

Investigating the mechanisms of blood flow regulation

Abstract: In normal tissues, blood supply is closely matched to tissue demand for wide ranges of oxygen demand and arterial pressure. This suggests that multiple mechanisms regulate blood flow. Theoretical models can be used to analyze these interacting mechanisms. In this study, a vascular wall mechanics model is used to calculate arteriolar diameters and smooth muscle tone. The dependence of vascular smooth muscle tone on metabolic signals, wall shear stress, and wall tension is modeled. The model can account for increases in perfusion consistent with experimental findings at low and moderate oxygen consumption rates. The same model is used to investigate blood flow autoregulation, which is the maintenance of nearly constant blood flow as arterial pressure is varied. The combined effects of myogenic (pressure) and metabolic regulation are predicted to be important in generating autoregulatory behavior. In summary, the theoretical model provides a quantitative assessment of the myogenic, shear-dependent and metabolic mechanisms that affect blood flow.