

A multimodal mass spectrometry imaging approach for the study of morphine addiction

Morphine is the substance that accompanying humans from thousands of years. It is used due to its nociceptive effect as well as because of the fact that it is able to evoke the feeling of euphoria, relaxation, and well-being. Several side effects are associated with its positive antinociceptive action, e.g. the development of tolerance, respiratory depression, constipation. On the other hand, using morphine as a substance that can reduce "emotional pain" usually lead to the development of addiction. Addiction is complex central nervous system disorder that becoming raising social and economic problem nowadays.

In our project, we would like to use modern technique of surface analysis called mass spectrometry imaging. With the aid of this technique, we can identify the substances presented at the analyzed surface and indicate their localization. In the context of biological science, we are able to analyze the tissue slices from the particular organ in this way. If during such experiment we compare the tissue slices from the control and morphine-addicted animals, we will able to indicate substances whose expression has been changed under the influence of morphine. Additionally, mass spectrometry imaging retains the information about structural localization of the molecules since it does not demand tissue homogenization. It means that we may elucidate molecular changes caused by morphine administration in different brain structures involved in the addiction phenomena. By using MALDI ion source, we are able to analyze alternations in proteins, lipids and small metabolites that are present in the tissue samples.

Our laboratory is engaged in the research that revealing molecular changes caused by morphine administration. However, up to now our efforts were focused on the proteomics approach. With its aid, we were able to indicate the changes in proteins involved in brain energy metabolism, which seems to be disturbed by morphine administration. Experiments proposed in this project are aimed to indicate how morphine influence the level of metabolites connected with energy metabolism and complement the extension of previous research. Additionally obtained results considering proteins alternations will be compared with proteomics results, verified and confirmed in this way.

We hope that our investigations will be able to indicate the key molecules whose level has changed under morphine administration and which are responsible for disturbance of the normal cell metabolism. After their identification, we could try to find the way to restore their levels to the control one. We hope that with this approach we will be able to overcome the side effect of morphine administration in the case of pain treatment and to help peoples with substance use disorder.