Ok Blood Group System

Number of antigens 3

High prevalence	Ok[a], OKGV, OKVM

Terminology

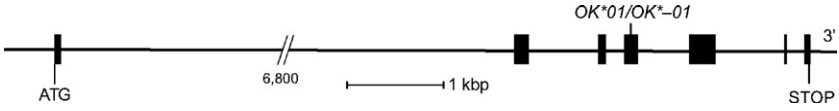
ISBT symbol (number)	OK (024)
CD number	CD147
History	The Ok[a] antigen achieved system status, becoming the OK system in 1998 when the antigen was found to be located on CD147.

Expression

Other blood cells	White blood cells, platelets
Tissues	Epithelium in kidney cortex and medullary, liver, acinar cells of pancreas, trachea, cervix, testes, colon, skin, smooth muscle, neural cells, forebrain, cerebellum[1–3]

Gene

Chromosome	19p13.3
Name	*OK* (*BSG, EMPRIN*)
Organization	7 exons distributed over 1.8 kbp of gDNA
Product	CD147 glycoprotein (OK glycoprotein; basigin, EMMPRIN[4]; M6 leukocyte activation antigen)



The Blood Group Antigen (3/e). DOI: http://dx.doi.org/10.1016/B978-0-12-415849-8.00026-0

Database accession numbers

GenBank	L10240 (mRNA); NM_001728 (mRNA); AY942196 (gene)
Entrez Gene ID	682

Molecular bases of Ok phenotypes

The reference allele, *OK*01* or *OK*A* (Accession number AY942196), encodes Ok[a] (OK1), OK2, and OK3. Nucleotide differences from this reference allele, and the amino acids affected, are given.

Allele encodes	Allele name	Exon	Nucleotide	Amino acid	Ethnicity (prevalence)
Ok(a–) or OK:–1	*OK*–01*	4	274G>A	Glu92Lys	Japanese (Rare)
OKGV– or OK:–2	*OK*–02*	2	176G>T	Gly59Val	(Rare)
OKVM– or OK:–3	*OK*–03*	2	178G>A	Val60Met	(Rare)

Amino acid sequence[5]

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MAAALFVLLG  FALLGTHGAS  GAAGTVFTTV  EDLGSKILLT  CSLNDSATEV   50
TGHRWLKGGV  VLKEDALPGQ  KTEFKVDSDD  QWGEYSCVFL  PEPMGTANIQ  100
LHGPPRVKAV  KSSEHINEGE  TAMLVCKSES  VPPVTDWAWY  KITDSEDKAL  150
MNGSESRFFV  SSSQGRSELH  IENLNMEADP  GQYRCNGTSS  KGSDQAIITL  200
RVRSHLAALW  PFLGIVAEVL  VLVTIIFIYE  KRRKPEDVLD  DDDAGSAPLK  250
SSGQHQNDKG  KNVRQRNSS                                     269
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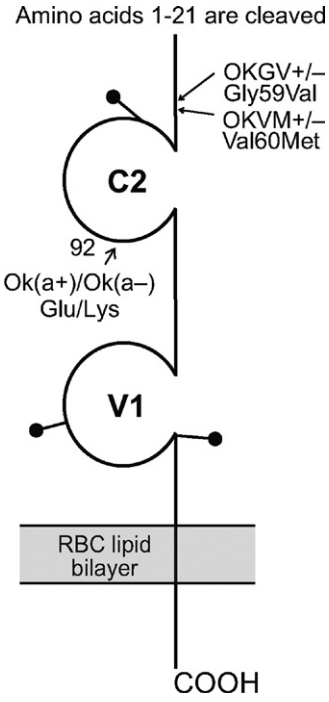
OK encodes a leader sequence of 21 amino acids.

Carrier molecule[1,3]

Single pass type I membrane glycoprotein with two IgSF domains.



M_r (SDS-PAGE)	35,000–69,000
CHO: N-glycan	3
Cysteine residues	4
Copies per RBC	3,000

Function

The protein encoded by this gene is a plasma membrane protein that is important in spermatogenesis, embryo implantation, and neural network formation. Human CD147 (EMMPRIN – extracellular matrix metalloproteinase inducer) on tumor cells is thought to bind to fibroblasts, which stimulates collagenase and other extracellular matrix metalloproteinases, thus enhancing tumor cell invasion and metastases[4,5]. The monocarboxylate (lactate) transporters, MCT1 and MCT4, require CD147 for their correct plasma membrane expression and function[6].

Disease association

Expression is increased on granulocytes in rheumatoid and reactive arthritis; may be involved in tumor metastases. Basigin/CD147 is a receptor essential for erythrocyte invasion by *Plasmodium falciparum*[7].

References

[1] Anstee, D.J., Spring, F.A., 1989. Red cell membrane glycoproteins with a broad tissue distribution. Transfusion Med Rev 3, 13–23.

[2] Spring, F.A., et al., 1997. The Ok^a blood group antigen is a marker for the M6 leukocyte activation antigen, the human homolog of OX-47 antigen, basigin and neurothelin, an immunoglobulin superfamily molecule that is widely expressed in human cells and tissues. Eur J Immunol 27, 891–897.

[3] Williams, B.P., et al., 1988. Biochemical and genetic analysis of the OK^a blood group antigen. Immunogenetics 27, 322–329.

[4] Biswas, C., et al., 1995. The human tumor cell-derived collagenase stimulatory factor (renamed EMMPRIN) is a member of the immunoglobulin superfamily. Cancer Res 55, 434–439.

[5] Barclay, A.N., et al., 1997.. In: Leucocyte Antigen FactsBook, second ed. Academic Press, San Diego, CA.

[6] Wilson, M.C., et al., 2002. Fluorescence resonance energy transfer studies on the interaction between the lactate transporter MCT1 and CD147 provide information on the topology and stoichiometry of the complex *in situ*. J Biol Chem 277, 3666–3672.

[7] Crosnier, et al., 2011. Basigin is a receptor essential for erythrocyte invasion by Plasmodium falciparum. Nature 480 (7378), 534–537.

Ok^a Antigen

Terminology

ISBT symbol (number)	OK1 (024001 or 24.1)
Obsolete names	901006; 900016
History	Named in 1979 after the family name of the patient (S.Ko.G.) whose RBCs lacked the antigen and whose plasma contained the antibody.

Occurrence

All eight Ok(a–) probands are Japanese.

Expression

Cord RBCs	Expressed
Other blood cells	All tested[1,2]
Tissues	All tested[1,2]

Molecular basis associated with Ok^a antigen[3]

Amino acid	Glu92
Nucleotide	G at bp 274 in exon 4
Ok(a–)	Lys92 and A at bp 274

Effect of enzymes and chemicals on Ok^a antigen on intact RBCs

Ficin/Papain	Resistant
Trypsin	Resistant
α-Chymotrypsin	Resistant
DTT 200 mM	Resistant
Acid	Resistant

In vitro characteristics of alloanti-Ok^a

Immunoglobulin class	IgG
Optimal technique	IAT

Clinical significance of alloanti-Ok^a

Transfusion reaction	^{51}Cr cell survival studies indicated reduced RBC survival
HDFN	No

Comments

Anti-Ok^a react variably with OKGV– RBCs.

References

[1] Anstee, D.J., Spring, F.A., 1989. Red cell membrane glycoproteins with a broad tissue distribution. Transfusion Med Rev 3, 13–23.

[2] Williams, B.P., et al., 1988. Biochemical and genetic analysis of the OK^a blood group antigen. Immunogenetics 27, 322–329.

[3] Spring, F.A., et al., 1997. The Ok^a blood group antigen is a marker for the M6 leukocyte activation antigen, the human homolog of OX-47 antigen, basigin and neurothelin, an immunoglobulin superfamily molecule that is widely expressed in human cells and tissues. Eur J Immunol 27, 891–897.

OKGV Antigen

Terminology

ISBT symbol (number)	OK2 (024002 or 24.2)
History	Described in 2003, and named in 2010 from "OK" for the blood group system and "G and V" for the glycine to valine change[1].

Occurrence

One Iranian OKGV– proband.

Molecular basis associated with OKGV antigen[2]

Amino acid	Gly59
Nucleotide	G at bp 176 in exon 2
OKGV–	Val59 and T at bp 176

Effect of enzymes and chemicals on OKGV antigen on intact RBCs

Ficin/Papain	Resistant
Trypsin	Presumed resistant
α-Chymotrypsin	Presumed resistant
DTT 200 mM	Presumed resistant

In vitro characteristics of alloanti-OKGV

Immunoglobulin class	IgG
Optimal technique	IAT

Clinical significance of alloanti-OKGV

No data because only one anti-OKGV has been reported.

Comments

OKGV– RBCs react variably with anti-Ok^a.

References

[1] Storry, J.R., et al., 2011. International society of blood transfusion working party on red cell immunogenetics and blood group terminology: Berlin report. Vox Sang 101, 77–82.

[2] Karamatic Crew, V., et al., 2003. A new variant in the Ok blood group system [abstract]. Transfus Med 13 (Suppl. 1), 32.

OKVM Antigen

Terminology

ISBT symbol (number)	OK3 (024003 or 24.3)
History	Described in 2006, and named in 2010 from "OK" for the blood group system and "V and M" for the valine to methionine change[1].

Occurrence

One Hispanic OKVM– proband.

Molecular basis associated with OKVM antigen[2]

Amino acid	Val60
Nucleotide	G at bp 178 in exon 2
OKVM–	Met60 and A at bp 178

Effect of enzymes and chemicals on OKVM antigen on intact RBCs

Ficin/Papain	Resistant
Trypsin	Presumed resistant
α-Chymotrypsin	Presumed resistant
DTT 200 mM	Presumed resistant

In vitro characteristics of alloanti-OKVM

Immunoglobulin class	IgG
Optimal technique	IAT

Clinical significance of alloanti-OKVM

No data because only one anti-OKVM has been reported.

References

[1] Storry, J.R., et al., 2011. International society of blood transfusion working party on red cell immunogenetics and blood group terminology: Berlin report. Vox Sang 101, 77–82.

[2] Karamatic Crew, V., et al., 2006. A novel variant in the Ok blood group system [abstract]. Transfus Med 16 (Suppl. 1), 41.