Microcirculation

see Microcirculatory changes.

Microcirculation is the circulation of the blood in the smallest blood vessels, present in the vasculature embedded within organ tissues.

This contrasts with macrocirculation, which is the circulation of blood to and from the organs. The microcirculation is composed of terminal arterioles, capillaries, and venules that drain capillary blood. The vessels on the arterial side of the microcirculation are called the arterioles, which are well innervated, are surrounded by smooth muscle cells, and are 10-100 µm in diameter. Arterioles carry the blood to the capillaries, which are not innervated, have no smooth muscle, and are about 5-8 µm in diameter. Blood flows out of the capillaries into the venules, which have little smooth muscle and are 10-200 µm. The blood flows from the venules into the veins. In addition to these blood vessels, the microcirculation also includes lymphatic capillaries and collecting ducts. The main functions of the microcirculation are the delivery of oxygen and nutrients and the removal of carbon dioxide (CO2). It also serves to regulate blood flow and tissue perfusion thereby affecting blood pressure and responses to inflammation which can include edema (swelling).

Pentoxifylline (PTX) is a methylxanthine derivative clinically proven to improve perfusion in the peripheral microcirculation and has been shown to have neuroprotective effects in brain trauma and global cerebral ischemia in experimental animal models.

Microcirculation plays a significant role in cerebral metabolism and blood flow control, yet explaining and predicting functional mechanisms remains elusive because it is difficult to make physiologically accurate mathematical models of the vascular network. As a precursor to the human brain, a paper presented a computational framework for synthesizing anatomically accurate network models for the cortical blood supply in mouse. It addresses two critical deficiencies in cerebrovascular modeling. At the microscopic length scale of individual capillaries, Linninger et al., presented a novel synthesis method for building anatomically consistent capillary networks with loops and anastomoses (=microcirculatory closure). This overcomes shortcomings in existing algorithms which are unable to create closed circulatory networks. A second critical innovation allowed the incorporation of detailed anatomical features from image data into vascular growth. Specifically, computed tomography and two photon laser scanning microscopy data are input into the novel synthesis algorithm to build the cortical circulation for the entire mouse brain in silico. Computer predictions of blood flow and oxygen exchange executed on synthetic large-scale network models are expected to elucidate poorly understood functional mechanisms of the cerebral circulation [1].

[1]
Linninger A, Hartung G, Badr S, Morley R. Mathematical synthesis of the cortical circulation for the whole mouse brain-part I. theory and image integration. Comput Biol Med. 2019 May 14;110:265-275. doi: 10.1016/j.compbiomed.2019.05.004. [Epub ahead of print] PubMed PMID: 31247510.