Reply to “Letter to the editor: Comments on ‘Value and determinants of the mean systemic filling pressure in critically ill patients’”

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REPLY: We thank Dr. Brengelmann for his letter (1) regarding our study (6). Let us focus on three important papers published by Guyton et al. In 1954, he measured mean systemic filling pressure (Pmsf) at zero flow in anesthetized dogs and found a mean value of 6.3 mmHg (4). In 1955, Guyton published the mathematical definition of the Pmsf as the ratio between total blood volume and capacitance of the aggregate vascular container, as Dr. Brengelmann reminds us, and not only the capacitance of the venous one (3). In a third paper published in 1957, he established a model for the determinants of the systemic venous return represented by the famous venous return curves (2), which was thereafter named Guyton’s law.

We designed this study to measure Pmsf in critically ill patients just after death. Indeed, we fully agree with Dr. Brengelmann that Pmsf can only be measured and interpreted at zero flow, which is an indisputable limitation for its use in clinical practice. In the same vein, we had also hypothesized that we would find a different value from that extrapolated in heart-beating patients. We confirmed that it was indeed quite different, as extensively discussed in our paper (6). Our article strongly suggests that the pressure obtained with extrapolated methods is not the Pmsf. Whether this pressure plays a role in venous return remains to be studied. We obviously never aimed at demonstrating that Guyton’s concept of systemic venous return can be fully applied in heart-beating patients with closed chest. As stated by Dr. Brengelmann, the difficulty of translating the Pmsf measured at zero flow and its related concept of venous return to heart-beating patients relates in part to the well-known relation between the flow and pressure gradient through the role of the Starling resistor (8). Many others have also described this concept of Starling resistor at different levels, such as John West and colleagues (9) for the pulmonary capillaries, Takata et al. (7) for the inferior vena cava, and our team (5) for the superior vena cava. If one imagines a compartment in heart-beating patients in which Pmsf represents the drive for venous return, it should probably be a compartment with a very low resistance to flow (no Starling resistor) and then mainly a high capacitance one, as the splanchnic territory.

Although one can think that measuring Pmsf in heart-beating patients has no physiological meaning besides being nearly impossible, we somewhat disagree Dr. Brengelmann’s suggestion to directly estimate volume by dye dilution for clinical assessment. In our study, as in Guyton’s study, we reported a relationship between infusion of norepinephrine, which decreases capacitance, and Pmsf, reflecting first of all that it is the stressed volume that matters for the systemic venous return and then the cardiac output more than the total volume. In many situations, as in heart failure, total volume is significantly increased, whereas flow is severely depressed. Hence, evaluating the hemodynamic status with the estimation of blood volume alone can be misleading.

Finally, Dr. Brengelmann’s comments also reflect a conflict among physiologists between the “defenders” of the Starling law and those of the Guyton’s view of venous return. We actually believe that both concepts are not contradictory. For instance, Dr. Brengelmann suggests improving cardiac output and the related maldistribution of volume rather than dropping right atrial pressure (Pra) to improve venous return. However, both work together. When the intravascular Pra is decreased (by decreasing intrathoracic pressure, for instance), the venous return increases, according to the Guyton’s law, and is then responsible for an increase of the distending Pra, leading to an increased cardiac output in accordance with the Starling’s law. In return, the increased flow improves the venous return by decreasing resistances to flow.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS


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