6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

A COMPUTATIONAL MODEL FOR VASCULAR FLUID BALANCE AT THE MICROSCALE

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Keywords: *Microcirculation, lymphatics, fluid homeostasis, finite element model*

We present a two phase model for microcirculation that describes the interaction of plasma with red blood cells [1]. The model describes the interaction of capillaries with the surrounding tissue, and in particular the interaction of capillary transmural flow with the surrounding interstitial pressure. Furthermore, the capillaries are represented as one-dimensional channels with arbitrary, possibly curved configuration. The latter two features rely on the unique ability of the model to account for variations of flow rate and pressure along the axis of the capillary, according to a local (differential) formulation of mass and momentum conservation. The model also takes into account of fundamental effects characterizing blood rheology, such as the Fahraeus-Lindqvist effect and plasma skimming.

Since processes involved in fluid balance are strongly related with exchanges at the microvascular level, we address the application of the model to study fluid homoeostasis. In this context, lymphatics play a relevant role. In order to describe the lymphatic flow rate a non-linear function of the interstitial pressure is defined, based on experimental literature data referred to the lymphatic system. The proposed model of lymphatic drainage is compared to a linear one, typically used in the finite element models of microvasculature. To evaluate the response of the model, a comparison is performed with reference to both physiological and pathological conditions [2].

This model captures the delicate balance of fluid exchange between arterial, venous and lymphatic system at the microvascular level. We will finally develop and discuss the application of this model to the specific case of the brain.

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