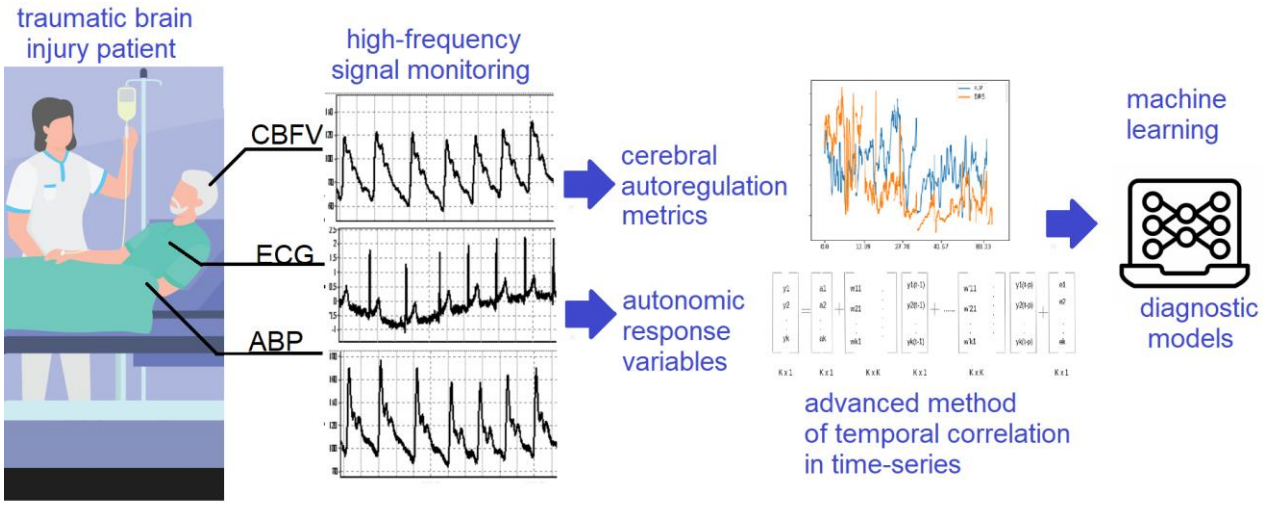
Global cerebral circulation is under the control of metabolic factors, **cerebral autoregulation**, and a mechanism responding to control by the **autonomic nervous system**. Cerebral vasculature is known to be heavily innervated by both sympathetic and parasympathetic neurones, strongly suggesting a role in the maintenance of brain perfusion. One of the most extensively analysed markers of the autonomic nervous system is baroreceptor sensitivity (BRS), due to their non-invasiveness and ease of application in clinical settings. However, the relationship between BRS and cerebral autoregulation is still unclear. Recent studies have shown that the **interrelationship between cerebral autoregulation and the autonomic nervous system is heterogeneous and varies from patient to patient** in traumatic brain injury. Even studies on healthy volunteers are inconclusive. It has been suggested on the one hand that there is an inverse correlation between cerebral autoregulation and autonomic response variables – when the activity of baroreflex increase cerebral autoregulation worsens. On the other hand, it has been shown that cerebral autoregulation was attenuated after baroreceptor suppression, implying a direct relationship.

It is believed that cerebral autoregulation and BRS are complementary to each other and provide a more complex picture of cerebral blood flow regulation. As biomedical signals and time-series parameters derived from signals are mostly non-stationary (their statistical properties change over time) there is **a high need to use more advanced methods to track and analyse of correlation between signals**. In the standard approach, the value of the signal is averaged in a moving time window and then a mean value from the recording is captured. To estimate the strength and direction of monotonic association between two metrics in the standard approach the Spearman or Pearson correlation coefficient is applied using a simple mean value in a total group of subjects. **This approach may lead to the leakage of crucial information about temporal correlation, which may be dynamic and vary in time, where the characteristics of this fluctuation may obtain additional prognostic information**. Moreover, current medicine is aimed at an individualised approach to patient treatment and condition assessment therefore "one patient-one curve" approach tends to be a better option than the "one patient-one value".

To bridge this gap, we propose a project called AUTOMATIC - Analysis of the relationship between the AUTOnoMic nervous system and cerebral AutoregulaTIon using the maChine learning approach. The main hypothesis in our project is that the **dynamic of temporal association between cerebral autoregulation and the autonomic nervous system is crucial** and needs to be investigated using more advanced approaches to data analysis, **exploiting the information contained in the fluctuations of this association**. This kind of method is well-established in econometry to track changes in stock indices and exchange rates, but we believed that they could be successfully adaptive for biomedical applications. We plan to use those methods to characterise a temporal profile of cerebral autoregulation-autonomic nervous system association based on data and signals (cerebral blood flow velocity (CBFV), electrocardiogram (ECG), arterial blood pressure (ABP)) captured during non-invasive hemodynamic measurements in healthy volunteers. As plenty of indices allow characterising cerebral autoregulation and the autonomic nervous system along with standard metrics and scales used to describe the condition of patients with intracranial pathologies, this association **cannot be interpreted in isolation from the rest of the biomedical signals and the patient's condition assessment.** Therefore**,** we plan to use a machine-learning approach to feature selection.



In final, our goal is **to build machine-learning-based diagnostic models in patients with intracranial pathologies.** A robust understanding of how cerebral autoregulation-autonomic response variables are interconnected **may improve the ability to predict patients with traumatic brain injury or subarachnoid haemorrhage at risk for cerebral autoregulation failure and autonomic nervous system dysfunction.**