A Computational Model of Fluid Transport Through Lymphatic Capillary Endothelial Junctions

By

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ABSTRACT

This study utilizes a finite element model to characterize the mechanics of primary lymphatic valves during uptake of interstitial fluid. A previous analytical model is analyzed [1], and compared to the computational model presented in this study. The goal of the present study is to improve the physiological accuracy of the model to better understand the interaction between lymph flow and the junctions between endothelial cells that line the wall of the lymphatic capillary. Although certain simplifying assumptions are made, the computational model adds a significant amount of complexity to the analysis. The present model draws upon anatomical and physiological data to construct a model that properly represents the actual geometry of these junctions. Available experimental data concerning flow of interstitial fluid is utilized to validate the results of the model. In addition to utilizing a fluid-structure algorithm to accurately model the interaction between the endothelial cells and the lymph, the model describes the flow exterior to the capillary using Brinkman equations to represent the extracellular matrix surrounding interstitial space as a porous medium. Using the results of the model, functional relationships are constructed that relate the transendothelial pressure to lymph flow rates and endothelial cell deflection. These relationships are compared to similar constructs presented in literature.