



A Brief History of Human Blood Groups

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Abstract

The evolution of human blood groups, without doubt, has a history as old as man himself. There are at least three hypotheses about the emergence and mutation of human blood groups. Global distribution pattern of blood groups depends on various environmental factors, such as disease, climate, altitude, humidity etc. In this survey, the collection of main blood groups ABO and Rh, along with some minor groups, are presented. Several investigations of blood groups from Iran, particularly a large sampling on 291857 individuals from Iran, including the main blood groups ABO and Rh, as well as minor blood groups such as Duffy, Lutheran, Kell, KP, Kidd, and Xg, have been reviewed.

Keywords: Major blood groups, ABO, Rh, Minor blood groups, Iran

Introduction

It was not until the year 1900, when Karl Landsteiner at the University of Vienna, discovered why some blood transfusions were successful while others could be deadly. Landsteiner discovered the ABO blood group system by mixing the red cells and serum of each of his staff. He demonstrated that the serum of some people agglutinated the red cells of other. From these early experiments, he identified three types, called A, B and C (C was later to be re-named O for the German “Ohne”, meaning “without”, or “Zero”, “null” in English). The fourth less frequent blood group AB, was discovered a year later. In 1930, Landsteiner received the Nobel Prize in physiology and medicine for his work (1).

The gene that determines human ABO blood type is located on chromosome 9 (9q34.1) and is called ABO glycosyltransferase. The ABO locus has three main allelic forms: A, B, and O, as men-

tioned above and each of them is responsible for the production of its glycoprotein. It is therefore the combination of alleles that are inherited from parents that determines which glycoproteins (antigens) are found on persons' blood cells and thereby their ABO blood type (1).

Genesis and Evolution

As investigations have demonstrated on monkeys (Table 1), human blood groups are very old genetic indicators which have evolved during several million years (2). Based on the primary races hypothesis, it was thought that in the three major races of man, blood groups A in Europe, B in Asian, and finally O in South America have been emerged and gradually due to the migration and mixing of the races, became the present situation. But we know that in each continent, the isolated

populations are seen that have completely different blood groups. For example, there is relatively high prevalence of blood group O in Siberian inhabitants; also this blood group is very common in some areas of Switzerland (3).

Table 1: Percentage of blood groups in monkeys (collected by Kramps 1960)

	n	AB	B	A	O
Chimpanzee	132	-	-	88	12
Gorilla	17	-	88	12	-
Orangutan	22	23	45	32	-
Gibbons	14	14	72	14	-

According to another hypothesis, the emergence of all blood groups A and B and their subgroups, are resulted from successive mutations, from a basic and common blood group, which is the O group, and have been branched over millions of years (Fig. 1).

Based on this theory, the old races have O blood group, such as Red Indians of South America, and Eskimos that among them the frequency of O blood group is between 75-100%. While in most of recent ethnic groups A and B blood groups are dominant.

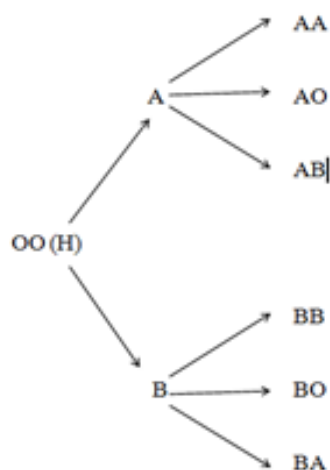


Fig.1: According to this hypothesis, the emergence of all blood groups is resulted from successive mutations, from the O group

In another hypothesis, the first blood group had been AB blood group, which gradually and over the time due to genetic mutations was resulted in A and B and finally O blood groups (Fig. 2). Base on this theory, perhaps a few million years ago all people have had type O blood only, which is more resistant against many infectious diseases.

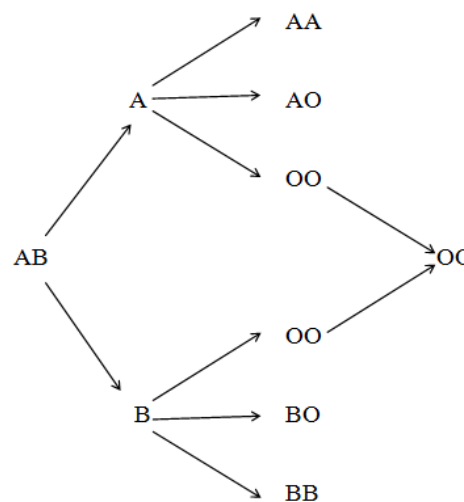


Fig. 2: Based on the second hypothesis, the first blood group had been AB, which gradually has been resulted in A and B and O blood groups

The emergence and evolution of blood groups in humans is still not clear. Geographic distribution and racial blood groups A and B and O in the world (according to the Mourant design 1958) are shown in Figures 3 to 5 (4). The geographical spread not only is a result of the above assumptions, but the current process of natural selection against environmental factors such as diseases, climate, humidity, altitude and etc. will continue.

After discovery of the first human blood groups (ABO) by Karl Landsteiner in 1901 (5), gradually from 1927, other blood groups were also discovered and reported which its collection is given in Table 2. It is important to mention that Landsteiner together with his American colleague Alexander Wiener discovered the Rh blood group and reported it in 1940, 1941.

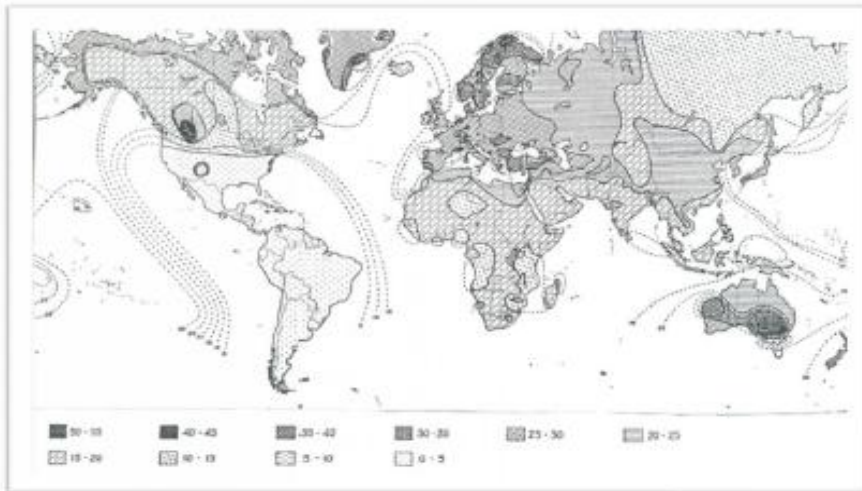


Fig. 3: Geographical distribution of blood group A, percentage (Mourant 1958)

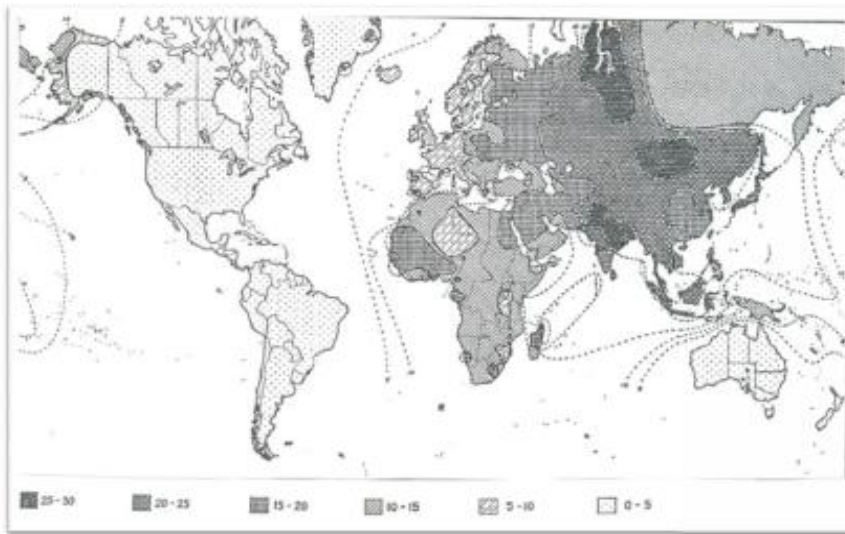


Fig. 4: Geographical distribution of blood group B, percentage (Mourant 1958)

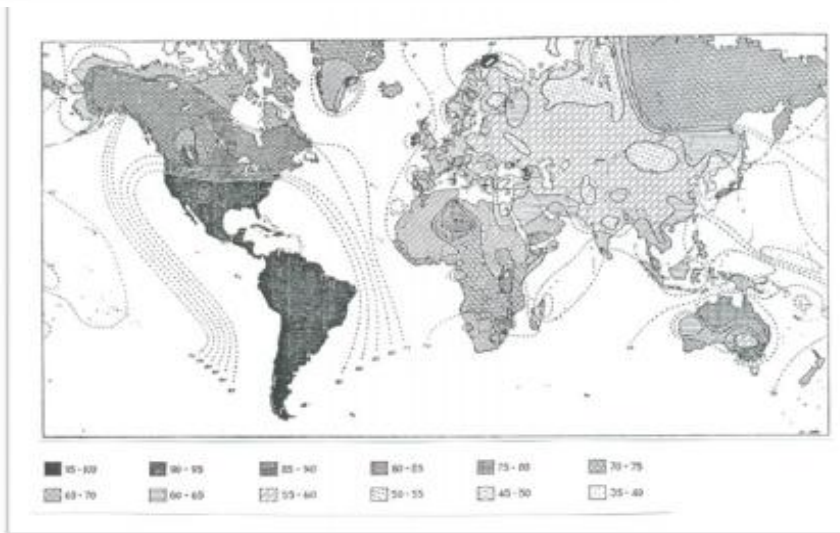


Fig. 5: Geographical distribution of blood group O, percentage (Mourant 1958)

Table 2: Major blood groups, year of report, discoverer/s

Blood Group	Year	Reporter (s)	Reference
ABO –System	1901	Landsteiner K	(5)
M/N –System	1927	Landsteiner K , Levine P	(6)
P – System	1927	Landsteiner K , Levine P	(7)
Secretor /Non –(ss)	1932	Schiff F , Sasaki H	(8)
Factor Q	1935	Imamuras S	(9)
Rhesus (Rh)	1940/41	Landsteiner K , Wiener A	(10, 11)
Lutheran (Lu)	1945	Callenders S , Race RR , Paykoc Z	(12)
Lewis (Le)	1946	Mourant AE	(13)
Kell (K)	1946	Coombs RRA , Mourant AE, Race RR	(14)
Factor S/s	1947	Walsh RJ , Montgomery C	(15)
Duffy (FY)	1950	Cutbush M , Mollison PL	(16)
Kidd (Jk)	1951	Race RR et al.	(17)
Diago (Di)	1954	Levine P et al.	(18)
Yt System	1956	Eaton BR et al.	(19)
Auberger (AU)	1961	Salmon C et al.	(20)
Xg	1962	Mann JD et al.	(21)
Dombrock (Do)	1965	Swanson J et al.	(22)

Karl Landsteiner was born on 14th June 1868, in Vienna, Austria; he died on 26th June 1943 AD, at 75 years old, in the United States.

Landsteiner in his 17th scientific paper in 1901 reported blood group ABO which was displayed at the beginning with the letters ABC. In 1930, he received the Nobel Prize in Medicine for his discovery.

In addition to the known blood groups (Table 2), nearly twenty public antigens and also sixty-specific antigen or family antigen (Private Antigens) have been reported (3).

Moreover, the main blood groups ABO, gradually discovered and reported (3) which the most notably of them are as follows:

- 1) A subgroups, including A1, A2, A3, and also rare types A4, A5, A6, Z, X, End, boutu, g, i.
- 2) B subgroups, including B1, B2, B3, and rare types w, x, v, m.
- 3) Subgroups, including O1, O2, O3, and other types such as Yy, Hh, Xx, and Bombay.

Blood groups in Iran

In a compilation by Mourant in 1958 (4), referring to a limited and small sampling from Iran (Tehran) by A.Ajir was seen, but there was no systematic and comprehensive research about types and frequencies of blood groups, serum proteins, and red blood cell enzymes, found in Iran.

The first report about the frequency of Lutheran blood group in Iran was published in 1979 (23). After a long study and targeted collection, detailed reports of the frequency of ABO blood groups in different Iranian ethnic groups was released (24). In another study, the frequency of blood groups, serum proteins and red cells enzymes in various Iranian populations were reported (25). Furthermore, a collection of valuable and extensive cooperation with Iran Blood Transfusion Organization, different types of blood groups in various population of Iran, was reported. This report included the study of ABO and Rh blood groups phenotype and genotype frequencies among 291857 individuals and their geographical spread in different provinces of Iran (26). In this

report, in addition to the ABO blood groups and Rh, genotype and phenotype frequencies of rare blood groups, including Kell (n=5522), Daffy (n=3764), Kidd (n=3650), Lutheran (n=3199), Kp (n=1489), Xg (n=3227), were also presented (26). Since over 20-30 years have passed from that sampling in different provinces of Iran, population displacement, and various environmental factors, diseases, immigration, exogamous marriages within different ethnic groups, no doubt that provincial prevalence of blood groups distribution, at this time has changed, too. However, over time, case reports and local frequencies of blood groups in different regions of Iran, were prepared and published, including ABO and Rh blood groups report in population of Larestan and Lamerd , Fars (27).

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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The authors declare that there is no conflict of interest.

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