THE IMPORTANCE OF INTRALUMINAL THROMBUS ON ABDOMINAL AORTIC GROWTH – A NUMERICAL STUDY

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The majority of abdominal aortic aneurysms (AAAs) harbor intraluminal thrombi (ILT) that biochemomechanicaly influence the aortic wall structure [1]. The numerical algorithm describing AAA growth describing biomechanical and biochemical interaction between ILT and aorta is developed. A computational model of multi-layered ILT, using an idealized cylindrical geometry, presented in Virag et al. [2] showed the complex and diverse effects of ILT on AAA development. In recent computational studies, a 3D finite element growth and remodeling (G&R) model of the aorta [3] has been expanded by the novel algorithm for thrombus deposition during a FEM simulation [4]. That enabled analysis of the mechanical influence of ILT on a 3D axisymmetric fusiform AAA. The study showed that ILT helps to slow down an aneurysm growth and it has the potential to cause AAA stabilization. Nevertheless, only the mechanical influence of the ILT was considered and thus an aneurysm rupture risk potential was underestimated.
Besides the positive mechanical influence, it is important to include a mostly negative influence of a proteolytically active luminal layer of the ILT as well. The luminal layer causes activation of enzymes (e.g. matrix metalloproteases) that degrade and weaken the aortic wall [1]. The finite element G&R model of AAA from [3] is expanded with ILT biochemical influence. A small local degradation of elastin was used to cause initial aortic wall expansion and deposition of thrombus. After that biochemomechanical interaction between ILT and aortic wall governed further aneurysm development. The new model showed us how diffusion of enzymes from the luminal layer of ILT and vasa vasorum affect the degradation of the aortic wall, and it helped us to get a better understanding of the complex role that ILT plays in AAA evolution.

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