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# Non-Newtonian Pulsatile Flows in an Aneurysm

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## Extended Abstract

This paper examines the flow dynamics in a representative model of an aneurysm in the common carotid artery under physiologically realistic pulsatile conditions and compares it with a healthy carotid artery for various degree of dilation using five blood rheological models. The results of transient simulations are presented in this study.

An aneurysm is an area of localized dilation of a blood vessel. An aneurysm in the carotid artery involves the two carotid arteries, the left and right common carotid arteries (CCAs) that supply blood to the brain. They supply the large, front part of the brain, which is responsible for our personality and our ability to think, speak and move. Aneurysms are frequently located at branching points of the major arteries. Most aneurysms are fusiforms. They are shaped like a spindle with widening all around the circumference of an artery. The inside walls are often lined with a laminated blood clot. Aneurysms are most common after 60 years of age. Men are more likely than women to be affected. The foremost health danger of this aneurysm is rupture which leads to death in up to 90% of the victims.

The most common cause of an aneurysm is hardening of the arteries, called arteriosclerosis [1]. The arteriosclerosis can weaken the arterial wall and the pressure of the blood being pumped through the aorta causes expansion at the site of weakness. Consequently, hemodynamic factors such as blood velocity, wall shear stress and pressure play important roles in the pathogenesis of aneurysms and thrombosis. The geometry of the aneurysm, its volume and aspect ratio (depth/neck width) and its relation to the parent vessel are also important factors affecting its hemodynamic.

There are three objectives of this study: first, to investigate the variation in wall shear stress in an aneurysm of the carotid artery at different flow rates and degrees of dilation; second, to compare the various blood models and hence quantify the differences between the models and judge their significance and lastly, to determine whether the use of the Newtonian blood model is appropriate over a wide range of shear rates.

Four non-Newtonian blood models, namely the Power Law, Casson, Carreau and the Generalized Power Law, as well as the Newtonian model of blood viscosity, are used to investigate the flow effects induced by these different blood constitutive equations. Results show significant differences between modeling blood as a Newtonian and non-Newtonian fluid at low shear rates. The dependence of the flow on the degree of abnormality is examined and differences from the Newtonian case are discussed.