Wave Reflection in Systolic Hypertension: Smaller Stature, Shorter Aorta: Higher Pulse Pressure?

To the Editor:

In a recent issue of Hypertension, Mitchell et al. suggested that, among patients with systolic hypertension, reduced aortic diameter and increased wall stiffness, rather than premature wave reflection, are primarily responsible for increasing pulse pressure (PP). We share the concerns gently expressed in the accompanying editorial that conceptual and methodologic issues do not substantiate the conclusions put forward by Mitchell et al.

First, the authors subdivided their patients according to median PP. This arbitrary dichotomization of the study population led to an overrepresentation of women with small stature in the high PP group (56% versus 28%). Body height averaged 166 cm as opposed to 172 cm in the high and low PP groups, respectively. This imbalance might flaw the interpretation of the results as proposed by Mitchell et al. Indeed, at similar heart rates, early wave reflection and, hence, systolic augmentation occur more readily in shorter individuals because of the shorter length of the aorta. Small stature is associated with increased peak systolic pressure and shorter travel time of reflected waves. In a recent longitudinal study by Regidor et al., short stature was independently associated with increased PP in women. In the same study, height was inversely associated with systolic blood pressure but positively with diastolic blood pressure, although an independent association between height and diastolic blood pressure was found only in women.

Second, in Figure 3, Mitchell et al. pooled women and men without providing any statistical evidence that the regression lines in the sexes were coincident, with no differences in intercepts or slopes.

Third, cyclic overstretching of the proximal aorta by elevated peak systolic blood pressure and subsequent elastin fracture contributes to the stiffening of the central arteries. We calculated the wall tension in the high PP group (56% versus 28%). Body height averaged 166 cm as opposed to 172 cm in the high and low PP groups, respectively. This imbalance might flaw the interpretation of the results as proposed by Mitchell et al. Indeed, at similar heart rates, early wave reflection and, hence, systolic augmentation occur more readily in shorter individuals because of the shorter length of the aorta. Small stature is associated with increased peak systolic pressure and shorter travel time of reflected waves. In a recent longitudinal study by Regidor et al., short stature was independently associated with increased PP in women. In the same study, height was inversely associated with systolic blood pressure but positively with diastolic blood pressure, although an independent association between height and diastolic blood pressure was found only in women.

We conclude that the 2 hypotheses on the pathogenesis of increased PP (small aortic outflow diameter versus increased wave reflection through arterial stiffening) might not be mutually exclusive. Only properly conducted longitudinal studies, not the analysis of an arbitrarily subdivided cross-sectional study, can inform a definite conclusion. Future studies should also include a proper quantification of “pump-and-tubing” geometry through state-of-the-art imaging techniques to avoid the use of the Moens-Korteweg equation for more objective results.

Disclosures

None.

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Table. Wall Tension at the Level of the Aortic Root

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Aortic Root Diameter, Mean±SD, cm</th>
<th>Systolic Blood Pressure, Mean±SD, mm Hg</th>
<th>Estimated Wall Thickness, mm</th>
<th>Tension at Aortic Root, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>High PP</td>
<td>2.99±0.36</td>
<td>173.5±12.0</td>
<td>0.184</td>
<td>2.86115</td>
</tr>
<tr>
<td>Low PP</td>
<td>3.13±0.28</td>
<td>155.7±9.5</td>
<td>0.195</td>
<td>2.59345</td>
</tr>
</tbody>
</table>

Values are point estimates for tension at the wall of the aortic roots.

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