

## **Elevator pitch**

### **Flow in prosthetic mechanical heart valves**

#### **Abstract**

Heart valve failure is one of the most common coronary issues affecting the population. Statistics show that, every year, over 300.000 people in Europe and the U.S. are in need of such surgery.

Among these issues, one may find aortic stenosis (valve does not open at all) and aortic regurgitation (valve does not closes at all). This is to be solved by means of bioprosthetic tissue-engineered (BHV) and mechanical heart prostheses (MHV).

Heart valve replacement is, mostly, a matter of patient's age. Data guidelines recommend such mechanical devices as a preferred option for those who, at the age of replacement, are under 50 years old, tissue-engineered valves for those beyond their 70's and either MHV or BHV for ages comprising 50-70.

The first ones, BHV, are harvested from pig heart valves or from the sac surrounding the heart of a cow. They are not meant to be used with anticoagulant medicine but they need to be replaced due to their tendency to wear out. Otherwise, MHV produce some "clicking" and need blood thinners to prevent from blood clot formation.

The ongoing research on both optimizing the hemodynamics and reducing the potential for blood clotting of the last type of devices is carried out with predictive modelling tools as Computational Fluid Dynamics (CFD). The underlying idea is the interaction of the blood flow within not just the valve domain but also its surroundings.

Several studies on the development of a bileaflet mechanical valve concluded where the platelets (red blood cells) activate, this is clot formation, due to shear forces whereas others showed how the leaflets dynamically move as the blood flow is rejected from the heart (systole). As well, they showed how the valve closes as the heart relaxes (diastole) by the recirculating flow generated on the vicinity of the valve (Valsalva's Sinus).

Nevertheless, despite the fact of such studies, there is still a long path to go through since these simulations require better improvements concerning the forementioned. In addition, CFD results rely heavily on alongside in vitro and animal experimentation to check the lack of accurated captures on all relevant scales of motion.