Мусорина А.С., Зенин В.В., Турилова В.И., Яковлева Т.К., Полянская Г.Г. 2019. Характеристика неиммортализованной линии мезенхимных стволовых клеток, выделенных из эпикардиальной жировой ткани человека. Цитология. Т. 61. С. 272. (*Musorina A.S., Zenin V.V., Turilova V.I., Yakovleva T.K., Polyanskaya G.G.* 2019. Characteristics of a non-immortalized line of mesenchymal stem cells isolated from human epicardial adipose tissue. Tsitologiya. V. 61. P. 272)
https://doi.org/10.1134/S0041377119040047

Попов Б.В., Петров Н.С. Михайлов В.М., Томилин А.Н., Алексеенко Л.Л., Гринчук Т.М., Зайчик А.М. 2009. Спонтанная трансформация и иммортализация мезенхимных стволовых клеток в культуре *in vitro*. Цитология. Т. 51. С. 91. (*Popov B.V., Petrov N.S. Mikhailov V.M., Tomilin A.N., Alekseenko L.L., Grinchuk T.M., Zaichik A.M.* 2009. Spontaneous transformation and immortalization of mesenchymal stem cells in *in vitro* culture. Tsitologiya. V. 51. P. 91.)

Borgonovo T., Vaz I.M., Senegaglia A.C., Rebelatto C.L., Brofman P.R. 2014. Genetic evaluation of mesenchymal stem cells by G-banded karyotyping in a Cell Technology Center. Rev. Bras. Hematol. Hemoter. V. 36. P. 202.
https://doi.org/10.1016/j.bjhh.2014.03.006

Domnina A., Ivanova J., Alekseenko L., Kozhukharova I., Borodkina A., Pugovkina N., Smirnova I., Lyublinskaya O., Fridlyanskaya I., Nikolsky N. 2020. Three-dimensional compaction switches stress response programs and enhances therapeutic efficacy of endometrial mesenchymal stem/stromal cells. Front. Cell Dev. Biol. V. 8. P. 473.
https://doi.org/10.3389/fcell.2020.00473

Heng H.H., Liu G., Stevens J.B., Abdallah B.Y., Horne S.D., Ye K.J., Bremer S.W., Chowdhury S.K., Ye C.J. 2013. Karyotype heterogeneity and unclassified chromosomal abnormalities. Cytogenet. Genome Res. V. 139. P. 144.
https://doi.org/10.1159/000348682

Jacobs K., Zambelli F., Mertzanidou A., Smolders I., Geens M., Nguyen H.T., Barbé L., Sermon K., Spits C. 2016. Higher-density culture in human embryonic stem cells results in DNA damage and genome instability. Stem Cell Reports. V. 6. P. 330.
https://doi.org/10.1016/j.stemcr.2016.01.015

Meng X., Ichim T.E., Zhong J., Rogers A., Yin Z., Jackson J., Wang H., Ge W., Bogin V., Chan K.W., Thébaud B., Riordan N.H. 2007. Endometrial regenerative cells: a novel stem cell population. J. Transl. Med. V. 5. P. 57.
https://doi.org/10.1186/1479-5876-5-57

Mitelman F. (Ed.) 1995. ISCN: Intrnation system for human cytogenetic nomenclature. Basel: S. Karger. 114 p.

Passerini V., Ozeri-Galai E., de Pagter M.S., Donnelly N., Schmalbrock S., Kloosterman W.P., Kerem B., Storchová Z. 2016. The presence of extra chromosomes leads to genomic instability. Nat. Commun. V. 7. P. 10754.
https://doi.org/10.1038/ncomms10754

Patel A.N., Park E., Kuzman M., Benetti F., Silva F.J., Allickson J.G. 2008. Multipotent menstrual blood stromal stem cells: isolation, characterization, and differentiation. Cell Transplant. V. 17. P. 303.
https://doi.org/10.1038/ncomms10754

Rajamani K., Li Y.S., Hsieh D.K., Lin S.Z., Harn H.J., Chiou T.W. 2014. Genetic and epigenetic instability of stem cells. Cell Transplant.V. 23. P. 417.
https://doi.org/10.3727/096368914X678472

Ross A.L., Leder D.E., Weiss J., Izakovic J., Grichnik J.M. 2011. Genomic instability in cultured stem cells: Associated risks and underlying mechanisms. Regen. Med. V. 5. P. 653.
https://doi.org/10.3727/096368914X678472

Ruby K.M., Zheng B. 2009. Gene targeting in a HUES line of human embryonic stem cells via electroporation. Stem Cells. V. 27. P. 1496.
https://doi.org/10.1002/stem.73

Shilina M.A., Grinchuk T.M., Anatskaya O.V., Vinogradov A.E., Alekseenko L.L., Elmuratov A.U., Nikolsky N.N. 2018. Cytogenetic and transcriptomic analysis of human endometrial msc retaining proliferative activity after sublethal heat shock. Cells. V. 7. P. 184.
https://doi.org/10.3390/cells7110184

Stultz B.G., McGinnis K., Thompson E.E., Lo Surdo J.L., Bauer S.R., Hursh D.A. 2016. Chromosomal stability of mesenchymal stromal cells during *in vitro* culture. Cytother. V. 18. P. 336.
https://doi.org/10.1016/j.jcyt.2015.11.017

Tan Z., Chan Y.J.A., Chua Y.J.K., Rutledge S.D., Pavelka N., Cimini D., Rancati G. 2019. Environmental stresses induce karyotypic instability in colorectal cancer cells. Mol. Biol. Cell. V. 30. P. 42.
https://doi.org/10.1091/mbc.E18-10-0626

Ueyama H., Horibe T., Hinotsu S., Tanaka T., Inoue T., Urushihara H., Kitagawa A., Kawakami K. 2012. Chromosomal variability of human mesenchymal stem cells cultured under hypoxic conditions. J. Cell Mol. Med. V. 16. P. 72.
https://doi.org/10.1111/j.1582-4934.2011.01303.x

Vinogradov A.E., Shilina M.A., Anatskaya O.V., Alekseenko L.L., Fridlyanskaya I.I., Krasnenko A., Kim A., Korostin D., Ilynsky V., Elmuratov A., Tsyganov O., Grinchuk T.M., Nikolsky N.N. 2017. Molecular Genetic Analysis of Human Endometrial Mesenchymal Stem Cells That Survived Sublethal Heat Shock. Stem Cells Int. e:2362630.
https://doi.org/10.1155/2017/2362630

Zuo W., Xie B., Li C., Yan Y., Zhang Y., Liu W., Huang J., Chen D. 2018. The clinical applications of endometrial mesenchymal stem cells. Biopreserv. Biobank. V. 16. P. 158.
https://doi.org/10.1089/bio.2017.0057

Stability of the Human Endometrial Mesenchymal Stem Cells Karyotype *In Vitro*

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The use of stem cells for therapeutic purposes presupposes the significant quantities and genetic stability of the transplanted cells. An increase in cell biomass is may only *in vitro*, which is associated with probable risks of their genetic stability violation. In this work, we analyzed the karyotypic stability of 3 endometrial MSC (eMSC) cell lines after

the transfer of cells in vitro and during subsequent cultivation. We are showing the cells underwent karyotypic changes after transferred to in vitro system. The variability profile of analyzed eMSCs had an individual character. It was found the cells without gross chromosomal changes underwent a reversion to the karyotypic norm. Cells with chromosomal breaks and aneuploidy tended to further destabilize during cultivation. The obtained data make a significant contribution to the eMSC genetic study.

Keywords: MSCs, eMSCs, chromosomes, ectopic conjugation, impaired condensation, chromosomal breakdowns, aneuploidy