Agreement between two methods for measuring pulse pressure variation. Cross-sectional study

Berraondo P.¹, Barrachina B.², Albinarrate A.², Cobos R.³, Vinuesa C.⁴

¹Galenic App, Software Developing, Vitoria, Spain, ²University Hospital of Araba, Dept of Anaesthesiology & Intensive Care, Vitoria, Spain, ³University Hospital of Araba, Research and Development Department, Vitoria, Spain, ⁴University Hospital of Araba, Dept of Intensive Care, Vitoria, Spain

Goal of Study:

New smartphone application called Capstesia^{1,2} estimates advanced haemodynamic parameters (cardiac output [CO], pulse pressure variation [PPV], max dP/dt) after digitalising and analysing the invasive arterial pressure (PA) curves from the snapshot of patient bedside monitor. The main aim of the study was to assess whether Capstesia Algorithms are valid to provide data not differing significantly from the traditional method (direct analysis of pressure signal).

Analysis Bland&Altman plot:

Materials and methods:

We prospectively assessed the level of agreement (L of A) between the direct analysis of images and that from recording and measuring PPV in 20 patients who had an arterial catheter in ICU at Araba University Hospital, from January to February 2015. Patients were monitored using Dräger® equipment. Signals were reproduced in real time on a remote computer (speed: 25 mm/s, 30-s sections were registered, 3 complete PA curve screens, 4 recorders/ patient, analysed by MatlabR2009A). Subsequently, a photo was taken of each complete screen using the App. We set the threshold for an agreement at ± 2.5 PPV due to the field work done. For a statistical power of 80% and a 95% confidence level, we estimated 235 images required to value the L of A between the two methods for measuring PPV. The primary endpoint was the PPV across each screen. Other variables recorded: sex, SOFA, type of access, CO and max dP/dt. The L of A between the methods was measured by intraclass correlation coefficients (ICCs: >0.75 : very good agreement), and the method of Bland&Altman.

Results:

We included 229 images; mean age of 69.55 years (SD10.13) mean SOFA of 7.55(SD5.88). PPV Concordance analysis: ICC 0.991(considered excellent, indicating either of the methods could be used). Analysis Bland&Altman plot, the mean of the differences is small (0.50) and only 6.14% of data points lay outside the L of A. We found clinically acceptable L of A for low ($\leq 10\%$), moderate (10-15%) and high ($\geq 15\%$) values of PPV; 7, 1 & 4 data points (6.14%, 3.70% and 4.6% of points) fell outside the L of A, respectively. CO and max dP/dt got excellent results (ICCs, 0.966 and 0.962, respectively), and with only 2(0.87%) and 11(4.85%) points outside the L of A in the Bland-Altman plot.

Values compared	Sample	ICC (95% CI)	Mean of the differences	Standard deviation of the differences	Limits of agreement
PPV _{smartphone} - PPV _{computer}	Full range PPV values	0.991 (0.988-0.993)	0.50	1.42	3.27;-2.28
	PPV ≤ 10	0.929 (0.898-0.950)	0.56	0.85	2.23;-1.11
	PPV >10 and <15	0.769 (0.554-0.888)	-0.0052	1.16	2.27;-2.28
	PPV ≥ 15	0.958 (0.936-0.972)	0.56	1.96	4.40;-3.28
CO _{smartphone} - CO _{computer}	Full range CO values	0.966 (0.956-0.974)	0.19	0.341	0.86;-0.48
maxdP/dt _{smartphone} - maxdP/dt _{computer}	Full range maxdP/dt values	0.962 (0.950-0.970)	1.33	77.71	153.64;-151

Conclusion:

Capstesia is reliable, regardless to the magnitude of the variation, pointing out whether patients would respond to fluidtherapy in order to increase their CO. Therefore, it's possible to use both methods for the stated purpose

¹Michard Ann. Hemodynamic monitoring in the era of digital health Intensive Care (2016) 6:15.
²Olivier Desebbe et al. A Novel Mobile Phone Application for Pulse Pressure Variation Monitoring Based on Feature Extraction Technology: A Method Comparison Study in a Simulated Environment Anesthesia&Analgesia (2016).