Title: **Assessment of myocardial scar/viability by dynamic computed tomography perfusion and dual-energy late iodine enhancement.**

Viability imaging, using either cardiac magnetic resonance (CMR) or computed tomography (CT), is based on the principle that appropriate contrast agents (gadolinium and iodine) have similar kinetics and accumulate in the intracellular space of the necrotic myocytes. Late iodine enhancement (LIE) shares many similarities with late gadolinium enhancement (LGE). In the early phase of acute coronary syndrome, the volume of contrast agent into myocardial tissue is increased due to rupturing of the cell membranes of the necrotic myocytes. In past infarcts, the necrotic cells are replaced by scar tissue consisting out of fibrotic, collagen-rich tissue also leading to an increased volume of contrast agent. This is visualised by hyper-enhanced areas on delayed image acquisitions.

A substantial proportion of patients after MI develop heart failure (HF) and/or undergo re-revascularization. The information on myocardial scar/viability is crucial especially before invasive treatment. Moreover, non-invasive imaging of myocardial scar could inform about the risk of worse outcomes. Therefore, imaging of myocardial scar/viability is essential for the proper use of invasive treatment strategies and patient prognostication. Current "gold standard" CMR is contraindicated in a significant proportion of these patients, causing serious problem (due to implanted metal elements, pacemakers, ICDs or CRTs (not adapted for CMR imaging), or in patients with claustrophobia or contraindications to gadolinium). Computed tomography would provide so much needed alternative imaging method. Additionally, CT is the preferred first choice diagnostic imaging modality for evaluation of coronary arteries in patients with suspected chronic coronary syndrome and addition of scarring/viability assessment would allow to streamline the diagnostic process. Therefore, we aimed to evaluate the novel method of myocardial scar/viability assessment in patients after MI based on comprehensive CT techniques, including: dynamic computed tomography perfusion (CTP) and dual-energy computed tomography (DECT) LIE in reference to the CMR with LGE.

This is a prospective study with planned inclusion of 100 consecutive patients (100 readable cases, additional 5 patients will be recruited for study protocol design) with history of MI (at least 6 weeks before the study inclusion). Inclusion criteria INCLUDE: 1) age ≥18 years; 2) signed informed consent for the participation in the study, and 3) history of myocardial infarction (evidence of past myocardial infarction in ECG or documentation of previous myocardial infarction from hospital records or chronic total occlusion of at least one coronary artery). The primary objective of the current study is to evaluate the feasibility and diagnostic value of dynamic CTP and DECT LIE in evaluation of myocardial scar/viability as compared to CMR with LGE. The secondary objectives of the study are: 1) to assess the safety of DECT LIE, 2) to develop the optimal study protocol for DECT LIE, and, 3) to develop optimal combined CTP and DECT LIE study protocol for patients with reduced left ventricle ejection fraction (LVEF).

The project builds upon our previous OPUS grant (nr 2015/19/B/NZ5/03502), which showed for the first time the clinical value of quantitative CTP in evaluation of reversible ischemia [1,2]. Despite few previous studies showing an initial potential of the CT, there is no data on the optimal acquisition and analysis of novel CT techniques to evaluate the myocardial scar/viability. The project would advance the knowledge and contribute to future development of novel imaging techniques improving patients' care.

This study will provide currently lacking knowledge on the complex processes involved in the formation and imaging of myocardial scar/viability with novel CT techniques, including dynamic CTP and DECT LIE. The unique insight gained due to the novel methodology, will improve understanding of the pathophysiology of myocardial scar and the adjacent ischemic rim formation, the interaction between the myocardial and scar tissue and the iodine contrast and the ability to grasp those interactions with modern CT based imaging techniques including dynamic perfusion and dual-energy CT. These information may lay ground for future development of a novel diagnostic methods, and improve patient management, ultimately translating into improved outcomes.