

Numerical Simulation of Blood Flow and Plaque Progression in Right Femoral Artery Bypass Patient – Specific Case



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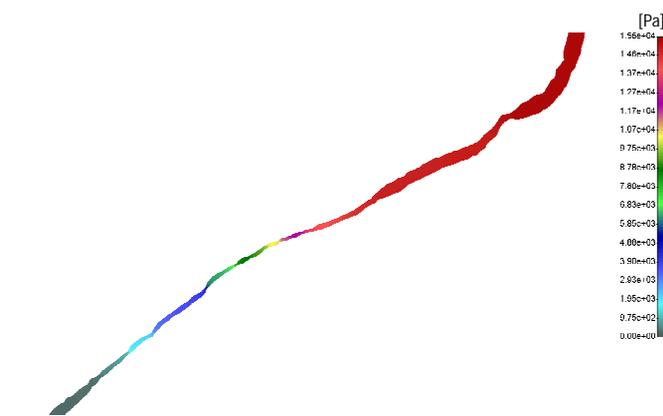
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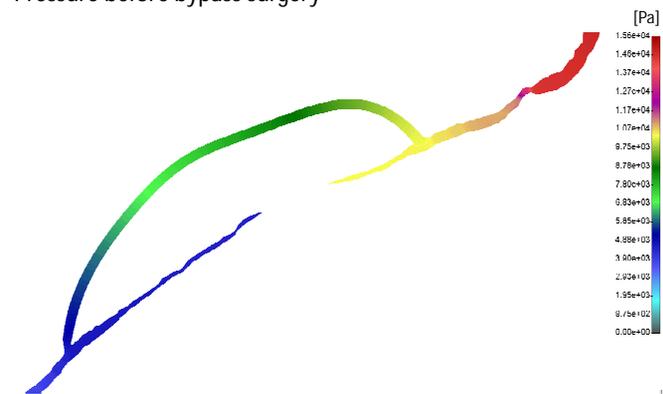
Introduction – Atherosclerosis in the leg arteries causes peripheral vascular disease. Femoral popliteal bypass surgery is used to treat blocked femoral artery (FA) due to plaque accumulation or atherosclerosis.

Aim – The aim of this study was to compare blood flow (pressures, shear stress, velocities) patterns in a diseased and by-passed right femoral artery using the finite element method.

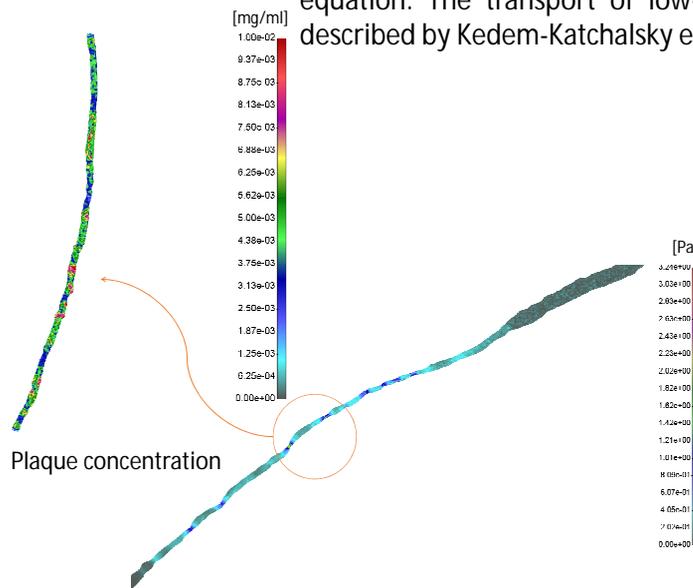
Materials and methods – The by-passed FA was obtained virtually, using software for 3D visualization from images, and software for 3D modeling to create the by-pass. The mass transfer within the blood lumen and through the arterial wall was coupled with the blood flow and modeled by convection-diffusion equation. Blood flow through the obtained 3D model was governed by Navier-Stokes equations including the continuity equation. The transport of low-density lipoprotein (LDL) in the vessel lumen was described by Kedem-Katchalsky equations.



Pressure before bypass surgery

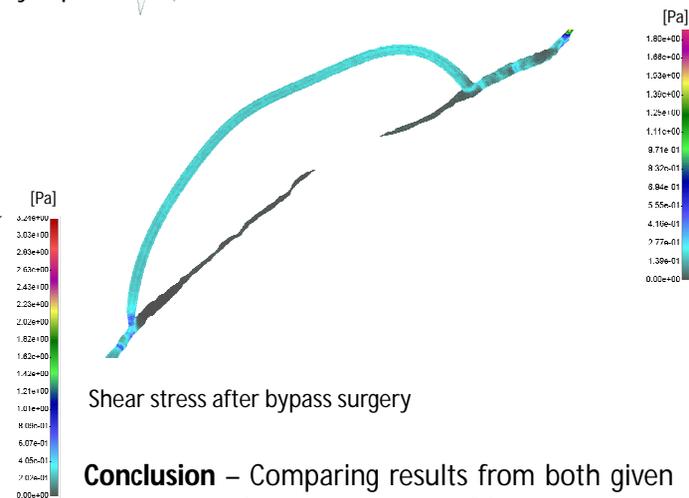


Pressure after bypass surgery



Plaque concentration

Shear stress before bypass surgery



Shear stress after bypass surgery

Results – Two cases were analyzed: case of the FA with restricted blood flow and bypassed FA. A three-dimensional simulation of blood flow through lumen and plaque progression in diseased vessel wall was also simulated.

Conclusion – Comparing results from both given cases obtained by user-friendly three-dimensional visualization of objects from patient's CT scans is suitable for monitoring the patient's condition, potential medical procedures risk assessment and decision on medical therapy.

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