Original Article

The Rh allele frequencies in Gaza city in Palestine

Younis Abed EL-Wahhab Skaik

Department of Laboratory Medicine, Faculty of Applied Medical Sciences, Al-Azhar University-Gaza, PO Box (1277), Gaza, Palestine

Abstract:

Background: The Rh blood group system is the second most clinically significant blood group system. It includes 49 antigens, but only five (D, C, E, c and e) are the most routinely identified due to their unique relation to hemolytic disease of the newborn (HDN) and transfusion reactions. Frequency of the Rh alleles showed variation, with regard to race and ethnic. **Objectives:** The purpose of the study was to document the Rh alleles' frequencies amongst males (M) and females (F) in Gaza city in Palestine. **Materials and Methods:** Two hundred and thirty-two blood samples (110 M and 122 F) were tested against monoclonal IgM anti-C,anti-c, anti-E, anti-e and a blend of monoclonal/polyclonal IgM/IgG anti-D. The expected Rh phenotypes were calculated using gene counting method. **Results:** The most frequent Rh antigen in the total sample was e, while the least frequent was E.The order of the combined Rh allele frequencies in both M and F was CDe > cDe > cde > CdE > cDE > Cde > CDE. A significant difference was reported between M and F regarding the phenotypic frequencies ($P < 0.05$). However, no significance ($P > 0.05$) was reported with reference to the observed and expected Rh phenotypic frequencies in either M or F students. **Conclusion:** It was concluded that the Rh antigens, alleles and phenotypes in Gaza city have unique frequencies, which may be of importance to the Blood Transfusion Center in Gaza city and anthropology.

Key words:

Rh allele frequency, Rh antigens, Rh frequency, Rh phenotypes, Rh system

Access this article online

Website: www.ajts.org

DOI: 10.4103/0973-6247.83241

Quick Response Code:

Correspondence to:
Dr. Younis A. Skaik,
16/46 Omar Al-Mokhtar Street, AL-Rimal, Gaza, Palestine.
E-mail: y_skaik@hotmail.com

Introduction

Red blood cells (RBCs) are not only vehicles of oxygen but also carriers of more than 600 antigens,[1] which have been classified into 29 blood group systems.[2] However, the Rh system still gains the second most clinically significant blood group system after the ABO system. The year 1940 marks the discovery of the Rh system by Landsteiner and Wiener. To date, the Rh system includes 49 antigens,[3] but only five have been given the 3rd, 4th and 5th letters of the English alphabets (C, D, E, c, e) and are commonly and routinely identified. The Rh system is important because of its proved and unique relation to hemolytic disease of the newborn (HDN) and blood transfusion.[4,5] Unlike the ABO system, the Rh system is genetically more complex, but it is simply described in terms of a single pair of alleles. Traditionally, there are two well-known genetic terminologies to explain the inheritance of these five immunogenic antigens.[6] Cc Dd Ee terms were first described by Fisher and Race. Here, each gene codes was explained for a single antigen production, with the exception of the amorph d gene, as no d antigen or anti-d antibody has been detected. Fisher also postulated the order of the genes on a chromosome as DCE. Second is the Rh/Hr system used by Wiener and his co-workers, who proposed only a single locus that could express multiple antigens. However, modern molecular biology techniques confirmed that production of the five Rh antigens is controlled by two closely linked loci, located at chromosome one.[7] The first locus is designed for the D polypeptide antigen and is called RHD. The second locus, known as RHCE, carries the codominant alleles to attach the RBCs with C/c and E/e antigens. There are two well-documented characteristics of the Rh system. One is the the extensive polymorphism.[8-10] The other one is the difference in the allelic frequency amongst different populations and even among different areas within one country. Such differences are significant in the field of anthropology and legal medicine and also in other branches of science. Up to the present, many reports have documented the Rh allele frequencies amongst Europeans.[2,11-14] However, no study is reported in the literature regarding the population of Palestine and even any of the neighbor Arab countries, with reference to the Rh allele distribution. Therefore, this study was aimed to document the Rh antigens, alleles, observed and expected phenotypic frequencies amongst M and F students in Gaza city in Palestine. In addition, this study may be significant to the anthropologists, who are concerned with exploring the common populations on the basis of the blood group systems.

Materials and Methods

Area of study

The study area was Gaza, which is the largest city in the Gaza Strip in Palestine. Gaza city has an estimated

population of about 496,410 (252,464 M and 243,946 F), according to the recent census preliminary findings.[15]

Sample size

Two hundred and thirty-two blood samples were used (110 M and 122 F). This sample size was close to the calculated sample size of 394 (199 M and 195 F). Therefore, a total of 232 blood samples can be considered somewhat as a representative sample to evaluate the population Rh chromosome frequencies in Gaza city in Palestine.

Sampling and ethical considerations

Four secondary schools (2 F and 2 M) from Gaza city were randomly chosen, and the classes in each selected school were also randomly selected. All students who belong to the Palestinians roots were verbally informed about the aim of the study and they agreed to participate. Students who have ethnic roots other than the Palestinian were excluded. Each participant was advised that s/he will personally receive the result in a card form that could be kept for future blood transfusion or donation.

Subjects and procedures

Over a period of 1 week, a total of 232 students, comprising 122 F (92%) and 110 M (83%), were phenotypically screened for their Rh antigens (D, C, c, E, e). All students were aged between 16 and 18 years.

A 1.0–2.0 ml blood sample was drawn from the antecubital vein of each participant in a tube containing ethylene diamine tetra acetic acid (EDTA). Rh antigens were tested by the classic slide antigen antibody agglutination test. According to the manufacturer's instructions, a drop of EDTA blood was added to a drop of monoclonal IgM anti-C, anti-c, anti-E, anti-e and a blend of monoclonal/polyclonal IgM/IgG anti-D (DiaMed, Cressier s/Morat, Switzerland) on a labeled slide and mixed well. Agglutination results were recorded within 2 minutes. All samples that showed a negative agglutination with anti-D were tested again in the antiglobulin technique for the presence of D^u. As a quality control, both Rh control and Coomb's control cells were used to ensure a highly diagnostic sensitivity and specificity, regarding the Rh (D) detection. In addition, commercial RBCs (rr, r''r, R_1R_1 and R_2R_2) were used with negative antigenic expression of E, C, c and e, respectively.

Statistical analysis

The Rh allele frequencies were calculated using the gene counting method, which was described by Mourant *et al.* in 1976. The observed phenotypic frequencies were compared with the expected frequencies by using Chi-square test (χ^2). In addition, the possible difference in the phenotypic distribution among both M and F was determined using χ^2.

Results

The percentage of D+, D–, C, c, E and e in male and female students is shown in Figure 1. The percentage of D+, D–, C, c, E and e in the total sample was 92%, 8%, 69%, 81%, 38% and 97%, respectively. No positive agglutination results were recorded when Rh (D) negative samples were tested in the antiglobulin test to exclude the presence of D^u. Table 1 shows the frequencies of the Rh alleles with gender distribution. The most prevalent allele frequency in both M and F was CDe (0.763). The cdE haplotype was not identified in both genders. The order of the combined Rh allele frequencies in both M and F can be shown in the general formula CDe > cDe > cde > CdE > cDE > Cde > CDE. The phenotype and the gene frequencies of the Rh blood group system, with the possible genotypes, are shown in Table 2. The observed frequencies fit well with the expected values in both genders ($P > 0.05$ and $P > 0.01$). There was a significant difference in the phenotypic frequencies between M and F ($P < 0.05$). No discrepancies were observed with Rh control, Coomb's control cells or commercial RBCs.

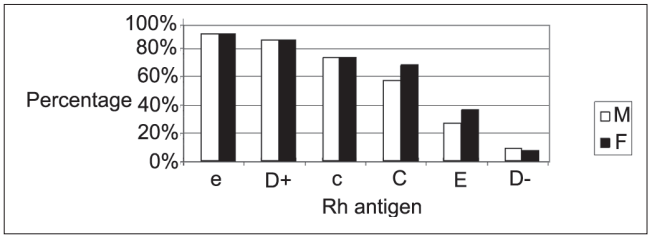

Figure 1: Spectrum of the Rh antigens in male and female students in Gaza city

Table 1: Frequencies of the Rh alleles in both genders

Chromosome frequencies	Gender	
	Male	Female
Cde	0.286	0.091
CdE	0.000	0.315
Cde	0.015	0.045
cdE	0.000	0.000
CDe	0.411	0.352
cDE	0.165	0.091
CDE	0.021	0.021
cDe	0.107	0.304

Table 2: The observed and expected Rh frequencies with the possible genotypes in Male and Female

Phenotype	Possible genotypes	Female			Male		
		Observed		Expected	Observed		Expected freq.
		No.	Freq.		No.	Freq.	
CCDee	DCe/dCe, DCe/DCe	19	0.1557	0.1555	20	0.1818	0.1812
CCDEe	DCE/dCe, DCE/DCe, DCe/DCE, dCE/DCe	2	0.0164	0.0158	2	0.0182	0.0178
CCDEE	DCE/DCE, DCE/dCE,	1	0.0082	0.0004	1	0.0091	0.0004
CcDEe	DCE/dce, DCE/Dce, DCe/dcE, dCE/Dce, DcE/DCe	27	0.2213	0.0165	9	0.0818	0.0165
CcDEE	DCE/dcE, DCE/DcE, DcE/dCE, DcE/DCE	1	0.0082	0.0038	0	0.0000	0.0069
CcDee	DCe/dce, DCe/Dce, Dce/dCe, Dce/DCe	32	0.2623	0.2780	36	0.3273	0.3230
ccDEe	cDE/cde, cDE/cDe, cDe/cdE, cDe/cDE	12	0.0984	0.0718	21	0.1909	0.1296
ccDEE	cDE/cdE, cDE/cDE	1	0.0082	0.0082	3	0.0273	0.0272
ccDee	cDe/cde, cDe/cDe	18	0.1475	0.0635	8	0.0727	0.1430
Ccdee	Cde/cde	1	0.0082	0.0081	1	0.0082	0.0085
CcdEe	CdE/cde, cdE/Cde	7	0.0574	0.0573	0	0.0000	0.0000
ccdee	cde/cde	1	0.0082	0.0082	9	0.0818	0.0817

Discussion

A wide spectrum of blood group systems (29) has been discovered till date.[2] However, the Rh system is still considered the second most clinically significant blood group system, next to the ABO system.[4,5] To the best of the author's knowledge, there is no published work in the literature, regarding the Rh allele and phenotypic frequencies in Palestine. Therefore, this study was undertaken to document the frequencies of the Rh antigens, alleles and phenotypes in the population of Gaza city in the Gaza Strip in Palestine. The frequency of the Rh antigens in the total sample can be shown as e > D+ > c > C > E > D– [Figure 1]. In the present study, the antigens e, c and C have almost identical frequencies compared to the English population. The e antigen has the highest prevalence. It is observed in especially in English, Nigerian and Chinese populations. Similar findings were observed in this study. However, Palestinians in Gaza city have a higher frequency of antigen E than the English and Nigerian populations, but is the same as in Chinese. In addition, frequency of antigen C in the present study was found to be higher than the frequency in Nigerians which was lower than the frequency in Chinese. However, it was not true regarding antigen c frequency.[2] The most frequent Rh allele amongst the Palestinian students (M and F) was CDe (0.763). This is in agreement with the German, English and Chinese populations, but not with the Nigerian population where Dce is the highest. The least frequent Rh allele in the present study population, and in Germans, English, Nigerian and Chinese was CDE.[2,13] The F/M ratios of the cDe and Cde allele frequencies were 3/1 and 4/1, respectively, while the M/F ratios of the cde, Cde, cDE and CDE alleles were 3/1, 1/1, 2/1 and 1/1, respectively. As people do live in a conflict area due to the Israeli–Palestinian conflicts, continuous blood donation is needed blood donation from local population is the only source. Therefore, the F/M ratio findings could be of great importance to the blood transfusion centers in Gaza city, as the females with highly frequent chromosomes can be a source of life saving to males, where such chromosome frequencies are rare. Hence, all females were educated well to record their full names and addresses and to donate their blood at the major blood bank centers. It is to be noted that the observed and expected frequencies of the Rh phenotype (CcDee) in the present study were similar to those previously reported by other workers in Germany.[13] However, frequency of the CcDee phenotype amongst Amis, Japanese, Vietnamese, Sudanese, Lepchas and Khasis was lower than that of the Palestinians in the present study.[16-19]

In conclusion, the Rh antigens, alleles and phenotype frequencies in the population of Gaza city in the Gaza Strip in Palestine are different from those that were previously reported among the populations of Asian, African or European countries. These differences may be of importance to the anthropologists, who are concerned with exploring the common populations on the basis of the blood groups, and also in forensic medicine. In addition, this study provides the local Blood Transfusion Center in Gaza city with the Rh blood types and frequencies that may play a role in the blood transfusion problems.

Acknowledgments

I would like to thank the schools' managers for their understanding to enable me to carry out this important study. I would also like to thank my wife Rania Samy Skaik for her generous assistance in writing and formatting this paper. In addition, I would like to thank those who helped me to collect the blood samples.

References

1. Overfield J, Dawson M, Hamer D. Other blood group systems. In: Pallister CJ, editor. Transfusion Science. 1st ed. Oxford: Scion Publishing Ltd; 1999. p. 87.
2. Daniels G, Bromilow I. An introduction to blood groups. In: Khan M, Seward J, Dodds E, Charman K, editors. Essential Guide to Blood Groups. 1st ed. Oxford: Blackwell Publishing Ltd; 2007. p. 4-44.
3. Daniels G, Fletcher A, Garratty G, Henry S, Jørgensen J, Judd WJ, *et al.* Blood group terminology 2004: From the International Society of Blood Transfusion committee on terminology for red cell surface antigens. Vox Sang 2004;87:304-16.
4. Daniels G, Poole J, de Silva M, Callaghan T, MacLennan S, Smith N. The clinical significance of blood group antibodies. Transfus Med 2002;12:287-95.
5. Garratty G. Evaluating the clinical significance of blood group alloantibodies that are causing problems in pretransfusion testing. Vox Sang 1998;74:285-90.
6. Mollison PL, Engelfriet CP, Contreras M. Blood Transfusion in Clinical Medicine. Oxford: Blackwell Scientific Publications; 2005.
7. Avent N, Reid M. The Rh blood group system: A review. Blood 2000;95:375-87.
8. Huang CH. Molecular insights into the Rh protein family and associated antigens. Curr Opin Hematol 1997;4:94-103.
9. Cartron JP, Bailly P, Le Van Kim C. Insights into the structure and function of membrane polypeptides carrying blood group antigens. Vox Sang 1998;74(Suppl 2):29-64.
10. Flegel WA, Wagner FF, Müller TH, Gassner C. Rh phenotype prediction by DNA typing and its application to practice. Transfus Med 1998;8:281-302.
11. Race RR, Mourant AE, Lawlwer SD, Sanger R. The Rh chromosome frequencies in England. Blood 1948;3:689-95.
12. Gershowitz H, Layrisse M, Layrisse Z, Neel J, Brewer C, Chagnon N, *et al.* Gene frequencies and microdifferentiation among the Makiritare Indians. I. Eleven blood group systems and the ABH-Le secretor traits: A note on Rh gene frequency determinations. Am J Hum Genet 1970;22:515-25.
13. Wagner FF, Kasulke D, Kerowgan M, Flegel WA. Frequencies of the blood groups ABO, Rhesus, D category VI, Kell, and of clinically relevant high-frequency antigens in South-Western Germany. Infusionsther Transfusionsmed 1995;22:285-90.
14. Palestinian Central Bureau of Statistics. The Population, housing and establishment census, press conference on the preliminary findings, (population, buildings, housing units and establishments), Ramallah, Palestine; 2007.
15. Mourant AE, Kipec AC, Domaniewska-Sobezak K. The Distribution of Human Blood Groups and Other Polymorphysims. London: Oxford University Press; 1976.
16. Ikemoto S, Ming CT, Haruyama N, Furuhata T. Blood group frequencies in the Ami Tribe (Formosa). Proc Jpn Acad 1966;42:173-7.
17. Ikemoto S, Watanabe S, Ogawa R, Furuhata T. Frequencies of blood groups among Vietnamese. Proc Jpn Acad 1966;42:975-9.
18. Miki T, Tanaka T, Furuhata T. On the distribution of the MN, Q and Rh blood types of the Lepchas and the Khasis. Proc Jpn Acad 1960;36:168-71.
19. Roberts DF, Ikin EW, Mourant AE. Blood groups of the northern Nilotes. Ann Hum Genet 1955;20:135-54.

Cite this article as: Skaik YA. The Rh allele frequencies in Gaza city in Palestine. Asian J Transfus Sci 2011;5:150-2.

Source of Support: Nil, **Conflict of Interest:** None declared.