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Abstract ISRA79

Vascular conducted responses - from biophysical properties to synchronization of dynamics in the microvascular network

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The main mechanism underlying vascular conducted responses (VCR) appears to be electrotonic spread of local changes in the membrane potential along the vessel. VCRs are present in most vessels in the microcirculation. From an electrical point of view, the vascular wall is a highly complex structure consisting of at least two conduction pathways, the smooth muscle layer and the endothelial cell layer. The two pathways are interconnected by myoendothelial junctions, and in addition, the electrical properties are nonlinear due to the biophysical characteristics of ion channels and gap junctions. The physiological significance of VCRs is coordination of vascular responses within the microcirculation. This coordination may be of both a serial character, whereby downstream changes are communicated to more upstream segments thereby amplifying the overall change in vascular resistance; or it may be of parallel character, whereby the activity in neighboring vascular units are synchronized. In some organs where the individual vascular units have autonomous dynamics, the interaction may lead to complex dynamics in blood flow that encompasses a large part of the organ. Using both experimental and computational approaches we have found that in the kidney VCRs causes synchronization of blood flow oscillations in the individual nephrons leading to phase and frequency entrainment over a substantial part of the kidney. This synchronization may play an important role for overall kidney function.