ORAL PRESENTATIONS

COFFEE ISH: DIGITAL PITCHS: ADVANCES IN DIGITAL DIAGNOSIS AND THERAPEUTICS

O83 ESTIMATING CARDIAC OUTPUT FROM ARTERIAL BLOOD PRESSURE WITHOUT PRESSURE WAVEFORMS

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Background and Objective: Noninvasive estimations of cardiac Output (CO) using pulse wave analysis have been studied for over a century, yielding contrasting results. Our research group has developed a novel method for the noninvasive estimation of CO based on brachial blood pressure (BP) measurements and total arterial compliance (Ct), eliminating the need for arterial pulse wave analysis. This study compares all reported methods for estimating CO without pulse wave contours using the same dataset to assess their accuracy.

Methods: A cross-sectional study was conducted involving 447 adult patients who underwent ambulatory transthoracic Doppler echocardiograms. Stroke volume (SV) was calculated as the product of the cross-sectional area of the aortic annulus and the average velocity of the left ventricular outflow tract. Simultaneously, oscillometric BP measurements were obtained, and CO was derived from Ct utilizing anthropometric variables, BP, and heart rates (HR). Calibration was conducted with 75% of the data using the formula: CO=K0+K1×estimator. The remaining 25% of the data was used for validation, with Bland-Altman analysis and the intraclass correlation coefficient (ICC). Calibration involved the following CO estimators: i) mean arterial pressure; ii) HR; iii) pulse pressure (PP); iv) PPxHR; v) Warner time-correction; vi) Liljestrand-Zander; vii) Wesseling-Langewouters; and viii) the new Ct-based method.

Results: Of the participants, 51.2% were men, with an average age of 51.0±15.0 years, weight of 75.0±14.0 kg, and height of 166.0±9.5 cm. The CO by echocardiography had an average of 4.9±1.0 L/min, with a range of 2.0 to 8.5 L/min. Among the compared methods, the new Ct-based method showed the smallest mean difference and error, as well as the largest ICC. The Bland-Altman analysis shows a normal distribution for the new Ct-based method, with agreement limits between -1.56 to 1.48 L/min (Figure).

Conclusions: The new Ct-based method developed surpasses other published methods and exhibits practical accuracy suitable for ambulatory use, such as hemodynamic monitoring of pathophysiological or therapeutic outcomes.

Keywords: Blood pressure; cardiac output; compliance; validity; echocardiography

Method	Mean difference (L/min)	Error	Intraclass correlation coefficient
New compliance-based method	0.04+0.78	15.6%	0.70
Heart rate	-0.06+0.93	18.7%	0.41
Liljestrand-Zander	-0.09+1.01	20.2%	0.30
Wesseling-Langewouters	-0.18+0.99	19.9%	0.30
Pulse pressure x heart rate	-0.10+1.03	20.7%	0.23
Warner time correction	-0.15+1.06	21.3%	0.16
Mean arterial pressure	-0.14+1.09	21.8%	0.07
Pulse pressure	-0.15+1.10	22.1%	0.02

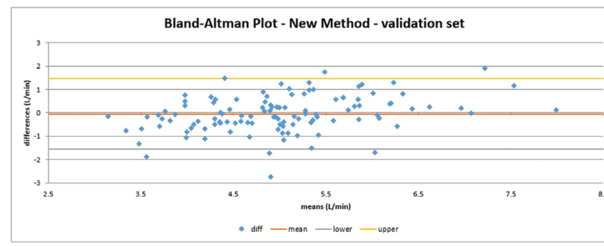

Figure. Accuracy of cardiac output estimated with different methods vs. Doppler echocardiography (mean difference, error and intraclass correlation coefficient), and Bland-Altman plot for cardiac output estimated by new compliance-based method vs. Doppler echocardiography.

O84 BLOOD PRESSURE MEASUREMENT VIA IMPEDANCE CARDIOGRAPHY: AN ARTIFICIAL INTELLIGENCE BASED PROOF-OF-CONCEPT

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Objective: Accurate blood pressure (BP) measurement is crucial for the diagnosis, risk assessment, treatment decision-making, and monitoring of cardiovascular diseases. Unfortunately, the gold-standard, cuff-based BP measurement suffer from inaccuracies and discomfort. As a result, continuous, cuff-less, and non-invasive BP assessment methods are merging as promising alternatives. This study is the first to comprehensively assess impedance cardiography (ICG) for Machine Learning enabled BP measurement.

Methods: We analysed ICG data from 71 young and healthy adults. Nine different Machine Learning algorithms were evaluated for their BP estimation performance. Accuracy measures comprised mean difference, standard deviation, Limits of Agreement, mean absolute error, and root mean squared error. Additionally, the B-Score was calculated to evaluate the "true", relative performance of the best-performing model.

Results: The Multi-Linear Regression model showed the highest performance (mean difference = -0.01, r = 0.82) for systolic BP. The Support Vector Regressor model achieved the best results (mean difference = 0.15, r = 0.51) for diastolic BP. Both models exhibited positive B-Scores, indicative of their predictive capability. All tested models' estimations correlated with both systolic and diastolic reference BP ($r > 0.72$ / $r > 0.34$, $p < 0.001$).

Conclusion: The study highlights the potential of ICG based Machine Learning algorithms for accurately estimating arterial BP. Such algorithms can provide accurate and continuous BP data. This offers the possibility of enhancing patient care, timely diagnostics, and treatment decision-making. Our approach is especially promising for post-surgical and intensive care environments.