Doctoral School of Information and Biomedical Technologies
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Title: Optimization of vasopressor dose in severe traumatic brain injuries using pulse-wave propagation modeling

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Research Project abstract: Traumatic brain injury is the leading cause of mortality and morbidity among young individuals in high- and middle-income countries. Precise control of systemic blood pressure in severe traumatic brain injury is of utmost importance. The most common method applied by the clinicians to keep systemic pressure levels above certain levels is to administer vasopressor agents, such as norepinephrine (noradrenalin). Vasopressors overdose can have, however, severe side effects such as hypertension resulting in cerebrovascular hemorrhage or cardiac ischemia.

The project will propose and evaluate new methods for optimizing vasopressors usage in patients with severe traumatic brain injuries. In particular, we hypothesize that the in-depth analysis of the pressure pulse wave shape augmented with already collected clinical data will allow to decipher what will be the patient-specific response to a given dose of the vasopressor. We will utilize a novel approach based on the mathematical pulse wave propagation modeling that will be used for computer simulations [1,2]. The model will allow to quantitatively and qualitatively describe important aspects of the influence of the vasopressor on the cardiovascular system. We plan also to gather clinical data in a group of patients with severe traumatic brain injuries that are treated at the intensive care unit.

Bibliography:

1. Poleszczuk J, Debowska M, Waniewski J, et al., Patient-specific pulse wave propagation model identifies cardiovascular risk characteristics in hemodialysis patients, PLOS Computational Biology, 2018, doi.org/10.1371/journal.pcbi.1006417

2. Poleszczuk J, Debowska M, Dabrowski W, et al., Subject-specific pulse wave propagation modeling: Towards enhancement of cardiovascular assessment methods, PLOS One, 2018, doi.org/10.1371/journal.pone.0190972.