# A new approach for blood hemodynamic reconstruction in human vessels with a new artificial circulatory model

**Andrzej Polanczyk[1,2], Aleksandra Piechota-Polanczyk[3], Martin Funovics[1], Christoph Domenig[1], Josif Nanobashvili[1], Christoph Neumayer[1]** and **Ihor Huk[1]**

[1]Medical University Vienna, Austria
[2]Lodz University of Technology, Poland
[3]Jagiellonian University, Krakow, Poland

**Introduction:** The aim of the study was to investigate a mechanical behavior of various types of artificial vessels in relation to the iliac arteries with the use of dedicated *ex vivo* bioengineering reactor.

**Methods:** Artificial circulatory model (ACM) for computational projection of vessel structure under different flow conditions was designed and built. Analyzed vessels were supplying with the homemade fluid mimicking blood. Following types of vessels were analyzed: synthetic prostheses (ePTFE, ePTFE with spiral, Dacron), biosynthetic prostheses (Omniflow II, gelatin sealed ePTFE), iliac arteries and silicon tubes. Each time the same length of vessel (100 mm) was analyzed. Mechanical behavior was introduced with the use of following parameters: change of diameter, wall displacement, deformation factor and divergent factor. Moreover, ACM results were verified with medical data. 2D-speckle-tracking-technique (2DSTT) was applied to assess diameter dilatation for patients with ePTFE prostheses/iliac arteries.

**Results:** It was presented that both Dacron and bio prostheses act similarly to real tissue. Approximately 21% difference for gelatin sealed ePTFE prostheses and 25% for Dacron prostheses compare to iliac arteries was observed. While, ePTFE prostheses presented about 2.4-fold increase of stiffness compare to the flexibility of iliac arteries. Moreover, ePTFE prostheses act much more like silicon tubes rather than iliac arteries.

**Conclusions:** Artificial reconstruction of blood flow in different spatial configuration of human and artificial vessels allows simulating different mechanical response of tissue vascular grafts and silicon tubes.

## Recent Publications

1. Polanczyk A, Piechota-PolanczykA and Stefanczyk L (2017) A new approach for the pre-clinical optimization of a spatial configuration of bifurcated endovascular prosthesis placed in abdominal aortic aneurysms. PLOS One DOI: 10.1371/journal.pone.0182717.
2. Polanczyk A, Podyma M, Trebinski L, Chrzastek J, Zbicinski I and Stefanczyk L A (2016) Novel attempt to standardize results of CFD simulations basing on spatial configuration of aortic stent-grafts. PLOS One DOI: 10.1371/journal.pone.0153332.
3. Polanczyk A, Podyma M, Stefanczyk L, Szubert W and Zbicinski I (2015) A 3D model of thrombus formation in a stent-graft after implantation in the abdominal aorta. Journal of Biomechanics 48(3):425-431.
4. Mundargi R, Venkataraman D, Kumar S, Mogal V, Ortiz R and Loo J (2015) Novel sensor-enabled *ex vivo* bioreactor: A new approach towards physiological parameters and porcine artery viability. BioMed Research International DOI: 10.1155/2015/958170.
5. F Prandi, M Piola, M Soncini, C Colussi, Y D'Alessandra, E Penza et al. (2015) Adventitial vessel growth and progenitor cells activation in an *ex vivo* culture system mimicking human saphenous vein wall strain after coronary artery bypass grafting. PLOS One 10:e0117409.

## Biography

Andrzej Polanczyk is a Researcher and a Team Leader at the Lodz University of Technology, Poland. He earned his PhD in Medical Engineering in 2013. He participated in scientific grants in which he build the installation to simulate the blood flow through the abdominal section of the aorta. Recently he received a grant funded by The National Centre for Research and Development. His research areas comprise biomedical, chemical and environmental engineering.