

# Utilization of biocompatible hydrogels based on 2-hydroxyethylmethacrylate to bridge the spinal cord lesion

*MUDr. Petr Lesný*

Biocompatible hydrogels based on copolymers of 2-hydroxyethylmethacrylate are suitable for implantation into a central nervous tissue lesion. Our prepared hydrogels were macroporous with predominantly communicating pores, and their mechanical properties were similar to those of spinal cord tissue. After we confirmed their biocompatibility by the growth of mesenchymal stem cells and determined the hydrogel diffusion properties, we implanted the prepared hydrogels into acute spinal cord injury in laboratory rats and studied the process of spinal cord tissue regeneration within the implants. When the hydrogels were implanted in subacute phase of spinal cord injury, we observed favorable impact on the spinal cord tissue regeneration and reduction of pseudocyst formation.

Using histological and immunohistochemical methods, we observed the ingrowth of central nervous tissue elements (connective tissue, vessels, neurofilaments, Schwann cells, astrocyte processes) into the hydrogels implanted into the spinal cord hemisections. We have found that copolymerization with a positively charged ammonium salt increases the adhesion of the cells to the hydrogels in vitro and the ingrowth of nonspecific tissue elements (connective tissue, vessels) into the hydrogels. However, the positive charge had no effect on the ingrowth of neural cell processes and astrocytes, which were found within all of the studied materials.

Using copolymerization with a hydrolytically degradable crosslinker, we prepared hydrogels biodegradable in vivo in 7-34 days. The regeneration of the spinal cord tissue in these biomaterials was similar to the regeneration in nonbiodegradable hydrogels without an electric charge; however, it was complicated by the condensation of hydrogel degradation products in the central zones of the hydrogels. By implanting these hydrogels in the phase of maximal hydration, we decreased the condensation process and increased the regeneration of neural cell processes within the implants.

This work has resulted in increased knowledge about spinal cord regenerative processes and also in improved technology for the preparation of biocompatible macroporous hydrogels, which can serve as implants into the central nervous tissue, as well as a better understanding of their properties both in vitro and in vivo. Our biomaterials were biocompatible, and after implantation into a spinal cord hemisection in the laboratory rat, they facilitated the ingrowth of connective tissue containing vessels as well as a network of neural cell processes in both acute and subacute spinal cord injury therapy models. These hydrogels can be utilized as a suitable experimental model in order to study the regenerative properties of the central nervous tissue.