Is Pressure Decrease at Peak Hyperemia Attributed to Poiseuille or Bernoulli or Both?

To the Editor:

In their elegant study, Jiang et al1 conclude that the lack of radial artery dilation immediately after cuff deflation is caused by a drop in mean intra-arterial pressure, which is an inevitable consequence of flow through the conduit artery by Poiseuille’s law. If the pressure drop between the aorta and the radial artery is 3 mm Hg at a blood velocity of 0.5 m/s (Figure 2 of Reference1) and the flow is laminar (Poiseuille) as suggested, pressure loss is proportional to flow, and we expect a pressure decrease of ~9 mm Hg at 1.5 m/s during the peak hyperemic phase. Thus, frictional loss explains approximately half of the 20 mm Hg decrease in arterial pressure observed during the peak hyperemic phase.

The Bernoulli principle predicts a decrease in pressure in a flowing fluid given by $\frac{V^2}{2} \rho$, where $V$ and $\rho$ are fluid velocity and density, respectively.2 At velocities of 0.5 and 1.5 m/s and a blood density of 1050 kg/m$^3$,3 the Bernoulli pressure decreases are 1 and 9 mm Hg, respectively. The velocity-squared term means that the pressure decrease caused by the Bernoulli effect during systole may be substantially greater than the mean decrease. For example, if systolic velocity is 35% higher than mean velocity (~2 m/s), the pressure decrease during systole would be 16 mm Hg. It is likely that the intra-arterial pressure decrease and, hence, the lack of vasodilation, observed during peak hyperemia is caused by a combination of resistive pressure loss and the Bernoulli effect.

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