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

To the Editor:

In their elegant study, Jiang et al.\(^1\) 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 Reference\(^1\)) and the flow is laminar (Poiseuille) as suggested, pressure loss is proportional to flow, and we expect a pressure decrease of \(\approx 9\) 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 \(V^2/2\rho\), 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 (\(\approx 2\) 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.

Sources of Funding

The University of Sydney provided computer facilities and library access.

Disclosures

None.

Martin J. Turner
School of Public Health
University of Sydney
New South Wales, Sydney, Australia

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

Martin J. Turner

Hypertension. 2011;58:e21; originally published online August 15, 2011;
doi: 10.1161/HYPERTENSIONAHA.111.175786

Hypertension is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2011 American Heart Association, Inc. All rights reserved.
Print ISSN: 0194-911X. Online ISSN: 1524-4563

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://hyper.ahajournals.org/content/58/4/e21

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published
in Hypertension can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial
Office. Once the online version of the published article for which permission is being requested is located,
click Request Permissions in the middle column of the Web page under Services. Further information about
this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Hypertension is online at:
http://hyper.ahajournals.org/subscriptions/