Mesenchymal stem/stem cells (MSCs) are becoming increasingly used in regenerative medicine due to their numerous properties. They can be isolated from many tissues: bone marrow, adipose tissue, dental pulp, or umbilical cord. They are multipotent cells, i.e. cells that differentiate into only a few cell types, linked by a common origin; they differentiate into cells of so-called mesenchymal tissues - bone, cartilage, and fat. However, some researchers have reported that, under certain conditions, MSCs express markers associated with neuronal cells, which could be used in therapies for the nervous system. In addition to differentiation, MSCs secrete many trophic and immunomodulatory factors that influence the surrounding tissue microenvironment. In this manner, they can promote the regeneration of damaged tissue.

The major challenge in the use of MSCs in therapies remains their heterogeneity - i.e. within a single population several subgroups of cells can be observed, which may differ in their ability to differentiate, in the rate of proliferation, or even in their origin. In our project, we will focus especially on one of the observed subpopulations, which is characterized by the presence of the surface molecule CD271, a low-affinity receptor for nerve growth factor. The CD271 marker is also found on the cells that migrate from the neural crest, which occurs during the formation of the nervous system during embryonic development. Cells that originate from the neural crest are found in many adult tissues and retain their ability to differentiate into neural and glial cells. This may indicate an unusual origin of the MSC-CD271+ subpopulation and thus unique properties, such as a better ability to differentiate towards neural as compared to the heterogeneous population.

Our study will use MSC cells derived from Wharton's jelly (WJ) - part of the umbilical cord, a newborn tissue. CD271+ cells will be isolated using the FACS technique – fluorescence-activated cell sorting. This will allow the separation of a heterogeneous population of WJ-MSCs into a fraction enriched with CD271+ cells and a fraction lacking these cells, i.e. CD271-. In the first stage of the study, we will determine how long after sorting the CD271 marker persists in the WJ-MSC-CD271+ population and examine the neural properties of the sorted cells - we will analyze the spontaneous expression of genes and proteins related to neural tissue. In the next step, we will test the ability of WJ-MSC-CD271+ cells to differentiate into neural and glial tissue cells by investigating this at several levels - co-culture with patients' cerebrospinal fluid, co-culture with neural stem cells, and co-culture with hippocampal slices. During this step, analysis of gene and protein expression associated with neural tissue will show us whether CD271+ cells have a better ability to differentiate as CD271- cells. In this manner, we will attempt to answer the question of whether the presence of neural cell-typical markers can be explained by the presence of neural crest-derived cells in a heterogeneous MSC population.