Organ transplantation is a life-saving therapy for millions of people with end-stage organ dysfunction worldwide. It is currently standard procedure and one of the fastest-growing area of medicine. However, transplantology faces many serious problems, such as organ shortage or lack of effective tools for organ quality assessment. Therefore, there are many avenues in biomedical research explored to address the aforementioned issues. Among them development of new methods of organ preservation, which would enable to use so called marginal or suboptimum organs and maintain physiological condition of the grafts, are one of the main directions. The other approach is to extend the panel of parameters or compounds allowing better evaluation of a true condition of the organ, because currently the primary assessment is made based on visual inspection of the graft.

The proposed research project aims to introduce method called solid phase microextraction (SPME) followed by comprehensive analysis of all small molecules in the kidney allocated for transplantation as well as in the blood and urine of grafts recipients. The major advantage of the proposed method is that SPME allows to obtain those molecules without collecting biopsy tissue sample from the organ, therefore minimizing its damage and possible associated complications. Also, the minimum invasiveness permits to perform analysis over time i.e. assess quality of the organ directly after its harvesting and subsequently during the period of its preservation and immediately before transplantation. The length and type of preservation are the major contributors to so called ischemia/reperfusion injury (IRI), which is the most common complication in transplantation resulting in early graft dysfunction and possibly rejection.

It is hypothesized that combination of the novel sampling and extraction solution together with profiling changes occurring in all small metabolites will permit to reveal metabolic pathways involved and responsible for IRI as well as to indicate a set of characteristic compounds contributing the most to the aforementioned changes, which could be good biological markers of the quality of the graft and indicators of possible development of graft dysfunction. The compounds to be used for the first purpose, an assessment of organ quality, will be analyzed by direct sampling of the preserved organ, while for the post-transplant monitoring of graft function in recipients analysis of blood and urine will be conducted.

The project will consist of two parts: one will be performed with the use of human organs allocated for transplantation followed by recipient monitoring and the second will be conducted on animal model (porcine). The two parts will involve two different preservation protocols: first will use routine method of cold perfusion, while the second is experimental model utilizing warm (normothermic) perfusion with oxygen delivery. This approach is developed in order to address limitation of the cold preservation, which is cellular damage associated with further underperformance of the graft and previously mentioned complications after transplantation. Although the phenomena are the major problems frequently indisposing successful treatment, their mechanism is still not fully understood. It is believed that proposed analytical solution and its validation on the models described above will significantly contribute to the improvement of transplantation outcomes in the future by providing clinicians with more reliable tools of organ assessment and early identification of post-transplant complications.