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ABO Blood Group System Polymorphism and its Relation to Diseases Affection in Diyala Province

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Abstract: ***Background: Blood groups are genetically determined. In different population exhibits significant differences in the frequency of each blood group. This study aimed to determine the most common blood groups in our population and to study the high incidence of certain disease in some blood group carriers. Objectives: We investigated the ABO genotypes and heterogeneity of the O alleles in veterinary college student in Diyala University and also from donors from blood bank in Baqubah city, side by side with same survey which had been done in the central hospital of the city for investigate the same alleles frequency in diseased and non-diseased individuals. Results: Samples collection took place from January 2011 to April 2011.The highest frequency in normal un-diseased individuals was that of blood group O (67.95%) followed by blood group A and B (15.38% and 10.26% respectively) and the lowest of blood group AB (6.41%). Among the Rhesus phenotype, the majority (78.21%) are Rhesus positive. The frequency of coexisting ABO/Rhesus phenotypes were calculated and the highest was that of O+ (56.41%) followed by A+ (10.26%) and B+ (6.41%) and AB+(5.13%). The blood groups O-, A-, B- and AB- occurred at lower frequency of 11.54%, 5.13%, 3.85% and 1.28% respectively.The frequency of the same blood groups in diseased patient that resident in medicine department of the central hospital of the city was that of blood group O (50.70%) followed by blood group A and B (20.00% and 18.22% respectively) and the lowest of blood group AB (11.08%). Among the Rhesus phenotype, the majority (87.01%) are Rhesus positive. In the comparison of the same blood group frequency in thalassemia individuals which it was that of blood group O (35.38%) followed by blood group A (31.60) , B (26.42)% and the blood group AB (6.60%). Among the Rhesus phenotype, the majority (89.62%) are Rhesus positive. Conclusions: Iraqi people "in general" have less blood group type O than Hujazi or Kuatipeople, and because of this type of blood group have more resistance survival phenomena.***

Keyword: ABO Blood, polymorphism, diseases affection

1. Introduction and Literature Review

Blood groups are genetically determined. In different population exhibits significant differences in the frequency of each blood group. The ABO blood group system is the most important blood type system (or blood group system) in human blood transfusion. The associated anti-Aantibodies and anti-B antibodies are usually IgM antibodies, which are usually produced in the first years of life by sensitization to environmental substances such as food, bacteria and viruses. ABO blood types are also present in some animals, for example apes such as chimpanzees, bonobos, and gorillas.

LudwikHirszfeld and E. von Dungern discovered the heritability of ABO blood groups in 1910, with Felix Bernstein demonstrating the correct blood group inheritance pattern of multiple alleles at one locus in 1924. Watkins and Morgan, in England, discovered that the ABO epitopes were conferred by sugars, specifically N-acetylgalactosamine for the A-type and galactose for the B-type. After much published literature claiming that the ABH substances were all attached to glycosphingolipids,Athreya and Coriell[1]found that the band 3 protein expressed a long polylactosamine chain which contained the major portion of the ABH substances attached. Later, Yamamoto's group showed the precise glycosyl transferase set that confers the A, B and O epitopes.

The H antigen is an essential precursor to the ABO blood group antigens. The H locus is located on chromosome 19. It contains 3exons that span more than 5 kb of genomic DNA, and it encodes a fucosyltransferase that produces the H antigen on RBCs. The H antigen is a carbohydrate sequence with carbohydrates linked mainly to protein (with a minor fraction attached to ceramidemoiety). It consists of a chain of β-D-galactose, β-D-N-acetylglucosamine, β-D-galactose, and 2-linked, α-L-fructose, the chain being attached to the protein or ceramide[2].

The ABO system consist of the A,B and H carbohydrate antigens synthesized by a serried of enzymatic reaction catalyzed by glycosyltransferase and antibodies against these antigens. The A, B and O genes are at the same genetic locus on chromosome 9 at q34, and the A and B alleles are co_ dominant against the recessive O allele[3]. Several point mutation on the A gene have been described. They cause a number of amino acid changes and alter the glycosyltransferase from A to B. Single guanine deletions at position 261 on the ABO gene resulting truncated, enzymatically inactive O protein (referred to asO^1) (Roubinet et al., 2004). Another O allele (O^2), which lacks this deletion, has been identified. A commonly occurring variant of the O^1 gene, $O^{1\ variant}$ has also been reported[4]. The combination of these alleles offers several genotypes, which result in four phenotypes, but the alleles have now been shown to be highly polymorphic [5, 6].

The importance of ABO histo-blood groups is supported by the observation that their geographical distribution varies significantly, suggesting that positive selective factors may have influenced gene spread [7]. Lell, et al.[8]mentioned a relationship between erythrocytic antigens of the ABO and Rh blood systems and cardiovascu-

lar pathology was revealed by comparing the distribution of blood groups in 13,175 patients and 7,800 donors. Prevalence of A gene and Rh+ phenotype in congenital and acquired heart diseases and ischemic heart disease was found. The frequency of B gene is increased in patients with acquired heart diseases[9].

Camargo, et al.[10] find in a series of male survivors of ischemic heart disease there were fewer patients belonging to the risk-factor blood group (group A) before than after age 55 who were either non-infarction patients in light work or infarction patients in active or heavy work. Conversely, there were more A's before than after age 55 who were either non-infarction patients in active or heavy work or infarction patients in light work.

2. Material and Methods

The subject of this study were (1075) individuals (78) normal un-diseased individuals and (785) diseased individuals that resident in medicine department of the central hospital of the city (353 patient from Nov.2010 record and 432 from Dec. 2010 record).And (212) thalassemia individuals; depending on the hospital records. The ABO blood group and rhesus type was carried out by standard agglutination test method.

Statistical analyses

Statistical analyses followed the methods of Steel and Torrie[11] The (χ^2) test statistical analysis and (LSD)were used to differentiate between and within the groupsgroups**.** The "T" test statistical analysis were used to differentiate between the two groups

3. Results and Discussion

Table 1: Prevalence of the phenotype of ABO and Rh alleles in normal population

Phenotype		Vet.students		Volunteers		Overall	
		Freq.	%	Freq.	%	Freq.	%
O	Rh+	11	55	33	56.90	44	56.41
	Rh-	3	15	6	10.34	9	11.54
Total O phenotype%		67.95%					
A	Rh+	2	10	6	10.34	8	10.26
	Rh-	1	5	3	5.17	4	5.13
Total A phenotype%		15.38%					
B	Rh+	1	5	4	6.90	5	6.41
	Rh-	1	5	2	3.45	3	3.85
Total B phenotype%		10.26%					
AB	Rh+	1	5	3	5.17	4	5.13
	Rh-	0	0.0	1	1.72	1	1.28
Total AB phenotype%		6.41%					
Total		20	100%	58	100%	78	100%

The prevalence of O, A, B, AB and Rhesus phenotypes (Rh) in undiseased individuals are presented in (tables 1). The most common blood group was group O (67.95%) followed by blood group A and B (15.38% and 10.26% respectively) and the lowest of blood group AB (6.41%). Among the Rhesus phenotype, the majority (78.21%) are Rhesus positive. The frequency of coexisting ABO/Rhesus phenotypes were calculated and the highest was that of O+ (56.41%) followed by A+ (10.26%) and B+ (6.41%) and AB+(5.13%). The blood groups O-, A-, B- and AB- occurred at lower frequency of 11.54%, 5.13%, 3.85% and 1.28% respectively.

The frequency of blood group in our population is parallel with that from Hujaz, Egypt, Kuwait, and differs from that in Lebanon, India, Turkey and European countries[12]**.**The blood group O is said to be the characteristic of Arabia as it occur in at high frequency in desert population and this confirmed in our study, which is related neighboring countries studies .

We believed the dropping of the frequency of blood group type O in Iraqi people in comparison with Hugazi population is normal because we cannot conceder the Iraqi people as a desert peoples. The Brazilian population has a highly heterogeneous ethnic composition ,which results from the hybridization of the Asia . Waves of immigration occurred in unequal proportion in the different region of the country [13]**.**The homozygous genotype ABO*O01O01 showed an expected higher frequency in the population studied, since phenotype studied of the ABO blood groups in Amerindian – descent population have revealed that most individuals are exclusively of the O group[13, 14]

The indigenous contributions in the ethnic formation of the North Brazil region are unquestioned , and the molecular basis of the O phenotype in Indian from the Brazilian Amazon was reported by [14]**.** Comparing the Brazilian population data, our results show that ^{O1varinat} allele frequencies are lower than the frequencies reported for some Amerindians and higher than those for populations of Caucasian and African ancestry [15]**,**probably due to the influence of Portuguese colonization in the northern region of Brazil as well as the presence of Amerindians[16].On the other hand, previous studies in Southeast Brazil.Mattos et al., [17]have shown lower $O^{1varinat}$ allele frequencies than those found in our sample, probably because the indigenous contribution in this region of countries the smallest. Along the same line , the frequency of the A phenotype reaches values around 35%, and the A allele frequency a more than 0.25 in these popula-

tions [17], while in our sample of the North region the frequencies were21.2 % and0.13 % respectively.

The frequency of the same blood groups in diseased patient that resident in medicine department of the central hospital of the city (Table 2) was that of blood group O (50.70%) followed by blood group A and B (18.22% and 20.00% respectively) and the lowest of blood group AB (11.08%). Among the Rhesus phenotype, the majority (87.01%) are Rhesus positive. The frequency of coexisting ABO/Rhesus phenotypes were calculated and the highest was that of O+ (43.69%) followed by A+ (15.80%) and B+ (18.09%) and AB+(9.42%). The blood groups O- , A-, B- and AB- occurred at lower frequency of 7.01%, 2.42%, 1.91% and 1.66% respectively.

Table 2: Prevalence of the phenotype of ABO and Rh alleles in diseased population

Phenotype		Nov.2010		Dec.2010		Overall	
		Freq.	%	Freq.	%	Freq.	%
O	Rh+	135	38.24	208	48.15	343	43.69
	Rh-	20	5.67	35	8.10	55	7.01
Total O phenotype%							50.70%
A	Rh+	66	18.70	58	13.43	124	15.80
	Rh-	7	1.98	12	2.78	19	2.42
Total A phenotype%							18.22%
B	Rh+	78	22.10	64	14.81	142	18.09
	Rh-	7	1.98	8	1.85	15	1.91
Total B phenotype%							20.00%
AB	Rh+	32	9.06	42	9.72	74	9.42
	Rh-	8	2.27	5	1.16	13	1.66
Total AB phenotype%							11.08%
Total		353	100%	432	100%	785	100%

In the comparison the results of our study between ABO frequencies between healthy and diseased individuals we saw high deference in blood group type O frequency which it was 67.95% in healthy group in comparison with 50.70% with high significance result (P > 0.01). This unexpected result (*at least for us*)include also the other types of blood group A, B, and AB. In addition to this we observed an inverted percent for blood group A and B. In normal population normally the frequency of type A exceed type B all over the world but in this study we saw increasing type B frequency against type A (P > 0.01).

Also there is a significant difference (P > 0.05) in overall blood Rhesus positive between healthy individual 78.2% and diseased population 87.01% .In regions that are highly endemic for *Plasmodium falciparum* malaria , it is well recognized that a range of red blood cell polymorphisms associated with resistance to severe disease have undergone positive selection[18]. Moreover , as mentioned before, the blood group O proved to be protective factor against sever malaria[19, 20].However, since in the Brazilian Amazon region malaria predominates in Mesoendemic condition with wide variation in transmission, malaria endemicity could be viewed as a selective pressure for maintenance of the observed frequencies of genotypes of the ABO system , which could be very interesting as the focus of a new investigation, including analysis of the genotypes in severe and non- severs malaria patients, as well as in individuals living in nonendemic areas.

In the comparison of the same blood group frequency in thalassemia individuals (Table 3), which it was that of blood group O (35.38%) followed by blood group A (31.60) , B (26.42)% and the blood group AB (6.60%). Among the Rhesus phenotype, the majority (89.62%) are Rhesus positive. The frequency of coexisting ABO/Rhesus phenotypes were calculated and the highest was that of O+ (33.49%) followed by A+ (27.36%) and B+ (23.11%) and AB+(5.66%). The blood groups O-A-, B- and AB- occurred at lower frequency of 1.89%, 4.25%, 3.30% and 0.94% respectively.

Table 3: Prevalence of the phenotype of ABO and Rh alleles in thalassemic patients

Phenotype		Thalassemia		Total type frequency	Blood type %
		Freq.	%		
O	Rh+	71	33.49	75	35.38
	Rh-	4	1.89		
A	Rh+	58	27.36	67	31.60
	Rh-	9	4.25		
B	Rh+	49	23.11	56	26.42
	Rh-	7	3.30		
AB	Rh+	12	5.66	14	6.60
	Rh-	2	.94		
Total		212	100%		100%

In comparison the result of ABO blood types between normal and thalassemic (*A* genetic disease marked by failure to produce a functional mRNA for one of the two major adult hemoglobin proteins, α-globin or β-globin.) patients we saw a dramatic drop in frequency of blood group type O in thalassemic individuals (35.38%) in

comparison with the frequency of the same blood group in normal population (56.41%), (P. > 0.01). And we saw an increase frequencies of type A and B (31.60 % and 26.42 %) in thalassemic person in comparison with the same blood group frequencies in healthy individuals (15.38% and 10.26%) respectively, with high significance results, (P. > 0.01). In comparison overall blood Rhesus positive (Rh+) frequency (Table 4) between both healthy individual (78.2%) and thalassemic individuals (89.62), there was a significant difference (P > 0.05) between them.

Table 4: Overall blood Rhesus positive (Rh+) frequency betweendifferent groups of population

Sample type(No.)	Number of Rh+	Number of Rh-	Rh+%
Normal individuals (78)	61	17	78.2%
Diseased patient (785)	683	102	87.01%
Thalassemic patient (212)	190	22	89.62

This data may give an indicator that individuals with blood group type O may have a genetic resistance against thalassemia.

Also there are a significant deviation in frequencies among blood types in diseased population especially type O which recorded a high decrease in frequency in comparison with healthy people, also the same opinion has been observed for A and B blood group.

Iraqi people “in general” have less blood group type O than Hujazi or Kuwati people, and because of this type of blood group have more resistance survival phenomena (have more phenotype frequency than the expected genotype one).When the expected change gene frequency in 1 generation is calculated [21]**,** allowing selection to work against the dominant phenotypes A and B, or favors the recessive and q to be =0.9 and s=0.1 , the resultant value is about 0.008. This small change, in the presence of other systematic and dispersive processes, is too weak to be noticed, or to produce a drastic shift in the present gene frequencies. On these bases it is expected that the persistency of the polymorphic state and the 3 other alleles (A, B and O) will remain in the population for many generations.

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