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The meningioma and glioma are one of the most common types of brain tumors. In Poland, the incidence and mortality rates are higher than in the rest of the European countries. This fact as well as the lack of full understanding of the etiopathogenesis of the diseases was the main reason of the project presented herein. The main objective of the project is an in-depth analysis of biochemistry of the tumors and the identification of specific metabolites, potential biomarkers, which would aim fast identification of these tumors. In the project we will modify and optimize the microextraction methods to characterize biochemistry of the brain tumors and to attempt selection of potential biomarkers, which could be used for screening thus enhancing targeted diagnostics of the diseases, enabling early treatment and increase the chance for patients survival.

To achieve the goal we will use the innovative technique called solid phase microextraction (SPME) in combination with mass spectrometry (MS). The SPME will enable metabolic profiling of the investigated tumors and identification of metabolic pathways involved in development of the cancer. The method utilizes the devices of the geometry of fibers or blades coated with the sorbent, which extracts the small molecules from biological matrices (blood, tissues, urine etc.). The innovation of the approach is to perform the analysis based on "chemical biopsy" i.e. monitoring of the entire tumor metabolome without collection of the sample, just by inserting the SPME device of the size of acupuncture needle into the tumor, what allows low invasive in vivo intraoperative analysis in the future. For postsurgical analysis, the resected tumor will be subjected to histological testing and SPME-MS imaging. This will indicate if SPME-MS imaging could provide additional information allowing for more precise identification of the tumor type as well as margin of cancerous tissue, which is extremely important in resection of brain tumors where each millimeter of the unnecessarily removed healthy tissue may have serious side effects. When compared to standard extraction methods based on tissue homogenisation, in vivo and rapid in situ solid phase microextraction has a few unique features such as immediate metabolism quenching, which permits capturing of short-lived and unstable species, and high efficient sample clean-up.

The project aims development of integrated platform for in situ analysis of meningioma and glioma both, for research purpose as well as neuro-oncology. The key element of this system is to use mass spectrometry for instrumental analysis to monitor distribution of the selected metabolites in the investigated tissue. The method characterizes high sensitivity and selectivity what enables precise determination of the compounds of interest.

Direct SPME-MS coupling permits for rapid and accurate close to real time measurements on-site in the OR, what would assist clinicians with determination of tumor type and more precise localization of cancerous tissue. The important aspect of the studies is the analysis of patients blood for selection of potential metabolites used for preventive screening. The project will be conducted at Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toru within international collaboration with scientists from University of Waterloo, Canada and Imperial College London, UK and with the support of Thermo Fisher Scientific, Germany and US. The clinical part of the project will be done in collaboration with Prof. Marek Harat from Military Hospital in Bydgoszcz and Collegium Medicum, NCU.