-toluidine method for photometric determining we read the sugar under the Epol's scheme. We made the hemoglobin level determining by means of hemoglobin cyanide method. We determined the erythrocytes and leucocytes in blood by means of visual-optical microscopic method. We used the Westergren's method for determining the erythrocytes precipitation velocity. On the basis of the determined hemoglobin quantity and erythrocytes number we calculated the color index. The data were analyzed by variation and correlation analysis.

Results and Discussion

The study of blood samples from 636 subjects showed 4 phenotype combinations of blood groups according to the erythrocyte factors ABO: A, B, AB and O. The revealed genic frequencies are for $p=0.3254$, $q=0.2248$ and $r=0.4498$. (Table 1 and Fig.1)

The co-ordination between the observed and the expected values is very good and according to Hardy-Weinberg's law it is evident that the studied population is in a genetic equilibrium regarding the blood group under the ABO system.
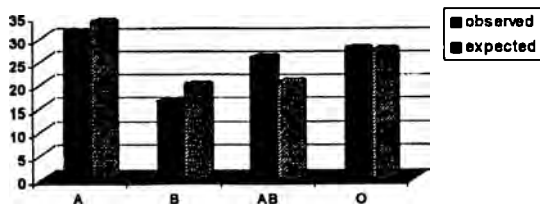

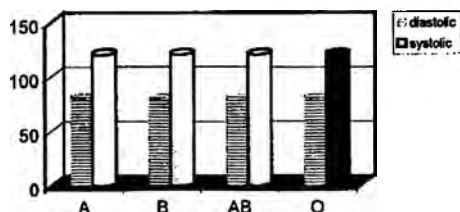Fig. 1. Distribution of phenotypes and gene frequency of erytrocyte systems ABO

Fig. 2. Distribution of blood pressure according phenotypes ABO blood groups system

The results from the measurement of the systolic and diastolic blood pressure of the studied 636 ABO phenotype subjects are given in Table 2 (Fig. 2).

The summarized results obtained from the blood pressure measurements provide good reason to draw the conclusion that blood pressure was within the normal range. The highest systolic and diastolic pressure readings were measured in blood group B. Phenotype O subjects were observed to have the same systolic pressure as phenotype B subjects. The lowest systolic pressure was taken in phenotype A subjects, while the lowest diastolic pressure was measured in blood group AB.

The results have a level of significance from $p > 0.1$ to $p > 0.01$. The systolic blood pressure was observed to vary only very slightly in all studied individuals, while for the diastolic blood pressure such variation was observed only in blood group O subjects. Phenotype A, B, and AB subjects are characterized by low variability of the diastolic blood pressure.

The data from the statistic analysis of correlation relationships between the separate phenotypes of the ABO blood-group system and the arterial blood pressure are given in Table 3 and Fig. 3.

The obtained results give grounds to conclude that all phenotypes of the ABO blood-group system have correlation relationships with blood pressure. A considerable correlation between blood groups A, B and O and the diastolic blood pressure was observed. Significant correlation relationships were found between blood group AB

Table 1. Distribution of phenotypes and gene frequency of erythrocyte systems ABO

Phenotype	Observed		Expected		Gene frequency	χ^2
	n	%	n	%		
A	198	31.13	211.02	33.18	0.3254	0.4017
B	102	16.04	124.50	19.58	0.2248	2.0331
AB	162	25.47	12824	20.16	–	4.4438
O	174	27.36	172.24	27.08	0.4498	0.0090
Total	636	100.00	636.00	100.00	0.0000	6.8876

Table 2. Distribution of blood pressure according phenotypes ABO blood groups systems

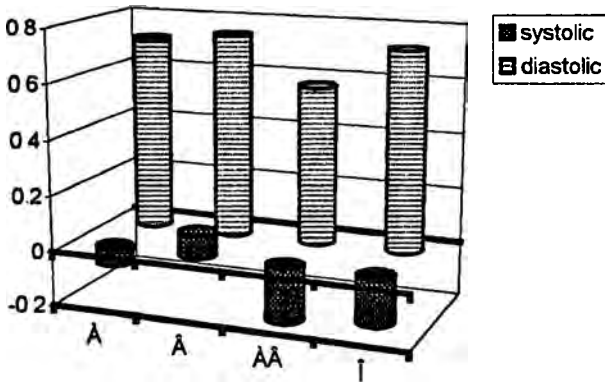| ABO	Systolic blood pressure, Torr				
	X	m_x	σ	C	C_v
A	120.26	0.19	1.88	0.26	1.56
B	12.,56	0.30	2.17	0.56	1.80
AB	120.38	0.19	1.68	0.38	1.40
O	120.56	0.22	2.10	0.56	1.74
Total	120.44	0.23	1.96	0.44	1.63
ABO	Diastolic blood pressure, Torr				
	X	m_x	σ	C	C_v
A	79.79	0.17	1.70	– 0.21	2.13
B	79.95	0.26	1.89	– 0.05	2.36
AB	78.95	0.19	1.72	– 1.05	2.18
O	79.77	0.17	1.54	– 0.23	1.93
Total	79.62	0.20	1.71	– 0.39	2.15

Fig. 3. Correlation between phenotypes of ABO blood groups and blood pressure

and the diastolic arterial pressure at a high reliability level ($p > 0.95$). A poor correlation relationship between the blood groups and the systolic blood pressure was observed.

The highest values of the correlation coefficient were recorded in phenotype B and AB, and the lowest – in subjects with blood groups A and O.

A statistical analysis of correlative relationships among the studied physiological indicators was also carried out.

Tables 4 and 5 the respective Figs 4 and 5 show correlations among the separate physiological indicators in terms of the ABO blood-group system. As a whole, the highest values of the correlation coefficient were found in phenotype B subjects, whereas the lowest were found in blood group O subjects.

The results from the correlation analysis revealed a moderate correlation relationship of the systolic blood pressure with total protein – in blood group AB; with the number of erythrocytes – in phenotype O, and with hemoglobin – in blood group AB ($r = 0.4287$ at $p > 0.995$). The correlation dependence of the systolic arterial pressure with total protein is low – in subjects with blood groups A, B and O; with cholesterol; with the number of leucocytes; with the number of erythrocytes – in subjects with blood
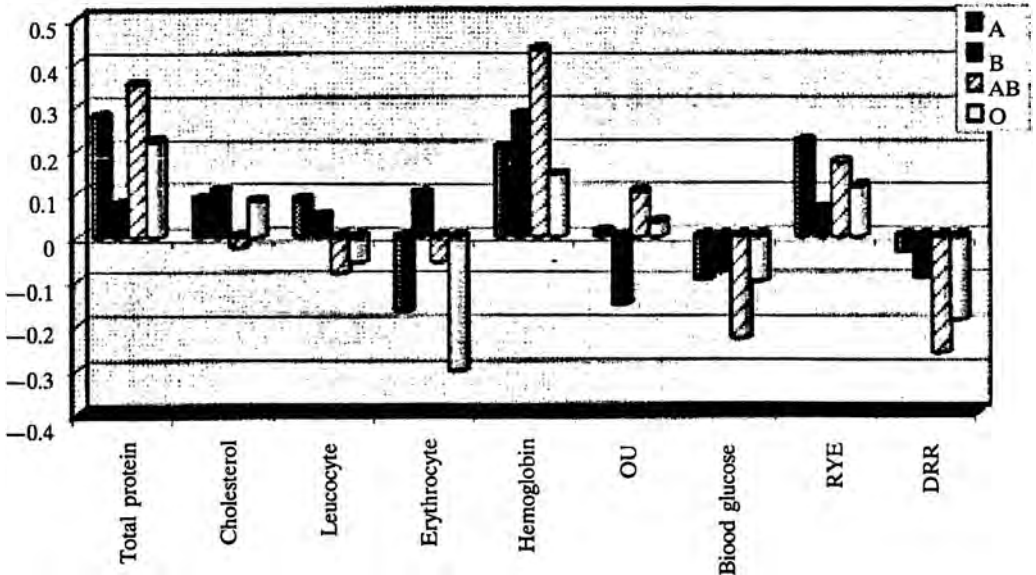

Fig. 4. Correlation between systolic blood pressure and some physiological indexes of blood
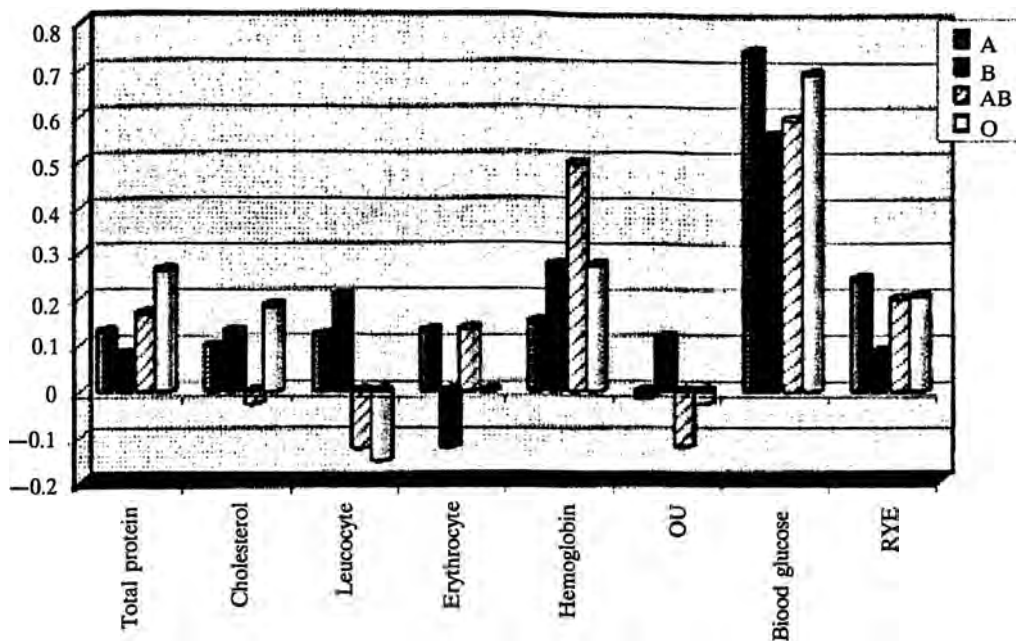
100

Fig. 5. Correlation between diastolic blood pressure and some physiological indexes of blood

groups A, B and AB; with hemoglobin – in phenotype A, B and O subjects; with the colouring index; with blood sugar; with RYE, and with the diastolic blood pressure (for phenotype AB $r = -0.2645$ at $p > 0.995$). The correlation between the diastolic pressure and blood sugar in subjects with blood groups A and O is considerable. Significant correlation relationships were found between the diastolic arterial pressure and blood sugar in subjects with blood groups B and AB. Moderate correlation dependence was observed between the diastolic blood pressure and hemoglobin in phenotype AB subjects.

The data in Table 5 illustrate the poor correlation relationship of the diastolic arterial pressure with total protein (for phenotype O $r = 0.2608$ at $p > 0.95$); with cholesterol;

T a b l e 3. Correlation between phenotypes of ABO blood groups and blood pressure

ABO	Systolic blood pressure		
	n	r	χ^2
A	198	– 0.0636	– 12.5928*
B	102	0.0840	0.3599
AB	162	– 0.1995	– 32.319
O	174	– 0.1690	– 29.406
ABO	Diastolic blood pressure		
	n	r	χ^2
A	198	0.7128	50.3003
B	102	0.7437	28.2076
AB	162	0.5699	26.3077*
O	174	0.7219	45.3391*****

Table 4. Correlation between systolic blood pressure and some physiological indexes of blood

ABO	Total protein			Cholesterol		Leucocyte		Erythrocyte		Hemoglobin		OU		Blood glucose		RYE		DRR	
	n	r	χ^2	r	χ^2	R	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2
A	98	0,28	7,65	0,09	0,75	0,09	0,72	-0,17	-33,34	0,21	4,16	0,02	0,01	-0,10	-19,80	0,22	4,68	-0,04	-7,15
B	102	0,07	0,28	0,11	0,56	0,05	0,12	0,10	0,49	0,28	3,98	-0,16	15,84	-0,08	-8,27	0,06	0,20	-0,10	--9,65
AB	162	0,35	9,94	0,02	-3,91	-0,08	-13,5	-0,06	-9,40	0,43	**** 14,89	0,11	0,82	-0,23	-37,79	0,17	2,26	-0,26	**** -42,85
O	174	0,22	4,21	-0,08	0,59	-0,06	-10,2	-0,30	-52,90	0,14	0,02	0,03	0,09	-0,10	-17,84	0,12	1,11	-0,19	-33,16

****p > 0.995

Table 5. Correlation between diastolic blood pressure and some physiological indexes of blood

ABO	Total protein			Cholesterol		Leucocyte		Erythrocyte		Hemoglobin		OU		Blood glucose		RYE	
	n	r	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2	r	χ^2
A	198	0.13	1.64	0.10	0.94	0.12	1.39	0.13	1.64	0.15	2.14	-0.02	-3.19	0.74	** 54.48	0.24	5.83
B	102	0.08	0.34	0.13	0.84	0.20	2.13	-0.12	* -12.56	0.27	3.77	0.12	0.68	0.56	15.91	0.09	0.37
AB	162	0.17	2.22	-0.03	-4.28	-0.13	-20.4	0.13	1.40	0.49	19.75	-0.12	-19.72	0.59	28.52	0.20	3.19
O	174	0.26	* 5.92	0.18	2.87	-0.15	**** 26.4	-0.01	-0.33	0.27	6.45	-0.03	-4.61	0.70	42.06	0.21	3.65

*p > 0.95, **p > 0.975, **** p > 0.995

with the number of leucocytes (for phenotype O the correlation coefficient was determined with reliability level $p > 0.995$); with the number of erythrocytes in blood groups A, B and AB (for phenotype B $r = -0.1231$ at very high reliability level $p > 0.99$); with the colouring index; with hemoglobin – in blood groups A, B and O, and with RYE. In blood group O there is no correlation between the diastolic pressure and the number of erythrocytes ($r = -0.0019$). On the basis of the measured blood pressure the highest correlation coefficients were computed in phenotype AB, while the lowest were in blood group B. On the basis of the obtained results we concluded that between the investigated physiological indicators according to the ABO blood group system a tendency for correlative relation increase to high can be observed between the following indicators: between the diastolic blood pressure and blood sugar – at persons with phenotypes A and O.

There is significant relationship between the diastolic blood pressure and the blood sugar – at persons with B and AB blood groups.

We ascertained a moderate correlation between the systolic blood pressure and the common protein – in phenotype AB; between diastolic blood pressure and the hemoglobin – at persons with AB blood group. Correlation is missing between the diastolic blood pressure and the number of erythrocytes – at persons with O blood group. The correlative relationships between the physiological indicators that are not specified are weak.

Conclusion

1. In blood group B donors the analysed indicators were observed to have the highest mean values.

2. The lowest systolic pressure was taken in phenotype A subjects, and the lowest diastolic pressure in blood group AB.

3. Correlation dependences vary from slight to considerable.

4. The obtained results give us reason to agree with the presence of some differential associations of the blood groups with blood physiological indicators.

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