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## A multi-layer non-Newtonian model of cardiovascular inflammation

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Cellular functions related to the maintenance of homoeostasis are regulated by shear forces sensed by endothelial cells. The endothelial cells sense local changes in shear stress. The resulting signals are either transduced into chemical responses or transmitted to the surroundings to regulate the cellular activity. In the current literature, models of blood flow applied to the characterization of atherosclerotic plaques consider blood as a Newtonian fluid because of the characteristic length of the domain. At predilection sites for plaque deposition, the diameter of the blood particles is much smaller than the normal arterial diameter. However, under disease condition, the proportions can dramatically change due to a reduction greater than 80% in the arterial cross-section, in cases of severe stenosis. Here we show that in diseased arteries, the local particle concentration can peak at locations associated to high inflammation. We found that such locations are correlated to the vulnerable plaque phenotype, which is prone to rupture. Our results demonstrate that at locations of high particle concentration, blood particles change the shear stress distribution and magnitude. Therefore, the non-Newtonian blood flow assumption provides new insights in the characterization of plaque built up. These results are combined to *in vitro* experiments that suggest the influence of blood particles in the activity of cytokines. An unbalance in pro and anti-inflammatory cytokines has been associated to an increase in inflammation and, consequently, in the volume of plaques forming. We anticipate our work to be a starting point for a more sophisticated multi-scale model, which combines experimental findings and computational modeling to characterize arterial segments affected by atherosclerosis. Such model includes a coupling between the distending arterial wall and the non-Newtonian blood flow.

### Biography

Glaucia C Pereira is a Principal Investigator in Machine Learning and Bioinformatics at the Icelandic Institute for Intelligent Machines. She is a former Member of Imperial College London and a past Researcher Visitor at the University of Cambridge, where she worked with microfluidics and computational bio-fluid mechanics applied to cardiovascular inflammation. She has also worked for both the Spanish and the Brazilian government, as a Researcher. She is currently applying knowledge from biomedical engineering, mathematics and computational systems engineering, while leading projects in the field of biotechnology, aiming at advancing knowledge in basic sciences and translational biomedicine.

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