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LETTER TO THE EDITOR

Pulse pressure variation using a novel smartphone application (Capstesia) versus invasive pulse contour analysis in patients undergoing cardiac surgery: a secondary analysis focusing on clinical decision making

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To the Editor,

Pulse pressure variation (PPV) is a well-known dynamic indicator of fluid responsiveness that can be used in anesthetized patients receiving controlled mechanical ventilation. PPV is often used in the operating room to guide decisions about fluid therapy, frequently as part of a goal-directed fluid therapy protocol. However, PPV calculation usually requires advanced hemodynamic monitoring. Capstesia™ (Galenic App, Vitoria-Gasteiz, Spain) is a novel smartphone application that automatically calculates PPV (PPV_{CAP}) and cardiac output from a digital photo of the invasive arterial pressure waveform obtained from a patient's monitor screen [1].

We recently reported that, during major abdominal surgery, PPVCAP agreed moderately with stroke volume variation (SVV) monitored using an uncalibrated pulse contour device (SVV_{PC}; EV1000, Edwards Lifesciences, Irvine, USA) across three categories of values reflecting the thresholds used for decisions related to fluid administration, with an overall agreement between PPV_{CAP} and SVV_{PC} of 79% [2]. However, a limitation of that study was that we compared two different variables: PPV and SVV.

We have also recently shown in 57 patients undergoing cardiac surgery that PPV_{CAP} and PPV obtained from a calibrated pulse contour monitoring device (PPV_{PC}; Pulsioflex™ device, Pulsion Medical Systems, Feldkirchen, Germany) both weakly predicted fluid responsiveness (area under the receiver operating characteristics curve of 0.74 (95% CI 0.60–0.84) for PPV_{CAP} versus 0.68 (95% CI 0.54–0.80) for PPV_{PC}, $P = 0.3$) [3]. However, we did not compare the agreement between PPV_{CAP} and PPV_{PC} in the different categories used to guide fluid administration. We therefore performed a secondary analysis focusing on the use of PPV for clinical decision making. For this purpose, we reanalyzed the PPV_{CAP} and PPV_{PC} values obtained before fluid loading in our previous study on cardiac surgical patients [3]. Assessments were performed either before incision (28 patients) or at the end of surgery (29 patients). PPV_{CAP} and PPV_{PC} were measured simultaneously and were calculated as the average of three measurements during a period of 1 min (immediately after the measurement of cardiac output using transpulmonary thermodilution with the Pulsioflex™ device).

We classified PPV values into three categories reflecting the thresholds used to determine whether fluids should be given, as recently described [2]: no fluid administration ($PPV < 9\%$), gray zone (PPV between 9 and 13%), and fluid administration ($PPV > 13\%$) [4]. The agreement between PPV_{CAP} and PPV_{PC} for these three categories was calculated as the number of concordant paired measurements in each category divided by the total number of paired measurements in that category. A Bland–Altman analysis showed

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Table 1 Distribution of PPV_{CAP} and PPV_{PC} values according to the three predefined categories

	PPV_{PC}	PPV_{CAP} using the Capstesia™ application		
		< 9%	9–13%	> 13%
PPV_{PC} using the Pulsioflex™ device	< 9%	26	0	1
	9–13%	4	9	0
	> 13%	2	3	12

Values inside the table represent the number of patients for each category Green cells represent a complete agreement regarding the predefined categories for PPV_{CAP} and PPV_{PC} while red cells represent no agreement between PPV_{CAP} and PPV_{PC}

a mean 0.9% difference between PPV_{CAP} and PPV_{PC} (limits of agreement: − 5.5–5.6%). In the 57 pairs of PPV_{CAP} and PPV_{PC} data obtained before fluid loading, the overall agreement regarding the predefined categories for PPV_{CAP} and PPV_{PC} was 82% (green cells, Table 1) and the Cohen's kappa coefficients were 0.66 (95% CI 0.55–0.77) and 0.62 (95% CI 0.44–0.79) before incision and at the end of the surgery respectively. PPV_{CAP} and PPV_{PC} would have resulted in completely opposite clinical decisions regarding fluid administration in 5% of the cases (red cells, Table 1).

Similar to the 79% concordance obtained between SVV_{PC} and PPV_{CAP} from our recent study [2], this secondary analysis confirms that PPV_{PC} and PPV_{CAP} lead to similar clinical decisions regarding fluid administration. Further studies are needed in other institutions and patient populations to better define the potential role of this promising new smartphone application.

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