Artery Research
Vol. **25**(**S1**); 2019, *pp.* S103–S104
DOI: https://doi.org/10.2991/artres.k.191224.093; ISSN 1872-9312; eISSN 1876-4401
https://www.atlantis-press.com/journals/artres

P62 Estimation of Wave Intensity in Humans Using only Pressure Waveforms and Reservoir Analysis

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ABSTRACT

Background: Measurement of wave intensity (WI) requires simultaneous or quasi-simultaneous measurement of pressure and flow limiting its use. Previous work in dogs [1] and humans [2] has shown that the excess pressure waveforms calculated using reservoir analysis correspond closely with aortic flow waveforms. This offers a potential method to estimate WI using only pressure waveforms (pWI). We investigated the feasibility of this approach and agreement with established methods.

Methods: 262 participants (68.3 (SD = 5.5); 74% male) without aortic stenosis or heart failure were recruited from a UK-based longitudinal study, Southall and Brent Revisited. Central pressure waveforms, aortic flow velocity and carotid WI were measured using tonometry (Sphygmocor, AtCor), echocardiography (iE33, Philips) and ultrasonography (SSD-5500, Aloka) respectively. Reservoir analysis was performed as previously described [2] and excess pressure waveforms were calibrated to flow velocity assuming a peak velocity of 1 m/s. Method agreement was assessed as mean difference (MD), limits of agreement (LOA) and concordance coefficient (CC).

Results: Analysis failed in 9 individuals; results for those with analysable data are shown in Table 1. Aortic pWI was higher than aortic WI but showed good concordance (logW1: MD(LOA) = −0.41(−0.73, −0.09) CC = 0.7; logW2: MD(LOA) = −0.41 (−0.73, −0.09); CC = 0.7). Agreement of pWI with carotid WI showed no bias and concordance was fair to poor (logW1: MD (LOA) = −0.16 (−1.30, 0.99) CC = 0.3; logW2: MD (LOA) = −0.02 (−1.23, 1.2); CC = 0.1).

Conclusion: Estimation of aortic WI from pressure waveforms using reservoir analysis is feasible.

Table 1 | Results

Variables	*N*	Median/(%)	p25	p75
Age, y	207	67.9	63.6	71.9
BMI, kg/m^2	207	26.6	24.1	30.1
Systolic BP, mmHg	207	139	126	148
Diastolic BP, mmHg	207	76	70	82
Heart rate, bpm	207	66	59	74.5
Male sex, %	150	72.5		
Ethnicity				
European	88	(42.5%)		
South Asian	75	(36.2%)		
African Caribbean	44	(21.3%)		
Current smoker	18	(8.8%)		
Diabetes	65	(31.4%)		
Hypertension	130	(62.8%)		
Aorta				
W1, mmHg.m.s^{-3}	207	7103	5041	9910
W2, mmHg.m.s^{-3}	207	1637	1147	2518
pW1, mmHg.m.s^{-3}	207	10,526	7677	14,336
pW2, mmHg.m.s^{-3}	207	2491	1779	3560
time W1 to W2, s	207	0.25	0.23	0.27
Peak velocity, m/s	207	1.34	1.2	1.46

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Variables	*N*	Median/(%)	p25	p75
Carotid artery				
W1, mmHg.m.s^{-3}	207	8714	6550	12,883
W2, mmHg.m.s^{-3}	207	2327	1471	3227
time W1 to W2, s	207	0.29	0.27	0.31
Peak velocity, m/s	207	1.10	0.92	1.30

BMI, body mass index; BP, blood pressure; p25, 25th centile; p75, 75th centile; pW1, peak intensity of initial forward compression wave (W1) estimated using pressure only; pW2, peak intensity of initial forward compression wave (W2) estimated using pressure only; W1, peak intensity of initial forward compression wave (W1) calculated using aortic velocity; W2, peak intensity of initial forward compression wave (W2) calculated using aortic velocity.

REFERENCES

[1] Wang, et al. Am J Physiol Heart Circ Physiol 2003;284:H1358–H68.
[2] Michail, et al. Physiol Meas 2018;39:064006.