Geoffrey Parkin

Re: Mean systemic filling pressure: we can now estimate it but for what?

Accepted: 26 August 2013
Published online: 11 September 2013
© Springer-Verlag Berlin Heidelberg and ESICM 2013

Dear Editor,

It is a pleasure to respond, as author of the Pms algorithm to which his editorial refers, to Prof. Teboul's provocative title [1].

Refreshingly, we see acceptance of Pms, rather than any preload measure, as the preferred method of evaluating the effective blood volume, definitely a step in the right direction.

So why does Teboul invite such a bleak reply? Why is a Guytonian approach to the circulation only now finding its way into mainstream care?

One answer, we agree, is that Pms is not easy to measure repeatedly using inspiratory hold or arm compression [2]. We have demonstrated [3] that a useful Pms analogue, Pmsa, can be calculated using

$$Pmsa = 0.96 * RAP + 0.04 * MAP + c * CO \quad (1)$$

where "c" is an anthropometrically based variable ($0.3 < c < 1.2$) with the dimensions of resistance. This approach allows for the confounding effect of unmeasurable venous resistance change upon measurement of the apparent volume state. Therein lie some of the reasons for "poor agreement" (Editorial) between dynamic Pmsa and static Pms (and by extension, Maas). Our article cautioned

against numerical comparison with static Pms for just this reason.

Since (Guyton)

$$CO = VR \\ = (Pmsa - RAP)/RVR \quad (2)$$

the role of the heart in determining CO may be seen as keeping RAP below Pms. A dimensionless heart variable E_h

$$E_h = (Pmsa - RAP)/Pmsa \quad 0 \leq E_h \leq 1 \quad (3)$$

is thus a very useful static descriptor of the global performance of the heart.

Using the SVR (for all its shortcomings) as a resistance measure, Pmsa, E_h and SVR calculated for the present and target circulations permit precise graphical vector guidance for the direction and priority of volumetric, cardioactive and vasoactive therapies.

In a closed loop study, for example [4], volume replacement was targeted to a clinician-prescribed Pmsa. In 601 h of CVVHD in ten subjects using a "bang bang" controller, 409 litres were replaced with a loss of 417 litres with no microcontroller 'knowledge' of the gains and losses. Cardiovascular stability exceeded controls.

In measuring volume responsiveness (Vr) we are interested in the change in CO and therefore $\Delta(Pmsa - RAP)$ (Eq. 2) produced by a volume change ΔPms , [5] i.e. [cf. (3) above]

$$Vr = \Delta(Pmsa - RAP)/\Delta Pmsa \quad (0 \leq Vr \leq 1) \quad (4)$$

Cecconi et al. [6] have carefully documented these changes showing how they are easily measured.

In their experiments, RVR changed minimally.

We agree that static measures do not predict volume responsiveness.

Our dynamic dimensionless measure accurately records volume responsiveness every time the volume state is changed. It does not require positive pressure ventilation, a regular heart rate or other preconditions. It is particularly suitable as is most of the above to closed loop systems of care.

Knowing the volume state, measuring heart performance, quantitating volume responsiveness and achieving vector guidance should we believe start to answer the good professor's "but for what?" challenge.

Conflicts of interest Dr. Parkin is a director and shareholder of Applied Physiology, an Australian medical software house.

References

1. Teboul JL (2013) Mean systemic pressure: we can now estimate it, but for what? *Intensive Care Med* 39:1487–1488. doi: [10.1007/s00134-013-2979-8](https://doi.org/10.1007/s00134-013-2979-8)
2. Maas J, Pinsky M, Geerts B, de Wilde R, Jansen J (2012) Estimation of mean systemic filling pressure in postoperative cardiac surgery patients with three methods. *Intensive Care Med* 38(9):1452–1460
3. Parkin WG (1999) Volume state control—a new approach *Crit. Care Resusc* 1(3):311–321
4. Parkin G, Wright C, Bellomo R, Boyce N (1994) Use of a mean systemic filling pressure analogue during the closed loop control of fluid replacement in continuous hemofiltration. *J Crit Care* 9(2):124–133
5. Personal communication—Dr. Mark Leaning
6. Cecconi M, Aya H, Geisen M, Ebm C, Fletcher N, Grounds R, Rhodes A (2013) Changes in the mean systemic filling pressure during a fluid challenge in post-surgical intensive care patients. *Intensive Care Med*. (doi:[10.1007/s00134-013-2928-6](https://doi.org/10.1007/s00134-013-2928-6))

G. Parkin (✉)
Monash Medical Centre, Clayton,
VIC 3168, Australia
e-mail: wgparkin@googlemail.com