

Adult stem cells (somatic stem cells) found in mature organisms have the potential to differentiate into selected cell types, maintaining the homeostasis of individual tissues and organs, renewing them, as well as regenerating after damage. Due to their regenerative properties, somatic stem cells have been the subject of interest in regenerative medicine and cell therapy. A better understanding of the processes regulating adult stem cells would greatly contribute to the improvement of their therapeutic use.

The hair follicle in the sense of a mini-organ is an excellent model for studying molecular mechanisms that governance the transition between quiescence and cyclic activation of the hair follicle stem cells (hfSCs) during the hair growth. hfSCs are located in the characteristic region of each hair follicle called bulge. Activation of hfSCs from the quiescence state allows cyclic hair regeneration. Moreover, they are able to regenerate epidermis, sebaceous gland, and entire hair follicle. An additional advantage of hfSCs is the possibility of their multiplication in *in vitro* culture without loss of their regenerative potential.

Our previous finding revealed, that competitive balance between two well known molecular pathways, wingless/integrated pathway (WNT) and bone morphogenetic protein pathway (BMP), is crucial for hfSCs homeostasis *in vivo*, thus their activation and quiescence. The aim of the proposed project is to investigate the role of selected modulators of the WNT pathway in the regulation of molecular mechanisms inside hfSCs during the hair regeneration cycle. The project assumes usage of CRISPR / Cas9 technique in combination with our unique research models for inactivation of selected genes within hfSCs and then performing hair and skin reconstruction assay *in vivo* in natural conditions within the mouse. Presented system is a great tool for testing functions of selected WNT pathway components during hfSCs activation in regeneration of the skin and hair follicles.

So far, no effective therapy for burn patients or patients with diabetic ulcers has been created that would allow for the reconstruction of fully functional skin with its appendages, that's way understanding of basic process regulating hfSCs would allow for their use in regenerative medicine. Moreover, WNT signaling pathways play a key role in regulation of the various types of SCs, therefore the studies described in this project may contribute to understanding the universal mechanisms regulating different stem cells populations.