CRITICAL CARE

LETTER

Pulse pressure variation, stroke volume variation and dynamic arterial elastance

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See related research by Monge Garcia *et al*., http://ccforum.com/content/15/1/R15

We read with interest the recent article by Monge Garcia and colleagues [1]. We have two comments regarding this interesting physiological study.

First, although we support their observation [2], their explanations may lead to some confusion. Indeed, the Edwards Vigileo™ system-FloTrac™ sensor calculates stroke volume (SV) using the equation:

$$SV = Khi \times \sigma AP$$

where σAP is the standard deviation of the arterial pressure (AP) curve and Khi a constant quantifying arterial elastance and vascular resistance [3]. As stroke volume variation (SVV):

$$SVV\ (\text{in}\ \%) = (SV_{max} - SV_{min})/SV_{mean}$$

$$SVV\ (\%) = (Khi \times \sigma AP_{max} - Khi \times \sigma AP_{min})/Khi \times \sigma AP_{mean}$$

$$SVV\ (\%) = Khi \times (\sigma AP_{max} - \sigma AP_{min})/Khi \times \sigma AP_{mean}$$

$$SVV\ (\%) = (\sigma AP_{max} - \sigma AP_{min})/\sigma AP_{mean}$$

$$SVV\ (\%) \approx (PP_{max} - PP_{min})/PP_{mean}$$

Which means that SVV (%) ≈ pulse pressure variation (PPV; %) for FloTrac™.

With the present mathematical equation, it can be demonstrated that the SVV calculated by FloTrac™ (SVV_{FT}) is not influenced by Khi, which means that SVV_{FT} calculation does not include effective arterial elastance (Ea). The originality of Garcia and colleagues' finding is that they realized that when measuring PPV conventionally [4], the ratio PPV/SVV_{FT} becomes a mirror of a dynamic Ea, as the conventional PPV selected integrates Khi (Figure 1). However, when the present innovative method is used, PPV and SVV should be sampled during the same period of time.

In conclusion, we believe that dynamic Ea predicting arterial pressure response to volume loading in preload-dependent patients is an interesting physiological concept. However, this demonstration cannot be achieved without taking into consideration the impact of PPV/SVV sampling.

Abbreviations

AP, arterial pressure; Ea, arterial elastance; PP, pulse pressure; PPV, pulse pressure variation; SV, stroke volume; SVV, stroke volume variation.

Competing interests

The authors declare that they have no competing interests.

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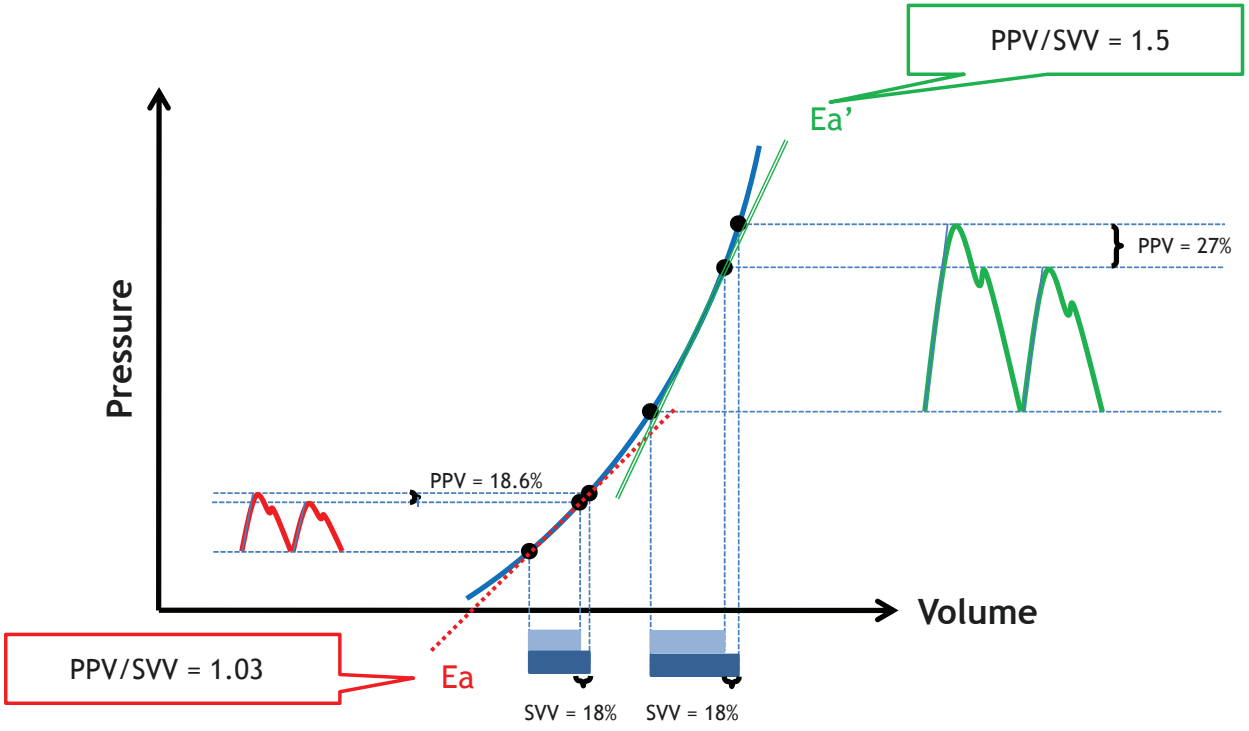

Figure 1. Model of two different arterial elastances (Ea and Ea') on the pulse pressure variation (PVV) relationship curve, with the same stroke volume variation (SVV) value.