Supplementary Information

Title

Dual-site ultrasound for simultaneous assessment of blood pressure and pulse wave velocity

Authors and affiliations

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Supplementary Information 1

Table SI1 shows that both SBP and DBP increase with higher flow rates and peripheral resistance. While increasing resistance raises SBP and DBP proportionally and maintains an approximately (SD ≈ 2 mmHg) constant pulse pressure, increasing flow rate at constant resistance leads to a marked increase in pulse pressure.

Table SI1: SBP/DBP in mmHg for flow rate and resistance.

		Resistance in needle valve setting			
		10	**6**	**4**	**2**
Flow rate in l/min	**0.2**	28/3	27/5	30/8	30/11
	0.4	70/10	85/23	94/33	107/45
	0.6	111/21	128/49	162/68	182/88
	0.7	180/31	180/67	207/96	238/132

Supplementary Information 2

Figure SI1, Figure SI2, and Figure SI3 show the Bland-Altman analysis for SBP, DBP, and MAP estimation, respectively, using Eq1, Eq2, and Eq3 across hypotensive, normotensive, hypertensive, and hypertensive crisis conditions. The analysis evaluates agreement between estimated and reference SBP values, including bias, limits of agreement, and regression trends across pressure ranges.

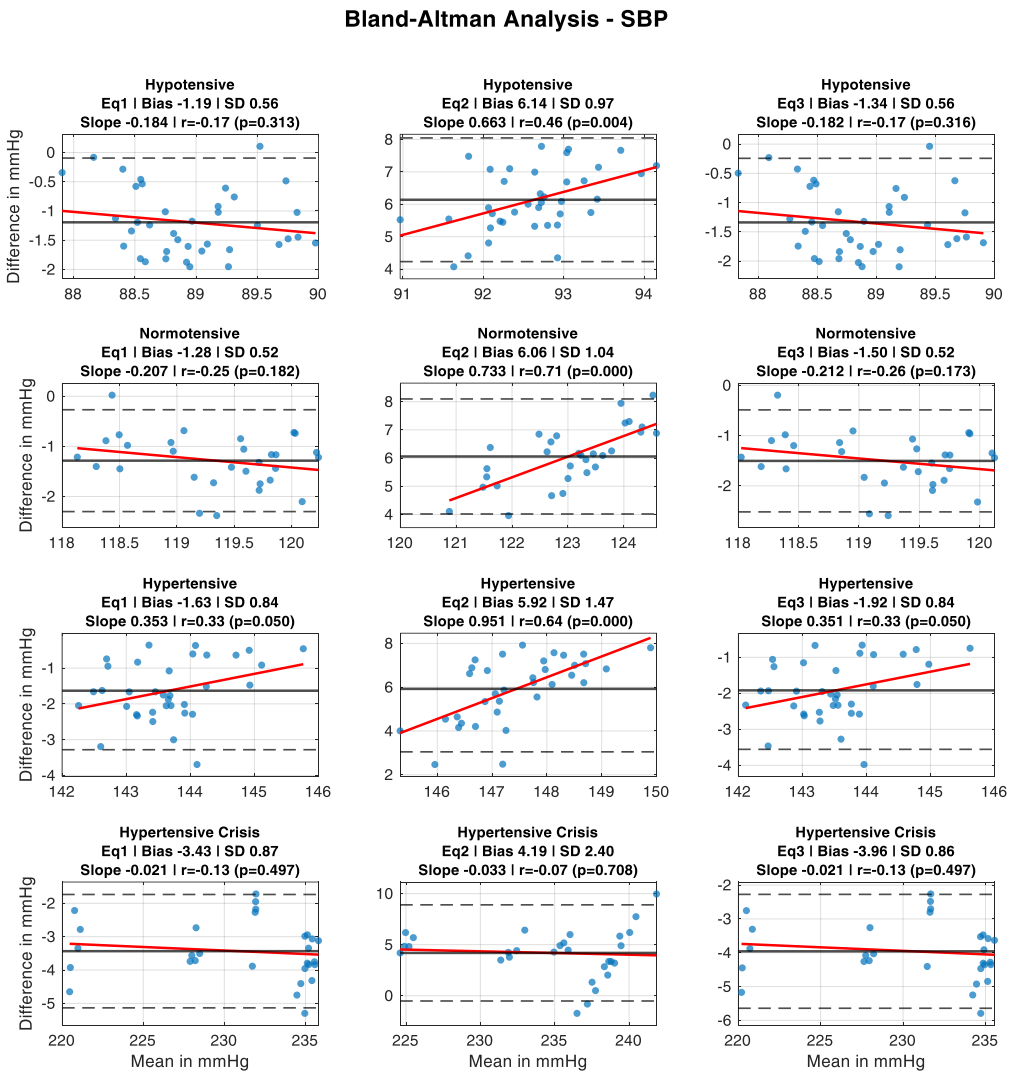

Figure SI1: SBP Bland-Altman Analysis. Bland-Altman plots comparing reference (from pressure sensor) and estimated SBP obtained using Eq1, Eq2, and Eq3 across hypotensive, normotensive, hypertensive, and hypertensive crisis conditions. Rows correspond to pressure conditions and columns correspond to the evaluated equations. Each point represents one cardiac cycle. The solid horizontal line indicates the mean difference (bias), defined as the average estimation error between the estimated and reference SBP values. Dashed horizontal lines indicate the limits of agreement, calculated as bias ± 1.96 SD of the differences. The red line represents the linear regression between the mean SBP and estimation error. Slope corresponds to the regression slope, r denotes the Pearson correlation coefficient, and p-value indicates the statistical significance of the correlation. Axes were independently scaled for each subplot according to the corresponding dataset range.

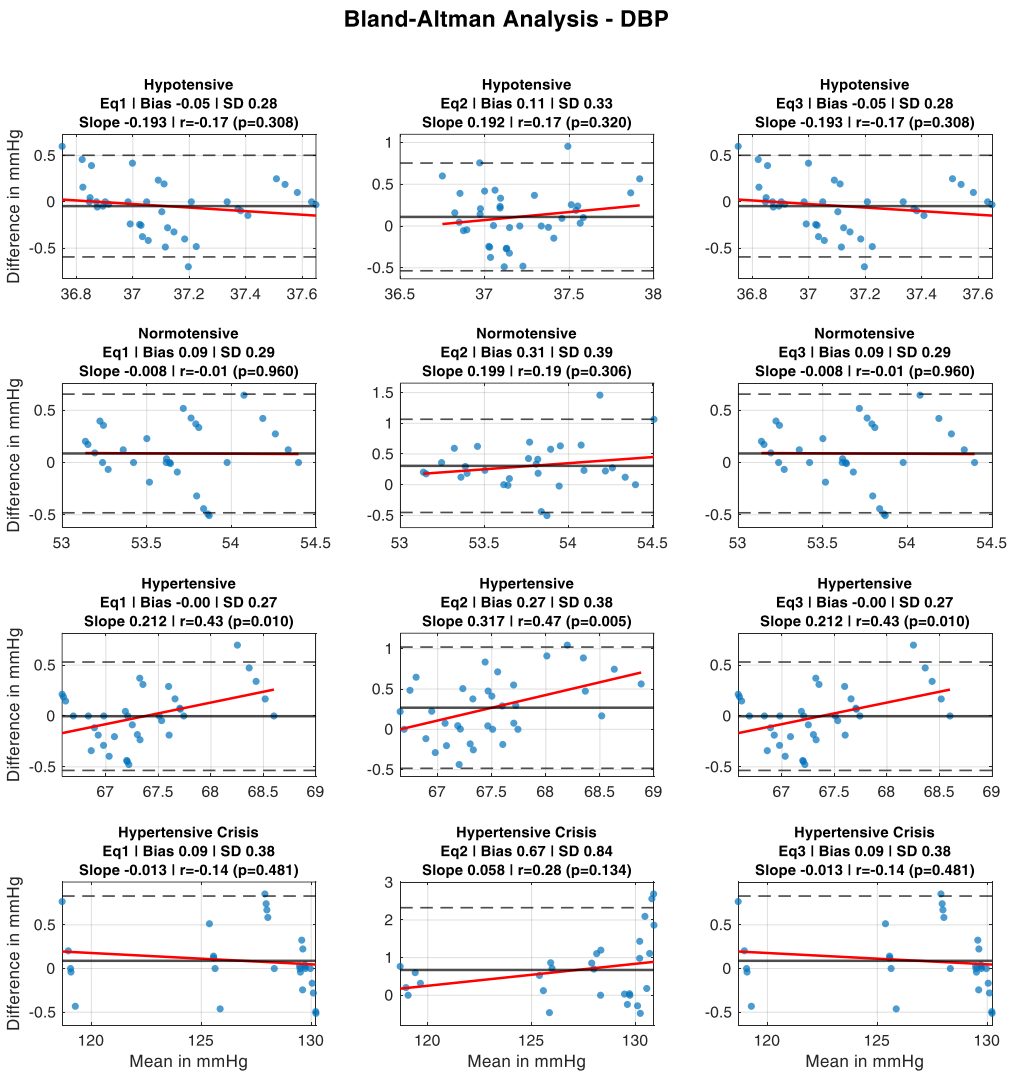

Figure SI2: DBP Bland-Altman Analysis. Bland-Altman plots comparing reference (from pressure sensor) and estimated DBP obtained using Eq1, Eq2, and Eq3 across hypotensive, normotensive, hypertensive, and hypertensive crisis conditions. Rows correspond to pressure conditions and columns correspond to the evaluated equations. Each point represents one cardiac cycle. The solid horizontal line indicates the mean difference (bias), defined as the average estimation error between the estimated and reference SBP values. Dashed horizontal lines indicate the limits of agreement, calculated as bias ± 1.96 SD of the differences. The red line represents the linear regression between the mean SBP and estimation error. Slope corresponds to the regression slope, r denotes the Pearson correlation coefficient, and p-value indicates the statistical significance of the correlation. Axes were independently scaled for each subplot according to the corresponding dataset range.

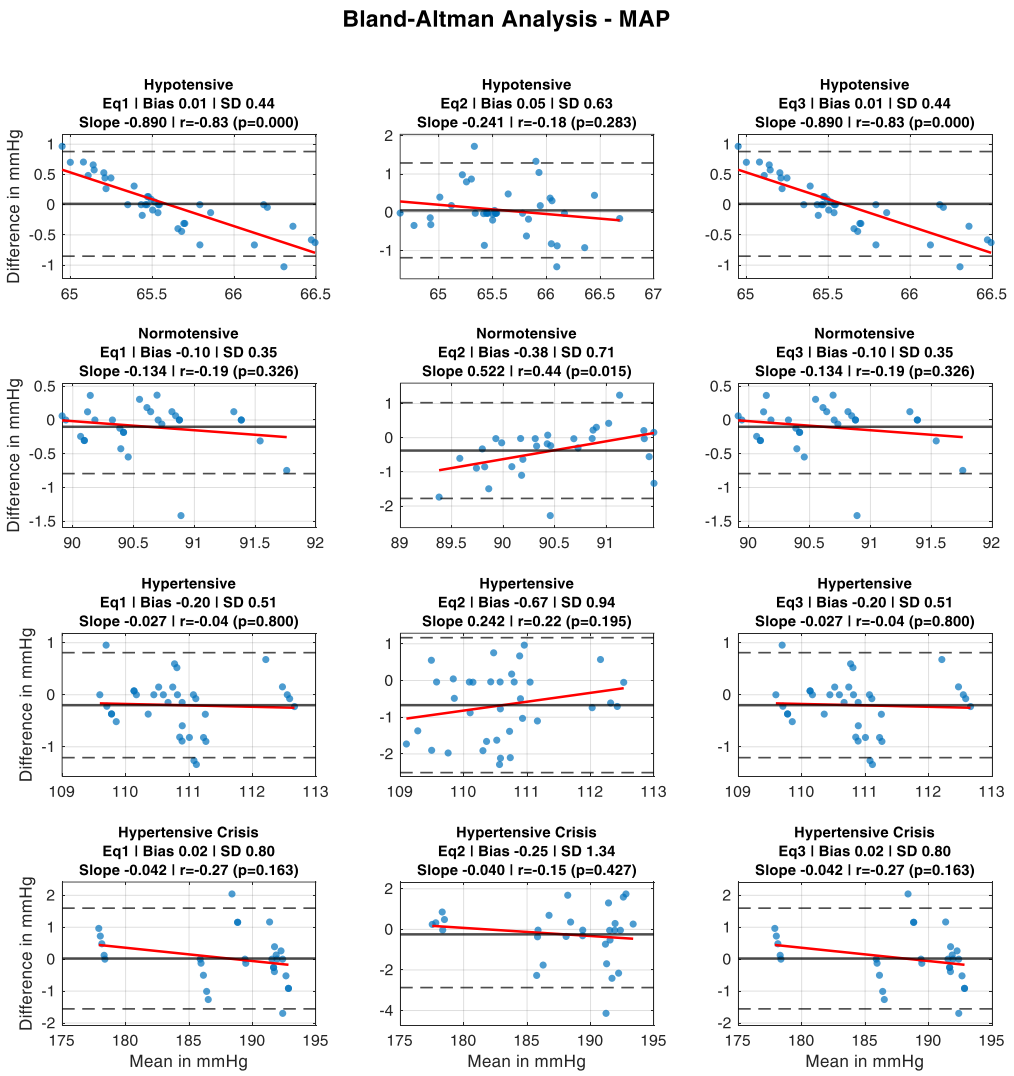

Figure SI3: MAP Bland-Altman Analysis. Bland-Altman plots comparing reference (from pressure sensor) and estimated MAP obtained using Eq1, Eq2, and Eq3 across hypotensive, normotensive, hypertensive, and hypertensive crisis conditions. Rows correspond to pressure conditions and columns correspond to the evaluated equations. Each point represents one cardiac cycle. The solid horizontal line indicates the mean difference (bias), defined as the average estimation error between the estimated and reference SBP values. Dashed horizontal lines indicate the limits of agreement, calculated as bias ± 1.96 SD of the differences. The red line represents the linear regression between the mean SBP and estimation error. Slope corresponds to the regression slope, r denotes the Pearson correlation coefficient, and p-value indicates the statistical significance of the correlation. Axes were independently scaled for each subplot according to the corresponding dataset range.

Table SI2 and Table SI3 indicate estimated DBP and MAP, respectively, MD, SD, and MAD to reference values in each of the four different pressure ranges and overall, as well as the accuracy evaluation per standard.

Table SI2: DBP accuracy assessment of three blood pressure estimation equations (Eq1–Eq3) under different conditions. Metrics included mean difference (MD), standard deviation (SD), and mean absolute difference (MAD), with accuracy evaluation according to the Universal Standard ISO 81060-2:2018 (ISO) - Pass (P) or Fail (F), British Hypertension Society (BHS) standard - Grade A to D (Grade C and D fail), and IEEE Cuffless Standard (IEEE) - Grade A to D (Grade D fails).

Condition	n	Pressure equations																	
		Eq1						Eq2						Eq3					
		Accuracy (DBP)			Standard			Accuracy (DBP)			Standard			Accuracy (DBP)			Standard		
		MD	SD	MAD	ISO	BHS	IEEE	MD	SD	MAD	ISO	BHS	IEEE	MD	SD	MAD	ISO	BHS	IEEE
Hypotensive	38	0.0	0.3	0.2	P	A	A	0.1	0.3	0.3	P	A	A	0.0	0.3	0.2	P	A	A
Normotensive	30	0.1	0.3	0.2	P	A	A	0.3	0.4	0.4	P	A	A	0.1	0.3	0.2	P	A	A
Hypertensive	35	0.0	0.3	0.2	P	A	A	0.3	0.4	0.4	P	A	A	0.0	0.3	0.2	P	A	A
Hypertensive crisis	29	0.1	0.4	0.3	P	A	A	0.7	0.8	0.8	P	A	A	0.1	0.4	0.3	P	A	A
Overall	132	0.0	0.3	0.2	P	A	A	0.3	0.5	0.4	P	A	A	0.0	0.3	0.2	P	A	A

Table SI3: MAP accuracy assessment of three blood pressure estimation equations (Eq1–Eq3) under different conditions. Metrics included mean difference (MD), standard deviation (SD), and mean absolute difference (MAD), with accuracy evaluation according to the Universal Standard ISO 81060-2:2018 (ISO) - Pass (P) or Fail (F), British Hypertension Society (BHS) standard - Grade A to D (Grade C and D fail), and IEEE Cuffless Standard (IEEE) - Grade A to D (Grade D fails).

Condition	n	Pressure equations																	
		Eq1						Eq2						Eq3					
		Accuracy (MAP)			Standard			Accuracy (MAP)			Standard			Accuracy (MAP)			Standard		
		MD	SD	MAD	ISO	BHS	IEEE	MD	SD	MAD	ISO	BHS	IEEE	MD	SD	MAD	ISO	BHS	IEEE
Hypotensive	38	0.0	0.4	0.3	P	A	A	0.1	0.6	0.4	P	A	A	0.0	0.4	0.3	P	A	A
Normotensive	30	-0.1	0.4	0.2	P	A	A	-0.4	0.7	0.6	P	A	A	-0.1	0.4	0.2	P	A	A
Hypertensive	35	-0.2	0.5	0.4	P	A	A	-0.7	0.9	0.9	P	A	A	-0.2	0.5	0.4	P	A	A
Hypertensive crisis	29	0.0	0.8	0.6	P	A	A	-0.2	1.3	0.9	P	A	A	0.0	0.8	0.6	P	A	A
Overall	132	-0.1	0.5	0.4	P	A	A	-0.3	1.0	0.7	P	A	A	-0.1	0.5	0.4	P	A	A