

The Frequency of Kell Red Cell Antigens (K,k) Among The Major Sudanese Tribes

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ABSTRACT: Objective: to determine the frequency of Kell-1 and Kell-2 and their gene frequencies in the Sudanese population. Design: This study was carried out on 500 samples in five major Sudanese tribes. Each sample was tested for Kell-1 and Kell-2 by indirect coombs' test using anti Kell-1 and Kell-2 antisera. Setting: AL-Neelain University – College of Medical Laboratory Sciences – Sudan – Khartoum. Results: The frequency of Kell-1 among the tribes was found to be 5.6% while that of Kell-2 was found to be 99.6%. Gene frequencies of Kell-1 and Kell-2 were found to be 0.03 and 0.97 respectively. Conclusions: The frequency of Kell-1 is 5.6% and its gene frequency is 0.03 while the positivity of Kell-2 is 99.6% and its gene frequency is 0.97.

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Introduction:

Kell glycoprotein appears on erythroid progenitor cells at an early stage of erythropoiesis⁽¹⁾.

Kell is one of the major blood group systems on human erythrocytes. It is a complex system containing large number of antigens⁽²⁾. Coombs et al⁽³⁾ and Race⁽⁴⁾ reported the first case of anti-K in 1946 while Levine et al⁽⁵⁾ discovered anti-K three years later. Presently 21 antigens are accepted to be associated with this system of blood group in Man. Kell-1 (K) which is present in 9% of the population of U.S.A. is antithetical to the high prevalence Kell-2 (k) antigen⁽⁶⁾. Besides these 21 antigens, two other antigens TOU⁽⁷⁾ and RAZ⁽⁸⁾ are believed to belong to this blood group system. Kell gene is carried on chromosome 7 and is located at 7q33. Kell transcripts are only present in fetal liver and bone marrow⁽⁹⁾.

Antibodies of Kell blood group system are immune in nature and belong to the IgG class of immunoglobulins. These antibodies can cause severe reactions if incompatible blood is transfused. They may also cause haemolytic disease of the newborn. Determination of Kell-1 and Kell-2 genotype using DNA-based method provides accurate and timely information that can aid the prenatal care of women sensitized to Kell antigens⁽¹⁰⁾.

Material and Methods:

This study was carried out on 500 random samples collected from different laboratories and blood banks in Khartoum Sudan. Each sample was tested for Kell-1 and Kell-2 antigens by indirect coombs' test. Red cells were washed with normal saline three times and 5% suspension was prepared. One drop each of anti-Kell-1 or anti-Kell-2 was added to three drops of cell suspension and incubated at 37°C for 30 minutes. After incubation the suspension was washed with normal saline three times. One drop of coombs' reagent was added and incubated at 37°C for one minute and observed for agglutination macroscopically and microscopically. A batch of 20 samples was run at a time, positive and negative controls were run with each batch.

Results:

Frequency for Kell-1 in Sudanese population is found to be 5.6% the gene frequency being 0.03. Percent positivity for Kell-2 is 99.6% and the gene frequency is 0.97. Positivity for KK genotype is 0.4% and its frequency is 0.0009. Percent positivity for Kk is found to be 5.2% and its gene frequency being 0.058. Percent positivity for kk is determined as 94.4% and its gene frequency is 0.941. K null genotype was encountered in 1.53% of the samples with the gene frequency of 0.00052.

Table (1): Incidence of Kell-1(K) among the tribes:

tribe	Frequency in the tribe	Frequency within total Kell-1 positive	Gene frequency
Shaigia	4.0%	14.3%	0.02
Dinka	6.0%	21.4%	0.035
Gaalien	6.0%	21.4%	0.03
Bani-amer	7.0%	25.0%	0.04
Nuba	5.0%	17.8%	0.025

Table (2): Incidence of Kell-2 (k) among the tribes:

tribe	Frequency in the tribe	Frequency within total Kell-2 positive	Gene frequency
Shaigia	100%	20.1%	0.98
Dinka	99%	19.9%	0.965
Gaalien	100%	20.1%	0.97
Bani-amer	99%	19.9%	0.96
Nuba	100%	20.1%	0.98

Table (3): Distribution of phenotypes among the tribes:

Phenotype	Genotype	Tribe frequency	Phenotype gene frequency
K-k+	kk	94.4%	0.941
K+k+	Kk	5.2%	0.058
K+k-	KK	0.4%	0.0009

Table (4): Relationship between the phenotypes frequency and its gene frequency in the tribes:

Tribe	Approximate tribe frequency	Phenotype frequency		
		K-k+	K+k+	K+k-
Shaigia	Frequency within tribe	96%	4%	-
	Frequency within the whole phenotype	20.3%	14.3%	-
	Gene frequency	0.960	0.039	0.0004
Dinka	Frequency within tribe	94.0%	5%	1%
	Frequency within the whole phenotype	19.9%	17.8%	50%
	Gene frequency	0.931	0.067	0.0012
Gaalien	Frequency within tribe	94.0%	6.0%	-
	Frequency within the whole phenotype	19.9%	21.4%	-
	Gene frequency	0.941	0.058	0.0009
Bani amer	Frequency within tribe	93.0%	6%	1.0%
	Frequency within the whole phenotype	19.7%	21.4%	50.0%
	Gene frequency	0.922	0.077	0.0016
Nuba	Frequency within tribe	95.0%	5.0%	-
	Frequency within the whole phenotype	20.1%	17.8%	-
	Gene frequency	0.960	0.049	0.0006

Table (5): Comparative positivity analysis of Kell-1 in Sudanese and other countries:

Population	No. of samples tested	Positive	Gene frequency
Sudanese	500	5.6%	0.03
Pakistani	15.500	4.6%	0.024
Japanese	14.541	0.02%	0.0001
US Blacks	4.079	1.50%	0.0075
Finns	5.000	4.10%	0.0207
Parisians	81.962	8.55%	0.0437
Norwegian countries	15.426	8.28%	Not stated
English	9.875	9.02%	0.0462
Arabian	Not stated	25.0%	0.14

Table (6): Comparative positivity analysis of Kell-2 in Sudanese and other countries:

Population	No. of samples tested	Positive	Gene frequency
Sudanese	500	99.6%	0.97
Pakistani	15.500	93.8%	0.976
English	10.000	90.98%	0.9538

Discussion:

Percent positivity for Kell-1 in the Sudanese population lies some where between the values found in the American (blacks) and Algeria. Among the studies carried out in other countries, Kell-1 has demonstrated its highest incidence in the Arabs i.e. 25% and least in the Japanese i.e., 0.0001.

Percent positivity for Kell-2 in the Sudanese population was compared with that in the English population and the study shows no significant difference in the values from these two racially diverse populations. Similar studies from other countries have not been reported.

Antibodies in the Kell blood group system are always immune antibodies of IgG type; no naturally occurring antibodies have so far been reported. These are produced as a result of pregnancy or repeated blood transfusions. This implies that the population at risk of developing Kell associated immune hemolysis comprises of patients who are obliged to receive repeated blood transfusions i.e., patients with aplastic anemias, congenital hemolytic anemias and acquired hemolytic anemias of immunological and non-immunological origin. The other group of individual to produce immune antibodies is women who conceive; the incidence of Kell sensitization increasing with each Kell –incompatible pregnancy.

Since hemolytic transfusion reactions due to Kell incompatibility are of significant magnitude and the hemolytic disease in the babies born to Kell sensitized mothers can be of serious import, it is suggested that:

a- Multiple transfused patients must be screened for the presence of anti-Kell antibodies. Presence of these antibodies shall make it mandatory to genotype all prospective donors selected for these patients; only those donors are to be accepted who lack the corresponding Kell antigen.

b- In women with the history of multiple pregnancies, repeated miscarriages and hemolytic disease of the newborn not due to feto-maternal Rh incompatibility, Kell blood group mismatch must be considered as a likely cause of these episodes.

c- prior screening for anti-Kell antibodies of the Kell negative expectant mothers is mandatory for timely intervention in the event that the newborn manifests hemolytic disease. Under these circumstances it will be mandatory to use Kell negative blood for exchange transfusion.

d- Genotyping for Kell genes and screening for anti Kell antibodies in the general population is not recommended for two reasons; firstly the antibodies are always immune and only those individuals who receive repeated blood transfusions or multi-gravida with the history of HDNB are at risk of developing them. Secondly Kell-1 gene is a comparatively low frequency gene, hence chances of a Kell-1 negative person receiving Kell-1 positive blood are relatively small. Also the cost of routine screening does not justify the expected benefits. It is therefore recommended that:

i- All multigravida females with a history of HDNB should be screened for anti Kell antibodies.

ii- All multitransfused patients should be screened for anti Kell antibodies.

iii- All units of blood to be transfused to Kell-1 sensitized patients must be Kell genotyped.

These recommendations shall ensure effective prevention of Kell associated hemolytic reactions at an acceptable expense and render Kell genotype and screen practicable and cost effective.

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