Contribution ID: **333** Type: **Poster (+) Presentation**

Modelling the role of vWF in initiating arterial thrombosis

Wednesday, 2 June 2021 16:00 (1 hour)

Coronary heart disease is characterised by the formation of plaque on artery walls, restricting blood flow. If a plaque deposit ruptures, blood clot formation (thrombosis) rapidly occurs with the potential to fatally occlude the vessel within minutes. Von Willebrand Factor (vWF) is a shear-sensitive protein which has a critical role in blood clot formation in arteries [1]. At the high shear rates typical in arterial constrictions (stenoses), vWF undergoes a conformation change, unfolding and exposing binding sites and facilitating rapid platelet deposition.

We develop a continuum model for the initiation of thrombus formation by vWF in an idealised arterial stenosis. We extend current continuum models for thrombosis by explicitly modelling the vWF unfolding dynamics [2,3]. The vWF and platelets are split into free and bound populations, where the bound populations are fixed to the stenosis surface and the free populations, are advected with the fluid. The model for vWF extension in the flow is derived by considering a dilute limit of a nonlinear viscoelastic fluid model, the FENE-P model, such that the protein has a negligible contribution to the fluid viscosity but the influence of fluid shear on protein extension is retained.

We exploit the slow timescale of thrombosis initiation to construct a reduced model of thrombosis, this allows us to examine the role of vWF in the cascade prior to rapid thrombus growth and vessel occlusion. We consider free vWF binding to available collagen on the stenosis surface which then forms a base for platelet deposition. Free platelets are then able to deposit to the bound vWF with a variable binding rate which increases proportional to the length of vWF.

Through numerical simulations, we investigate the effect of varying stenosis geometry and blood flow conditions on the unfolding of vWF and subsequent platelet binding. This allows prediction of the location and timescale platelet deposition for a given stenosis.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

[1] Casa, Lauren DC, and David N. Ku. "Thrombus formation at high shear rates." Annual review of biomedical engineering 19 (2017): 415-433.
[2] Wu, Wei-Tao, et al. "Simulation of thrombosis in a stenotic microchannel: The effects of vWF-enhanced shear activation of platelets." International Journal of Engineering Science 147 (2020): 103206.
[3] Du, Jian, et al. "Clot Permeability, Agonist Transport, and Platelet Binding Kinetics in Arterial Thrombosis." Biophysical Journal 119.10 (2020): 2102-2115.

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