

Distribution of Kell, Duffy and Kidd Blood Group Genetic Markers in Random Tamil Population

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Özet

Rastlantısal Seçilmiş Bir Tamil Popülasyonunda, Kell, Duffy, Kidd Kan Grubu Genetik Marker'larının Dağılımı

Kell, Duffy ve Kidd kan grubu genetik marker'larının dağılımı ilk kez, adli-tıbbi amaçlı nesep incelemeleri için rastlantısal olarak seçilmiş bir Tamil popülasyonunda araştırıldı. Kan grubu, serum proteinleri, eritrosit enzimleri vb. serolojik faktörlere dayanan babalık tayini incelemeleri, doyurucu yanıt almak için matematiksel yöntemlerle olasılık hesaplarını gerektirir. Olasılığın hesaplanabilmesi, karşılaştırılan genetik varyantların gen frekanslarının veya genotipinin doğru olarak bilinmesine bağlıdır. Bu bağlamda, yapılan çalışma, bir Tamil popülasyonunda, Kell, Duffy ve Kidd kan grubu sistemlerinin gen frekanslarını ilk defa bilgisayar yardımıyla değerlendirmekte ve adli-tıbbi amaçlı babalık tayininde güçlü bir yöntem sağlamaktadır.

Anahtar Kelimeler: Alleller, frekans, gen, fenotip, eritrosit antijenleri, Tamiller.

Summary

Distribution of Kell, Duffy and Kidd blood group genetic markers was studied for the first time in the random Tamil population for application in forensic paternity test cases. Parentage test based on serological characteristics such as blood groups, serum proteins, red cell enzymes etc., involve mathematical probabilities to ascertain the likelihood of the probability for conclusive answer. The calculation of probability depends on accurate knowledge of the phenotype or gene frequencies of the genetic variants being compared. In this context the present study computing gene frequencies for the first time for the Kell, Duffy and Kidd blood group systems in Tamil population will provide a powerful tool in forensic kinship testing.

Key Words: Alleles, frequency, gene, phenotype, red cell antigen, Tamils.

Introduction

More is known about the red cell antigens than other genetic markers, which is the result of systematic evaluation and documentation of these antigens by various authors (1-44). Well documented data are available for various major population groups of the world including the population groups of the Indian subcontinent for the distribution of ABO, Rh, MN blood group genetic markers (4-7,12,13,19-26,29-44). In contrast though there is extensive data on the distribution of Kell, Duffy, Kidd, Lutheran, P, etc., blood group genetic markers available for Whites, Negroes and Japanese populations (1,2,4,8,13,20,27-32,34-43), there is very little data in the literature for the various population groups in India (3,44) and particularly there is no study so far undertaken on the distribution of Kell, Duffy and

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Kidd blood group antigens in the Tamil population. Since the red cell blood group markers are mostly genetically determined in a codominant fashion and inherited in a simple Mendelian way (1,2-6) and can be resolved into phenotypes, they are widely applied in forensic problems and more specifically for paternity testing. In this context the present study to compute the gene frequencies for these antigens in the Tamilnadu population assumes importance.

Materials and Methods

138 apparently normal, healthy individuals of the Tamil ethnic population were blood typed for Kell, Duffy and Kidd codominant two allelic genetic markers following the modified indirect antiglobulin test described by Coomb's et al (45). The principle of the method is as follows: The red cells (3-5%) suspension in LISS to be tested is allowed to react with appropriate serum and incubated for 60' at 37°C. If they carry the appropriate antigen they become coated with the incomplete antibody which is a globulin G. The cells are washed several times and allowed to react with an antiglobulin G serum prepared in rabbits. If the red cells are coated with globulin, agglutination takes place (indirect antiglobulin G test). The validity of the negative test reactions were confirmed by checking with IgG sensitised cells.

Results

The phenotypes on blood typing of the 138 individuals for Kell, Duffy and Kidd blood group systems were recorded and the phenotypes frequencies for each system were ascertained and the gene frequencies for the three blood group systems were estimated by the widely used method of maximum likelihood (46). The method of maximum likelihood for estimating gene frequencies for two allelic (p1 and p2) codominant system is

$$p1 = (2x + y/2N) \text{ and}$$

$$p2 = 1 - p1$$

where 'x' symbolises the number of homozygous type, 'y' symbolises the number of heterozygous type and the 'N' is the total number of individuals analysed. Gene frequencies were computed and Chi-square test was also performed to assess the randomness of the population taken for study. The phenotype/gene frequencies for Kell, Duffy and Kidd blood group systems are given in the Table 1. Incidentally the gene frequencies ascertained for the three blood group systems were compared with the gene frequencies of the various population groups as reported in the literature (2-4,8,13,20,27-32,34-44).

Table 1. Distribution of gene frequencies of Kell, Duffy and Kidd blood group genetic

Kell			Duffy			Kidd		
Phenotype	Observed	Expected	Phenotype	Observed	Expected	Phenotype	Observed	Expected
K+k-	0	0	Fy ^a +Fy ^b -	42	40	Jk ^a +Jk ^b -	32	30
K+k+	8	15	Fy ^a +Fy ^b +	61	67	Jk ^a +Jk ^b +	69	68
K-k+	130	123	Fy ^a -Fy ^b +	33	31	Jk ^a -Jk ^b +	47	40
			Fy ^a -Fy ^b -	2	0			
Gene frequency:			Gene frequency:			Gene frequency:		
K=0.058			Fy ^a =0.5254			Jk ^a =0.4638		
k=0.942			Fy ^b =0.4601			Jk ^b =0.5362		
X ² (d.f.2) =3.6649			X ² (d.f.3) =0.7662			X ² (d.f.2) =0.3492		
P>0.05			P>0.05			P>0.05		

markers in random Tamil population (N=138).

Discussion

The expansion of informations on the various blood group systems dating back to Landsteiner's discovery of ABO blood group system helped to estab-

lish systematic compilation of population characteristics of the blood group systems and which were routinely applied in forensic science for parentage test cases (17,47,48) and for medical prognostics (49-53).

Recent studies with advanced tools in molecular biology elucidated the molecular characterisation of the blood group antigens and their physiological role. Kell antigen is classified in the neprilysin family of endopeptidases and resides on a 93-kDa membrane glycoprotein (54-57) in association with XK (58), a transporter protein. Duffy antigens appear to be multimeric erythrocyte-membrane proteins composed of different subunits and the red cell component that carries Duffy antigen is a 35 to 43-kDa protein (50,51,55,59,60). Kidd antigen is encoded by the locus UT11 and is a 36-kDa protein and is related to transporter of urea in red cells (52,53,61,62).

These blood group systems of forensic importance are codominant alleles and this greatly simplifies the detection of heterozygotes by serological techniques. The evaluation of the inherited characteristic of a parent to his/her progeny termed a phenotype is dependent on the information contained in the antigen typing and the parentage testing is closely related to the behaviour of the genes in population.

The most useful device to determine the behaviour of the genes is derived by mathematical analysis of gene frequencies. The gene frequencies computed in the present study for Kell, Duffy and Kidd using maximum likelihood method is given in the Table 1 (present study). No significant deviation from the Hardy-Weinberg expectation was observed (Table 1). All the three blood group systems showed extremely good fit to the theoretical frequencies which reinforces the assumption that the Kell, Duffy and Kidd blood group systems in the present study are in Hardy-Weinberg equilibrium (Table 1).

Intergroup comparisons for the various population groups in India could not be made for want of well documented phenotype/gene frequency data. However the gene frequencies for the three blood group systems in the present study (Table 1) were compared with the gene frequencies of the various other population groups of the world as reported in the literature by various authors (1,2,4,5,8,13,20,27-32,34-44).

In the Tamil population (present study) the percentage frequencies of K (Kell) gene (5.8% Table 1) and the k (cellano) gene (94.2%) are close to the distribution of Kell antigens in the populations of European countries (Russians, French, Swedish, English) (4,20,31,32,35,37,41,43). In contrast in the near Asian population groups (the Japanese, Chinese and Malaysian populations) the K (Kell) gene frequency is nil (4,42). The low incidence gene in the Kell system is K (Kell), which ranges from 0% to 12% in the various populations of the world (4,20,31,35,37,41-43). In the Chenchu tribe an endogamous population living in Andhrapradesh in India, an adjacent territory to the geographical location of Tamilnadu population, exhibits the highest incidence of K (Kell) gene frequency (12.5%) than any other populations of the world (4).

The Duffy blood group system exhibit three antigens Fy^a , Fy^b and Fy^- . The distribution of these antigens in the Tamil population is 52.54%; 46.87% and 1.45% respectively (Table 1). The Fy^a frequency in the white populations of Europe ranges from 73% to 78% (4,20,30,31,37,41). The Fy^a incidence in the Black population is very less (11.1%) (20). The Fy^- gene frequency ranges from 1.45% to 9% in the various populations except the Black population in which it is the predominant gene frequency (75.3%) (20).

The Kidd gene frequencies Jk^a and Jk^b in the Tamil population is 46.78% and 53.62% (Table 1). In the populations of the European countries (4,20,31,37,39) the frequency distribution of these alleles is around 50%. However Jka is the most frequent gene in American

Negroes (92%) and Dajaks (100%) (4). The observation of variations in the gene frequencies in the various populations for the blood group genetic markers by various researchers reinforces the view that the distribution of gene frequencies is population specific (4,20,23,47,48).

Conclusion

The distribution of Kell, Duffy and Kidd blood group genetic markers are population specific though there is nearness in distribution among the population groups in a race. The evaluation of distribution of gene frequency for a particular genetic marker is a prerequisite for application in paternity test cases. Considering the essentialness of computation of gene frequency for paternity testing, the present study on the distribution of Kell, Duffy and Kidd genetic markers in the random Tamil population of Tamilnadu is highly significant.

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