

Protein Displays of the Human Immunoglobulin Heavy, Kappa and Lambda Variable and Joining Regions

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Key Words

IMGT · Immunoglobulin · Heavy variable and joining regions · Kappa variable and joining regions · Lambda variable and joining regions

Abstract

'Protein displays of the Human Immunoglobulin Heavy, Kappa and Lambda Variable and Joining Regions', the 6th report of the 'IMGT Locus on Focus' section, comprises 4 figures: (1) 'Protein display of human IGH V-REGIONS'; (2) 'Protein display of human IGK V-REGIONS'; (3) 'Protein display of human IGL V-REGIONS and V-PREB REGION'; (4) 'Protein display of human IGH, IGK and IGL J-REGIONS', and 1 table entitled: 'FR-IMGT and CDR-IMGT length of the human IGHV, IGKV, IGLV and V-PREB genes'. These figures and table are available at the IMGT Marie-Paule page from **IMGT**, the international ImMunoGeneTics database (<http://imgt.cnusc.fr:8104>) created by Marie-Paule Lefranc, Université Montpellier II, CNRS, France.

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'Protein displays of the Human Immunoglobulin Heavy, Kappa and Lambda Variable and Joining Regions' is the 6th report of the 'IMGT Locus on Focus' section launched in the April 1998 issue of *Experimental and Clinical Immunogenetics* [1]. We have previously reported the complete repertoire of human germline IGLV, IGKV and IGHV genes localized at the major IGL (22q11.1-q11.2), IGK (2p12) and IGH (14q32.33) loci, respectively, as well as orphion genes identified in other chromosomal locations. Germline gene tables and allele tables have been provided for the human IGLV and IGLJ [2], IGKV and IGKJ [3], IGHV [4], IGHD and IGHJ [5] genes.

Fig. 1. Protein display of human IGH V-REGIONS. Only the *01 allele of each functional or ORF V-REGION is shown. One pseudogene IGHV3-19 whose defects do not affect the V-REGION has been included. Letters in red correspond to amino acids which are polymorphic in the other alleles. IGHV genes are listed, for each subgroup, according to their position from 3' to 5' in the locus.

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[illegible]

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IGLV gene	FR1-INGT (1-26)	CDR1-INGT (27-38)	FR2-INGT (39-55)	CDR2-INGT (56-65)	FR3-INGT (66-104)	CDR3-INGT (105-115)
273653, IGLV1-36	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
M94116, IGLV1-40	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
M94118, IGLV1-41	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273654, IGLV1-44	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273655, IGLV1-47	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
M94112, IGLV1-50	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273661, IGLV1-51	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X97462, IGLV2-8	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273657, IGLV2-11	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273664, IGLV2-14	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273662, IGLV2-18	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X14613, IGLV2-23	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273643, IGLV2-33	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X57826, IGLV3-1	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X97473, IGLV3-3	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X97464, IGLV3-10	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273658, IGLV3-12	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X97471, IGLV3-16	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X56178, IGLV3-19	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X71966, IGLV3-21	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273666, IGLV3-22	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X97474, IGLV3-25	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
D86994, IGLV3-27	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273645, IGLV3-32	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X57828, IGLV4-3	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273667, IGLV4-60	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273648, IGLV4-69	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273672, IGLV5-37	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273668, IGLV5-39	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273670, IGLV5-45	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273649, IGLV5-48	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273669, IGLV5-52	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273673, IGLV6-57	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
X14614, IGLV7-43	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273674, IGLV7-46	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273650, IGLV8-61	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273675, IGLV9-49	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
273676, IGLV10-54	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
D86996, IGLV11-55	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC
M34927, V-PREB	QSVLTQPPS.VSAPRQRTVITSCSGS	SSNIGNNA....	VNMYQLEPGKAPKLLIY	YDD.....	LLPSGV.SDRFSGSK..SGTSASLAI	SGLQSEDEADYYC

Fig. 3. Protein display of human IGL V-REGIONS and V-PREB REGION. Only the *01 allele of each functional or ORF V-REGION is shown. Letters in red correspond to amino acids which are polymorphic in the other alleles. IGLV genes are listed, for each subgroup, according to their position from 3' to 5' in the locus. V-PREB region is displayed at the bottom of this table (only a part of the non-identical nucleotides. Detailed protein displays of the different alleles of the human IGH D-REGIONS and J-REGIONS with nucleotide sequences have previously been reported [5].

Fig. 4. Protein display of the human IGH, IGK and IGL J-REGIONS. **a** Overview. Only the *01 allele of each functional or ORF V-REGION is shown. **b** Detailed protein displays of the different alleles of the human IGK and IGL J-REGIONS with nucleotide sequences. Only one sequence for each allele is shown. This set of sequences is part of the IMGT reference directory. Dashes indicate identical nucleotides. Detailed protein displays of the different alleles of the human IGH D-REGIONS and J-REGIONS with nucleotide sequences have previously been reported [5].

(For legend see p. 237.)

4a

IGHJ segments	J-REGIONS	
	1	10 20
J00256, IGHJ1		
J00256, IGHJ2	...AEYFQHWGGTILVTVSS	
J00256, IGHJ3	...YWFYDLWGRGTLVTVSS	
J00256, IGHJ4	AFDVMGQGTMTVTVSS	
J00256, IGHJ5	YFDVMGQGTILVTVSS	
J00256, IGHJ6	NWFDSWGQGTILVTVSS	
	YYYYYGMVDVWGGTIVTVTVSS	

IGKJ segments	J-REGIONS	
	1	10
J00242, IGKJ1		
J00242, IGKJ2	WTFQGGTKVEIK	
J00242, IGKJ3	YTFQGGTKLEIK	
J00242, IGKJ4	FTFGPGTKVDIK	
J00242, IGKJ5	LTFGGGTRLEIK	

IGLJ segments	J-REGIONS	
	1	10
X04457, IGLJ1		
M15641, IGLJ2	YVFGTGTKVTVL	
M15642, IGLJ3	WVFGGQTKLTVL	
X51755, IGLJ4	WVFGGQTKLTVL	
X51755, IGLJ5	WVFGGQTKLTVL	
M18338, IGLJ6	WVFGGQTKLTVL	
X51755, IGLJ7	WVFGGQTKLTVL	

4b

IGKJ segments	J-REGIONS	
	1	10 20
J00242 , IGKJ1*01	W T F G O G T K V E I K	G TGG ACG TTC GGC CAA GGG ACC AAG GTG GAA ATC AAA C
J00242 , IGKJ2*01	Y T F G O G T K L E I K	TG TAC ACT TTT GGC CAG GGG ACC AAG CTG GAG ATC AAA C
J00242 , IGKJ3*01	F T F G P G T K V D I K	A TTC ACT TTC GGC CCT GGG ACC AAA GTG GAT ATC AAA C
J00242 , IGKJ4*01	L T F G G G T K V E I K	G CTC ACT TTC GGC GGG ACC AAG GTG GAG ATC AAA C
J00242 , IGKJ5*01	I T F G Q G T R L E I K	G ATC ACC TTC GGC CAA GGG ACA CGA CTG GAG ATT AAA C

IGLJ segments	J-REGIONS	
	1	10
X04457 , IGLJ1*01	Y V F G T G T K V T V L	T TAT GTC TTC GGA ACT GGG ACC AAG GTC ACC GTC CTA G
M15641 , IGLJ2*01	V V F G G G T K L T V L	T GTG GTA TTC GGC GGA GGG ACC AAG CTG ACC GTC CTA G
M15642 , IGLJ3*01	V V F G G G T K L T V L	T GTG GTA TTC GGC GGA GGG ACC AAG CTG ACC GTC CTA G
D87023 , IGLJ3*02	- TG- --G	- TG- --G
X51755 , IGLJ4*01	F V F G G G T O I I L	T TTT GTA TTT GGT GGA GGA ACC CAG CTG ATC ATT TTA G
X51755 , IGLJ5*01	W V F G E G T E L T V L	C TGG GTG TTT GGT GAG GGG ACC GAG CTG ACC GTC CTA G
D87017 , IGLJ5*02	- - - - -G	- - - - -G
M18338 , IGLJ6*01	N V F G S G T K V T V L	T AAT GTG TTC GGC AGT GGC ACC AAG GTG ACC GTC CTC G
X51755 , IGLJ7*01	A V F G G G T Q L T V L	T GCT GTG TTC GGA GGA GGC ACC CAG CTG ACC GTC CTC G
D87017 , IGLJ7*02	- - - - -C-	- - - - -C-

Table 1

FR-IMGT and CDR-IMGT length of the human IGHV, IGKV, IGLV and V-PREB genes

IGHV and IGKV subgroups are designed according to IMGT gene tables [3,4] and locus representations [see IMGT repertoire at IMGT Home page, <http://imgt.cnusc.fr:8104>]. Numbers in bold, on the second line at the top of each column, represent the IMGT unique numbering for the FR-IMGT and CDR-IMGT. Numbers between parentheses, on the third line, correspond to the range of FR-IMGT and CDR-IMGT lengths (in number of amino acids) observed for the gene subgroups of the IGHV, IGKV, IGLV and V-PREB tables, respectively. Numbers in the CDR1-IMGT, CDR2-IMGT and CDR3-IMGT columns show the CDR lengths in number of amino acids. Information in the FR1-IMGT, FR2-IMGT and FR3-IMGT columns show the gaps compared to the IMGT numbering: the number of missing amino acids is indicated following the sign "-" with, between parentheses, the position(s) of the missing amino acid(s) compared to the IMGT numbering. Columns are left in blank if there are no gaps.

IGHV subgroups	FR1-IMGT 1 to 26	CDR1-IMGT 27 to 38	FR2-IMGT 39 to 55	CDR2-IMGT 56 to 65	FR3-IMGT 66 to 104	CDR3-IMGT (germline V-GENE) 105 to 115
	(25)	(8 to 10)	(17)	(6 to 10)	(38)	(2,3)
1	-1 (aa 10)	8		8	-1 (aa 73)	2
2	-1 (aa 10)	10		7	-1 (aa 73)	3
3	-1 (aa 10)	8		6,7,8,10	-1 (aa 73)	2,3
4	-1 (aa 10)	8,9,10		7	-1 (aa 73)	2
5	-1 (aa 10)	8		8	-1 (aa 73)	2
6	-1 (aa 10)	10		9	-1 (aa 73)	2
7	-1 (aa 10)	8		8	-1 (aa 73)	2

IGKV subgroups	FR1-IMGT 1 to 26	CDR1-IMGT 27 to 38	FR2-IMGT 39 to 55	CDR2-IMGT 56 to 65	FR3-IMGT 66 to 104	CDR3-IMGT (germline V-GENE) 105 to 115
	(26)	(6,7,10,11,12)	(17)	(3)	(36)	(7)
1		6		3	-3 (aa 73,81,82)	7
2		11,12		3	-3 (aa 73,81,82)	7
3		6,7		3	-3 (aa 73,81,82)	7
4		12		3	-3 (aa 73,81,82)	7
5		6		3	-3 (aa 73,81,82)	7
6		6		3	-3 (aa 73,81,82)	7
7		10		3	-3 (aa 73,81,82)	7

IGLV subgroups	FR1-IMGT 1 to 26	CDR1-IMGT 27 to 38	FR2-IMGT 39 to 55	CDR2-IMGT 56 to 65	FR3-IMGT 66 to 104	CDR3-IMGT (germline V-GENE) 105 to 115
	(25)	(6 to 9)	(17)	(3,7,8)	(36,38)	(7, 8, 9, 11)
1	-1 (aa 10)	8,9		3	-3 (aa 73,81,82)	9
2	-1 (aa 10)	9		3	-3 (aa 73,81,82)	9
3	-1 (aa 10)	6		3	-3 (aa 73,81,82)	7,8,9
4	-1 (aa 10)	7		7	-3 (aa 73,81,82)	7,11
5	-1 (aa 10)	9		7	-1 (aa 73)	8,9
6	-1 (aa 10)	8		3	-1 (aa 73)	7
7	-1 (aa 10)	9		3	-3 (aa 73,81,82)	8
8	-1 (aa 10)	9		3	-3 (aa 73,81,82)	8
9	-1 (aa 10)	7		8	-3 (aa 73,81,82)	11
10	-1 (aa 10)	8		3	-3 (aa 73,81,82)	9
11	-1 (aa 10)	9		7	-1 (aa 73)	8

V-PREB gene	FR1-IMGT 1 to 26	CDR1-IMGT 27 to 38	FR2-IMGT 39 to 55	CDR2-IMGT 56 to 65	FR3-IMGT 66 to 104	CDR3-IMGT (germline V-GENE) 105 to 115
	(25)	(9)	(17)	(7)	(38)	(30 non Ig-like)
V-PREB	-1 (aa 10)	9		7	-1 (aa 73)	30 non Ig-like

This 6th report completes these data by providing the protein displays of the corresponding reference coding regions. It comprises 4 figures: (1) 'Protein display of human IGH V-REGIONS'; (2) 'Protein display of human IGK V-REGIONS'; (3) 'Protein display of human IGL V-REGIONS and V-PREB REGION'; (4) 'Protein display of human IGH, IGK and IGL J-REGIONS'; and 1 table entitled 'FR-IMGT and CDR-IMGT length of the human IGHV, IGKV, IGLV and V-PREB genes'. These figures and table are available at the IMGT Marie-Paule page from **IMGT**, the international ImMunoGeneTics database (<http://imgt.cnusc.fr:8104>) created by Marie-Paule Lefranc, Université Montpellier II, CNRS, France [6–8]. Nucleotide and amino acid numbering of the V-REGION is according to the IMGT unique numbering [1, 9].

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