

Significance of coronary artery disease in patients with aortic stenosis undergoing transcatheter valve implantation

Aortic stenosis (AS) is the most common heart valve disease in the western world (affecting ~12% of people above 75 years, with severe disease in ~4%). AS is caused by calcification of valve leaflets leading to progressive valve narrowing causing reduction of blood flow from the heart to aorta. Due to an aging population, the prevalence and healthcare burden of AS will rise. Since no pharmacological treatment to slow the progression of AS is available, only surgery is a definitive cure. Recently transcatheter aortic valve implantation (TAVI), a minimally-invasive alternative to open heart surgery, has been a major breakthrough and became a treatment of choice for many patients. TAVI consists of delivering an aortic valve prosthesis to a desired position in the heart through a small puncture in the artery. It has been estimated that TAVI procedures will grow from ~100 000 in 2017 to nearly ~300 000 in 2025.

Coronary artery disease (CAD), is the major cause of death in most countries. It is frequently diagnosed in patients with AS referred for TAVI, typically as narrowings of coronary arteries supplying the heart with blood, but optimal treatment of CAD in these patients is unknown. Importantly, treating coronary blockages after TAVI by implanting coronary stents can be technically difficult due to construction of the prosthetic valve. However, it is already apparent that certain types of coronary atherosclerosis (so-called 'high-risk plaques') more frequently lead heart attack and death than others, and coronary computed tomography (CTA) is particularly useful in identifying them. Notably, majority of patients with AS undergo CTA as part of their cardiac assessment. Using a dedicated software one can perform quantitative (expressed as absolute volumes or percentages) measurement of each component of atherosclerotic plaque as well as examine the perivascular fat for signs of high CAD activity based on CTA. In patients without AS this method helps predict future myocardial infarction better than currently used cardiovascular risk scores. In this proposal we aim to verify whether the volume of high-risk coronary atherosclerosis in patients with AS undergoing TAVI is associated with future heart attack and death.

The study is designed as a multicenter retrospective analysis. We plan to use the existing TAVI database at the National Institute of Cardiology in Warsaw and the nationwide POL-TAVI registry to select all patients with available pre-TAVI CTA. Tomographic images will be downloaded from a permanent server and analyzed both using standard CTA software (SyngoVia, Siemens) as well as a dedicated quantitative plaque analysis software (AutoPlaque, Cedars Sinai Medical Center, USA). Particularly we will measure the volumes and percentages of total plaque, calcified plaque, noncalcified plaque and low-attenuation plaque for each patient separately. Additionally, we shall analyze the pericoronary fat tissue attenuation which is a marker of CAD activity. We will verify how the presence and amount of high-risk atherosclerosis influences patients prognosis by verifying the incidence of myocardial infarctions and unplanned coronary stenting in all patients using the data from the National Health Fund. To draw meaningful conclusions inclusion of around 900 patients is needed.

The project has the potential to verify the usefulness of high-risk plaque features diagnosed with CTA for prediction of future cardiac events in patients evaluated for TAVI. In the study we shall validate a powerful tool capable of accurately selecting patients with aortic stenosis for whom invasive treatment of coronary narrowings is necessary prior to TAVI as well as those who can safely be treated medically. This is in line with the idea of 'precision medicine' in which therapy is tailored to each individual's risk profile, thus providing best clinical results and optimizing costs by reducing unnecessary and potentially harmful interventions.