

и отсутствием разработанных экспериментальных систем. При этом понятно, что для процесса имплантации бластоцисты в эндометрий важна «правильная» работа рассматриваемой сигнальной системы на разных этапах. Возможно, некоторые проблемы с репродуктивным здоровьем, а именно самопроизвольные аборт, нарушения нормального течения беременности и бесплодие, связаны с нарушениями функционирования рецептора EGF и его лигандов как на уровне экспрессии мРНК и белка,

так и при нарушениях таких процессов, как эндоцитоз, определяющих баланс синтеза и деградации комплекса соответствующих белков, уровень которых, по всей видимости, должен коррелировать с определенными фазами цикла. Поэтому не вызывает сомнения актуальность изучения регуляции экспрессии как рецепторов, так и лигандов в эндометрии и бластоцисте и их нарушений при различных патологиях, а также поиск и разработка новых методических подходов для решения этих задач.

СПИСОК ЛИТЕРАТУРЫ

1. Кожухарова И. В., Кунеев И. К., Шорохова М. А., Харченко М. В., Корнилова Е. С., Домнина А. П. 2024. Выделение и культивирование клеток эпителия эндометрия человека. Регенерация органов и тканей. Т. 2. № 4. С. 49. (Kozhukharova I. V., Kuneev I. K., Shorokhova M. A., Kharchenko M. V., Kornilova E. S., Domnina A. P. 2024. Isolation and cultivation of human endometrial epithelial cells. Tiss. Organ Regeneration. 2024. V. 2. No. 4. P. 49.) <https://doi.org/10.60043/2949-5938-2024-4-49-67>
2. Achache H., Revel A. 2006. Endometrial receptivity markers, the journey to successful embryo implantation. Human Reprod. Update. V. 12. P. 731. <https://doi.org/10.1093/humupd/dml004>
3. Altmäe S., Koel M., Vösa U., Adler P., Suhorutšenko M., Laisk-Podar T., Kukushkina V., Saare M., Velthut-Meikas A., Krjutškov K., Aghajanova L., Lalitkumar P. G., Gemzell-Danielsson K., Giudice L., Simón C., Salumets A. 2017. Meta-signature of human endometrial receptivity: a meta-analysis and validation study of transcriptomic biomarkers. Sci. Rep. V. 7. Art. ID: 10077. doi: 10.1038/s41598-017-10098-3.
4. Ancha H. R., Kurella R. R., Stewart C. A., Damera, G., Ceresa, B.P., Harty, R.F. 2007. Histamine stimulation of MMP-1(collagenase-1) secretion and gene expression in gastric epithelial cells: Role of EGFR transactivation and the MAP kinase pathway. Int. J. Biochem. Cell Biol. V. 39. P. 2143. <https://doi.org/10.1016/j.biocel.2007.06.003>
5. Balci M., Ozdemir G. 2018. Differential expression of egfr-1, mmp-3, and mmp-9 in spontaneous abortions, induced abortions, and tubal pregnancies. Turk Patoloji Derg. V. 35. Art. ID: 1432. <https://doi.org/10.5146/tjpath.2018.01432>
6. Baldys A., Gööz M., Morinelli T. A., Lee M.-H., Raymond J. R., Luttrell L. M., Raymond J. R. 2009. Essential Role of c-Cbl in amphiregulin-induced recycling and signaling of the endogenous epidermal growth factor receptor. Biochemistry. V. 48. P. 1462. <https://doi.org/10.1021/bi801771g>
7. Bashendjieva E. O., Barashkova E. A., Tatishcheva J. A., Kalugina A. S., Enukashvily N. I. 2024. AREG expression in cumulus cells as a prognostic marker of oocyte quality. Transl. Med. V. 11. P. 407–418. <https://doi.org/10.18705/2311-4495-2024-11-5-407-418>
8. Blobel C. P. 2005. ADAMs: key components in EGFR signalling and development. Nat. Rev. Mol. Cell Biol. V. 6. P. 32. <https://doi.org/10.1038/nrm1548>
9. Chatterjee K., Jana S., DasMahapatra P., Swarnakar S. 2018. EGFR-mediated matrix metalloproteinase-7 up-regulation promotes epithelial-mesenchymal transition via ERK1-AP1 axis during ovarian endometriosis progression. FASEB J. V. 32. P. 4560. <https://doi.org/10.1096/fj.201701382RR>
10. Clemente L., Bird I. M. 2023. The epidermal growth factor receptor in healthy pregnancy and preeclampsia. J. Mol. Endocrinol. V. 70. Art. ID: e220105. <https://doi.org/10.1530/JME-22-0105>
11. Das S. K. 2012. Developmental regulation of decidual cell polyploidy at the site of implantation. Front. Biosci. V. 4. P. 1475. <https://doi.org/10.2741/s347>
12. Das S. K., Wang X.-N., Paria B. C., Damm D., Abraham J. A., Klagsbrun M., Andrews G. K., Dey S. K. 1994. Heparin-binding EGF-like growth factor gene is induced in the mouse uterus temporally by the blastocyst solely at the site of its apposition: a possible ligand for interaction with blastocyst EGF-receptor in implantation. Development. V. 120. P. 1071. <https://doi.org/10.1242/dev.120.5.1071>

13. Deguchi E., Lin S., Hirayama D., Matsuda K., Tanave A., Sumiyama K., Tsukiji S., Otani T., Furuse M., Sorkin A., Matsuda M., Terai K. 2024. Low-affinity ligands of the epidermal growth factor receptor are long-range signal transmitters in collective cell migration of epithelial cells. *Cell Reports*. V. 43. P. 114986. <https://doi.org/10.1016/j.celrep.2024.114986>
14. Deryabin P. I., Borodkina A. V. 2022. Stromal cell senescence contributes to impaired endometrial decidualization and defective interaction with trophoblast cells. *Human Reproduction*. V. 37. P. 1505. <https://doi.org/10.1093/humrep/deac112>
15. Deryabin P. I., Ivanova J. S., Borodkina A. V. 2022. Senescent endometrial stromal cells transmit reactive oxygen species to the trophoblast-like cells and impair spreading of blastocyst-like spheroids. *Molecular Human Reproduction*. V. 28. Art. ID: gaac039. <https://doi.org/10.1093/molehr/gaac039>
16. Ferguson K. M. 2008. Structure-based view of epidermal growth factor receptor regulation. *Annual Rev. Biophys.* V. 37. P. 353. <https://doi.org/10.1146/annurev.biophys.37.032807.125829>
17. Freed D. M., Bessman N. J., Kiyatkin A., Salazar-Cavazos E., Byrne P. O., Moore J. O., Valley C. C., Ferguson K. M., Leahy D. J., Lidke D. S., Lemmon M. A. 2017. EGFR ligands differentially stabilize receptor dimers to specify signaling kinetics. *Cell*. V. 171. P. 683.e18. <https://doi.org/10.1016/j.cell.2017.09.017>
18. Fukui Y., Hirota Y., Matsuo M., Gebril M., Akaeda S., Hiraoka T., Osuga Y. 2019. Uterine receptivity, embryo attachment, and embryo invasion: Multistep processes in embryo implantation. *Reprod. Med. Biol.* V. 18. P. 234. <https://doi.org/10.1002/rmb2.12280>
19. Hamatani T., Daikoku T., Wang H., Matsumoto H., Carter M. G., Ko M. S. H., Dey S. K. 2004. Global gene expression analysis identifies molecular pathways distinguishing blastocyst dormancy and activation. *Proc. Natl. Acad. Sci. USA*. V. 101. P. 10326. <https://doi.org/10.1073/pnas.0402597101>
20. Hantak A. M., Bagchi I. C., Bagchi M. K. 2014. Role of uterine stromal-epithelial crosstalk in embryo implantation. *Int. J. Dev. Biol.* V. 58. P. 139. <https://doi.org/10.1387/ijdb.130348mb>
21. Hardy K., Spanos S. 2002. Growth factor expression and function in the human and mouse preimplantation embryo. *J. Endocrinol.* V. 172. P. 221. <https://doi.org/10.1677/joe.0.1720221>
22. Hervent A.-S., De Keulenaer G. W. 2012. Molecular mechanisms of cardiotoxicity induced by ErbB receptor inhibitor cancer therapeutics. *Int. J. Mol. Sci.* V. 13. Frt. ID: 12268. <https://doi.org/10.3390/ijms131012268>
23. Higashiyama S., Abraham J., Klagsbrun M. 1993. Heparin-binding EGF-like growth factor stimulation of smooth muscle cell migration: dependence on interactions with cell surface heparan sulfate. *J. Cell Biol.* V. 122. P. 933. <https://doi.org/10.1083/jcb.122.4.933>
24. Horiuchi K., Kimura T., Miyamoto T., Takaishi H., Okada Y., Toyama Y., Blobel C. P. 2007. Cutting edge: TNF- α -converting enzyme (TACE/ADAM17) inactivation in mouse myeloid cells prevents lethality from endotoxin shock. *J. Immunol.* V. 179. P. 2686. <https://doi.org/10.4049/jimmunol.179.5.2686>
25. Huang Y., Ognjenovic J., Karandur D., Miller K., Merk A., Subramaniam S., Kuriyan J. 2021. A molecular mechanism for the generation of ligand-dependent differential outputs by the epidermal growth factor receptor. *Elife*. V. 10. Art ID: e73218. <https://doi.org/10.7554/eLife.73218>
26. Jin D.-D., He Y.-Y., Ran F., Yang H.-Y., Yan G.-J., Yang Z.-M. 2025. Embryo-derived human chorionic gonadotropin promotes human decidualization through activating epithelial prostaglandin F2 α secretion. *Molecular and Cellular Endocrinology*. V. 606. Art ID: 112581. <https://doi.org/10.1016/j.mce.2025.112581>
27. Jowicz A. P., Brown J. K., McDonald S. E., Shaw J. L. V., Critchley H. O. D., Horne A. W. 2013. Characterization of the temporal and spatial expression of a disintegrin and metalloprotease 17 in the human endometrium and fallopian tube. *Reprod. Sci.* V. 20. P. 1321. <https://doi.org/10.1177/1933719113485289>

28. *Kamentseva R. S., Kharchenko M. V., Gabdrahmanova G. V., Kotov M. A., Kosheverova V. V., Kornilova E. S.* 2023. EGF, TGF- α and amphiregulin differently regulate endometrium-derived mesenchymal stromal/stem cells. *Int. J. Mol. Sci.* V. 24. Art ID: 13408.
<https://doi.org/10.3390/ijms241713408>
29. *Khouma A., Moeini M. M., Plamondon J., Richard D., Caron A., Michael N. J.* 2023. Histaminergic regulation of food intake. *Front. Endocrinol.* V. 14. Art ID: 1202089.
<https://doi.org/10.3389/fendo.2023.1202089>
30. *Kjær I. M., Olsen D. A., Alnor A., Brandslund I., Bechmann T., Madsen J. S.* 2019. EGFR and EGFR ligands in serum in healthy women; reference intervals and age dependency. *Clin. Chem. Lab. Med. (CCLM).* V. 57. P. 1948.
<https://doi.org/10.1515/cclm-2019-0376>
31. *Kolte A. M., Bernardi L. A., Christiansen O. B., Quenby S., Farquharson R. G., Goddijn M., Stephenson M. D.* 2015. Terminology for pregnancy loss prior to viability: a consensus statement from the ESHRE early pregnancy special interest group. *Human Reprod.* V. 30. P. 495–498.
<https://doi.org/10.1093/humrep/deu299>
32. *Kosheverova V., Kharchenko M., Kamentseva R., Kotov M., Schwarz A., Kuneev I., Kotova A., Enukashvily N., Kornilova E.* 2025. Human mesenchymal stromal cells derived from different tissues show similar profiles of c-ErbB receptor family expression at the mRNA and protein levels. *Int. J. Mol. Sci.* V. 26. P. 7201.
<https://doi.org/10.3390/ijms26157201>
33. *Lai X., Ye L., Liao Y., Jin L., Ma Q., Lu B., Sun Y., Shi Y., Zhou N.* 2016. Agonist-induced activation of histamine H3 receptor signals to extracellular signal-regulated kinases 1 and 2 through PKC-, PLD-, and EGFR-dependent mechanisms. *J. Neurochem.* V. 137. P. 200.
<https://doi.org/10.1111/jnc.13559>
34. *Large M. J., Wetendorf M., Lanz R. B., Hartig S. M., Creighton C. J., Mancini M. A., Kovanci E., Lee K.-F., Threadgill D. W., Lydon J. P., Jeong J.-W., DeMayo F. J.* 2014. The epidermal growth factor receptor critically regulates endometrial function during early pregnancy. *PLoS Genet.* V. 10. Art. ID: e1004451.
<https://doi.org/10.1371/journal.pgen.1004451>
35. *Lessey B. A., Gui Y., Apparao K. B. C., Young S. L., Mulholland J.* 2002. Regulated expression of heparin-binding EGF-like growth factor (HB-EGF) in the human endometrium: A potential paracrine role during implantation. *Molecular Reproduction Devel.* V. 62. P. 446–455.
<https://doi.org/10.1002/mrd.10129>
36. *Lim H. J., Dey S. K.* 2009. HB-EGF: A unique mediator of embryo-uterine interactions during implantation. *Experimental Cell Research.* V. 315. P. 619.
<https://doi.org/10.1016/j.yexcr.2008.07.025>
37. *Liu C., Fukui E., Matsumoto H.* 2025. Molecular and cellular regulators of embryo implantation and their application in improving the implantation potential of IVF-derived blastocysts. *Reprod. Med. Biol.* V. 24. Art. ID: e12633.
<https://doi.org/10.1002/rmb2.12633>
38. *Liu C., He Y., Chen S., Shi W., Wang Y., Luo H., Yang Z.* 2024. Histamine promotes mouse decidualization through stimulating epithelial amphiregulin release. *FEBS J.* V. 291. P. 3924.
<https://doi.org/10.1111/febs.17219>
39. *Marečková M., Garcia-Alonso L., Moullet M., Lorenzi V., Petryszak R., Sancho-Serra C., Oszlanczi A., Icoresi Mazzeo C., Wong F. C. K., Kelava I., Hoffman S., Krassowski M., Garbutt K., Gaitskell K., Yancheva S., Woon E. V., Male V., Granne I., Hellner K., Mahbubani K. T., Saeb-Parsy K., Lotfollahi M., Prigmore E., Southcombe J., Dragovic R. A., Becker C. M., Zondervan K. T., Vento-Tormo R.* 2024. An integrated single-cell reference atlas of the human endometrium. *Nat. Genet.* V. 56. P. 1925. doi: 10.1038/s41588-024-01873-w.
40. *Massri N., Loia R., Sones J. L., Arora R., Douglas N. C.* 2023. Vascular changes in the cycling and early pregnant uterus. *JCI Insight.* V. 8. Art. ID: e163422.
<https://doi.org/10.1172/jci.insight.163422>
41. *Mikhailov V. M.* 2003. Life cycle of decidual cells, in: *Int. Review Cytol.* V. 227. P. 1.
[https://doi.org/10.1016/S0074-7696\(03\)01007-6](https://doi.org/10.1016/S0074-7696(03)01007-6)
42. *Nakatsuji Y., Nishio Y., Tani N., Adachi K., Ohmichi M., Hisamoto K., Morishige K., Kurachi H., Tasaka K., Murata Y., Matsuura N.* 2003. Epidermal growth factor enhances invasive activity of BeWo choriocarcinoma cells by inducing ALPHA.2 Integrin expression. *Endocrinol. J.* V. 50. P. 703.
<https://doi.org/10.1507/endocrj.50.703>

43. Ogiso H., Ishitani R., Nureki O., Fukai S., Yamanaka M., Kim J.-H., Saito K., Sakamoto A., Inoue M., Shirouzu M., Yokoyama S. 2002. Crystal structure of the complex of human epidermal growth factor and receptor extracellular domains. *Cell*. V. 110. P. 775.
[https://doi.org/10.1016/S0092-8674\(02\)00963-7](https://doi.org/10.1016/S0092-8674(02)00963-7)
44. Ojosnegros S., Seriola A., Godeau A. L., Veiga A. 2021. Embryo implantation in the laboratory: an update on current techniques. *Human Reprod. Update*. V. 27. P. 501.
<https://doi.org/10.1093/humupd/dmaa054>
45. Okada H., Tsuzuki T., Murata H. 2018. Decidualization of the human endometrium. *Reprod. Med. Biol.* V. 17. P. 220.
<https://doi.org/10.1002/rmb2.12088>
46. Poorasamy J., Garg D., Bharti J., Nambirajan A., Patil A., Sengupta J., Ghosh D. 2022. Overexpression of ErbB-1 (EGFR) Protein in eutopic endometrium of infertile women with severe ovarian endometriosis during the 'Implantation window' of menstrual cycle. *Reprod. Med.* V. 3. P. 280.
<https://doi.org/10.3390/reprodmed3040022>
47. Paria B. C., Elenius K., Klagsbrun M., Dey S. K. 1999. Heparin-binding EGF-like growth factor interacts with mouse blastocysts independently of ErbB1: a possible role for heparan sulfate proteoglycans and ErbB4 in blastocyst implantation. *Development*. V. 126. P. 1997.
<https://doi.org/10.1242/dev.126.9.1997>
48. Paria B. C., Ma W., Tan J., Raja S., Das S. K., Dey S. K., Hogan B. L. M. 2001. Cellular and molecular responses of the uterus to embryo implantation can be elicited by locally applied growth factors. *Proc. Natl. Acad. Sci. USA*. V. 98. P. 1047.
<https://doi.org/10.1073/pnas.98.3.1047>
49. Poh Q. H., Rai A., Cross J., Greening D. W. 2024. HB-EGF-loaded nanovesicles enhance trophectodermal spheroid attachment and invasion. *Proteomics*. V. 24. Art ID: 2200145.
<https://doi.org/10.1002/pmic.202200145>
50. Puttabyatappa M., Brogan R. S., VandeVoort C. A., Chaffin C. L. 2013. EGF-like ligands mediate progesterone's anti-apoptotic action on macaque granulosa cells. *Biol. Reprod.* V. 88. P. 18.
<https://doi.org/10.1095/biolreprod.112.103002>
51. Rawlings T. M., Makwana K., Tryfonos M., Lucas E. S. 2021. Organoids to model the endometrium: implantation and beyond. *Reprod. Fertil.* V. 2. Art. ID: R85-R101. doi: 10.1530/RAF-21-0023.
52. Qi Q.-R., Zhao X.-Y., Zuo R.-J., Wang T.-S., Gu X.-W., Liu J.-L., Yang Z.-M. 2015. Involvement of atypical transcription factor E2F8 in the polyploidization during mouse and human decidualization. *Cell Cycle*. V. 14. P. 1842.
<https://doi.org/10.1080/15384101.2015.1033593>
53. Qu H., Khalil R. A. 2022. Role of ADAM and ADAMTS disintegrin and metalloproteinases in normal pregnancy and preeclampsia. *Biochemical Pharmacology*. V. 206. P. 115266.
<https://doi.org/10.1016/j.bcp.2022.115266>
54. Rahman A.-N. Md. I., Yun C. S., Salama A., Islam Md. R., Khandoker M. A. M. Y., Takahashi T., Miyamoto K., Yamauchi N. 2025. MMP3 mediates E2-induced bovine endometrial cell proliferation by releasing HB-EGF. *J. Reprod. Dev.* V. 71. P. 217.
<https://doi.org/10.1262/jrd.2025-021>
55. Rogers P. 1995. Current studies on human implantation: a brief overview. *Reproduction, Fertility, and Development*. V. 7. P. 1395–1399.
<https://doi.org/10.1071/RD9951395>
56. Saad M. I., Rose-John S., Jenkins B. J. 2019. ADAM17: An emerging therapeutic target for lung cancer. *Cancers*. V. 11. Art ID: 1218.
<https://doi.org/10.3390/cancers11091218>
57. Schüring A. N., Schulte N., Kelsch R., Röpke A., Kiesel L., Götte M. 2011. Characterization of endometrial mesenchymal stem-like cells obtained by endometrial biopsy during routine diagnostics. *Fertility Sterility*. V. 95. P. 423.
<https://doi.org/10.1016/j.fertnstert.2010.08.035>
58. Schwab K. E., Chan R. W. S., Gargett C. E. 2005. Putative stem cell activity of human endometrial epithelial and stromal cells during the menstrual cycle. *Fertility Sterility*. V. 84. P. 1124.
<https://doi.org/10.1016/j.fertnstert.2005.02.056>
59. Sciorio R., Miranian D., Smith G. D. 2022. Non-invasive oocyte quality assessment. *Biology of Reproduction*. V. 106. P. 274–290.
<https://doi.org/10.1093/biolre/ioac009>

60. Singh B., Carpenter G., Coffey R. J. 2016. EGF receptor ligands: recent advances. *F1000Res*. V. 5. Art. ID: 2270. <https://doi.org/10.12688/f1000research.9025.1>
61. Sternlicht M. D., Sunnarborg S. W. 2008. The ADAM17—amphiregulin—egfr axis in mammary development and cancer. *J. Mammary Gland BiolNeoplasia*. V. 13. P. 181. <https://doi.org/10.1007/s10911-008-9084-6>
62. Takeuchi M., Seki M., Furukawa E., Takahashi A., Saito K., Kobayashi M., Ezoe K., Fukui E., Yoshizawa M., Matsumoto H. 2017. Improvement of implantation potential in mouse blastocysts derived from IVF by combined treatment with prolactin, epidermal growth factor and 4-hydroxyestradiol. *MHR: Basic Sci. Reprod. Med*. V. 23. P. 557. <https://doi.org/10.1093/molehr/gax035>
63. Thathiah A., Blobel C. P., Carson D. D. 2003. Tumor necrosis factor- α converting enzyme/ADAM 17 mediates MUC1 shedding. *J. Biol. Chem*. V. 278. P. 3386. <https://doi.org/10.1074/jbc.M208326200>
64. Thathiah A., Carson D. D. 2004. MT1-MMP mediates MUC1 shedding independent of TACE/ADAM17. *Biochem. J*. V. 382. P. 363. <https://doi.org/10.1042/BJ20040513>
65. Wang H., Dey S. K. 2006. Roadmap to embryo implantation: clues from mouse models. *Nat. Rev. Genet*. V. 7. P. 185. <https://doi.org/10.1038/nrg1808>
66. Wang J., Li J., Wang S., Pan Y., Yang J., Yin L., Dou H., Hou Y. 2024. Amphiregulin secreted by umbilical cord multipotent stromal cells protects against ferroptosis of macrophages via the activating transcription factor 3-CD36 axis to alleviate endometrial fibrosis. *Stem Cells*. V. 42. P. 763. <https://doi.org/10.1093/stmcls/sxae035>
67. Wang X., Yang D., Peng H. 2025. Female reproductive tract organoids: applications from physiology to pathology. *Biomolecules*. V. 15. Art ID: 925. <https://doi.org/10.3390/biom15070925>
68. Wang Y.-M., Wu M.-J., Lin Y.-H., Chen J. 2019. Association of epidermal growth factor receptor (EGFR) gene polymorphisms with endometriosis. *Medicine*. V. 98. Art. ID: e15137. <https://doi.org/10.1097/MD.00000000000015137>
69. Waye A. A., Moeller J., Veiga-Lopez A. 2025. Epidermal growth factor receptor in placental health and disease: pathways, dysfunction, and chemical disruption. *Toxicol. Sci*. V. 205. P. 11. <https://doi.org/10.1093/toxsci/kfaf024>
70. Yamashita Y., Kawashima I., Gunji Y., Hishinuma M., Shimada M. 2010. Progesterone is essential for maintenance of Tace/Adam17 mRNA expression, but not EGF-like factor, in cumulus cells, which enhances the EGF receptor signaling pathway during in vitro maturation of porcine COCs. *J. Reprod. Dev*. V. 56. P. 315. <https://doi.org/10.1262/jrd.09-199H>
71. Yuan J., Deng W., Cha J., Sun X., Borg J.-P., Dey Sudhansu K. 2018. Tridimensional visualization reveals direct communication between the embryo and glands critical for implantation. *Nat. Commun*. V. 9. P. 603. <https://doi.org/10.1038/s41467-018-03092-4>
72. Zbodakova O., Chalupsky K., Sarnova L., Kasperek P., Jirouskova M., Gregor M., Sedlacek R. 2021. ADAM10 and ADAM17 regulate EGFR, c-Met and TNF RI signalling in liver regeneration and fibrosis. *Sci Rep*. V. 11. P. 11414. <https://doi.org/10.1038/s41598-021-90716-3>
73. Zhang Y., Tang L., Liu H., Cheng Y. 2024. The multiple functions of HB-EGF in female reproduction and related cancer: molecular mechanisms and targeting strategies. *Reprod. Sci*. V. 31. P. 2588. <https://doi.org/10.1007/s43032-024-01454-6>
74. Zhang Y., Wolf-Yadlin A., Ross P. L., Pappin D. J., Rush J., Lauffenburger D. A., White F. M. 2005. Time-resolved mass spectrometry of tyrosine phosphorylation sites in the epidermal growth factor receptor signaling network reveals dynamic modules. *Mol. Cell. Proteomics*. V. 4. P. 1240. <https://doi.org/10.1074/mcp.M500089-MCP200>
75. Zhang Z., Funk C., Glasser S. R., Mulholland J. 1994. Progesterone regulation of heparin-binding epidermal growth factor-like growth factor gene expression during sensitization and decidualization in the rat uterus: effects of the anti-progestin, ZK 98.299. *Endocrinology*. V. 135. P. 1256. <https://doi.org/10.1210/endo.135.3.8070371>
76. Zolkiewska A. 2008. ADAM proteases: ligand processing and modulation of the Notch pathway. *Cell. Mol. Life Sci*. V. 65. P. 2056. <https://doi.org/10.1007/s00018-008-7586-4>