

Supplementary material

Supplementary Table S1. List of proteoglycan genes together with those reported to be expressed by the placenta.

Entrez Gene ID	Gene Symbol	Gene Name	Reported in placenta
176	<i>ACAN</i>	aggrecan	
375790	<i>AGRN</i>	agrin	[1]
54829	<i>ASPN</i>	asporin	
63827	<i>BCAN</i>	brevican	
633	<i>BGN</i>	biglycan	[2-4]
960	<i>CD44</i>	CD44 molecule (Indian blood group)	[5-8]
1101	<i>CHAD</i>	chondroadherin	
1303	<i>COL12A1</i>	collagen, type XII, alpha 1	[9]
1306	<i>COL15A1</i>	collagen, type XV, alpha 1	[10]
80781	<i>COL18A1</i>	collagen, type XVIII	[11]
1298	<i>COL9A2</i>	collagen, type IX, alpha 2	
1464	<i>CSPG4</i>	chondroitin sulfate proteoglycan 4	[12]
10675	<i>CSPG5</i>	chondroitin sulfate proteoglycan 5 (neuroglycan C)	
1634	<i>DCN</i>	decorin	[13-17]
1842	<i>ECM2</i>	extracellular matrix protein 2, female organ and adipocyte specific	
1833	<i>EPYC</i>	epiphycan	
2331	<i>FMOD</i>	fibromodulin	
2817	<i>GPC1</i>	glypican-1	[18-20]
221914	<i>GPC2</i>	glypican-2	
2719	<i>GPC3</i>	glypican-3	[20-22]
2239	<i>GPC4</i>	glypican-4	
2262	<i>GPC5</i>	glypican-5	
10082	<i>GPC6</i>	glypican-6	
3339	<i>HSPG2</i>	heparan sulfate proteoglycan 2 (perlecan)	[23]
11081	<i>KERA</i>	keratocan	
64175	<i>P3H1</i> (<i>LEPRE1</i>)	prolyl 3-hydroxylase 1 (leucine proline-enriched proteoglycan, leprecan-1)	
4060	<i>LUM</i>	lumican	[24, 25]
1463	<i>NCAN</i>	neurocan	
60506	<i>NYX</i>	nyctalopin	
4969	<i>OGN</i>	osteoglycin	
4958	<i>OMD</i>	osteomodulin	
26254	<i>OPTC</i>	opticin	
127435	<i>PODN</i>	podocan	[26]
79883	<i>PODNL1</i>	podocan-like 1	
5549	<i>PRELP</i>	proline/arginine-rich end leucine-rich repeat protein	
5803	<i>PTPRZ1</i>	protein tyrosine phosphatase, receptor-type, Z polypeptide 1	
6382	<i>SDC1</i>	syndecan-1	[27-29]
6383	<i>SDC2</i>	syndecan-2	[30]
9672	<i>SDC3</i>	syndecan-3	[30]
6385	<i>SDC4</i>	syndecan-4	[18, 30, 31]
9126	<i>SMC3</i>	structural maintenance of chromosomes 3 (bamacan)	
6695	<i>SPOCK1</i>	sparc/osteonectin, cwcv and kazal-like domains proteoglycan (testican-1)	

9806	<i>SPOCK2</i>	sparc/osteonectin, cwcw and kazal-like domains proteoglycan (testican 2)	
50859	<i>SPOCK3</i>	sparc/osteonectin, cwcw and kazal-like domains proteoglycan (testican 3)	
5552	<i>SRGN</i>	serglycin	
7049	<i>TGFBR3</i>	transforming growth factor, beta receptor III (betaglycan)	[32-34]
25987	<i>TSKU</i>	tsukushi, small leucine rich proteoglycan	
1462	<i>VCAN</i>	versican	

References

- Chen, C. P.; Liu, S. H.; Lee, M. Y.; Chen, Y. Y., Heparan sulfate proteoglycans in the basement membranes of the human placenta and decidua. *Placenta* **2008**, 29, (4), 309-16.
- Wiberg, C.; Hedbom, E.; Khairullina, A.; Lamande, S. R.; Oldberg, A.; Timpl, R.; Morgelin, M.; Heinegard, D., Biglycan and decorin bind close to the n-terminal region of the collagen VI triple helix. *The Journal of biological chemistry* **2001**, 276, (22), 18947-52.
- Goryszewska-Szczurek, E.; Baryla, M.; Kaczynski, P.; Wacławik, A., Prokineticin 1-prokineticin receptor 1 signaling in trophoblast promotes embryo implantation and placenta development. *Sci Rep* **2021**, 11, (1), 13715.
- Chui, A.; Gunatillake, T.; Brennecke, S. P.; Ignjatovic, V.; Monagle, P. T.; Whitelock, J. M.; van Zanten, D. E.; Eijssink, J.; Wang, Y.; Deane, J.; Borg, A. J.; Stevenson, J.; Erwich, J. J.; Said, J. M.; Murthi, P., Expression of Biglycan in First Trimester Chorionic Villous Sampling Placental Samples and Altered Function in Telomerase-Immortalized Microvascular Endothelial Cells. *Arterioscler Thromb Vasc Biol* **2017**, 37, (6), 1168-1179.
- Marziani, D.; Crescimanno, C.; Zaccheo, D.; Coppari, R.; Underhill, C. B.; Castellucci, M., Hyaluronate and CD44 expression patterns in the human placenta throughout pregnancy. *European journal of histochemistry : EJH* **2001**, 45, (2), 131-40.
- Obut, M.; Oglak, S. C., Expression of CD44 and IL-10 in normotensive and preeclamptic placental tissue. *Ginekol Pol* **2020**, 91, (6), 334-341.
- Takahashi, H.; Ogoyama, M.; Nagayama, S.; Suzuki, H.; Ohkuchi, A.; Matsubara, S.; Takizawa, T., Extravillous trophoblast invasion accelerated by WNT3A, 5A, and 10B via CD44. *J Matern Fetal Neonatal Med* **2021**, 34, (20), 3377-3385.
- Todd, N.; McNally, R.; Alqudah, A.; Jerotic, D.; Suvakov, S.; Obradovic, D.; Hoch, D.; Hombrebueno, J. R.; Campos, G. L.; Watson, C. J.; Gojnic-Dugalic, M.; Simic, T. P.; Krasnodembskaya, A.; Desoye, G.; Eastwood, K. A.; Hunter, A. J.; Holmes, V. A.; McCance, D. R.; Young, I. S.; Grieve, D. J.; Kenny, L. C.; Garovic, V. D.; Robson, T.; McClements, L., Role of A Novel Angiogenesis FKBPL-CD44 Pathway in Preeclampsia Risk Stratification and Mesenchymal Stem Cell Treatment. *The Journal of clinical endocrinology and metabolism* **2021**, 106, (1), 26-41.
- Shangguan, Y.; Wang, Y.; Shi, W.; Guo, R.; Zeng, Z.; Hu, W.; Cai, W.; Yan, Q.; Xu, Y.; Tang, D.; Dai, Y., Systematic proteomics analysis of lysine acetylation reveals critical features of placental proteins in pregnant women with preeclampsia. *J Cell Mol Med* **2021**, 25, (22), 10614-10626.
- Muragaki, Y.; Abe, N.; Ninomiya, Y.; Olsen, B. R.; Ooshima, A., The human alpha 1(XV) collagen chain contains a large amino-terminal non-triple helical domain with a tandem repeat structure and homology to alpha 1(XVIII) collagen. *The Journal of biological chemistry* **1994**, 269, (6), 4042-6.
- Nasu, K.; Fujisawa, K.; Nishida, Y.; Kai, S.; Sugano, T.; Miyakawa, I.; Tateishi, Y., Expression of collagen XVIII mRNA and protein in human umbilical vein and placenta. *Reproduction, fertility, and development* **2003**, 15, (1-2), 107-14.

12. Van Sinderen, M.; Cuman, C.; Winship, A.; Menkhorst, E.; Dimitriadis, E., The chondroitin sulfate proteoglycan (CSPG4) regulates human trophoblast function. *Placenta* **2013**, *34*, (10), 907-12.
13. Pulkkinen, L.; Alitalo, T.; Krusius, T.; Peltonen, L., Expression of decorin in human tissues and cell lines and defined chromosomal assignment of the gene locus (DCN). *Cytogenetics and cell genetics* **1992**, *60*, (2), 107-11.
14. Siddiqui, M. F.; Nandi, P.; Girish, G. V.; Nygard, K.; Eastabrook, G.; de Vrijer, B.; Han, V. K.; Lala, P. K., Decorin over-expression by decidual cells in preeclampsia: a potential blood biomarker. *Am J Obstet Gynecol* **2016**, *215*, (3), 361 e1-361 e15.
15. Daglar, K.; Kirbas, A.; Timur, H.; Ozturk Inal, Z.; Danisman, N., Placental levels of total oxidative and anti-oxidative status, ADAMTS-12 and decorin in early- and late-onset severe preeclampsia. *J Matern Fetal Neonatal Med* **2016**, *29*, (24), 4059-64.
16. Uzun Cilingir, I.; Varol, F.; Gurkan, H.; Sutcu, H.; Atli, E.; Eker, D.; Inan, C.; Erzincan, S.; Sayin, C., Placental and serum levels of human Klotho in severe preeclampsia: A potential sensitive biomarker. *Placenta* **2019**, *85*, 49-55.
17. Murthi, P.; van Zanten, D. E.; Eijnsink, J. J.; Borg, A. J.; Stevenson, J. L.; Kalionis, B.; Chui, A. K.; Said, J. M.; Brennecke, S. P.; Erwich, J. J., Decorin expression is decreased in first trimester placental tissue from pregnancies with small for gestation age infants at birth. *Placenta* **2016**, *45*, 58-62.
18. Crescimanno, C.; Marzioni, D.; Paradinas, F. J.; Schrurs, B.; Muhlhauser, J.; Todros, T.; Newlands, E.; David, G.; Castellucci, M., Expression pattern alterations of syndecans and glypican-1 in normal and pathological trophoblast. *The Journal of pathology* **1999**, *189*, (4), 600-8.
19. Li, Q.; Han, Y.; Xu, P.; Yin, L.; Si, Y.; Zhang, C.; Meng, Y.; Feng, W.; Pan, Z.; Gao, Z.; Li, J.; Yang, W., Elevated microRNA-125b inhibits cytotrophoblast invasion and impairs endothelial cell function in preeclampsia. *Cell Death Discov* **2020**, *6*, 35.
20. Gunatillake, T.; Chui, A.; Fitzpatrick, E.; Ignjatovic, V.; Monagle, P.; Whitelock, J.; Zanten, D.; Eijnsink, J.; Borg, A.; Stevenson, J.; Brennecke, S. P.; Erwich, J.; Said, J. M.; Murthi, P., Decreased placental glypican expression is associated with human fetal growth restriction. *Placenta* **2019**, *76*, 6-9.
21. Khan, S.; Blackburn, M.; Mao, D. L.; Huber, R.; Schlessinger, D.; Fant, M., Glypican-3 (GPC3) expression in human placenta: localization to the differentiated syncytiotrophoblast. *Histology and histopathology* **2001**, *16*, (1), 71-8.
22. Deyssenroth, M. A.; Li, Q.; Lacasana, M.; Nomura, Y.; Marsit, C.; Chen, J., Expression of placental regulatory genes is associated with fetal growth. *J Perinat Med* **2017**, *45*, (7), 887-893.
23. Rohde, L. H.; Janatpore, M. J.; McMaster, M. T.; Fisher, S.; Zhou, Y.; Lim, K. H.; French, M.; Hoke, D.; Julian, J.; Carson, D. D., Complementary expression of HIP, a cell-surface heparan sulfate binding protein, and perlecan at the human fetal-maternal interface. *Biology of reproduction* **1998**, *58*, (4), 1075-83.
24. Grover, J.; Chen, X. N.; Korenberg, J. R.; Roughley, P. J., The human lumican gene. Organization, chromosomal location, and expression in articular cartilage. *The Journal of biological chemistry* **1995**, *270*, (37), 21942-9.
25. Liu, C.; Hu, Y.; Wang, Z.; Pan, H.; Ren, Y.; Li, X.; Liu, Z.; Gao, H., The Downregulation of Placental Lumican Promotes the Progression of Preeclampsia. *Reprod Sci* **2021**, *28*, (11), 3147-3154.
26. Li, N.; Hou, R.; Liu, C.; Yang, T.; Qiao, C.; Wei, J., Integration of transcriptome and proteome profiles in placenta accreta reveals trophoblast over-migration as the underlying pathogenesis. *Clin Proteomics* **2021**, *18*, (1), 31.
27. Jokimaa, V.; Inki, P.; Kujari, H.; Hirvonen, O.; Ekholm, E.; Anttila, L., Expression of syndecan-1 in human placenta and decidua. *Placenta* **1998**, *19*, (2-3), 157-63.
28. Szabo, S.; Xu, Y.; Romero, R.; Fule, T.; Karaszi, K.; Bhatti, G.; Varkonyi, T.; Varkonyi, I.; Krenacs, T.; Dong, Z.; Tarca, A. L.; Chaiworapongsa, T.; Hassan, S. S.; Papp, Z.; Kovalszky, I.; Than, N.

- G., Changes of placental syndecan-1 expression in preeclampsia and HELLP syndrome. *Virchows Arch* **2013**, 463, (3), 445-58.
29. Garcha, D.; Walker, S. P.; MacDonald, T. M.; Hyett, J.; Jellins, J.; Myers, J.; Illanes, S. E.; Nien, J. K.; Schepeler, M.; Keenan, E.; Whigham, C. A.; Cannon, P.; Murray, E.; Nguyen, T. V.; Kandel, M.; Masci, J.; Murphy, C.; Cruickshank, T.; Pritchard, N.; Hannan, N. J.; Brownfoot, F.; Roddy Mitchell, A.; Middleton, A.; Pell, G.; Wong, G. P.; Tong, S.; Kaitu'u-Lino, T. J., Circulating syndecan-1 is reduced in pregnancies with poor fetal growth and its secretion regulated by matrix metalloproteinases and the mitochondria. *Sci Rep* **2021**, 11, (1), 16595.
 30. Chui, A.; Zainuddin, N.; Rajaraman, G.; Murthi, P.; Brennecke, S. P.; Ignjatovic, V.; Monagle, P. T.; Said, J. M., Placental syndecan expression is altered in human idiopathic fetal growth restriction. *Am J Pathol* **2012**, 180, (2), 693-702.
 31. Jeyarajah, M. J.; Jaju Bhattad, G.; Kops, B. F.; Renaud, S. J., Syndecan-4 regulates extravillous trophoblast migration by coordinating protein kinase C activation. *Sci Rep* **2019**, 9, (1), 10175.
 32. Jones, R. L.; Salamonsen, L. A.; Zhao, Y. C.; Ethier, J. F.; Drummond, A. E.; Findlay, J. K., Expression of activin receptors, follistatin and betaglycan by human endometrial stromal cells; consistent with a role for activins during decidualization. *Molecular human reproduction* **2002**, 8, (4), 363-74.
 33. Ciarmela, P.; Florio, P.; Toti, P.; Grasso, D.; Santopietro, R.; Tosi, P.; Petraglia, F., Expression of betaglycan in pregnant tissues throughout gestation. *European journal of endocrinology* **2003**, 149, (5), 433-7.
 34. Yi, Y.; Zhu, H.; Klausen, C.; Chang, H. M.; Inkster, A. M.; Terry, J.; Leung, P. C. K., Dysregulated BMP2 in the Placenta May Contribute to Early-Onset Preeclampsia by Regulating Human Trophoblast Expression of Extracellular Matrix and Adhesion Molecules. *Front Cell Dev Biol* **2021**, 9, 768669.