Letter to the Editor

Is the Guytonian framework justified in explaining heart-lung interactions?

Rafael Dalmau

Department of Anesthesiology, Hospital Español de Rosario, Rosario, Argentina

Correspondence to: Rafael Dalmau. Department of Anesthesiology, Hospital Español de Rosario, Rosario, Argentina. Email: rdalmau@hotmail.com.

Submitted Nov 23, 2018. Accepted for publication Mar 14, 2019.
doi: 10.21037/atm.2019.03.41
View this article at: http://dx.doi.org/10.21037/atm.2019.03.41

In their recent article devoted to venous return and heart-lung interactions (1), Berger and Takala address well-known points of Guyton's model of the systemic circulation, such as:

- The dependency of cardiac output (CO) on "venous return" (VR);
- The quantitative description of VR (and CO) as the pressure gradient between "mean systemic pressure" (Pms) and right atrial pressure (Pra) over the "venous resistance" (Rv) (as in their Equation 1);
- Pms as the driving force (or, "pressure head") for VR;
- Pms physically persistent in the venous segments of the peripheral vasculature;
- Pra as a "back-pressure" limiting VR;
- Total blood volume comprised of "stressed" and "unstressed" components with the former responsible of Pms and VR.

While the authenticity of Guyton's model as presented by the authors, and summarized above, has been refuted at many opportunities (2-10), here to me remains the question of whether it effectively explains the physiology of heart-lung interactions, i.e., how the ventilatory swing of intrathoracic pressures affects cardiac loading conditions, and the pulmonary circulation as well; since, the idea of Pra as a back-pressure is especially appealing in this particular scenario.

The answer is that "*it does not*"; since it is, as mentioned, cardiac loading what is affected by airway pressures and, hence, CO. With reduced atrial and ventricular distending pressures (defined as the difference between inside and outside pressures) with positive-pressure ventilation, their volumes are proportionally reduced.

This fundamental principle of CO regulation must not be confused with the pattern of cyclic variation of ventricular venous inflow, also induced by positive-pressure inspiration, which is about cyclic transients of regional, intrathoracic blood flow, not about steady-state dynamics. It would be analogous to confusing the regional pulsatility of arterial flow with the source of mechanical energy for steady-state CO.

Acknowledgements

To Evangelina Dalmau, MD, for discussions in flow:volume interaction in the peripheral vasculature.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

References

1. Berger D, Takala J. Determinants of systemic venous return and the impact of positive pressure ventilation. Ann Transl Med 2018;6:350.
2. Brengelmann GL. The classical Guyton view that mean systemic pressure, right atrial pressure, and venous resistance govern venous return is/is not correct. J Appl Physiol (1985) 2006;101:1532.
3. Brengelmann GL. A critical analysis of the view that right atrial pressure determines venous return. J Appl Physiol (1985) 2003;94:849-59.
4. Beard DA, Feigl EO. Understanding Guyton's venous return curves. Am J Physiol Heart Circ Physiol 2011;301:H629-33.
5. Brengelmann GL. Letter to the editor: Comments on "Value and determinants of the mean systemic filling

pressure in critically ill patients". Am J Physiol Heart Circ Physiol 2015;309:H1370-1.
6. Brengelmann GL. Letter to the editor: Why persist in the fallacy that mean systemic pressure drives venous return? Am J Physiol Heart Circ Physiol 2016;311:H1333-5.
7. Beard DA, Feigl EO. Reply to "letter to the editor: a return to the venous return controversy: a visual aid for combatants'". Am J Physiol Heart Circ Physiol 2013;304:H489.
8. Beard DA, Feigl EO. CrossTalk opposing view: Guyton's venous return curves should not be taught. J Physiol 2013;591:5795-7.
9. Galetti VM. An analytical perspective on the venous return controversy. Can J Anaesth 2018;65:1074-5.
10. Reddi BA, Carpenter RH. Venous excess: a new approach to cardiovascular control and its teaching. J Appl Physiol (1985) 2005;98:356-64.

Cite this article as: Dalmau R. Is the Guytonian framework justified in explaining heart-lung interactions? Ann Transl Med 2019;7(8):184. doi: 10.21037/atm.2019.03.41

