Phenotyping the Microcirculation With Contrast-Enhanced Ultrasound

To the Editor:

In their interesting review, Struijker-Boudier et al provide a critical appraisal of current methods to study the microcirculation. In the extensive review, contrast-enhanced ultrasonography (CEU) remains undiscussed, whereas this method holds great promise as a tool in hypertension research.

CEU is an imaging tool that enables quantification of microvascular perfusion in organs and tissues. It uses gas-filled microbubbles, typically with a lipid shell, that are inert, remain entirely within the vascular space, and possess an intravascular rheology similar to that of erythrocytes. Therefore, they specifically enhance imaging of the (micro-)vessels. During intravenous infusion of these microbubbles and attainment of a steady state, microbubbles can be destroyed with high-energy ultrasound. Subsequently, new microbubbles will flow into the region of interest. The rate of microbubble replenishment represents microvascular flow velocity. When the microbubbles are fully replenished, a plateau of video intensity is reached corresponding with the relative microvascular blood volume. The product of microvascular flow velocity and microvascular blood volume is a measure of microvascular perfusion. Because microbubbles are distributed throughout the entire vasculature, simultaneous study of microvascular beds of different organs (eg, skeletal muscle, the heart, and kidney) is possible.

Surprisingly, although CEU has been used to study the pathophysiological role of microvascular perfusion in obesity-related insulin resistance and other metabolic syndrome characteristics, no data are available on the relation with blood pressure/hypertension. In a post hoc analysis of a recent study measuring microvascular perfusion in skeletal muscle with CEU, we assessed the association of muscle microvascular perfusion with blood pressure. In this healthy, normotensive group, blood pressure was inversely related with skeletal muscle perfusion in the forearm ($\beta_{\text{systolic blood pressure}} = -0.50, P = 0.05$; $\beta_{\text{diastolic blood pressure}} = -0.49, P = 0.03$; and $\beta_{\text{mean arterial pressure}} = -0.53, P = 0.02$) after adjustment for sex and age. These relationships did not change after additional adjustment for body mass index. This post hoc analysis shows the potential of CEU to be applied in blood pressure and hypertension research.

Apart from the mentioned imaging capabilities, microbubbles can be targeted using antibodies and loaded with interventional drugs. Therefore, CEU combines the assets of intravital microscopy, capillary videomicroscopy, and other imaging strategies. Minimally invasive, low cost and patient friendly, CEU has proven itself as a validated and valuable technique to phenotype the microcirculation in metabolic, as well as blood pressure, research.

Disclosures

None.

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Michiel P. de Boer, Erik H. Serné, Yvo M. Smulders, Etto C. Eringa and Rick I. Meijer

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