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Group 1: Kidney/Pancreas

Bead	Antigen ID	Protein	Organ	Description	References	Gene
005	VIM	Vimentin	Kidney, Heart	Cytoskeleton protein also secreted by endothelial cells, vascular smooth muscle cells, activated platelets and apoptotic T cells and neutrophils.	<ul style="list-style-type: none"> Zhang X, Reinsmoen NL. Impact of Non-Human Leukocyte Antigen-Specific Antibodies in Kidney and Heart Transplantation. <i>Front Immunol.</i> 2017 Apr 13;8:434 Lopez-Soler RI, Borgia JA, Kanangat S, Fhied CL, Conti DJ, Constantino D, Ata A, Chan R, Wang Z. Anti-vimentin Antibodies Present at the Time of Transplantation May Predict Early Development of Interstitial Fibrosis/Tubular Atrophy. <i>Transplant Proc.</i> 2016 Jul-Aug;48(6):2023-33 Carter V, Howell, WM. Vimentin antibody production in transplant patients and immunomodulatory effects of vimentin in-vitro. <i>Human Immunology.</i> 2013 Nov;74(11):1463-9 	http://www.uniprot.org/uniprot/P08670
011	AGT	Angiotensinogen	Kidney	Essential component of the renin-angiotensin system (RAS), a potent regulator of blood pressure, body fluid and electrolyte homeostasis	<ul style="list-style-type: none"> Li L, Sigdel T, Vitalone M, Lee SH, Sarwal M, Differential immunogenicity and clinical relevance of kidney compartment specific antigens after renal transplantation. <i>J Proteome Res.</i> 2010 Dec 3;9(12):6715-21 Li L, Wadia P, Chen R, Kambham N, Naesens M, Sigdel TK, et al. Identifying compartment-specific non-HLA targets after renal transplantation by integrating transcriptome and "antibodyome" measures. <i>Proc Natl Acad Sci USA</i> 2009;106(11):4148 	http://www.uniprot.org/uniprot/P01019
021	PECR	Peroxisomal trans-2-enoyl-CoA reductase	Kidney	Participates in chain elongation of fatty acids. Has no 2,4-dienoyl-CoA reductase activity.	<ul style="list-style-type: none"> Dinavahi R, George A, Tretin A, Akalin E, Ames S, Bromberg JS, Deboccardo G, Dipaola N, Lerner SM, Mehrotra A, Murphy BT, Nadasdy T, Paz-Artal E, Salomon DR, Schröppel B, Sehgal V, Sachidanandam R, Heeger PS. Antibodies reactive to non-HLA antigens in transplant glomerulopathy. <i>J Am Soc Nephrol.</i> 2011 Jun;22(6):1168-78 	http://www.uniprot.org/uniprot/Q9BY49
024	CXCL11	C-X-C motif chemokine 11	Kidney	Chemotactic for interleukin-activated T-cells but not unstimulated T-cells, neutrophils or monocytes. Induces calcium release in activated T-cells.	<ul style="list-style-type: none"> Sigdel TK, Li L, Tran TQ, Khatri P, Naesens M, Sansanwal P, et al. Non-HLA antibodies to immunogenic epitopes predict the evolution of chronic renal allograft injury. <i>J Am Soc Nephrol</i> 2012;23(4):750 	http://www.uniprot.org/uniprot/O14625
026	CXCL9	C-X-C motif chemokine 9	Kidney	Cytokine that affects the growth, movement, or activation state of cells that participate in immune and inflammatory response. Chemotactic for activated T-cells.	<ul style="list-style-type: none"> Sigdel TK, Li L, Tran TQ, Khatri P, Naesens M, Sansanwal P, et al. Non-HLA antibodies to immunogenic epitopes predict the evolution of chronic renal allograft injury. <i>J Am Soc Nephrol</i> 2012;23(4):750 	http://www.uniprot.org/uniprot/Q07325
027	AGRN	Agrin	Kidney	Involved in regulation of neurite outgrowth. Also involved in modulation of growth factor signaling.	<ul style="list-style-type: none"> Joosten SA, Sijpkens YW, van Ham V, Trouw LA, van der Vlag J, van den Heuvel B, van Kooten C, Paul LC. Antibody response against the glomerular basement membrane protein agrin in patients with transplant glomerulopathy. <i>Am J Transplant.</i> 2005 Feb;5(2):383-93 	http://www.uniprot.org/uniprot/O00468

Group 1: Kidney/Pancreas

Bead	Antigen ID	Protein	Organ	Description	References	Gene
031	IFNG	Interferon gamma	Kidney	Produced by lymphocytes activated by specific antigens or mitogens. IFN-gamma has important immunoregulatory functions. It is a potent activator of macrophages, it has antiproliferative effects on transformed cells and it can potentiate the antiviral and antitumor effects of the type I interferons.	<ul style="list-style-type: none"> Sigdel TK, Li L, Tran TQ, Khatri P, Naesens M, Sansanwal P, et al. Non-HLA antibodies to immunogenic epitopes predict the evolution of chronic renal allograft injury. <i>J Am Soc Nephrol</i> 2012;23(4):750 	http://www.uniprot.org/uniprot/P17803
038	PLA2R	Secretory phospholipase A2 receptor	Kidney	Receptor for secretory phospholipase A2 (sPLA2). May be involved in responses in proinflammatory cytokine productions during endotoxic shock.	<ul style="list-style-type: none"> Dai H, Zhang H, He Y. Diagnostic accuracy of PLA2R autoantibodies and glomerular staining for the differentiation of idiopathic and secondary membranous nephropathy: an updated meta-analysis. <i>Sci Rep.</i> 2015 Mar 5;5:8803 	http://www.uniprot.org/uniprot/Q13018
012	PTPRN	Receptor-type tyrosine-protein phosphatase-like N	Pancreas	Required for normal accumulation of secretory vesicles in hippocampus, pituitary and pancreatic islets. Required for the accumulation of normal levels of insulin-containing vesicles and preventing their degradation.	<ul style="list-style-type: none"> Burke GW 3rd, Vendrame F, Virdi SK, Ciancio G, Chen L, Ruiz P, Messinger S, Reijonen HK, Pugliese A. Lessons From Pancreas Transplantation in Type 1 Diabetes: Recurrence of Islet Autoimmunity. <i>Curr Diab Rep.</i> 2015 Dec;15(12):121 Wiberg A, Granstam A, Ingvast S, Härkönen T, Knip M, Korsgren O, Skog O. Characterization of human organ donors testing positive for type 1 diabetes-associated autoantibodies. <i>Clin Exp Immunol.</i> 2015 Dec;182(3):278-88 Pugliese A, Reijonen HK, Nepom J, Burke GW 3rd. Recurrence of autoimmunity in pancreas transplant patients: research update. <i>Diabetes Manag (Lond).</i> 2011 Mar; 1(2): 229-238 	http://www.uniprot.org/uniprot/Q16849
033	REG3A	Regenerating islet-derived protein 3-alpha	Pancreas	Bactericidal C-type lectin which acts exclusively against Gram-positive bacteria and mediates bacterial killing by binding to surface-exposed carbohydrate moieties of peptidoglycan.	<ul style="list-style-type: none"> van der Pijl JW, Boonstra JG, Barthelemy S, Smets YF, Hermans J, Bruijn JA, de Fijter JW, Daha MR, Dagorn JC. Pancreatitis-associated protein: a putative marker for pancreas graft rejection. <i>Transplantation.</i> 1997 Apr 15;63(7):995-1003 	http://www.uniprot.org/uniprot/Q06141

Group 1: Heart/Lung

Bead	Antigen ID	Protein	Organ	Description	References	Gene
003	ENO1	Alpha-enolase	Heart	Receptor and activator of plasminogen on cell surface of leukocytes and neurons. Stimulates immunoglobulin production	<ul style="list-style-type: none"> Shi J, Li Y, Yang X, Yang D, Zhang Y, Liu Y. Upregulation of α-enolase in acute rejection of cardiac transplant in rat model: implications for the secretion of interleukin-17. <i>Pediatr Transplant</i>. 2014 Sep;18(6):575-85 	http://www.uniprot.org/uniprot/P06733
007	CD36	Platelet glycoprotein 4	Heart	Receptor for multiple ligands including fibronectin and collagen. Cellular response to these ligands are involved in angiogenesis, inflammatory response, fatty acid metabolism.	<ul style="list-style-type: none"> Ationu A (1998). Identification of endothelial antigens relevant to transplant coronary artery disease from a human endothelial cell cDNA expression library. <i>Int J Mol Med</i> 1:1007-1010 	http://www.uniprot.org/uniprot/P16671
010	Myosin	Myosin-binding protein C, cardiac-type	Heart	Thick filament-associated protein. In vitro it binds MHC, F-actin and native thick filaments, and modifies the activity of actin-activated myosin ATPase	<ul style="list-style-type: none"> Zhang X, Reinsmoen NL. Impact of Non-Human Leukocyte Antigen-Specific Antibodies in Kidney and Heart Transplantation. <i>Front Immunol</i>. 2017 Apr 13;8:434 Kalache S, Dinavahi R, Pinney S, Mehrotra A, Cunningham MW, Heeger PS. Anticardiac myosin immunity and chronic allograft vasculopathy in heart transplant recipients. <i>J Immunol</i>. 2011 Jul 15;187(2):1023-30 Nath DS, Ilias Basha H, Tiriveedhi V, Alur C, Phelan D, Ewald GA, Moazami N, Mohanakumar T. Characterization of immune responses to cardiac self-antigens myosin and vimentin in human cardiac allograft recipients with antibody mediated rejection and cardiac allograft vasculopathy. <i>J Heart Lung Transplant</i>. 2010;29(11):1277-85 	http://www.uniprot.org/uniprot/Q14896
030	HNRNPK	Heterogeneous nuclear ribonucleoprotein K	Heart	One of the major pre-mRNA-binding proteins. Plays an important role in p53/TP53 response to DNA damage, acting at the level of both transcription activation and repression.	<ul style="list-style-type: none"> Acevedo MJ, Caro-Oleas JL, Alvarez-Marquez AJ, Sobrino JM, Lage-Galle E, Aguilera I, et al. Antibodies against heterogeneous nuclear ribonucleoprotein K in patients with cardiac allograft vasculopathy. <i>J Heart Lung Transplant</i> 2011;30(9):1051 	http://www.uniprot.org/uniprot/P61978
006	TUBA1B	Tubulin alpha-1B chain	Lung	Major part of microtubules for cytoskeleton	<ul style="list-style-type: none"> Tiriveedhi V, Gautam B, Sarma NJ, Askar M, Budev M, Aloush A, Hachem R, Trulock E, Myers B, Patterson AG, Mohanakumar T. Pre-transplant antibodies to Kα1 tubulin and collagen-V in lung transplantation: clinical correlations. <i>The Journal of Heart and Lung Transplantation</i>. 2013 Aug;32(8):807-14 Hachem RR, Tiriveedhi V, Patterson GA, Aloush A, Trulock EP, Mohanakumar T. Antibodies to K-α 1 tubulin and collagen V are associated with chronic rejection after lung transplantation. <i>Am J Transplant</i>. 2012 Aug;12(8):2164-71 Goers TA, Ramachandran S, Aloush A, Trulock E, Patterson GA, Mohanakumar T. De novo production of K-alpha1 tubulin-specific antibodies: role in chronic lung allograft rejection. <i>J Immunol</i> 2008;180(7):4487. 	http://www.uniprot.org/uniprot/P68363

Group 1: HSCT

Bead	Antigen ID	Protein	Organ	Description	References	Gene
014	CHAF1B	Chromatin assembly factor 1 subunit B	HSCT	Complex that is thought to mediate chromatin assembly in DNA replication and DNA repair.	<ul style="list-style-type: none"> Wadia PP, Coram M, Armstrong RJ, Mindrinos M, Butte AJ, Miklos DB. Antibodies specifically target AML antigen NuSAP1 after allogeneic bone marrow transplantation. <i>Blood</i> 2010;115(10):2077 	http://www.uniprot.org/uniprot/Q13112
017	GSTT1	Glutathione S-transferase theta-1	HSCT, Liver, Kidney	Member of a superfamily of proteins that catalyze the conjugation of reduced glutathione to a variety of electrophilic and hydrophobic compounds.	<ul style="list-style-type: none"> Aguilera I, Sousa JM, Núñez-Roldán A. Clinical relevance of GSTT1 mismatch in solid organ and hematopoietic stem cell transplantation. <i>Hum Immunol.</i> 2013 Nov;74(11):1470-3 Alvarez-Márquez A, Aguilera I, Gentil MA, Caro JL, Bernal G, Fernández Alonso J, Acevedo MJ, Cabello V, Wichmann I, Gonzalez-Escribano MF, Núñez-Roldán A. Donor-specific antibodies against HLA, MICA, and GSTT1 in patients with allograft rejection and C4d deposition in renal biopsies. <i>Transplantation.</i> 2009 Jan 15;87(1):94-9 Aguilera I, Sousa JM, Gavilán F, Bernardos A, Wichmann I, Nuñez-Roldán A. Glutathione S-transferase T1 mismatch constitutes a risk factor for de novo immune hepatitis after liver transplantation. <i>Liver Transpl.</i> 2004 Sep;10(9):1166-72 	http://www.uniprot.org/uniprot/P30711
019	NUSAP1	Nucleolar and spindle-associated protein 1	HSCT	Microtubule-associated protein with the capacity to bundle and stabilize microtubules.	<ul style="list-style-type: none"> Wadia PP, Coram M, Armstrong RJ, Mindrinos M, Butte AJ, Miklos DB. Antibodies specifically target AML antigen NuSAP1 after allogeneic bone marrow transplantation. <i>Blood</i> 2010;115(10):2077 	http://www.uniprot.org/uniprot/Q9BXS6

Group 1: Experimental

Bead	Antigen ID	Protein	Description	Gene
004	FLRT2	Leucine-rich repeat transmembrane protein FLRT2	Functions in cell-cell adhesion, cell migration and axon guidance. Anti-endothelial cell antibody (AECA) of lupus	http://www.uniprot.org/uniprot/O43155
009	IFIH1	Interferon-induced helicase C domain-containing protein 1	Innate immune receptor which plays a role in sensing viral infection and activation of antiviral responses including the induction of type I interferons and proinflammatory cytokines	http://www.uniprot.org/uniprot/Q9BYX4
013	AURKA	Aurora kinase A-interacting protein	May act as a negative regulator of Aurora-A kinase (regulator of cell cycle progression), by down-regulation through proteasome-dependent degradation.	http://www.uniprot.org/uniprot/Q9NWT8
015	PPIA	Peptidyl-prolyl cis-trans isomerase A	PPases accelerate the folding of proteins. The encoded protein is a cyclosporin binding-protein and may play a role in cyclosporin A-mediated immunosuppression.	http://www.uniprot.org/uniprot/P62937
016	EIF2A	Eukaryotic translation initiation factor 2A	Functions in the early steps of protein synthesis of a small number of specific mRNAs	http://www.uniprot.org/uniprot/Q9BY44
018	LMNA	Prelamin-A/C	Lamins are components of the nuclear lamina, a fibrous layer on the nucleoplasmic side of the inner nuclear membrane, which is thought to provide a framework for the nuclear envelope and may also interact with chromatin.	http://www.uniprot.org/uniprot/P02545
020	PRKCZ	Protein kinase C zeta type	In the inflammatory response, is required for the T-helper 2 (Th2) differentiation process, including interleukin production, efficient activation of JAK1 and the subsequent phosphorylation and nuclear translocation of STAT6. May be involved in development of allergic airway inflammation (asthma), a process dependent on Th2 immune response	http://www.uniprot.org/uniprot/Q05513
022	PRKCH	Protein kinase C eta type	Involved in the regulation of cell differentiation in keratinocytes and pre-B cell receptor, mediates regulation of epithelial tight junction integrity and foam cell formation, and is required for glioblastoma proliferation and apoptosis prevention in MCF-7 cells	http://www.uniprot.org/uniprot/P24723
023	LMNB	Lamin-B1	Lamins are components of the nuclear lamina, a fibrous layer on the nucleoplasmic side of the inner nuclear membrane, which is thought to provide a framework for the nuclear envelope and may also interact with chromatin.	http://www.uniprot.org/uniprot/P20700
025	CXCL10	C-X-C motif chemokine 10	Chemotactic for monocytes and T-lymphocytes.	http://www.uniprot.org/uniprot/P02778
028	ARHGDIB	Rho GDP-dissociation inhibitor 2	Regulates the GDP/GTP exchange reaction of the Rho proteins. Regulates reorganization of the actin cytoskeleton mediated by Rho family members.	http://www.uniprot.org/uniprot/P52566
029	GDNF	Glial cell line-derived neurotrophic factor	Neurotrophic factor that enhances survival and morphological differentiation of dopaminergic neurons and increases their high-affinity dopamine uptake.	http://www.uniprot.org/uniprot/P39905
034	GAPDH	Glyceraldehyde-3-phosphate dehydrogenase	Plays a role in glycolysis and nuclear functions including transcription, RNA transport, DNA replication and apoptosis. Component of the GAIT complex which mediates interferon-gamma-induced transcript-selective translation inhibition in inflammation processes.	http://www.uniprot.org/uniprot/P04406
036	TNFA	Tumor necrosis factor	Impairs regulatory T-cells (Treg) function in individuals with rheumatoid arthritis. Upregulates the expression of protein phosphatase 1 (PP1), which inactivates FOXP3 and rendering Treg functionally defective.	http://www.uniprot.org/uniprot/P01375

Group 2: Kidney and Lung

Bead	Antigen ID	Protein	Organ	Description	References	Gene
44	LG3	Basement membrane-specific heparan sulfate proteoglycan core protein (aka perlecan)	Lung, Kidney	Novel accelerator of immune-mediated vascular injury and obliterative remodeling	<ul style="list-style-type: none">• Cardinal H, Dieudé M, Hébert MJ. The Emerging Importance of Non-HLA Autoantibodies in Kidney Transplant Complications. <i>J Am Soc Nephrol</i>. 2016 Oct 17• Cardinal H1, et al. Antiperlecan antibodies are novel accelerators of immune-mediated vascular injury. <i>Am J Transplant</i>. 2013 Apr;13(4):861-74• Joosten SA, van Dixhoorn MG, Borrias MC, et al. Antibody response against perlecan and collagen types IV and VI in chronic renal allograft rejection in the rat. <i>Am J Pathol</i> 2002; 160: 1301–1310.	http://www.uniprot.org/uniprot/P98160

Group 3: Kidney and Lung

Bead	Antigen ID	Protein	Organ	Description	References	Gene
005	COL1	Collagen I	Kidney	Is the major insoluble fibrous protein in the extracellular matrix and in connective tissue	<ul style="list-style-type: none"> Bakker RC, Koop K, Sijpkens YW, Eikmans M, Bajema IM, De Heer E, Bruijn JA, Paul LC. Early interstitial accumulation of collagen type I discriminates chronic rejection from chronic cyclosporine nephrotoxicity. <i>J Am Soc Nephrol.</i> 2003 Aug;14(8):2142-9 	http://www.uniprot.org/uniprot/P02452
021	COL3	Collagen III	Kidney	In most soft connective tissues. Is crucial for collagen I fibrillogenesis and for normal cardiovascular development	<ul style="list-style-type: none"> Bakker RC, Koop K, Sijpkens YW, Eikmans M, Bajema IM, De Heer E, Bruijn JA, Paul LC. Early interstitial accumulation of collagen type I discriminates chronic rejection from chronic cyclosporine nephrotoxicity. <i>J Am Soc Nephrol.</i> 2003 Aug;14(8):2142-9 	http://www.uniprot.org/uniprot/P02461
024	COL4	Collagen IV	Kidney	Essential for basement membrane stability in basal lamina	<ul style="list-style-type: none"> Angaswamy N, Klein C, Tiriveedhi V, Gaut J, Anwar S, Rossi A, Phelan D, Wellen JR, Shenoy S, Chapman WC, Mohanakumar T. Immune responses to collagen-IV and fibronectin in renal transplant recipients with transplant glomerulopathy. <i>Am J Transplant.</i> 2014 Mar;14(3):685-93 Joosten SA, van Dixhoorn MG, Borrias MC, et al. Antibody response against perlecan and collagen types IV and VI in chronic renal allograft rejection in the rat. <i>Am J Pathol</i> 2002; 160: 1301–1310. 	http://www.uniprot.org/uniprot/P29400
027	FN1	Fibronectin	Kidney	As an Integrin. Binds extracellular matrix components such as collagen, fibrin, and heparan sulfate proteoglycans	<ul style="list-style-type: none"> Angaswamy N, Klein C, Tiriveedhi V, Gaut J, Anwar S, Rossi A, Phelan D, Wellen JR, Shenoy S, Chapman WC, Mohanakumar T. Immune responses to collagen-IV and fibronectin in renal transplant recipients with transplant glomerulopathy. <i>Am J Transplant.</i> 2014 Mar;14(3):685-93 	http://www.uniprot.org/uniprot/P02751
026	COL5	Collagen V	Lung	Structure support proteins. Control initial Collagen fibril assembling	<ul style="list-style-type: none"> Tiriveedhi V, Angaswamy N, Brand D, Weber J, Gelman AG, Hachem R, et al. A shift in the collagen V antigenic epitope leads to T helper phenotype switch and immune response to self-antigen leading to chronic lung allograft rejection. <i>Clin Exp Immunol</i> 2012;167(1):158. Burlingham WJ, Love RB, Jankowska-Gan E, Haynes LD, Xu Q, Bobadilla JL, et al. IL-17-dependent cellular immunity to collagen type V predisposes to obliterative bronchiolitis in human lung transplants. <i>J Clin Invest</i> 2007;117(11):3498. Haque MA, Mizobuchi T, Yasufuku K, Fujisawa T, Brutkiewicz RR, Zheng Y, Woods K, Smith GN, Cummings OW, Heidler KM, Blum JS, Wilkes DS. Evidence for immune responses to a self-antigen in lung transplantation: role of type V collagen-specific T cells in the pathogenesis of lung allograft rejection. <i>J Immunol.</i> 2002 Aug 1;169(3):1542-9 	http://www.uniprot.org/uniprot/P20908
011	COL2	Collagen II		Is the primary protein in cartilage. Associated with antibody induced rheumatoid arthritis		http://www.uniprot.org/uniprot/P02458