TITLE: Optimisation of peritoneal dialysis by modelling of water and solute transport

SUPERVISIOR: dr hab. J. Poleszczuk,

Auxillary supervisior (*optional*): dr J. Stachowska-Piętka (jstachowska@ibib.waw.pl)

DOCTORAL SCHOOL (*delete as appropriate*):

1. Doctoral School of Information and Biomedical Technologies Polish Academy of Science (TIB PAN)
2. ~~DOCTORAL SCHOOL OF TRANSLATION MEDICINE „Bench to Bedside – B 2 B 4 PhD"~~

AFFILIATION: Instytut Biocybernetyki i Inżynierii Biomedycznej im. Macieja Nałęcza Polskiej Akademii Nauk, ul. Ks. Trojdena 4, 02-109 Warszawa (IBIB PAN)

SCIENTIFIC DISCIPLINE: biomedical engineering

PROJECT DESCRIPTION (max. 2500 characters; *containing general information on the scientific purpose of the project and research hypotheses, the current state of art, a short research plan and research methodology*)

It is estimated that chronic kidney disease affects one per ten adults, and based on the current dynamics, it is projected to become the fifth most common cause of premature death globally by 2040. Unlike other renal replacement therapies, peritoneal dialysis (PD) is performed by patient at home. Lack of frequent hospital visits for the dialysis sessions allows patients to align personal life and work with the treatment requirements. In peritoneal dialysis, the inner tissue layers surrounding peritoneal cavity act as a natural filter (peritoneal barrier) removing excess water and toxins accumulating in the patient's body due to the kidney failure. The properties of this barrier are patient specific and change over treatment time. Determination of filtration properties and their monitoring are important for clinical practice. Inefficiency of the therapy may lead to the serious imbalance in the body, further complications and the need to change the treatment.

The aim of the study is to optimize the therapy by modelling transport processes occurring during peritoneal dialysis based on the latest knowledge on the tissue physiology and processes taking place during the treatment. Dynamic model describing transport of water and solutes that are clinically important will be implemented and numerically solved. Modelling of therapy and processes occurring during PD will be used to optimize therapy and to monitor properties of the peritoneal barrier. In the study clinical and experimental data from domestic and foreign centers will be used.

An example of the application of modelling in peritoneal dialysis can be found in [1,2].

BIBLIOGRAPHY

1. Stachowska-Pietka J, Poleszczuk J, Teixido-Planas J, Bonet-Sol J, Troya-Saborido MI, Waniewski J. Fluid tonicity affects peritoneal characteristics derived by three-pore model. Perit Dial Int. 2019 May-Jun;39(3):243-251. doi:10.3747/pdi.2017.00267

2. Stachowska-Pietka J, Poleszczuk J, Flessner M, Lindholm B, Waniewski Alterations of peritoneal transport characteristics in dialysis patients with ultrafiltration failure: tissue and capillary components. Nephrol Dial Transplant. 2019;34(5):864-70.

REQUIREMENTS FOR CANDIDATES

Basic knowledge on the mathematical modeling and programming skills in Matlab.