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DOES ANEURYSM WALL SHEAR STRESS CHARACTERIZATION DEPEND ON BLOOD VISCOSITY MODEL?

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Abstract. The optimal management of unruptured aneurysms is controversial, and current decision making is mainly based on aneurysm size and location. Incidentally detected unruptured aneurysms less than 5mm in diameter should be treated conservatively. However, small unruptured aneurysms also bleed. Risk factors based on the hemodynamic forces exerted over the arterial wall have been investigated using image-based computational fluid dynamic (CFD) methodologies during the last decade. Accurate estimation of wall shear stress (WSS) is required to properly study associations between flow features and aneurysm processes. Previous works showed that Newtonian and non-Newtonian (Casson) models produce similar WSS distributions and characterization, with no significant differences. Other authors showed that the WSS distribution computed from time-averaged velocity fields is significantly higher for the Newtonian model where WSS is low. In this work we reconstructed ten patient-specific CFD models from angiography images to investigate the time evolution of WSS at selected locations such as aneurysm blebs (low WSS), and the parent artery close to the aneurysm neck (high WSS). When averaging all cases it is seen that the estimation of the time-averaged WSS, the peak WSS and the minimum WSS value before the systolic peak were all higher when the Casson rheology was considered. However, none of them showed statistically significant differences. At the afferent artery Casson rheology systematically predicted higher WSS values. On the other hand, at the selected blebs either Newtonian or Casson WSS estimations are higher in some phases of the cardiac cycle. Those observations differ among individual cases. WSS distributions at the end diastole, where the lowest WSS values are expected, also show regions where either Casson or Newtonian rheology predicts greater values. From our analysis, there is no evidence that Newtonian rheology overestimates WSS.