DESCRIPTION FOR THE GENERAL PUBLIC

Traumatic brain injury occurs as a result of brain damage by external force and is now one of the most serious health problems. Brain injury is a major cause of permanent disability or death in patients under 40 years of age. Statistics show that over the past 5 years there has been an increase in incidents of brain injury by 21% and the annual expenditure on treating the consequences of accidents exceed 100 billion per year. Despite huge social and financial costs, the R & D contribution in improving the diagnosis and treatment of brain injuries is inadequate.

Diagnosis of brain damage is based on modern imaging modalities such as computed tomography and magnetic resonance. These techniques allow for the diagnosis and monitoring of brain damage, but have their limitations. The main limitations are their stationary nature, need to transport the patient and the lack of continuous monitoring. Although in developed countries these techniques are called "golden standard", there is still a need to develop non-invasive, continuous, monitoring of brain tissue at the bedside. The main advantages of optical methods are their non-invasive nature, small size devices and thus the possibility of using at the patient's bedside and continuous monitoring.

The aim of the project is to examine the possibility of using non-invasive measurement techniques for simultaneous monitoring of oxygenation, auto-regulation and brain tissue perfusion, one of the most important parameters to assess the state of the brain. The project involves the use of the near infrared spectroscopy technique combined with optical contrast agent. Near infrared spectroscopy bases on measuring of changes in light intensity after passing through the investigated structure for two or more wavelengths. In turn, this allows to determine changes in the absorption coefficient and consequently changes in hemoglobin concentration. The optical contrast agent, which injected intravenously mixes with the blood and goes into the brain tissue allowing for determining parameters of tissue perfusion. The proposed optical contrast agent, indocyanine green, is non-toxic and commonly used in medical practice. Proposed methodology will allow to estimate series of parameters:

- brain tissue oxygenation,
- Cerebral Blood Flow (CBF)
- Cerebral Blood Volume (CBV)
- cerebral autoregulation

The parameters will be compared to standard diagnostics techniques including invasive ones.

The vision of the project is to make a significant contribution to the development of non-invasive diagnostic techniques. From a clinical point of view, it is vital to continuously monitor the state of the patient's brain. Development of the methodology for the simultaneous measurement of oxygenation, perfusion and autoregulation of brain tissue may allow for a deeper understanding of the mechanisms in the brain. The proposed measuring technique can be extremely useful in patients with ischemic stroke during thrombolytic therapy aimed at restoring blood flow. It can also be used among other things to continuous assessment of intracerebral hematoma, and the patient's response to medical treatment.

The measuring system will be developed and constructed at the Nalecz Institute of Biocybernetics and Biomedical Engineering Polish Academy of Sciences. Clinical trials shall be conducted in the UK in collaboration with Addenbrooke's University Hospital, Cambridge and the Queen Elizabeth Hospital in Birmingham.