The adipose tissue constitutes about 20% of human body weight, may be divided into several subtypes and is located in numerous depots in the human body. White adipose tissue (WAT) and brown adipose tissue (BAT) are two basic types of the adipose tissue showing different morphological and functional characteristics. Additionally, the intermediate form, i.e. the beige (brittle) adipose tissue can be distinguish. WAT cells contain very small nuclei and large lipid droplets. The WAT main function is storing lipids and maintaining triacylglicerols' homeostasis. BAT adipocytes contain small lipid droplets, numerous mitochondria (hence the color) and are responsible for the non-shivering thermogenesis. 'Beiging' of WAT, i.e. a change of the WAT phenotype toward BAT is currently considered one of the strategies of preventing obesity and cardiovascular diseases.

Perivascular adipose tissue (pVAT) surrounds all blood vessels except for the vasculature in the brain. Since some time it has become clear that pVAT is not only a structural support for the vessel walls, but is also **a very active endocrine organ secreting many compounds that regulate functions of blood vessels**. Depending on the vessel location, pVAT may functionally and morphologically resemble BAT, WAT or beige adipose tissue. In addition, numerous studies have shown that the activity and structure of pVAT changes under development of cardiovascular diseases, and these changes are also strongly dependent on the vascular bed. So far, however, **chemical alterations that occur in pVAT under development of cardiovascular pathologies have not been studied**.

Cardiovascular diseases are still the number one factor in the mortality of the human population. One of the problems of prevention and treatment of cardiovascular diseases is the lack of noninvasive modalities enabling early diagnosis and long-term prognosis. The objectives of this project, i.e. determination of the chemical changes of pVAT in cardiovascular diseases, and correlating them with changes in the deeper layers of the blood vessel, cardiovascular risk and inflammation parameters may lead to finding new markers of the cardiovascular system. **The hypothesis of this project is that the parameters defining pVAT dysfunction, in particularly the lipid unsaturation degree, are potential new markers of the vascular inflammation that may be important from the point of view of both prediction of cardiovascular complications and treatment of cardiovascular pathologies.**

Chemical changes in pVAT will be investigated both in tissues in murine models of cardiovascular diseases (atherosclerosis, heart failure, diabetes) *ex vivo*, as well as in simplified cell models, i.e. in isolated primary adipocytes and adipocyte cultures *in vivo*, where the impact of inflammatory factors (for example tumor necrosis factor α) and supplementation with protective compounds (for example carotenoids) will be studied in a direct fashion.

A panel of research methods is planned to be used in the project, both physicochemical techniques and biochemical tests. **A particularly important new aspect of the project is the use of novel techniques of Raman spectroscopy, in particular fiber optic probe Raman spectroscopy, spatially offset Raman spectroscopy (SORS) and Raman imaging**. Raman spectroscopy is a method recording inelastic scattering of light by sample components and provides information about the molecular structure, hence, the chemical composition of the sample. Raman spectroscopy is a label-free technique, particularly sensitive on lipids, nevertheless, up to now it has not been used to characterization of the perivascular adipose tissue changes. The use of a fiber optic Raman spectroscopy enables for analyzing tissue *in situ*, SORS – *in vivo*, and Raman imaging gives information about distribution of components in the cell with sub-cellular resolution *in vivo*. Using these methods combined with reference techniques and biochemical test will provide information about the chemical changes in pVAT tissues and adipocytes under development of cardiovascular diseases, their mechanisms and enable their correlation with parameters of vascular dysfunction and cardiovascular risk.

The overriding goal of the project is better understanding of the role of pVAT in the onset and development of cardiovascular pathologies what may result in finding new markers of the cardiovascular risk. The expected fundamental result of the project is verification of the hypothesis that chemical changes, in particular the lipid unsaturation degree in pVAT are markers of vascular dysfunction with potential diagnostic and therapeutic applications.