Embryonic cells inside the blastocyst, which divide and differentiate into cells of all tissues of organism, are called embryonic stem (ES) cells. Using the ES cells for transplantations is one the potential ways in regenerative medicine.

The present study deals with two different lines of mouse pluripotent cells: embryonic carcinoma (EC) cells line P19 and ES cells line D3. The *in vitro* cultivation was performed in basal cultivation medium with fetal bovine serum (FBS) and in addition of leukemia inhibitory factor (LIF) in case of ES cells. The neurodifferentiation was induced by medium without FBS and without LIF in case of ES cells and supported by retinoic acid in case of P19 cells and embryoid bodies cultivation in case of ES cells. Pluripotency and neurodifferentiation of the cells were confirmed by presence of molecular markers of pluripotency and neurodifferentiation in both lines in nondifferentiated and differentiated states.

Mouse EC P19 cells were transfected by gene for green fluorescent protein (GFP) and used for transplantation in cerebellum of wild type (WT) and Lurcher (Lc) mutant mice. Nondifferentiated cells (P19) and neuroprogenitors (NPG) derived from these cells were used. The study followed the survival, morphology and localization of the grafts.

The survival of both types of GFP grafts was similar in both types of mouse. Survival of NPG and P19 cells was significantly lower in cerebellum of Lc than WT mice. Destructions of grafts were found only in NPG grafts; expansions were more frequent in grafts with P19 cells, than in NPG grafts. The transplanted cells didn't migrate nor spread into cerebellum. The phenotype of GFP transplanted cells was confirmed by presence of neuronal markers by using immunohistochemistry. Grafts were localized in WT mouse mainly in cerebellum on the contrary to Lc mouse, where they were localized outside the degenerated cerebellum only.

Part of the presented study was focused on the characteristic of LIF and its impact on early embryogenesis. This also means its importance for fertility which is deeply investigated also in humans and not only in cell lines. So the part of the study was dedicated to the correlation of the LIF gene status and fertility in women. We investigated the prevalence of the LIF gene mutations in the population of infertile and control healthy fertile women. In fifteen infertile women the potentially functional LIF gene mutation, the G to A transitions at the position 3400 leading to the valin to methionin exchange at codon 64 (V64M) in the AB loop region of the LIF protein, were detected. Finally, the possible impact of this mutation on the infertility treatment outcome was followed.