Table 3: **p24**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(8–17)	p24(140–149)	GQMVHQAISP	HIV-1 infection	human(B57)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was HLA A*0201, A1, B57 and responded to four B57 epitopes and two others				
p24(8–20)	p24(140–152 IIIB)	GQMVHQAISPRTL	HIV-1 infection	human(Cw3)	[Littaua (1991)]
	• Fine specificity of human Cw3 restricted Gag CTL epitope				
p24(8–27)	p24(140–159)	GQMVHQAISPRTLNA-WVKVV	HIV-1 infection	human(B14)	[Musey (1997)]
	• CTL-specific for this epitope were found in the peripheral blood but not in the cervical mucosa of one donor				
p24(11–24)	p24( )	VQHAISPRTLNAWV	HIV-1 infection	human( )	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ Haitian living in Boston, who was A34/68 B57/71 Cw3/7 – this epitope fell outside the most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa				
p24(11–32)	p24(143–164 BH10)	VHQAISPRTLNAWVK-VVEEKAF	HIV-1 infection	human(Bw57)	[Johnson (1991)]
	• Gag CTL response studied in three individuals				
p24(12–20)	Gag(146–154)	HQAISPRTL	HIV-1 infection	chimpanzee(Patr-B*02)	[Balla-Jhagjhoorsingh (1999b)]
	• Certain HLA-alleles have been associated with long-term survival – among them are HLA-B*27 and HLA-B*57 • Of more than 150 chimpanzees that have been reported to be infected with HIV-1, only one has developed AIDS • CTL responses were studied in two HIV-1 infected chimpanzees that have strong CTL responses, and they were found to respond to highly conserved epitopes that are recognized in humans in the context of HLA-B*27 and HLA-B*57 • The human HLA protein which presents this Patr-B*02 epitope is HLA-B*5701 but the amino acid sequences in the binding pockets of HLA-B*5701 and Patr-B*02 are distinctive				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(13–23)	p24(145–155)	QAISPRTLNAW	HIV-1 infection	human( )	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was HLA A*0201, A1, B57 and responded to QAISPRTLNAW noted previously to be A25				
p24(13–23)	p24(145–155 LAI)	QAISPRTLNAW		human(A*2501)	[Brander & Goulder(2001)]
	• C. Brander notes that this is an A*2501 (Pers. Comm. I. Kurane and K. West)				
p24(13–23)	p24(145–155 LAI)	QAISPRTLNAW		human(A5)	[Kurane & West(1998)]
p24(15–23)	p24(147–155 IIIB)	ISPRTLNAW	HIV-1 infection	human(B*5701)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5701 epitope				
p24(15–23)	Gag(147–155 LAI)	ISPRTLNAW	HIV-1 infection	human(B*5701 B*5801)	[Klein (1998)]
	• B57 has been associated with long-term non-progression in the Amsterdam cohort • The most pronounced CTL responses in HLA B*5701 LTS were to RT and Gag				
p24(15–23)	p24(147–155)	ISPRTLNAW	HIV-1 infection	human(B57)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was HLA A*0201, A1, B57 and responded to four B57 epitopes and two others, but not SLYNTVATL				
p24(15–23)	p24(147–155 IIIB)	ISPRTLNAW	HIV-1 infection	human(B57,B*5801)	[Goulder (1996b)]
	• Five slow progressors made a response to this epitope, and in two it was the dominant response • Peptide defined on the basis of B*5801 binding motif, yet not cross-restricted except at high concentrations				
p24(15–23)	p24( )	LSPRTLNAW	HIV-1 exposed seronegative	human(B57,B58)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-specific CD8 γ-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(16–24)	p24( )	SPRTLNAWV	HIV-1 infection	chimpanzee( )	[Santra (1999)]
	• 3/4 animals displayed HIV-1 Gag-specific CTL activity • Effector cells from two chimpanzees were able to recognize epitopes also recognized by human HIV-1 Gag-specific CTL (SPRTL-NAWV, HLA-B7, and DLNTMLNTV, HLA-B14) • No chimpanzee CTL were detected to the following human HIV-1 specific Gag epitopes, although they were embedded within 20mer peptides that contained a reactive epitope: ISPRTLNAW, HLA-B57; KRWIILGLNK, HLA-B27; and DRFYKTLRA, HLA-B14				
p24(16–24)	p24(148–156)	SPRTLNAWV		human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope • Optimal peptide mapped by titration, Pers. Comm. from D. Lewinsohn to C. Brander and B. Walker				
p24(16–24)	p24(148–156)	SPRTLNAWV		human(B7)	[Brander & Walker(1997)]
	• Optimal peptide mapped by titration, Pers. Comm. from D. Lewinsohn to C. Brander and B. Walker				
p24(16–24)	p24(148–156)	SPRTLNAWV	HIV infection	human(B7)	[Brodie (2000)]
	• Study tracks and quantifies *in vivo* migration of neo-marked CD8 HIV-specific CTL • Adoptively transferred gene-marked HIV-specific CTL homed to specific lymph node sites, colocalizing within the parafollicular regions of the lymph node adjacent to cells expressing HIV Tat-fusion transcripts, indicative of viral replication • The CTL clones expressed CCR5 and localized among HIV-1 infected cells expressing MIP-1α and MIP-1β, CC-chemokines produced at sites of viral replication, suggesting a possible homing mechanism • This study provides a methodology for tracking and studying antigen specific CTL *in vivo*				
p24(16–24)	p24( )	SPRTLNAWV	HIV-1 exposed seronegative	human(B7,B*8101)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-specific CD8 γ-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
p24(16–24)	Gag( )	SPRTLNAWV	HIV-1 exposure	human(B7,B*8101)	[Rowland-Jones (1998b)]
	• HIV-specific CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90–95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(19–27)	p24(151–159)	TLNAWVKVV	HIV-1 infection	human(A*02)	[Huang (2000)]
	• The single cell ELISPOT assay was optimized and highly specific, and found to work well even after the primary cells had been frozen and thawed • Increases in gamma interferon producing cells were observed in response to anti-retroviral therapy using single cell IFN-γ-production ELISPOT • In 3/3 HLA-A*02 B*27 subjects the immunodominant epitope was against HLA B*27 Gag p24 epitope KRWIILGL, not A2 Gag epitopes				
p24(19–27)	p24(151–159)	TLNAWVKVV	HIV-1 infection	human(A2)	[Parker (1992), Parker (1994)]
	• Study of sequence motifs preferred for peptide binding to class I HLA-A2				
p24(19–27)	p24( )	TLNAWVKVV	HIV-1 exposure	human(A2, A*0202)	[Rowland-Jones (1998b)]
	• HIV-specific CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90–95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B and D clade viruses				
p24(21–40)	p24(153–172 SF2)	NAWVKVVEEKAFSPE-VIPMF	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A2, B21				
p24(21–40)	p24(153–172 SF2)	NAWVKVVEEKAFSPE-VIPMF	HIV-1 Pr55Gag VLP with anchored gp120 or V3+CD4 linear domains	*Macaca mulatta*( )	[Wagner (1998b)]
	• A VLP is a non-infectious virus-like particle self-assembled from HIV Pr55 Gag – macaques were immunized with VLPs bound to either gp120 or V3+CD4 linear domains Gag and Env specific CTL were stimulated in each case, and Ab response to Gag and gp120 was elicited, but the gp120 neutralizing response occurred only with whole gp120, not V3+CD4 – despite the CTL and Ab response, immunized macaques were infected by intervenous challenge with SHIV chimeric challenge stock [Wagner (1998b)] • CTL-specific for this epitope could be found both before and after SHIV challenge				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(21–40)	Gag(153–172)	NAWVKVVEEKAFSPE-VIPMF	HIV-1 infection	human(B57)	[Brodie (1999)]
	• The ability of CTL effector cells was studied by expanding autologous HIV-1 Gag-specific CTL *in vitro*, and adoptively transferring them • The transferred CTLs migrated to the lymph nodes and transiently reduced circulating productively infected CD4+ T cells, showing that CTL move to appropriate target sites and mediate anti-viral effects				
p24(21–40)	p24(153–172)	NAWVKVVEEKAFSPE-VIPMF	HIV infection	human(B57)	[Brodie (2000)]
	• Study tracks and quantifies *in vivo* migration of neo-marked CD8 HIV-specific CTL • Adoptively transferred gene-marked HIV-specific CTL homed to specific lymph node sites, colocalizing within the parafollicular regions of the lymph node adjacent to cells expressing HIV Tat-fusion transcripts, indicative of viral replication • The CTL clones expressed CCR5 and localized among HIV-1 infected cells expressing MIP-1α and MIP-1β, CC-chemokines produced at sites of viral replication, suggesting a possible homing mechanism • This study provides a methodology for tracking and studying antigen specific CTL *in vivo*				
p24(21–42)	p24(153–174 BH10)	NAWVKVVEEKAFSPE-VIPMFSA	HIV-1 infection	human(Bw57)	[Johnson (1991)]
	• Gag CTL response studied in three individuals				
p24(28–47)	p24(160–179)	EEKAFSPEVIPMFSALS-EGA	HIV-1 infection	human(B27)	[Musey (1997)]
	• Cervical and peripheral blood derived CTL clones from an HIV-infected woman recognized this epitope				
p24(30–37)	p24(162–170 LAI)	KAFSPEVI	HIV-1 infection	human(B*5703)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5703 epitope				
p24(30–37)	p24(30–37)	KAFSPEVI	HIV-1 infection	human(B57)	[Goulder (2000b)]
	• Two strong clonal CTL responses were generated in donor 026-BMC (HLA A3/-, B42/B57, Cw7/17) against different optimal versions of this epitope, one 8 amino acids long, one 11 • Improved stabilization of the B57-peptide complex was demonstrated by the 11 mer which fits the B57 binding motif, relative to the 8 mer, which does not • B57 tolerates marked difference in optimal peptide length – and B57 is associated with non-progressive infection				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(30–40)	p24( )	KAFSPEVIPMF	HIV-1 infection	human(B*57)	[Spiegel (1999)]
	• Study examines the effect of highly active antiretroviral therapy (HAART) on HIV-1 plasma viral load, CTLp and CTLe frequencies in 8 infected children • CTLp (precursors) were measured by stimulating in culture and assaying using 51Cr release, against vaccina expressed IIIB Env, Gag, Pol, Nef, and CTLe were measured by ELISPOT • CTL against B*57-KAFSPEVIPMF was a de novo response observed in one of the children when viral load increased as a result of stopping therapy • HIV-1 specific CTL responses initially increased in children with complete viral suppression, but then decreased, suggesting viral replication is needed to maintain CTL responses				
p24(30–40)	p24(162–172 LAI)	KAFSPEVIPMF	HIV-1 infection	human(B*5701)	[Goulder (1996b)]
	• This peptide was recognized by CTL from five slow progressors • Peptide defined on the basis of B*5801 binding motif, yet not cross-restricted except at high concentrations • This epitope is highly conserved				
p24(30–40)	p24(162–172 LAI)	KAFSPEVIPMF	HIV-1 infection	human(B*5701)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5701 epitope				
p24(30–40)	p24(162–172 LAI)	KAFSPEVIPMF	HIV-1 infection	human(B*5703)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5703 epitope				
p24(30–40)	p24(30–40)	KAFSPEVIPMF	HIV-1 infection	human(B57)	[Goulder (2000b)]
	• Two strong clonal CTL responses were generated in donor 026-BMC (HLA A3/-, B42/B57, Cw7/17) against different optimal versions of this epitope, one 8 amino acids long, one 11 • Improved stabilization of the B57-peptide complex was demonstrated by the 11mer which fits the B57 binding motif, relative to the 8 mer, which does not • B57 tolerates marked difference in optimal peptide length – and B57 is associated with non-progressive infection				
p24(30–40)	p24(162–172)	KAFSPEVIPMF	HIV-1 infection	human(B57)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was HLA A*0201, A1, B57 and responded to four B57 epitopes and two others				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(30–40)	p24( )	KAFSPEVIPMF	HIV-1 infection	human(B57)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ Caucasian living in Boston – this epitope is not among the most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(31–50)	p24(163–182)	AFSPEVIPMFSALSEG-ATPQ	HIV infection	human( )	[Lieberman (1995)]
	• HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				
p24(31–50)	p24(163–182 SF2)	AFSPEVIPMFSALSEG-ATPQ	HIV infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A2, B21				
p24(31–50)	p24(163–182 SF2)	AFSPEVIPMFSALSEG-ATPQ	HIV-1 infection	human( )	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
p24(35–43)	p24(167–175 LAI)	EVIPMFSAL		human(A*2601)	[Goulder (1996a)]
	• Identified as optimal epitope within Gag sequence AFSPEVIPMFSALSEGATPQ • Relatively conserved epitope within B clade and in other clades • Suspected binding motif for HLA-A26 includes T or V anchor at position 2, negative charge at position 1 • C. Brander notes that this is an A*2601 epitope in the 1999 database				
p24(35–43)	p24(167–175 LAI)	EVIPMFSAL		human(A*2601)	[Brander & Goulder(2001)]
	• C. Brander notes that this is an A*2601				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(35–43)	p24(167–175)	EVIPMFSAL	HIV-1 infection	human(A26)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn't respond to SLYNTVATL reacted with seven other epitopes including this epitope				
p24(36–43)	p24(168–175 LAI)	VIPMFSAL	?	human(C*0102(Cw1))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0102(Cw1) epitope				
p24(36–43)	p24(168–175 LAI)	VIPMFSAL		human(Cw*0102,Cw1)	[Goulder (1997c)]
p24(36–43)	p24(168–175)	VIPMFSAL	HIV-1 infection	human(Cw01,02)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn't respond to SLYNTVATL reacted with seven other epitopes including this epitope				
p24(37–52)	Gag(169–184 LAI)	IPMFSALSEGATPQDL	HIV-1 infection	human(B12)	[Buseyne (1993a)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in five children were mapped using synthetic • Patient EM17 (CDC P2A+C+D2) had a CTL response to two epitopes in Gag				
p24(37–52)	p24(169–184 LAI)	IPMFSALSEGATPQDL	HIV-1 infection	human(B12(44))	[Buseyne (1993b)]
	• Clustering of Gag p24 CTL epitopes recognized in 29 HIV-infected people				
p24(41–60)	p24(173–192 SF2)	SALSEGATPQDLNTML-NTVG	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • 12 subjects had CTL that could recognize vaccinia-expressed LAI Gag • Three of these 12 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B7, B14; and HLA-A2, A3, B14, B44				
p24(41–60)	p24(173–192 SF2)	SALSEGATPQDLNTML-NTVG	HIV-1 infection	human( )	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(41–60)	p24(179–188 Clade A)	SALSEGATPQDLNMM-LNIVG	HIV-1 infection	human(B*8101)	[Dorrell (1999)]
• CTL responses in three individuals with non-clade B infections were studied, 2 with subtype A infections, 1 with subtype C – their infections all originated in East Africa • This CTL epitope is presented by B*8101 in one of the patients with an A subtype infection – B*8101 is a newly discovered HLA allele found in Africans, and the epitope has yet to be mapped precisely • This epitope is distinct in subtype A relative to subtypes B, C, and D which share the dominant sequence: SALSEGATPQDLNTML-NTVG					
p24(41–62)	p24(173–194 BH10)	SALSEGATPQDLNTML-NTVGGH	HIV-1 infection	human(B14)	[Johnson (1991)]
• Gag CTL response studied in three individuals					
p24(44–52)	p24(176–184)	SEGATPQDL		human(B*4001)	[Brander & Goulder(2001)]
• C. Brander notes this is a B*4001, B60 epitope (Pers. Comm. A. Trocha and S. Kalams)					
p24(46–59)	p24( )	GATPQDLNTMLNTV	HIV-1 infection	human( )	[Goulder (2000a)]
• The CTL-dominant response was focused on this epitope in an HIV+ African American living in Boston with HLA A*3002/68 B14/*5802 Cw6/8 – this epitope fell within the most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa					
p24(47–56)	p24( )	ATPQDLNMML	HIV-1 exposed seronegative	human(B53)	[Kaul (2000)]
• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-specific CD8 γ-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women					
p24(47–58)	p24(181–192)	CTPYDINQMLNC	HIV-2 infection	human(B58)	[Bertoletti(1998)]
• HIV-2 epitope defined from an infection in Gambia, Bertoletti, Pers. Comm.					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(48–56)	p24(180–188 IIIB)	TPQDLNTML	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
p24(48–56)	p24(179–187 LAI)	TPQDLNTML		human(B*4201)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*4201 epitope				
p24(48–56)	Gag(173–181 HIV-2)	TPYDINQML	HIV-2	human(B*5301)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5301 epitope				
p24(48–56)	p24(180–188 LAI)	TPQDLNTML	HIV-1 infection	human(B*8101)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*8101 epitope				
p24(48–56)	p24( )	TPQDLNTML	HIV-1 infection	human(B42)	[Goulder (2000a)]
	• B42 and B81 are very similar, and both can present this epitope to B42-positive effector cells – this epitope is almost certainly optimal for B81 as well – B42 and or B81 are expressed in 40–45% of Zulu and Xhosa infected individuals in South Africa, and in 14/18 B42 or B81+ individuals, the dominant Gag response was to TPQDLNTML • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects.				
p24(48–56)	p24( )	TPQDLNQML		human(B53)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, and the B35 allele seems to be protective • HIV-2 sequence: TPYDINQML, no cross-reactivity, [Gotch (1993)]				
p24(48–56)	Gag(173–181 HIV-2)	TPYDINQML	HIV-2	human(B53)	[Gotch (1993)]

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(48–56)	p24(180–188 IIIB)	TPQDLNTML	HIV-1 infection	human(B7)	[Wilson (1999a)]
• This study describes maternal CTL responses in the context of mother-to-infant transmission • Detection of CTL escape mutants in the mother was associated with transmission, but the CTL-susceptible forms of the virus tended to be found in infected infants • No variants of this epitope were found in a non-transmitting mother that had a CTL response to this epitope					
p24(48–56)	p24(180–188)	TPQDLNTML	HIV-1 infection	human(B7)	[Jin (2000)]
• This is the optimal epitope for the immunodominant response defined using a conventional approach in an HLA B7+ long-term non-progressor • Three additional sub-dominant HLA B7 epitopes were defined using EpiMatrix, a non-anchor based strategy for defining potential epitopes, which highlighted 2078 possible epitopes in the autologous HIV-1 derived from the study subject – this was followed by B7 anchor residue prediction which narrowed the set to 55 peptides, three of which could serve as functional CTL epitopes					
p24(48–56)	p24(180–188 LAI)	TPQDLNTML	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
• C. Brander notes this is a C*0802(Cw8) epitope					
p24(49–57)	p24(181–189 LAI)	PQDLNTMLN	HIV-1 infection	human(B14, Cw8)	[Lubaki (1997)]
• Eighty two HIV-1-specific CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a Polyclonal response • Despite this being a well defined conserved epitope, none of the 11 Gag-specific clones from a B-14 positive subject could recognize either it or p24 RAEQASQEV • Christian Brander notes that B14 and Cw8 are in linkage disequilibrium, and that this epitope may be Cw8					
p24(51–59)	p24( )	DLNTMLNTV	HIV-1 infection	chimpanzee( )	[Santra (1999)]
• 3/4 animals displayed HIV-1 Gag-specific CTL activity • Effector cells from two chimpanzees were able to recognize two epitopes also recognized by human HIV-1 Gag-specific CTL (SPRTLNAWV, HLA-B7, and DLNTMLNTV, HLA-B14) • No chimpanzee CTL were detected to the following human HIV-1 specific Gag epitopes, although they were embedded within 20mer peptides that contained a reactive epitope: ISPRTLNAW, HLA-B57; KRWIILGLNK, HLA-B27; and DRFYKTLRA, HLA-B14					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(51–59)	p24( )	DLNMMLNIV	HIV-1 exposed seronegative	human(B14)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-specific CD8 γ-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
p24(51–59)	p24(183–191 LAI)	DLNTMLNTV	HIV-1 infection	human(B14, Cw8)	[Nixon (1988), Johnson (1992)]
	• Recent evidence indicates this is a Cw8 epitope; B14 and Cw8 are in linkage disequilibrium and the HLA presenting molecule is hard to distinguish (P. Goulder, personal communication)				
p24(51–59)	p24( )	DLNTMLNTV	HIV-1 exposure	human(B14, Cw8)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-defined B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A subtype consensus is identical to the B clade epitope • The D subtype consensus is dLNmMLNiV • Recent evidence indicates this is a Cw8 epitope;B14 and Cw8 are in linkage disequilibrium and the HLA presenting molecule is hard to distinguish (P. Goulder, personal communication)				
p24(51–59)	p24(183–191 LAI)	DLNTMLNTV	HIV-1 infection	human(C*0802)	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802 epitope				
p24(51–59)	p24(183–191 LAI)	DLNTMLNTV	HIV-1 infection	human(Cw8)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes – defined by B14 motif found within a larger peptide • Recent evidence indicates this is a Cw8 epitope;B14 and Cw8 are in linkage disequilibrium and the HLA presenting molecule is hard to distinguish (P. Goulder, personal communication)				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(51–59)	p24( )	DLNTMLNTV	HIV-1 exposure	human(Cw8, B*1402)	[Rowland-Jones (1998b)]
• HIV-specific CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90–95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among B and D clade viruses • The Clade A version of the epitope, DLNNMLNIV, was preferentially recognized by CTL • Recent evidence indicates this is a Cw8 epitope;B14 and Cw8 are in linkage disequilibrium and the HLA presenting molecule is hard to distinguish (P. Goulder, personal communication)					
p24(51–70)	p24(183–202 SF2)	DLNTMLNTVGGHQAA-MQMLK	HIV-1 infection	human( )	[Lieberman (1997a)]
• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A26, A30, B38					
p24(51–82)	Gag(183–214 LAI)	DLNTMLNTVGGHQAA-MQMLKETINEEAAEWD-R	Lipopeptide vaccine	human( )	[Gahery-Segard (2000)]
• Anti-HIV lipopeptide vaccine consisting of six long amino acid peptides derived from Nef, Gag and Env HIV-1 proteins modified by a palmitoyl chain was administered in a phase I trial • A CD4+ T cell proliferative response to at least one of the six peptides was observed in 9/10 vaccinees – 2/10 reacted to this peptide • 9/12 tested mounted a CTL response to at least one of the six peptides; each of the six peptides elicited a CTL response in at least one individual • None of the 12 tested had an IgG response to this peptide					
p24(61–69)	p24(193–201 LAI)	GHQAAMQML		human(B*3901)	[Brander & Goulder(2001)]
• C. Brander notes this is a B*3901 epitope					
p24(61–69)	p24(193–201 LAI)	GHQAAMQML		human(B39)	[Kurane & West(1998)]
• Optimal peptide defined by titration					
p24(61–71)	p24(193–203 BRU)	GHQAAMQMLKE	HIV-1 infection	human(A2)	[Claverie (1988)]
• One of 4 epitopes first predicted, then shown to stimulate HLA-A2 restricted CTL line					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(61–80)	p24(193–212 SF2)	GHQAAMQMKETINEE-AAEW	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A26, A30, B38				
p24(61–82)	p24(193–214 BH10)	GHQAAMQMLKETINE-EAAEWDR	HIV-1 infection	human(Bw52)	[Johnson (1991)]
	• Gag CTL response studied in three individuals				
p24(62–70)	p24(194–202 LAI)	HQAAMQMLK		human(B52)	[Brander & Walker(1996)]
	• P. Goulder, pers. comm.				
p24(65–73)	Gag(199–207 HXB2)	AMQMLKETI	Gag i.m. DNA vaccination	murine(H-2^d)	[Qiu (1999)]
	• Different expression vectors were tested to increase Gag expression in cell lines and create suitable vectors for DNA vaccines • Stable Gag expression was achieved in murine p815 cells, using a Gag gene that had mutated silent base positions that disrupt inhibitory RNA sequences which promote RNA degradation • Silent mutations were more effective than introduction of the D retrovirus cis-acting posttranscriptional control element (CTE) for enhancing Gag expression • The Gag vector with silent mutations given as a vaccine to BALB/c mice gave CTL responses in splenic mononuclear cells, using peptide pulsed cells as targets				
p24(65–73)	p24(199–207 SF2)	AMQMLKETI	vaccinia expressing Gag and Pol	murine(H-2K^d)	[Doe & Walker(1997)]
	• Immunodominant murine CTL response to this peptide observed after immunization with vaccine VVGagPol • Optimal peptide was defined				
p24(69–86)	Gag(201–218 LAI)	LKETINEEAAEWDRVP-V	HIV-1 infection	human( )	[Buseyne (1993a)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in five children were mapped using synthetic peptides and secondary cultures • Patient EM28 (CDC P2A) had a CTL response to four epitopes in Gag				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(71–80)	p24(203–212)	ETINEEAAEW	HIV-1 infection	human(A*2501)	[Klenerman (1996)]
	• The epitope was defined through direct stimulation of PBMC with 20-mer peptides • It is in a conserved region, ETINEEAAEW is found in most B, D, and E subtype isolates • DTINEEAAEW is found in A and some D subtype sequences				
p24(71–80)	p24(203–212)	ETINEEAAEW	HIV-1 infection	human(A*2501)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*2501 epitope				
p24(71–80)	p24(203–212)	ETINEEAAEW	HIV-1 infection	human(A*2501)	[van Baalen (1996)]
	• Conserved between B and D subtypes, variable in other clades; a consensus of clades A,C, F, G, and H and a peptide of HIV-2ROD over this region were not recognized by CTL recognizing the index peptide • C. Brander notes that this is an A*2501 epitope in the 1999 database				
p24(71–80)	p24( )	ETINEEAAEW		human(A25)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, and the B35 allele seems to be protective • HIV-2 sequence: EIINEEAAEW, no cross-reactivity [van Baalen (1996)]				
p24(71–90)	p24(203–222 SF2)	ETINEEAAEWDRVHP-VVHAGP	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A2, B21				
p24(83–92)	p24(215–223 IIIB)	VHPVHAGPIA	HIV-1 infection	human(B55)	[Sipsas (1997)]
	• HIV IIIB proteins were used to define the range of CTL epitopes recognized by 3 lab workers accidentally infected with HIV-1 IIIB • LHPVHAGPVA, a variant found in HIV-1 PH136, was also recognized • LHPVHAGPIA, a variant found in HIV-1 RF, was also recognized • LHPVHAGPIT, a variant found in HIV-1 MN, was also recognized • LHPAQAGPIA, a variant found in HIV-1 JH3, was recognized at high peptide concentrations				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(87–101)	Gag(219–233 LAI)	HAGPIAPGQMREPRG	HIV-1 infection	human( )	[Buseyne (1993a)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in five children were mapped using synthetic peptides and secondary cultures • Patient EM28 (CDC P2A) had a CTL response to four epitopes in Gag				
p24(87–101)	p24(219–233 BRU)	HAGPIAPGQMREPRG	HIV-1 infection	human(A2)	[Claverie (1988)]
	• One of 4 epitopes predicted then shown to stimulate HLA-A2 restricted CTL line				
p24(91–110)	p24(223–242 SF2)	IAPGQMREPRGSDIAG-TTST	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A2, A24, B13, B35				
p24(101–120)	p24(233–252 SF2)	GSDIAGTTSTLQEQIG-WMTN	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A26, A30, B38				
p24(108–117)	p24(240–249 LAI)	TSTLQEQIGWF	HIV-1 infection	human(B*57,B*5801)	[Goulder (1996b)]
	• Response to this epitope was found in 4 slow progressing HLA-B*57 individuals, in 2 it was dominant or very strong • For one donor (from Zimbabwe) this was defined as the optimal peptide • This epitope can be presented in the context of the closely related HLA molecules B*5801 and B*57				
p24(108–117)	p24(241–250 LAI)	TSTVEEQQIW	HIV-2 infection	human(B*5801)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5801 epitope				
p24(108–117)	P24(240–249 LAI)	TSTLQEQIGW	HIV-1 infection	human(B*5801)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5801 epitope				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(108–117)	p24(233–252)	TSTLQEQIGW	HIV-1 infection	human(B57)	[Bernard (1998)]
	• This study focuses on six rare long-term survivor HIV-infected people who were infected for many years without exhibiting immune dysregulation – such immunologically normal HIV-infected (INHI) cases occur at a frequency between 0.1 and 1% in the infected population • No direct CTL were found in any of the six INHIs, but above background CTLp activity was founded in 3/6 INHIs • Epitope sequences were deduced from larger reactive peptides based on HLA binding motifs – XSXXXXXXXW is a B57 binding motif, and CTL activity against TSTLQEQIGW has been found in two other B57 long-term non-progressors				
p24(108–117)	p24(241–250)	TSTVEEQQIW	HIV-2 infection	human(B58)	[Bertoletti(1998)]
	• HIV-2 epitope defined from an infection in Gambia, Bertoletti, Pers. Comm. • All HIV-2 sequences from the database are TSTVEEQIQW in this region, not TSTVEEQQW as in the paper				
p24(108–117)	p24( )	TSTLQEQIGW	HIV exposure	human(B58)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, and the B35 allele seems to be protective • HIV-2 sequence: TSTVEEQIQW, CTL are cross-reactive, [Bertoletti (1998)]				
p24(108–117)	p24(240–249)	TSTLQEQIGW	HIV-2 infection	human(B58)	[Bertoletti (1998)]
	• CTL responses in HLA-B*5801 positive HIV-2 infected individuals have a dominant response to Gag and tolerate extensive substitution, thus HLA-B*5801+ individuals may have an enhanced potential for cross-protection between HIV-1 and HIV-2 • This can be an immunodominant epitope in HLA-B57 and B*5801 infected individuals, and is associated with long-term non-progression [Goulder (1996b)] • HIV-2 sequence: HIV-2 ROD has the epitope sequence TSTVEEQIQW, and the CTL from a person infected with HIV-2 was cross-reactive with HIV-1 epitopes • The epitope is TSTLQEQIGW in HIV-1 B clade, and TSTVEEQIQW in HIV-2 ROD • HLA B*5801 and B35 may preferentially select HIV-1 and HIV-2 cross-reactive epitopes				
p24(108–118)	p24(240–249 LAI)	TSTLQEQIGWF	HIV-1 infection	human(B*5701)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5701 epitope				
p24(109–117)	Gag(241–249 LAI)	STLQEQIGW	HIV-1 infection	human(B*5701 B*5801)	[Klein (1998)]
	• B57 has been associated with long-term non-progression in the Amsterdam cohort • The most pronounced CTL responses in HLA B*5701 LTS were to RT and Gag				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(121–135)	p24(253–267)	NPPIPVGEIYKRWII	HIV-1 infection	human(B8)	[Gotch (1990)]
	• High frequency of memory and effector Gag-specific CTL				
p24(121–135)	p24(255–274 SF2)	NPPIPVGEIYKRWII	HIV-1 infection	human(B8)	[Phillips (1991), Goulder (1997a)]
	• Longitudinal study of CTL escape mutants in people with the appropriate HLA types – little variation was observed in the immunodominant B27 epitope, relative to B8 epitopes, which varied over time • [Goulder (1997a)] is a review of immune escape that points out that there may be a protective effect associated with B27, and that HLA-B8 individuals tend to progress more rapidly than HLA B27 patients				
p24(121–140)	p24(253–272)	NPPIPVGEIYKRWIILG-LNK	HIV infection	human( )	[Lieberman (1995)]
	• HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				
p24(121–140)	p24(253–272 SF2)	NPPIPVGEIYKRWIILG-LNK	HIV infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • Two of these 12 had CTL response to this peptide • The responding subjects were HLA-A2, A3, B8, B62, and HLA-A1, B8, B18				
p24(121–140)	p24(253–272 SF2)	NPPIPGEIKRWIILGNIK	HIV-1 infection	human( )	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
p24(121–140)	p24(255–274 SF2)	NPPIPVGEIYKRWIILG-LNK	HIV-1 infection	human( )	[van Baalen (1993)]
	• Gag CTL epitope precursor frequencies were estimated and peptide mapping was performed				
p24(121–142)	p24(253–274 BH10)	NPPIPVGEIYKRWIILG-LNKIV	HIV-1 infection	human(B8)	[Johnson (1991)]
	• Gag CTL response studied in three individuals				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(121–152)	Gag(183–214 LAI)	NPPIPVGEIYKRWIILG-LNKIVRMYSPTSILD	Lipopeptide vaccine	human( )	[Gahery-Segard (2000)]
	• Anti-HIV lipopeptide vaccine consisting of six long amino acid peptides derived from Nef, Gag and Env HIV-1 proteins modified by a palmitoyl chain was administered in a phase I trial • A CD4+ T cell proliferative response to at least one of the six peptides was observed in 9/10 vaccinees – 9/10 reacted to this peptide • 9/12 tested mounted a CTL response to at least one of the six peptides; each of the six peptides elicited a CTL response in at least one individual – this peptide was particularly immunogenic, eliciting a CTL response in four vaccinees • All of the 12 tested had an IgG response to this peptide				
p24(121–152)	Gag( )	NPPIPVGEIYKRWIILG-LNKIVRMYSPTSILD	HIV-1 Gag lipopeptide conjugate vaccine (P3C541b)	human(A*0201)	[Seth (2000)]
	• Immunization of 2/4 HIV seropositive HLA selected individuals with a 32 amino acid Gag lipopeptide that contains CTL epitopes restricted by HLA A33, B8, B27, B35, and Bw62 gave a transient increase in peptide-specific bulk CTL response, but they did not decrease plasma viral • Placebo and HLA mis-matched controls showed no change in CTL • The responders carried HLA Bw62 and B35 – the two HLA-matched that did not respond carried B35 and B8				
p24(122–130)	p24(260–268 LAI)	PPIPVGDIY	HIV-1 or -2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
p24(122–130)	p24(245–253 HIV-2)	NPVPVGNIY	HIV-1 infection	human(B*3501)	[Rowland-Jones (1995)]
p24(122–130)	p24(245–253 HIV-2)	NPVPVGNIY	HIV-1 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
p24(122–130)	p24(260–268 LAI)	PPIPVGDIY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• Defined as minimal peptide by titration curve, PPIPVGEIY and HIV-2 form NPVPVGNIY are also recognized				
p24(122–130)	p24(260–268 LAI)	PPIPVGDIY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-specific CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(122–130)	p24(260–268 LAI)	PPIPVGDIY	HIV-1 infection	human(B35)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes				
p24(122–130)	p24( )	PPIPVGEIY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-specific CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90–95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among B and D clade viruses • The Clade A version of the epitope, PPIPVGDIY, was preferentially recognized by CTL				
p24(122–130)	( )	PPIPVGEIY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-specific CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-specific CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-specific T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been defined earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL				
p24(122–130)	p24( )	PPIPVGDIY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, and the B35 allele seems to be protective • HIV-2 version of this epitope is not conserved: NPVPVGNIY, but the CTLs are cross-reactive – one of five B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
p24(124–138)	p24(256–270 LAI)	IPVGEIYKRWIILGL	HIV-1 infection	human(B8)	[Buseyne (1993b)]
	• Clustering of Gag p24 CTL epitopes recognized in 29 HIV-infected people				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(124–138)	Gag(256–270 LAI)	IPVEGEIYKRWIILGL	HIV-1 infection	human(B8)	[Buseyne (1993a)]
• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in five children were mapped using synthetic peptides and secondary cultures • Two children, EM16 (CDC P2A+D2) and EM18 (CDC P2A), had a CTL response to this epitope, and it was shown to be presented by B8 in EM18					
p24(127–135)	p24(259–267 SF2)	GDIYKRWII	HIV-1 infection	human(B*0801)	[McAdam (1998)]
• GDIYKRWII specific CTL clone also recognized GEIYKRWII					
p24(127–135)	p24(261–269)	GEIYKRWII	HIV-1 infection	human(B8)	[Sutton (1993)]
• Predicted epitope based on B8-binding motifs, from larger peptide NPPIPVGEIYKRWII					
p24(127–135)	p24(259–267)	GEIYKRWII	Stimulation of CD8 cultures	human(B8)	[Zarling (1999)]
• This study compares the ability of macrophages and dendritic cells to stimulate primary responses in CD8+ lymphocytes isolated from HLA-appropriate HIV-uninfected donors using peptide-pulsed APC – the dendritic cells performed better as APC for the stimulation of primary responses • Strong CTL responses were elicited by the epitopes DRFYKTLRA and GEIYKRWII when presented by either immature or mature dendritic cells – macrophages were not able to prime a CTL response against DRFYKTLRA • A weak response to KLTPLCVSL was stimulated using macrophages as the APC • No detectable response was observed for the following previously-defined HIV epitopes: KIRLRPGGK, ILKEPVHGV, IRLRPGGK, GPKVKQWPL					
p24(127–135)	p24(259–267 LAI)	GEIYKRWII	HIV-1 infection	human(B8)	[Klenerman (1994)]
• Naturally occurring variant GDIYKRWII may act as antagonist					
p24(127–135)	p24(259–267)	GEIYKRWII	HIV-1 infection	human(B8)	[Betts (2000)]
• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the HLA A2+ was HLA A*0201, A31, B8, B51 and responded to this epitope as well as seven others					
p24(127–135)	p24(259–267)	GEIYKRWII	HIV-1 infection	human(B8)	[Nowak (1995)]
• Longitudinal study of CTL response and study of immune escape – GDIYKRWII could also stimulate CTL, reactivity fluctuated					
p24(127–135)	p24(259–267)	GEIYKRWII	HIV-1 infection	human(B8)	[McAdam (1995)]
• Equivalent sequence GDIYKRWII also recognized by CTL from some donors					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(128–135)	p24(260–267 LAI)	EIYKRWII		human(B*0801)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0801 epitope				
p24(128–135)	p24(260–267 LAI)	EIYKRWII		human(B8)	[Goulder (1997g)]
	• Defined in a study of the B8 binding motif				
p24(128–135)	p24( )	EIYKRWII	HIV-1 infection	human(B8)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ Caucasian living in Boston – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(128–135)	p24( )	DIYKRWII	HIV-1 infection	human(B8)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ South African – this epitope did not fall within the five most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(129–136)	p24(263–270 SF2)	IYKRWIIL	HIV-1 infection	human(A*2402)	[Ikeda-Moore (1997)]
	• Defined using reverse immunogenetics – 59 HLA-A*2402 binding peptides were predicted by searching for A*2402 anchors in HIV proteins (Tyr at 2, and Phe, Leu or Ile at the C term) – 53 of the 59 peptides bound A*2402 • This peptide induced CTL in 1/4 HIV-1+ people tested • IYKRWIIL bound to A*2402 with medium strength, the epitope can be processed in a vaccinia construct and presented – two specific CTL clones were obtained				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(129–138)	p24(263–272 SF2)	IYKRWIILGL	HIV-1 infection	human(A*2402)	[Ikeda-Moore (1997)]
	• Defined using reverse immunogenetics – 59 HLA-A*2402 binding peptides were predicted by searching for A*2402 anchors in HIV proteins (Tyr at 2, and Phe, Leu or Ile at the C term) – 53 of the 59 peptides bound A*2402 • This peptide induced CTL in 1/4 HIV-1+ people tested • IYKRWIILGL bound to A*2402 with medium strength, the epitope can be processed in a vaccinia construct and presented – two specific CTL clones were obtained				
p24(129–138)	p24(263–272)	IYKRWIILGL	HIV-1 infection	human(B27)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was B27 and responded to IYKRWIILGL				
p24(130–148)	p24(265–280 BRU)	YKRWIILGLNKIVRMY-SPT	HIV-1 infection	human(B27)	[Dadaglio (1991)]
	• Used as a positive control for HLA specificity				
p24(131–139)	p24(263–272)	KRWIILGNK	HIV-1 infection	human(B27)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype Gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: KRWIILGNK				
p24(131–139)	Gag(265–273)	KRWIILGLN	HIV-1 infection	chimpanzee(Patr-B*03)	[Balla-Jhagjhoorsingh (1999b)]
	• Certain HLA-alleles have been associated with long-term survival – among them are HLA-B*27 and HLA-B*57 • Of more than 150 chimpanzees that have been reported to be infected with HIV-1, only one has developed AIDS • CTL responses were studied in two HIV-1 infected chimpanzees that have strong CTL responses, and they were found to respond to highly conserved epitopes that are recognized in humans in the context of HLA-B*27 and HLA-B*57 • The human HLA protein which presents this Patr-B*03 epitope is HLA B*2705 but the amino acid sequences in the binding pockets of HLA-B*2705 and Patr-B*03 are distinctive				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(131–140)	Gag(263–272 LAI)	KRWILLGLNK	HIV-1 infection	human( )	[Buseyne (1993a)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in five children were mapped using synthetic peptides and secondary cultures • Patient EM28 (CDC P2A) had a CTL response to four epitopes in Gag				
p24(131–140)	p24(263–272)	KRWIILLGLNK	HIV-1 infection	human(B*27)	[Huang (2000)]
	• The single cell ELISPOT assay was optimized and highly specific, and found to work well even after the primary cells had been frozen and thawed • Increases in gamma interferon producing cells were observed in response to anti-retroviral therapy using single cell IFN-γ-production ELISPOT • In 3/3 HLA A*02, B*27 individuals, the dominant response in Gag measured by both γ IFN production and T cell lysis was to the B27 epitope, KRWIILLGLNK, not the A2 SLYNTVATL epitope				
p24(131–140)	p24(263–272 SF2)	KRWIILGLNK	HIV-1 infection	human(B*27)	[McAdam (1998)]
	• Epitope invariant across clades A, B, C, and D				
p24(131–140)	p24(260–269 HIV-2)	RRWIQLGLQK		human(B*2703)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*2703 epitope				
p24(131–140)	p24( )	KRWIILGGLNK	HIV-1 infection	human(B*2705)	[Wilson (2000)]
	• Three individuals with highly focused HIV-specific CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-specific CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-specific T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • Tetramers with peptide variants KRWIILGGLNK and KRWIIMGGLNK were used – CTL from most B27 donors recognize both variants, although one of the three subjects recognized only KRWIILGGLNK • ELISPOT was used to test a panel of CTL epitopes that had been defined earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderately strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(131–140)	p24(263–272 LAI)	KRWIILGLNK	HIV-1 infection	human(B*2705)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*2705 epitope				
p24(131–140)	p24(263–272 LAI)	KRWIILGLNK	HIV-1 infection	human(B*2705,B27)	[Goulder (1997d), Goulder (1997a)]
	• HLA-B*2705 is associated with slow HIV disease progression • 11/11 HLA-B*2705 donors make a response to this epitope, usually an immunodominant response • This is a highly conserved epitope • The HLA-B*2705 binding motif includes R at position 2, and L in the C-term position • [Goulder (1997a)] is a review on CTL immune escape that discusses this epitope in the context of the difficulty in detection of immune escape – KRWIILGLNK and an R2K change, KKWIILGLNK, show little difference in titration curves, yet the K2 variants fail to bind to targets for more than 1 hour, while the R2 form can sensitize lysis by CTL for over 24 hours – minigene transfection experiments confirmed the importance of this for the CTL response				
p24(131–140)	p24(260–269 HIV-2)	RRWIQLGLQK		human(B27)	[Brander & Walker(1996)]
	• HIV-2, HLA-B*2703, S. Rowland-Jones, Pers. Comm.				
p24(131–140)	p24(263–272 LAI)	KRWIILGLNK	HIV-1 infection	human(B27)	[Fan (1997)]
	• The capacity of dendritic cells to process and present antigen and stimulate anti-HIV-1 CTL memory responses was studied				
p24(131–140)	Gag(263–272)	KRWIILGLNK	HIV-1 infection	human(B27)	[Zheng (1999)]
	• Protein delivery (gp160 LAV, p66 LAV, and p24 NY5) to human dendritic cells (DC) with liposomes provides enhanced memory CTL response relative to delivery of protein alone • Chloroquine administration enhanced epitope presentation, and brefeldin A and peptide aldehyde inhibitors inhibited antigen presentation, suggesting epitopes were processed by classical proteasome pathway • The CTL response to p24 was measured in individuals with a response to B27-KRWIILGLNK				
p24(131–140)	p24(263–272 LAI)	KRWIILGLNK	HIV-1 infection	human(B27)	[Wilson (1998a)]
	• HIV+ individuals were followed longitudinally using MHC tetramers in combination with 14 anti-BV chain MAbs, and clonal expansion of HIV-specific T cells was followed *in vivo* • Seven HIV+ people were studied, and all showed expansions of particular TCR BV clones, often several, relative to uninfected controls • Three patients were followed in detail, TCR VB expansions persisted for 2 to 3 years, with occasional transient increases				
p24(131–140)	p24( )	KRWIILGLNK	HIV infection	human(B27)	[Rowland-Jones (1997)]
	• Described in this review as the first identified HIV CTL epitope				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(131–140)	p24(263–272 LAI)	KRWIILGLNK	HIV-1 infection	human(B27)	[Buseyne (1993b)]
	• Clustering of Gag p24 CTL epitopes recognized in 29 HIV-infected people				
p24(131–140)	p24(263–272 LAI)	KRWIILGLNK	HIV-1 infection	human(B27)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes				
p24(131–140)	p24(263–272)	KRWIIMGLNK	HIV-1 infection	human(B27)	[Klenerman (1994)]
	• Naturally occurring variant KRWIILGLNK may act as antagonist				
p24(131–140)	p24(263–272)	KRWIIMGLNK	HIV-1 infection	human(B27)	[Klenerman (1995)]
	• Naturally occurring variant KRWIILGLNK may act as antagonist				
p24(131–140)	p24(265–274)	KRWIILGLNK	HIV infection	human(B27)	[Moss (1995)]
	• In one individual, TCR usage changed over time indicating that new populations of CTL can be recruited • TCR usage showed a CTL clonal response to this epitope that persisted over 5 years • CTL clones specific for HIV epitopes may represent between 0.2 and 1% of the total CD8+ population of T cells				
p24(131–140)	p24(265–276)	KRWIILGLNK		human(B27)	[Carreno (1992)]
	• Included in HLA-B27 binding peptide competition study				
p24(131–140)	p24(265–274 SF2)	KRWIILGLNK	HIV-1 infection	human(B27)	[Phillips (1991), Goulder (1997a)]
	• Longitudinal study of CTL escape mutants – little variation was observed in the immunodominant B27 epitope, relative to B8 epitope • [Goulder (1997a)] is a review of immune escape that points out that there may be a protective effect associated with B27, and that HLA-B8 individuals tend to progress more rapidly than HLA B27 patients				
p24(131–140)	p24(263–272)	KRWIILGLNK	HIV-1 infection	human(B27)	[Nietfeld (1995), Goulder (1997a)]
	• Single point mutations were introduced and viral viability and CTL recognition tested – an Arg to Lys change at anchor position P2 abrogates binding to B27, but doesn't change viral viability *in vitro* • [Goulder (1997a)] is a review of immune escape that summarizes this study				
p24(131–140)	p24(263–272)	KRWIIMGNK	HIV-1 infection	human(B27)	[Nowak (1995)]
	• Longitudinal study of CTL response and immune escape – the form KRWIILGNK was also found, and both forms stimulate CTL				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(131–140)	p24(263–272)	KRWIIMGLNK	HIV-1 infection	human(B27)	[Goulder (1997f), Goulder (1997a)]
	• Six HLA-B27 donors studied make a strong response to this epitope • In 4/6 cases, this was the immunodominant or only CTL response • Two of the cases had an epitope switch to the form KKWIIMGLNK during a period of rapid decline to AIDS, following their asymptomatic period • The arginine to lysine switch is in an anchor residue, and results in immune escape due to severely diminished binding to the B27 molecule • [Goulder (1997a)] is a review of immune escape that summarizes this study in the context of CTL escape to fixation				
p24(131–140)	p24( )	KRWIILGLNK		human(B27)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, and the B35 allele seems to be protective • HIV-2 sequence: RRWIQLGLQK – this epitope was not HIV-1 and HIV-2 cross-reactive				
p24(131–140)	Gag( )	KRWILGLNK	none, computer prediction	(B27)	[Schafer (1998)]
	• This study uses EpiMatrix for T cell epitope prediction to identify possible HLA-B27 and A-2 CTL epitopes in HIV • Based on EpiMatrix predictions, 28 peptides were synthesized and tested using T2 binding assays for potential HLA A2 or B27 binding, and 12 of these were shown to bind to the predicted HLA molecule • Two of these 12 peptides had been previously identified as CTL epitopes: HLA-B27 KRWILGLNK and HLA-A2 ILKEPVHGV • This peptide sequence is not conserved between clades, but is found in most B clade isolates				
p24(131–140)	p24(263–282)	KRWIILGLNK	HIV-1 infection	human(B27)	[Bernard (1998)]
	• This study focuses on six rare long-term survivor HIV-infected people who were infected for many years without exhibiting immune dysregulation – such immunologically normal HIV-infected (INHI) cases occur at a frequency between 0.1 and 1% in the infected population • No direct CTL were found in any of the six INHIs, but above background CTLp activity was founded in 3/6 INHIs • Epitope sequences were deduced from larger reactive peptides based on HLA binding motifs – XRXXXXXXXK is a B*2705 binding motif				
p24(131–142)	p24(265–276)	KRWIILGLNKIV	no CTL shown	human(B27)	[Jardetzky (1991)]
	• Epitope examined in the context of peptide binding to HLA-B27				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(131–142)	p24(263–274 LAI)	KRWIILGLNKIV	HIV-1 infection	human(B27)	[Fan (1997)]
	• The capacity of dendritic cells to process and present antigen and stimulate anti-HIV-1 CTL memory responses was studied				
p24(131–145)	p24( )	KRWILGLNKIVRMY	HIV-1 infection	human( )	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ African American living in Boston with unknown HLA – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPGGKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(131–145)	p24(263–277 LAI)	KRWIILGLNKIVMRY	HIV-1 infection	human(A33)	[Buseyne (1993b)]
	• Clustering of Gag p24 CTL epitopes recognized in 29 HIV-infected people				
p24(131–145)	p24(266–277)	KRWIILGLNKIVRMY	rec Gag-vaccinia	human(B27)	[Nixon (1988)]
	• Gag CTL epitope mapped with rec Gag-vaccinia and synthetic peptides • This was the first HIV-1 epitope to be mapped				
p24(131–145)	p24(266–277 LAI)	KRWIILGLNKIVMRY	HIV-1 infection	human(B27)	[Meyerhans (1991)]
	• Longitudinal study showing persistence of epitope despite CTL activity				
p24(131–145)	p24(265–279)	KRWIILGLNKIVRMY	HIV-1 infection	human(B27)	[Nixon (1990), Rowland-Jones (1999)]
	• HIV-1 and HIV-2 cross-reactive CTL clone, highly conserved epitope • Reviewed in Rowland-Jones99, notes that it did not appear cross-reactive with HIV-2 in Rowland-Jones98, HIV-2 form: RRWIQLGLQK				
p24(131–146)	p24(265–279)	KRWIILGLNKIVRMYC	HIV-1 infection	human(B27)	[Bouillot (1989)]
	• HLA-B27 restricted epitope also binds to HLA-A2 and HLA-B37 in solid phase assay				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(131–150)	p24(263–282 SF2)	KRWIILGLNKIVRMYS-PTSI	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 A-2 had CTL response to this peptide • The responding subject was HLA-A3, A32, B51, B62				
p24(131–150)	p24(265–284 SF2)	KRWIILGLNKIVRMYS-PTSI	HIV-1 infection	human(Bw62?)	[van Baalen (1993)]
	• Gag CTL epitope precursor frequencies estimated				
p24(131–152)	p24(263–284 BH10)	KRWIILGLNKIVRMYS-PTSILD	HIV-1 infection	human(Bw62)	[Johnson (1991)]
	• Gag CTL response studied in three individuals				
p24(132–145)	Gag( )	KWILGLNKIVRMY	HIV-infection	human( )	[Weekes (1999a)]
	• Peptide 728: Memory CTL-specific for HIV-1 may contribute to oligoclonal expansions within the CD57+ CD28- CD8+ CTLp populations				
p24(132–145)	Gag( )	KWILGLNKIVRMY	HIV-infection	human(B27)	[Weekes (1999b)]
	• Peptide 728: Almost all CD8+ T cells are CD28+ at birth, and the proportion of CD28-CD8+ cells increases with age – this study examines the contribution of CD8+CD28- cells to CTL memory pools for CTL clones specific for two persistent human viruses, CMV and HIV – clones were found to be similarly distributed in the CD28 depleted cell population • HIV CTL responses to 3 Env and 2 Gag peptides were studied • The clonal composition of the TCR Vbeta responses was studied and was found to be highly focused, with one TCR β-chain sequence tending to dominate the peptide-specific response – clones to this epitope were Vbeta22.1				
p24(134–143)	p24( )	IILGLNKIVR	HIV-1 exposure	human(A33)	[Rowland-Jones (1998b)]
	• HIV-specific CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90–95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B and D clade viruses				
p24(136–145)	p24(268–277 LAI)	LGLNKIVRMY	Predicted from larger peptide	human(Bw62)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • Also P. Johnson, Pers. Comm.				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(136–146)	p24(271–281)	LGLNKIVRMYS	HIV-1 infection	human(B62)	[Lubaki (1997)]
	• Eighty two HIV-1-specific CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a Polyclonal response • A subject who was B62+ had CTL that recognized this peptide, p17 KIRLRPGGKKKYKL, and one additional unknown epitope • The two clones that recognized this epitope used two different Vβ genes, further demonstrating a Polyclonal response				
p24(137–145)	p24( )	GLNKIVRMY	HIV-1 infection	human( )	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ South African living in Durban, HLA A2/- B5802/62 Cw4/6 – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa				
p24(137–145)	p24(272–280 LAI)	GLNKIVRMY	HIV-1 infection	human(B*1501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*1501 epitope				
p24(137–145)	p24(272–280 LAI)	GLNKIVRMY	HIV-1 infection	human(B62)	[Goulder (1997a)]
	• This paper is a review of CTL and immune evasion, but it presents a study of a shift from an HLA-A*0201 response to SLYNTVATL, to a B62 response to GLNKIVRMY • As long as a strong CTL response to SLYNTVATL was evident, the epitope variants SLFNTVATL or SLYNTIATL dominated the viral population – eventually the CTL response to the index peptide became undetectable, the CTL response shifted to a focus on GLNKIVRMY, and the index peptide SLYNTVATL once again established itself as the dominant form				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(137–145)	p24( )	GLNKIVRMY	HIV-1 infection	human(B62)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ African American living in Boston – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(143–150)	p24(273–283 IIIB)	RMYSPTSI	HIV-1 infection	human(B*5201)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*5201 epitope				
p24(143–150)	p24(273–283 IIIB)	RMYSPTSI	HIV-1 infection	human(B52)	[Brander (1999)]
	• Epitope SL9: Multiple natural variations in the SL9 flanking regions of the immunodominant epitope SLYNTVATL were tested and found not to adversely affect CTL recognition or prevent epitope processing, suggesting that viral escape from the HLA-A*0201-restricted CTL response against SLYNTVATL is probably not linked to variations in the flanking regions of this epitope • The CTL response to RMYSPTSI was used as a control				
p24(143–150)	p24(273–283 IIIB)	RMYSPTSI	HIV-1 infection	human(B52)	[Wilson (1999a)]
	• This study describes maternal CTL responses in the context of mother-to-infant transmission • Detection of CTL escape mutants in the mother was associated with transmission, but the CTL-susceptible forms of the virus tended to be found in infected infants • No variants of this epitope were found in a non-transmitting mother that had a CTL response to this epitope				
p24(151–170)	p24(283–302 SF2)	LDIRQGPKEPFRDYVD-RFYK	HIV-1 infection	human( )	[McAdam (1998)]
p24(155–177)	p24(287–309)	QGPKEPFRDYVDRFY-KTLRAEQA	Peptide vaccination	murine( )	[Nakamura (1997)]
	• Mice immunized with this synthetic peptide generated specific CTLs, a proliferative response, and antibodies • The amino acids shown in the epitope field were based on the numbering provided by Nakamura *et al.*, and may not be correct • The CTL epitope was shown to be located in positions 291–300				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(157–178)	p24(290–309)	PKEPFRDYVDRFYKTL-RAEQAS	HIV-1 infection	human(B14)	[Musey (1997)]
	• Cervical and peripheral blood derived CTL clones from an HIV-infected woman recognized this epitope				
p24(161–170)	p24( )	FRDYVDRFYK	HIV-1 infection	human(B*1801)	[Ogg (1998a)]
	• Noted in Brander 1999, this database, to be B*1801, FRDYVDRFY				
p24(161–170)	p24( )	FRDYVDRFYK	HIV-1 infection	human(B*1801)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*1801 epitope				
p24(161–180)	p24(293–312 SF2)	FRDYVDRFYKTLRAE-QASQD	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A2, A3, B8, B62				
p24(161–180)	p24(293–312 SF2)	FRDYVDRFYKTLRAE-QASQD	HIV-1 infection	human( )	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
p24(161–180)	p24(293–312 SF2)	FRDYVDRFYKTLRAE-QASQD	HIV-1 infection	human(B71)	[McAdam (1998)]
p24(162–172)	p24(296–306 Clade A)	RDYVDRFFKTL	HIV-1 infection	human(A*2402)	[Dorrell (1999)]
	• CTL responses in three individuals with non-clade B infections were studied, 2 with subtype A infections, 1 with subtype C – their infections all originated in East Africa • This epitope is similar to the A24 DYVDRYFKT epitope found for B subtype, but CTL from this A subtype infection required the additional Arg – the B clade sequence change from F to Y diminished CTL reactivity • C. Brander notes that this is an A*2402 epitope in the 1999 database				
p24(162–172)	p24(296–306 Clade A)	RDYVDRFFKTL	HIV-1 infection	human(A*2402)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*2402 epitope				
p24(162–172)	p24(293–312 LAI)	RDYVDRFYKTL	HIV-1 infection	human(B*4402)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*4402 epitope				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(162–172)	p24(293–312 LAI)	RDYVDRFYKTL	HIV-1 infection	human(B44,A26 or B70)	[Ogg (1998a)]
p24(164–172)	p24(298–306 Clade A)	YVDRFFKTL	HIV-1 infection	human(A26 or B70)	[Dorrell (1999)]
	• CTL responses in three individuals with non-clade B infections were studied, 2 with subtype A infections, 1 with subtype C – their infections all originated in East Africa • This CTL epitope is conserved in A and C subtype, and B clade sequences tend to have a change from F to Y, YVDRFYKTL – both variants showed strong CTL reactivity • CTL reacted with targets presenting either in the context A26 or B70 – the epitope has the HLA-26 motif of Val at position 2 and Leu at the carboxy terminus, and the B70 anchor residue motif is unknown				
p24(166–174)	p24(298–306 LAI)	DRFYKTLRA	HIV-1 infection	human(B*1402)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*1402 epitope				
p24(166–174)	p24(298–306 IIIB)	DRFYKTLRA	HIV-1 infection	human(B14)	[Wilson (1996)]
	• Epitope defined in the context of the Pediatric AIDS Foundation ARIEL Project, a mother-infant HIV transmission study • DRFYKILRA, a naturally occurring variant, was found in mother, and is recognized although less reactive • DQFYKTLRA, a naturally occurring variant, was found in infant and is not recognized				
p24(166–174)	p24(298–306 IIIB)	DRFYKTLRA	HIV-1 infection	human(B14)	[Cao (1997)]
	• The consensus peptide for clades B and D is DRFYKTLRA • The consensus peptide for clades A and C is DRFFKTLRA and it is equally reactive				
p24(166–174)	p24(298–306 HXB2)	DRFYKTLRA	HIV-1 infection	human(B14)	[Yang (1997b)]
	• A chimeric universal T cell receptor was created by linking CD4 or an HIV-specific anti-gp41 Ig sequence to the signaling domain of the T cell receptor chain ζ, and transducing into CD8+ cells • The response using universal-receptor-bearing CD8+ cells to lyse infected cells *in vitro* was comparable to the natural occurring responses of CTL-clones from HIV+ individuals in terms of kinetics and efficiency • A CTL clone specific for this epitope was used for the comparison				
p24(166–174)	p24( )	DRFWKTLRA	HIV-1 exposure	human(B14)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-defined B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The D subtype consensus is identical to the B clade epitope • The A subtype consensus is drFfKtLRA				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(166–174)	p24(298–306 LAI)	DRFYKTLRA	HIV-1 infection	human(B14)	[Harrer (1996b)]
p24(166–174)	p24(298–306)	DRFYKTLRA	HIV-1 infection	human(B14)	[Yang (1996)]
	• CD4+ cell lines acutely infected with HIV were studied to determine their susceptibility to lysis by CTL • Clones specific for RT lysed HIV-1 infected cells at lower levels than Env or Gag specific clones • The distinction was thought to be due to lower expression of RT relative to Env and Gag • CTL can lyse infected cells early after infection, possibly prior to viral production				
p24(166–174)	p24(298–306)	DRFYKTLRA	HIV-1 infection	human(B14)	[Yang (1997a)]
	• CTL inhibit HIV-1 replication at effector cell concentrations comparable to those found *in vivo* • CTL produced HIV-1-suppressive soluble factors – MIP-1α, MIP-1β, RANTES, after antigen-specific activation • CTL suppress HIV replication more efficiently in HLA-matched cells				
p24(166–174)	p24(298–306)	DRFYKTLRA	*in vitro* stimulation	human(B14)	[Zarling (1999)]
	• This study compares the ability of macrophages and dendritic cells to stimulate primary responses in CD8+ lymphocytes isolated from HLA-appropriate HIV-uninfected donors using peptide-pulsed APC – the dendritic cells performed better as APC for the stimulation of primary responses • Strong CTL responses were elicited by the epitopes DRFYKTLRA and GEIYKRWII when presented by either immature or mature dendritic cells – macrophages were not able to prime a CTL response against DRFYKTLRA • A weak response to KLTPLCVSL was stimulated using macrophages as the APC • No detectable response was observed for the following previously-defined HIV epitopes: KIRLRPGGK, ILKEPVHGV, IRLRPGGK, GPKVKQWPL				
p24(166–174)	p24( )	DRFYKLTRA		human(B14)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, and the B35 allele seems to be protective • HIV-2 sequence: DRFYKSLRA is cross-reactive, [T (1993)]				
p24(166–174)	p24(298–306 IIIB)	DRFYKTLRA	HIV-1 infection	human(B14)	[Wilson (1999a)]
	• This study describes maternal CTL responses in the context of mother-to-infant transmission • Detection of CTL escape mutants in the mother was associated with transmission, but the CTL-susceptible forms of the virus tended to be found in infected infants • DRFYKILRA and DQFYKTLRA were escape mutants				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(166–174)	p24( )	DRFYKTLRA	HIV-1 infection	human(B14)	[Goulder (2000a)]
• The CTL-dominant response was focused on this epitope in 2/5 HIV+ individuals who were HLA B14 living in Boston – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPGGKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa				
p24(166–174)	p24( )	DRFYKTLRA	HIV-1 exposure	human(B14, B*1402)	[Rowland-Jones (1998b)]
• HIV-specific CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90–95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among B and D clade viruses • The Clade A version of the epitope, DRFFKLTRA, was preferentially recognized by CTL • This epitope was recognized by two different exposed and uninfected prostitutes				
p24(166–175)	p24(298–306 HX10)	DRFYKTLRAE	HIV-1 infection	human(B14)	[Wagner (1999)]
• The immunodominant CTL response in a long-term survivor was to this highly conserved and functionally relevant epitope • By testing mutations in an HXB2 background, it was found that all mutations within the epitope that abrogate CTL recognition also abolished viral infectivity • The epitope in this study overlaps the major homology region for which highly conserved residues exist in all known lenti- and onco-viruses and yeast transposons • Patient was part of the study in [Harrer (1996a)]					
p24(173–181)	p24(305–313)	RAEQASQEV	HIV-1 infection	human( )	[Lubaki (1997)]
• Eighty two HIV-1-specific CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a Polyclonal response • Despite this being a well defined conserved epitope, and thought to be presented by B14, none of the 11 Gag-specific clones from a B-14 positive subject could recognize either it or p24 PQDLNTMLN • Thought to be HLA-Cw8 restricted, not B14 as originally reported (C. Brander, B. Walker, and S. Rowland-Jones, personal communication)					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(173–181)	p24(305–313)	RAEQASQEV	HIV-1 infection	human(B14?)	[Price (1995)]
	• Study of cytokines released by HIV-1 specific activated CTL • Thought to be HLA-Cw8 restricted, not B14 as originally reported (C. Brander, B. Walker, and S. Rowland-Jones, personal communication)				
p24(173–181)	p24(305–313)	RAEQASQEV	HIV-1 infection	human(Cw8)	[Johnson (1991)]
	• Originally reported as HLA-B14 restricted, but subsequently found not to be presented by cells transfected with B14 • Thought to be HLA-Cw8 restricted (C. Brander and B. Walker)				
p24(173–181)	p24( )	RAEQASQEV	HIV-1 exposure	human(Cw8)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-defined B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A subtype consensus is RAeQAtQEV • The D subtype consensus is RAEQsQdV • Thought to be HLA-Cw8 restricted, not B14 as originally reported (C. Brander, B. Walker, and S. Rowland-Jones, personal communication)				
p24(174–184)	p24(306–316 LAI)	AEQASQDVKNW		human(B*4402)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*4402 epitope				
p24(174–184)	p24(306–316 LAI)	AEQASQDVKNW		human(B*4402,B44)	[Brander & Walker(1997)]
	• Pers. Comm. from D. Lewinsohn to C. Brander and B. Walker, C Brander *et al.*, this database, 1999				
p24(174–184)	Gag(306–316)	AEQASQEVKNW	HIV-1 infection	human(B44)	[Brodie (1999)]
	• The ability of CTL effector cells was studied by expanding autologous HIV-1 Gag-specific CTL *in vitro*, and adoptively transferring them • The transferred CTLs migrated to the lymph nodes and transiently reduced circulating productively infected CD4+ T cells, showing that CTL move to appropriate target sites and mediate anti-viral effects				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(174–184)	p24(306–316)	AEQASQEVKNW	HIV infection	human(B44)	[Brodie (2000)]
• Study tracks and quantifies *in vivo* migration of neo-marked CD8 HIV-specific CTL • Adoptively transferred gene-marked HIV-specific CTL homed to specific lymph node sites, colocalizing within the parafollicular regions of the lymph node adjacent to cells expressing HIV Tat-fusion transcripts, indicative of viral replication • The CTL clones expressed CCR5 and localized among HIV-1 infected cells expressing MIP-1α and MIP-1β, CC-chemokines produced at sites of viral replication, suggesting a possible homing mechanism • This study provides a methodology for tracking and studying antigen specific CTL *in vivo*					
p24(175–186)	p24(307–318)	EQASQEVKNWMT	HIV-1 infection	human(B44)	[Quayle (1998)]
• HIV is found in semen both as cell-associated and cell-free forms, and HIV-specific CTL could be found in the semen of 5/5 men with CD4 greater than 500 – 3 of the men were analyzed in detail and had broad CTL to Gag, Env and Pol • Two CTL lines from one donor recognized this epitope • Isolation of CTLs specific to HIV in both male and female urinal tracts provide evidence that virus-specific lymphocytes come from the urogenital mucosa, and the authors speculate that CTL in mucosal tissues may be correlated with lower viral load in semen and reduced transmission					
p24(176–184)	p24(308–316 LAI)	QASQEVKNW	HIV-1 infection	human(B*5301)	[Brander & Goulder(2001)]
• C. Brander notes this is a B*5301 epitope					
p24(176–184)	p24(309–317 LAI)	QASQEVKNW	HIV-1 infection	human(B*5701)	[Goulder (1996b)]
• Recognition of this peptide by two long-term non-progressors • Peptide defined on the basis of B*5801 binding motif, yet not cross-restricted except at high concentrations • Described as B*5701 in C. Brander *et al.*, this database, 1999					
p24(176–184)	p24(311–319 LAI)	QASQEVKNW	HIV-1 infection	human(B*5701)	[Brander & Goulder(2001)]
• C. Brander notes this is a B*5701 epitope					
p24(176–184)	p24(308–316 LAI)	QASQEVKNW	HIV-1 infection	human(B53)	[Buseyne (1997)]
• Minimal sequence determined through epitope mapping • This is a relatively conserved epitope • HLA-Cw*0401 was defined as the restricting element, but cells that carry Cw*0401 varied in their ability to present this epitope – this could be the result of diminished cell-surface expression of Cw*0401 in some cells • The HLA presenting molecule for this epitope was originally described as Cw*0401, but subsequent experiments with an HLA B53+ C4- cell line and with C1R cells transfected with HLA-B53 have shown that the HLA restricting element is HLA-B53 (Pers. Comm., Dr. Florence Buseyne, 2000)					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(176–184)	( )	QASQEVKNW		(B53)	[Brander & Goulder(2001), Buseyne (1996), Buseyne (1997), Buseyne(1999)]
p24(176–184)	( )	QASQEVKNW		(Cw4)	[Brander & Goulder(2001), Buseyne (1997), Buseyne(1999)]
p24(181–190)	p24(313–322 LAI) • P. Johnson, pers. comm.	VKNWMTETLL		human(B8)	[Brander & Walker(1996)]
p24(191–205)	p24(323–337) • Two CTL epitopes defined (see also p17(21–35))	VQNANPDCKTILKAL	HIV-1 infection	human(B8)	[Nixon & McMichael(1991)]
p24(191–205)	p24(325–339 SF2) • Longitudinal study of CTL escape mutants in people with the appropriate HLA types – little variation was observed in the immunodominant B27 epitope, relative to the B8 epitopes, which varied over time • [Goulder (1997a)] is a review of immune escape that points out that there may be a protective effect associated with B27, and that HLA-B8 individuals tend to progress more rapidly than HLA B27 patients	VQNANPDCKTILKAL	HIV-1 infection	human(B8)	[Phillips (1991), Goulder (1997a)]
p24(191–210)	p24(323–342 SF2) • Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • Three of these 12 had CTL response to this peptide • The responding subjects were HLA-A3, A24, B8, B55; HLA-A1, A11, B8, B27	VQNANPDCKTILKAL-GPAAT	HIV-1 infection	human( )	[Lieberman (1997a)]
p24(191–210)	p24(323–342 SF2) • CTL expanded *ex vivo* were later infused into HIV-1 infected patients	VQNANPDCKTILKAL-GPAAT	HIV-1 infection	human( )	[Lieberman (1997b)]
p24(193–201)	Gag(327–335 SF2) • HLA-B27, -B51, and -B57 are associated with slow progression to AIDS, while HLA-B35, -B8, -B24 are associated with a rapid progression to AIDS (Nat. Med. 2:405, 1996;Lancet 22:1187, 1986;Hum Immunol 22:73, 1988;Hum Immunol 44:156, 1995) • 15% of Japanese populations carry HLA-B51 while HLA-B27 and -B57 are detected in less than 0.3% • Of the 172 HIV-1 peptides with HLA-B*5101 anchor residues, 33 bound to HLA-B*5101, seven of these peptides were reactive with CTL from 3 B*5101 positive individuals, and six were properly processed • Four of the six epitopes were highly conserved among B subtype sequences, NANPDCKTI is conserved	NANPDCKTI	HIV-1 infection	human(B*5101)	[Tomiyama (1999)]

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(193–201)	p24(325–333)	NANPDCKTI?	HIV-1 infection	human(B51)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty five optimally defined peptides from this database were used to screen for gamma interferon responses to other epitopes • 3/11 of the HLA A2+ individuals were HLA B51 and two of these responded to this epitope as well as to other epitopes				
p24(193–201)	p24(324–335 IIIB)	NANPDCKTI	HIV-1 infection	human(B51)	[Wilson (1999a)]
	• This study describes maternal CTL responses in the context of mother-to-infant transmission • Detection of CTL escape mutants in the mother was associated with transmission, but the CTL-susceptible forms of the virus tended to be found in infected infants • No variants of this epitope were found in a non-transmitting mother that had a CTL response to this epitope				
p24(195–202)	p24(323–342)	NPDCKTIL	HIV-1 infection	human(B35)	[Bernard (1998)]
	• This study focuses on six rare long-term survivor HIV-infected people who were infected for many years without exhibiting immune dysregulation – such immunologically normal HIV-infected (INHI) cases occur at a frequency between 0.1 and 1% in the infected population • No direct CTL were found in any of the six INHIs, but above background CTLp activity was founded in 3/6 INHIs • Epitope sequences were deduced from larger reactive peptides based on HLA binding motifs – XPXXXXXL is a B35 binding motif				
p24(197–205)	p24(329–337 LAI)	DCKTILKAL		human(B*0801)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0801 epitope				
p24(197–205)	p24(329–337 LAI)	DCKTILKAL		human(B8)	[Sutton (1993)]
	• Predicted epitope based on B8-binding motifs, from larger peptide VQNANPDCKTILKAL				
p24(197–205)	p24(329–337)	DCKTILKAL	HIV-1 infection	human(B8)	[Nowak (1995)]
	• In a longitudinal study of CTL response and immune escape – the variant DCRTILKAL was also found, binds to B8, but is not recognized				
p24(197–205)	p24(329–337)	DCKTILKAL		human(B8)	[McAdam (1995)]
	• Defined as minimal epitope by titration and binding studies				
p24(197–205)	p24(197–205)	DCKTILKAL		human(B8)	[Goulder (1997g)]
	• Included in a study of the B8 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(211–230)	p24(345–364 SF2)	LEEMMTACQGVGGPG-HKARV	HIV-1 infection	human( )	[van Baalen (1993)]
	• Gag CTL epitope precursor frequencies estimated, peptide mapping				
p24(211–230)	p24(343–362 SF2)	LEEMMTACQGVGGPG-HKARV	HIV-1 infection	human(B7)	[McAdam (1998)]
p24(211–231)	p24(343–362 SF2)	LEEMMTACQGVGGPG-HKARVL	HIV-1 infection	human( )	[Lieberman (1997a)]
	• Of 25 patients, most had CTL-specific for more than 1 HIV-1 protein • Twelve subjects had CTL that could recognize vaccinia-expressed LAI Gag • One of these 12 had CTL response to this peptide • The responding subject was HLA-A1, A2, B50, B57				
p24(217–227)	p24(349–359 IIIB)	ACQGVGGPGHK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
p24(217–227)	p24(349–359 IIIB)	ACQGVGGPGHK	HIV-1 infection	human(A11)	[Sipsas (1997)]
	• HIV IIIB proteins were used to define the range of CTL epitopes recognized by three lab workers accidentally infected with HIV-1 IIIB • ACQGVGGPSHK, a variant found in HIV RF, was also recognized				
p24(217–227)	p24( )	ACQGVGGPGHK	HIV-1 infection	human(A11)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ Caucasian living in Boston – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(223–231)	p24(355–363 LAI)	GPGHKARVL	HIV-1 infection	human(B7)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • One had a strong response to this peptide, the other a weak response • [Goulder (1997a)] is a review of immune escape that summarizes this study				

HIV CTL Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(223–231)	p24( )	GPSHKARVL	HIV-1 infection	human(B7)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ Caucasian living in Boston – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24(223–231)	p24( )	GPSHKARVL	HIV-1 infection	human(B7)	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ Caucasian living in Boston – this epitope did not fall within the three most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			
p24( )	p24( )		HIV-1 infection	human( )	[Goulder (2000a)]
	• The CTL-dominant response was focused on this epitope in an HIV+ South African – this epitope did not fall within the five most recognized peptides in the study • Three peptides GSEELRSLYNTVATL (p17 residues 71–85), SALSEGATPQDLNTMLNTVG (p24 41–60), and WEKIRLRPG-GKKKYKLK(p17 16–30) contained the dominant Gag-specific epitope in 31 out of 44 B-clade infected individuals from Boston who showed Gag-CTL responses • Five peptides RLRPGGKKHYMIKHLVW (p17 20–36), ELRSLYNTVATLYCV (p17Gag 74–88), SALSEGATPQDLNTMLNTVG (p24 41–60), FRDYVDRFFKTLRAEQA (p24 161–177), and SILDIKQGKEPFRDY (p24 149–164) contained dominant Gag-specific epitopes in 32 out of 37 C-clade infected subjects from South Africa			