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LETTER TO THE EDITOR

Response to Dr. Bernstein's Review: Pressure Pulse Contour-Derived Stroke Volume and Cardiac Output in the Morbidly Obese Patient

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To the Editor:

We read with interest the article by Dr. Bernstein on *Pressure Pulse Contour-derived Stroke Volume and Cardiac Output in the Morbidly Obese Patient* [1]. It is important to discuss the data presented in the review, considering that caution is necessary to accept his conclusion on pressure recording analytical method (PRAM) [2]. We wonder how it is possible to draw similar conclusions based on the small number of studies considered and patients enrolled [3–5]. We may also highlight some discrepancies not only between the studies considered but also within each study [3–5]. It is important to distinguish between hemodynamic data measured directly, such as mean arterial pressure (MAP) or heart rate (HR), and hemodynamic data calculated by the PRAM [6–11] or other methods [12].

From an analysis of MAP and HR in reviewed studies, we can observe how [3–5] these values present different trends compared with our results (Table 1).

Stroke volume (SV) of our patients [1], calculated from stroke volume index (SVI), according to the formula SV=SVI×BSA (Mosteller-derived), is similar to the data of Dumont et al. [4] until MAP and HR do not diverge from ours, while the data of Nguyen et al. [5] and Artuso et al. [3] are different from ours [1] and similar between themselves, as shown on Table 1 (we prefer to analyze stroke volume instead of cardiac index because the latter is directly related to heart rate). Our systemic vascular resistance (SVR), calculated from systemic vascular resistance index (SVRI) according to the formula SVR=SVRI/BSA, is very different from Nguyen et al. [5] and Artuso et al. [3] and slightly different from Dumont et al. [4] (Table 1).

The difference between the data of Nguyen et al. [5] and Artuso et al. [3], which found similar cardiac output (CO) with different SVR, leads us to question the data proposed by the authors. Using the formula SVR=(MAP−CVP)×CO/80, we observe that the data of Artuso et al. [3] are incorrect to generate the SVR or the CO values presented (Table 1).

Thus, considering the limitations of the studies [3–5] analyzed by Dr. Bernstein, we cannot understand how the PRAM method "does not adequately integrate vascular wall abnormalities or body habitus into the overall gestalt of the method" [1] because important differences are already present in the selected studies regarding cardiovascular-measured and cardiovascular-derived parameters.

Moreover, we do not believe that the end diastolic volume (EDV) value suggested by Dr. Bernstein [1], obtained by comparing different data measured in different circumstances (preoperative ambulatory ejection fraction with intraoperative SV measurement) [2], may be useful to predict the cardiovascular status of these patients.

Other authors [13–15], not mentioned in Dr. Bernstein's review, published results different from those presented in Dr. Bernstein's review [1]. SV from the studies of Perilli et al. [13] and Prior et al. [14], with data obtained with trans-esophageal echocardiography, are similar to ours (SV, 51 ml Balderi vs 58 ml Perilli and 44 ml Prior; Table 1).

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Table 1 Hemodynamic data of the reviewed studies

	Baseline	Pneumoperitoneum				Desufflation	
		5 min	15 min	30 min	60–120 min		
Balderi et al. [2]	79 (7)	100 (9)	98 (8)	97 (10)	97 (8)	81 (6)	MAP
	79 (9)	75 (5)	75 (7)	79 (8)	80 (7)	79 (8)	HR
	51	67	68	67	67	66	SV
	1,478	1,522	1,530	1,495	1,513	1,434	SVR
Dumont et al. [4]	75 (7)	89 (22)	100 (10)	91 (12)	95 (11)	109 (14)	MAP
	78 (8)	86 (10)	90 (11)	90 (11)	96 (7)	96 (8)	HR
	67 (14)	59 (14)	70 (12)	68 (13)	63 (11)	106 (20)	SV
	1,085 (190)	1,294 (405)	1,146 (241)	1,059 (205)	1,112 (227)	775 (122)	SVR
Nguyen et al. [5]	80 (16)			94 (15)	–	86 (12)	MAP
	74 (15)			–	79 (12)	85 (12)	HR
	99 (21)			91 (21)	–	126 (39)	SV
	727 (179)			975 (425)	–	–	SVR
	Baseline	Insufflation		Anti-Trendelemburg		Desuffation	
Artuso et al. [3]	83 (11)	103 (14)		84 (11)		95 (10)	MAP
	83 (8)	85 (7)		87 (149		85 (9)	HR
	111	117		113		129	SV
	1,545 (315)	1,748 (450)		1,548 (349)		1,494 (227)	SVR
Prior et al. [13]	84	117					MAP[a]
	77 (4)	73 (4)					HR
	44	40					SV[b]
Perilli et al. [14]	99 (10)						MAP
	82 (16)						HR
	58						SV
El Dawlatly [15]	97.7 (11)	89.5 (17)				104 (16)	MAP
	87.5 (9)	72.2 (14)				98 (15)	HR
	61	53				53	SV

[a] Derived from values of systolic and diastolic blood pressure
[b] Derived from end diastolic volume (EDV) and ejection fraction (EF) with the formula SV=EDV×EF

To explain discrepancies between the different studies, we have to consider the different anesthetic technique, patient population, body mass index, ventilatory strategies, intra-abdominal pressure, and positioning [16]. We do not wish to comment on the PRAM because a number of studies have validated that methodology [17].

We do not concur with Dr. Bernstein's review [1]; PRAM may be useful to assess cardiovascular changes in obese patients during laparoscopy [2], but we believe also that every monitoring application that uses a calculated parameter should be seen in its trend rather than single value.

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