

DESCRIPTION FOR THE GENERAL PUBLIC

The human (and all other vertebrates) nervous system can be divided into the central nervous system and the peripheral nervous system. The central nervous system consists of the brain and the spinal cord. The remaining nerve tissue elements belong to the peripheral nervous system. The peripheral nervous system can be seen as a complex net of wires with assistance of sensory receptors and clusters of nerve cell bodies called ganglia. These elements are spread throughout the body constituting one of the most complex and advanced structures in the living organism. The main function of the peripheral nervous system is to transmit sensory and motor signals between tissues and the central nervous system.

The number of patients suffering from peripheral nerve injuries is steadily increasing every year. Injuries resulting from motor vehicle accidents are pointed out as a main cause of peripheral nerve damages. According to the World Health Organization between 20 and 50 million of people suffer from collision or crash non-fatal injuries each year. Reconstruction of functional peripheral nervous tissue is a challenging task. Complete recovery of lost sensory and motor functions can be rarely achieved due to the complex biochemical composition of the human body. Many approaches have been developed and applied with a different degree of success. Standard methods for treatment of peripheral nerve injuries encompass: end-to-end coaptations, autografts, and allografts. Despite being effective, they have numerous disadvantages: creation of tension between sutured nerve stumps, need of the second surgery along with sacrifice of the donor nerve, and necessity of toxic immunosuppression, just to name a few. Over the past two decades, researches have focused their attention on replacing these traditional approaches to peripheral nerve injury treatment by methods using the achievements of biomedical engineering. In recent years, a number of scientific papers describing more and more specific factors responsible for the regeneration of nerve cells have been published.

It seems that one of the most important factors for success in the regeneration of the nervous system is the creation of an "artificial environment" that will incorporate all these molecules and factors that the body uses itself to restore lost neurological functions. Such an environment can be a tubular implant that can be inserted on damaged nerve cells. The structure of the implant is designed to create a space that will benefit the regeneration process. The surface of the tube is designed to physically isolate the nerve tissue from the surrounding tissues and thus prevent the infiltration of harmful substances. In addition, such structure is a "scaffold", after which the nerve cells are rebuilding.

The goal of the project will be to create new implants intended for the regeneration of damaged nerve tissue. To accomplish this task, a new material will be developed. It is assumed that its chemical composition and mechanical properties will be similar to those of the native nervous tissue. In addition, the structure of the implant will be enriched with biomolecules, which as shown by the latest scientific research are crucial in the regeneration of the nervous system. Particular attention will be paid to the enzymes that control the demethylation of DNA. The latest scientific evidence shows that DNA demethylation serves as a fundamental mechanism for the global reprogramming of the cellular state of mature neurons to allow the regeneration of axons.

The development of new material can contribute to the progression in regeneration of damaged nerve tissue. The recovery of lost sensory and motor functions should be faster and more complete. Previously applied solutions allowed on incomplete regeneration of damaged nerve tissue, which was reflected in sensory disorders, motor function defects, cold intolerance and pain. These factors, such as damage to the cells innervation hand, led to its impairment, which in turn caused deterioration in the quality of life, problems at work, personal and social life of the patient.

The developed implants will have a structure enriched with biomolecules, which by stimulating nerve cells for regeneration, will increase the effectiveness of therapy and will allow for the recovery of lost sensory and motor functions. In addition, faster regeneration of the nerve tissue will reduce the cost of treatment by limiting the patient's hospitalization time.