

Scientific outcome

The aim of the project was to combine the expertise of the Institute of Applied Medicine, RWTH Aachen University on computational fluid dynamics (CFD) and multiscale simulations with the expertise of my group (Product Development Group Zurich, ETH Zurich) on modelling of cardiovascular systems and in vitro testing of active and passive cardiovascular implants. Thus, the hydraulic and hemodynamic properties of Fontan grafts would be investigated. We started with the development of a multiscale simulation which consists of a Fontan graft coupled with a Fontan circulation. This part of the work was conducted in Aachen. There, we used recorded MRI patient data to construct in software a 3D geometry of a total cavopulmonary support connection (TCPC). This TCPC was coupled with an earlier developed numerical model of a Fontan circulation, whose condition was either healthy or failing. Rest to exercise experiments, which included the body baroreflex mechanisms were also simulated. During Kristin's visit at our lab, we managed to implement this numerical model on a new hybrid mock circulation and manufacture with 3D printing the simulated 3D geometry. Thus, an in vitro validation of our simulation would be possible. However, the final experiments were not conducted, as we didn't manage to develop a multiscale simulation that contains the whole complexity of the numerical model. That constitutes future work for us and hope to ultimately develop a useful testing environment for improving TCPC geometries or investigating MCS devices for Fontan patients.

Interdisciplinary and social outcome

This exchange brought together two different kind of expertise. I learned a lot about how to setup a CFD simulation and especially, a multiscale one. Furthermore, as this project is not part of my research focus, I had the opportunity to learn about the Fontan patients, their treatment options and their problems. Being part of the Institute of the Applied Medicine for a week was a unique experience. I got the chance to see how a group with a lot of experience and focus on cardiovascular devices is organized and works at a daily basis, as well as to see their labs. The environment was very friendly and I got to know many other researches and exchange ideas for many various topics. The after-work activities were even better and gave us the opportunity to get know better each other and of course see the city. I greatly suggest every young researcher to apply for the yESAO Exchange Award as it is an opportunity for a great experience during the PhD life that helps to broad your horizons. Many thanks to yESAO committee that they offered me this opportunity