

Computational Exploration of Liver Acinus Microstructure

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Microcirculation and its regulatory mechanisms are gaining increasing importance for a variety of medical applications. The intimate relationship between many liver diseases and the circulation is emphasized for obvious cases such as cirrhosis and portal hypertension as well as liver cancer. In this study, we focus on the computational hepatic blood circulation analysis. One of the most important and challenging problems in the hepatic vasculature is the understanding of mixing of high pressure/velocity hepatic arterioles and low pressure /velocity portal venule which drains into the hepatic venules. The choice of radial flow was based on mimicking the flow distribution patterns in vivo. At the microscopic level, the acinar arrangement of the vascular system creates a unique series of microenvironments, which are acknowledged to be of paramount importance in controlling the functional characteristics of the parenchymal cells. In the current study we considered a simple liver acinus, which represents a small parenchymal mass consisting of terminal hepatic arteriole and portal venule along with a sinusoidal space surrounded by the fenestrated endothelial cells and hepatic venule. The model solves the Navier–Stokes equations for unsteady Newtonian fluid flow using a finite volume approach. The results discuss the transmittent activity of the hepatic arteriole, pressure distribution in the sinusoidal space, the effect of mass flow rate on the hepatic cells and their consequences.

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