Names for RHAG (ISBT 030) Blood Group Alleles

Intro

General description:	The RHAG blood group system consists of three antigens carried on a multipass membrane glycoprotein called RhAG (Rh-associated glycoprotein; aka CD241). It consists of 409 amino acids and both amino and carboxyl termini are predicted to be intracellular. It is predicted to sit in the membrane in a tri-molecular complex with either RhD or RhCE in a 2:1 ratio. (1; PMID 16281947)
Gene name:	*RHAG*
Number of exons: Initiation codon: Stop codon:	10 Within exon 1 Within exon 10
Entrez Gene ID:	6005
LRG: LRG sequence:	LRG_822 NG_011704.1 (genomic) NM_000324.2 (transcript)
Reference allele:	*RHAG*01* (shaded)
Reference allele *RHAG*01* encodes:	RHAG1, RHAG3
Antithetical antigens:	n.a.
Additional information	RHAG3 assigned provisionally. Assignment of null (N) and mod (M) alleles has been made according to the phenotypic expression of RhD and RhCE antigens. † The breakpoints for the deleted *RHAG* allele(s), *RHAG*01N.15* (PMID: 25069376 (25); PMID: 28470789 (26)) have not been determined and are assumed to be the same until proven different. At that time, a new allele number will be assigned to distinguish the alleles from each other.

Phenotype	Allele name	Nucleotide change	Exon Intron	Predicted amino acid change	(Reference No.) PMID	Accession number	rs number
RHAG:1 or Duclos+	*RHAG*01*						
RHAG:−1 or Duclos−	*RHAG*01.−01*	c.316C>G	2	p.Gln106Glu	PMID: 19744193	n.a.	rs1180686517
RHAG:2 or Ol(a+) Variant also weakens RhAG expression (3)	*RHAG*01.02*	c.680C>T	5	p.Ser227Leu	PMID: 19744193 (1), Abstract	n.a.	rs902283342
RHAG:−3,5 or DSLK−, Kg+	*RHAG*01.−03*	c.490A>C	3	p.Lys164Gln	PMID: 19744193 PMID: 32705675	n.a.	rs144305805
RHAG:4	obsolete as of 2018				PMID: 30421425		
RHAG:6 or SHER	*RHAG*01.06*	c.1063A>C	7	p.Asn355His	(11), Abstract	n.a.	rs1187324502
RHAG:7 or THIN	*RHAG*01.07*	c.140T>C	1	p.Phe47Ser	(13), Abstract	OL541903	rs2127360274
Weak phenotypes							
Rhmod	*RHAG*01M.01*	c.1183delA	9	p.Asn395Thrfs*68	PMID: 11961248	n.a.	n.a.
Rhmod	*RHAG*01M.02*	c.3G>T	1	p.Arg2_Met8del	PMID: 9915949	n.a.	rs121918588
Rhmod	*RHAG*01M.03*	c.236G>A	2	p.Ser79Asn	PMID: 8563755	n.a.	rs121918586
Rhmod	*RHAG*01M.04*	c.269G>T	2	p.Gly90Val	(2), Abstract	n.a.	n.a.
Rhmod	*RHAG*01M.05*	c.398T>C	3	p.Leu133Pro	(1), Abstract	n.a.	n.a.
Rhmod	*RHAG*01M.06*	c.560G>A	4	p.Gly187Asp	(2), Abstract	n.a.	n.a.
Rhmod	*RHAG*01M.07*	c.1195G>T	9	p.Asp399Tyr	PMID: 10895258	n.a.	n.a.
Rhmod	*RHAG*01M.08*	c.182T>G	2	p.Ile61Arg	PMID: 18931342	n.a.	rs863225469
Rhmod	*RHAG*01M.09*	c.194T>C	2	p.Phe65Ser	PMID: 18931342	n.a.	rs863225468
Rhmod	*RHAG*01M.10*	c.572G>A	4	p.Arg191Gln	(3), Abstract	n.a.	rs550840907
Rhmod	*RHAG*01M.11*	c.241G>C	2	p.Gly81Arg	PMID: 27079312	HF934040	n.a.

Phenotype	Allele name	Nucleotide change	Exon Intron	Predicted amino acid change	(Reference No.) PMID	Accession number	rs number
Rhmod	*RHAG*01M.12*	c.920C>T	6	p.Ser307 Phe	PMID: 32378229	n.a.	n.a.
Rhmod	*RHAG*01M.13*	c.514A>G	4	p.Met172Val	(8), Abstract	n.a.	rs759281201
Rhmod	*RHAG*01M.14*	c.572G>A c.707A>C	4 5	p.Arg191Gln p.Gln236Arg	PMID: 31032541	MH397221	rs550840907 rs777825752
Rhmod	*RHAG*01M.15*	c.1034G>A	7	p.Gly345Asp	(12), Abstract	MT939879.1	n.a.
Null phenotypes							
Rhnull	*RHAG*01N.01*	c.154_157delinsGA	2	p.Pro52Aspfs*57	PMID: 8563755	n.a.	rs387906519
Rhnull	*RHAG*01N.02*	c.1086delA	8	p.Ala363Leufs*15	PMID: 8563755	n.a.	rs1562011389
Rhnull	*RHAG*01N.03*	c.157+1G>A	i1	Aberrant splicing	PMID: 9746795 PMID: 10394146	n.a.	rs1166675172
Rhnull	*RHAG*01N.04*	c.945+1G>A	i6	Aberrant splicing	(4), Abstract PMID: 30990901	n.a.	n.a.
Rhnull	*RHAG*01N.05*	c.946-1G>A	i6	Aberrant splicing	PMID: 9746795	n.a.	rs1562012697
Rhnull	*RHAG*01N.06*	c.946-1G>T	i6	Aberrant splicing	PMID: 9759472	n.a.	n.a.
Rhnull	*RHAG*01N.07*	c.1067+1G>A	i7	Aberrant splicing	PMID: 9442063	n.a.	rs1562012617
Rhnull	*RHAG*01N.08*	c.808G>A c.838G>A	6	p.Val270Ile p.Gly280Arg	PMID: 10467273	n.a.	rs16879498 rs104893987
Rhnull	*RHAG*01N.09*	c.836G>A	6	p.Gly279Glu	PMID: 9454778 PMID: 9716608	n.a.	rs121918587
Rhnull	*RHAG*01N.10*	c.1094T>G	8	p.Leu365Arg	(4), Abstract	n.a.	n.a.
Rhnull	*RHAG*01N.11*	c.1139G>T	9	p.Gly380Val Aberrant splicing	PMID: 10467273	n.a.	rs121918589
Rhnull	*RHAG*01N.12*	c.353C>T	3	p.Ala118Glu	(5), Abstract	n.a.	n.a.
Rhnull	*RHAG*01N.13*	c.1003G>A	7	p.Gly335Ser	PMID: 25296744	n.a.	rs976240588
Rhnull	*RHAG*01N.14*	c.946-2A>G	i6	Aberrant splicing	(6), Abstract	n.a.	rs754264275

Phenotype	Allele name	Nucleotide change	Exon Intron	Predicted amino acid change	(Reference No.) PMID	Accession number	rs number
Rhnull	*RHAG*01N.15†*	c.(?_-62)_(*638_?)del; Gene deletion	43840	p.0	PMID: 25069376 PMID: 28470789†	n.a.	n.a.
Rhnull	*RHAG*01N.16*	c.310C>T	2	p.Gln104Ter	PMID: 26175207	n.a.	rs1240511011
Rhnull	*RHAG*01N.17*	c.640+3del14	i4	Aberrant splicing	PMID: 27079312	HG971762	n.a.
Rhnull	*RHAG*01N.18*	c.790C>T	5	p.Arg264X	(1), no PMID	AB938314.1	rs1397420527
Rhnull	*RHAG*01N.19*	c.543delT	4	p.Phe181Leufs*5	(7), Abstract	n.a.	n.a.
Rhnull	*RHAG*01N.20*	c.672C>A	5	p.Ser224Arg	PMID: 21682734	n.a.	n.a.
Rhnull	*RHAG*01N.21*	c.571C>T	4	p.Arg191Ter	(9), Abstract	n.a.	rs758540029
Rhnull	*RHAG*01N.22*	c.540C>A	4	p.Tyr180Ter	PMID: 28063760	n.a.	n.a.
Rhnull	*RHAG*01N.23*	c.532delG	4	p.178Glyfs185	PMID: 29266289	KY094063	n.a.
Rhnull	*RHAG*01N.24*	c.12delA	1	p.Phe5fs	(10), Abstract	n.a.	n.a.
Rhnull	*RHAG*01N.25*	c.236G > A	2	pSer79Asn	PMID: 29508504	GQ477180	rs121918586
Rhnull	*RHAG*01N.26*	c.544G>A	4	p.Gly182Ser	PMID: 34309026	MW570764	
Rhnull	*RHAG*01N.27*	c.1108G>A	8	p.Gly370Arg	(13), in press	OM793280	rs751577470

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Track of changes

			from	to
1	**Version**		**v6.3 30-SEP-2022**	**v6.4 31-JUL-2023**
2	Author	created	Jill Storry, August 2022	Jill Storry, July 2023
3	Reviewer	reviewed	C. Gassner, September 2022	Ellen Van der Schoot, July 2023
4	Allele Table	Antigen/ allele added		*RHAG*01.07,* added new antigen THIN
5	References	added		Abstract (13)
6	References	change		moved PMID 30421425 to correct column
7	**End Version**		**v6.3 30-SEP-2022**	**v6.4 31-JUL-2023**

Track of changes

			from	to
1	**Version**		**v6.2 30-NOV-2021**	**v6.3 30-SEP-2022**
2				
3	Author	created	Jill Storry, September 2021	Jill Storry, August 2022
4	Reviewer	reviewed	Ellen Van der Schoot, November 2021	C. Gassner, September 2022
5				
6	General	All		
7	Allele Table	Antigen/ allele added		*RHAG*01.06*
8	Allele Table	Antigen/ allele added		*RHAG*01M.15*
9	Allele Table	Antigen/ allele added		*RHAG*01N.27*
10	References	added		References for the above new alleles added to the ref list: Abstract (11), Abstract (12), PMID 36093570
11	**End Version**		**v6.2 30-NOV-2021**	**v6.3 30-SEP-2022**

Track of changes

			from	to
1	**Version**		**v6.1 30-MAR-2021**	**v6.2 30-NOV-2021**
2				
3	Author	created	Jill Storry	Jill Storry, September 2021
4	Reviewer	reviewed	n.a.	Ellen Van der Schoot, November 2021
5				
6	General	All		update to newest project-2-format
7	Allele Table	Antigen/ allele added		*RHAG*01N.26*
8	Allele Table	renumbered		renumbered '(3), Abstract' to '(1), Abstract'
9	Allele Table	renumbered		renumbered '(8), Abstract' to '(2), Abstract'
10	Allele Table	renumbered		renumbered '(11), Abstract' to '(3), Abstract'
11	Allele Table	renumbered		renumbered '(16), Abstract' to '(4), Abstract'
12	Allele Table	renumbered		renumbered '(22), Abstract' to '(5), Abstract'
13	Allele Table	renumbered		renumbered '(24), Abstract' to '(6), Abstract'
14	Allele Table	renumbered		renumbered '(29), Abstract' to '(7), Abstract'
15	Allele Table	renumbered		renumbered '(31), Abstract' to '(8), Abstract'
16	Allele Table	renumbered		renumbered '(32), Abstract' to '(9), Abstract'
17	Allele Table	renumbered		renumbered '(36), Abstract' to '(10), Abstract'
18	Allele Table	renumbered		renumbered '(28), No PMID' to '(1), No PMID'
19	Allele Table	renumbered		renumbered '(41), In press' to 'PMID: 34309026'
20	**End Version**		**v6.1 30-MAR-2021**	**v6.2 30-NOV-2021**

Track of changes

			from	to
1	**Version**		**v6.0 30-OCT-2020**	**v6.1 30-MAR-2021**
2				
3	Author	created	Jill Storry	Jill Storry
4	Reviewer	reviewed	n.a.	n.a.
5	Allele Table	Antigen/allele renamed	*RHAG*01.-03*	RHAG:-3 renamed RHAG:-3, 5 or DSLK-, Kg+
7	References	added		Reference for the change above added
8	References		References found for all alleles and collated	
9				
10	**End Version**		**v6.0 30-OCT-2020**	**v6.1 30-MAR-2021**

Track of changes

			from	to
1	**Version**		**v5.0 170514**	**v6.0 30-OCT-2020**
2				
3	Author	created	Geoff Daniels	Jill Storry
4	Reviewer	reviewed	n.a.	n.a.
4	General			
5	Intro	Text changed		It is predicted to sit in the membrane in a tri-molecular complex with either RhD or RhCE in a 2:1 ratio. (1; PMID 16281947)
6	Intro	LRG ID line added:		LRG_822
7	Allele Table			
8	Allele Table	Text change: Line moved to Intro:		RHAG3 assigned provisionally. Assignment of null (N) and mod (M) alleles has been made according to the phenotypic expression of RhD and RhCE antigens.
9	Allele Table	Text change:		
10	Allele Table	Antigen/allele	*RHAG*-01*	*RHAG*01.-01*
11	Allele Table	Antigen/allele	*RHAG*02*	*RHAG*01.02*
12	Allele Table	Antigen/allele	*RHAG*-03*	*RHAG*01.-03*
13	Allele Table	Antigen/allele added:	RHAG:4	Deleted. RHAG:4 was made obsolete 2018 (39)
14	Allele Table	Antigen/allele	p.Arg263X	Corrected to p.Arg264X after review of the original paper and the Ensembl database
15	Allele Table	Antigen/allele added:		*RHAG*01M.13, RHAG*01M.14*
16	Allele Table	Antigen/allele added:		*RHAG*01N.19 to RHAG*01N.25*
17	References		References 1-8 updated	References found for all alleles and collated
18	**End Version**		**v5.0 170514**	**v6.0 30-OCT-2020**