Associations between indicators of cardiovascular disease and pulse wave analysis and velocity: a comparison of devices

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Background

- Pulse wave analysis (PWA) indices and pulse wave velocity (PWV) provide important information about arterial function
- Associated with cardiovascular outcomes
- Number of devices available to assess these measures



Background

Sphygmocor -applanation tonometry





Vicorder –cuff based





 To investigate if there were differences in the associations between markers of cardiovascular disease (CVD) and PWA variables and PWV as assessed by the Sphygmocor & Vicorder



British Regional Heart Study (BRHS)

- Prospective study of middle-aged men
- Recruited from GP practices in 24 British towns 1978-1980
- To determine factors responsible for variation in CHD, hypertension & stroke in Great Britain
- To determine causes of these conditions to provide rational basis for recommendations towards their prevention





BRHS



Vascular assessment

- Pulse wave velocity and pulse wave analysis (assessed by Vicorder and Sphygmocor)
- Carotid intima media thickness, carotid distensibility and presence of plaque (ultrasound)
- Ankle brachial pressure index (Vicorder)
- Blood pressure



Other measures

- Left ventricular hypertrophy (LVH) ECG (Minnesota Code)
- NT-proBNP
- Blood tests including lipid profile and glucose
- Anthropometric measures
- History of previous CVD
- Smoking



Analysis

- Only participants with data from both devices included
- Assessed associations between AP, Alx, CBP & PWV with LVH, NT-ProBNP & IMT
- Linear and logistic regression(LVH) with adjustments for cardiovascular risk factors such as blood pressure, obesity & glucose



| | PWA n=1373 | PWV n=1122 |
|----------------------------------|-----------------|-----------------|
| Age (yrs) | 78.2 ± 4.6 | /8.0 ± 4.4 |
| Systolic blood pressure (mmHg) | 148 ± 19 | 148 ± 19 |
| Diastolic blood pressure (mmHg) | 77 ± 11 | 77 ± 11 |
| Total cholesterol (mmol/L) | 4.67 ± 1.03 | 4.71 ± 1.02 |
| LDL (mmol/L) | 2.64 ± 0.93 | 2.68 ± 0.94 |
| HDL (mmol/L) | 1.46 ± 0.42 | 1.48 ± 0.42 |
| Triglycerides (mmol/L) | 1.30 ± 0.66 | 1.28 ± 0.67 |
| Glucose (mmol/L) | 5.74 ± 1.47 | 5.71 ± 1.42 |
| BMI (kg/m²) | 27.08 ± 3.85 | 26.54 ± 3.31 |
| Smoking (Y) | 44 (3.2%) | 34 (3%) |
| IMT (mm) | 0.80 ± 0.16 | 0.80 ± 0.16 |
| NT-proBNP (pg/ml) | 279 ± 743 | 228 ± 394 |
| Left ventricular hypertrophy (Y) | 105 (7.6%) | 84 (7.5%) |



| | Sphygmocor | Vicorder | р |
|------------|------------|--------------|--------|
| AP (mmHg) | 17 ± 9 | 13 ± 5 | <0.001 |
| Alx (%) | 29 ± 10 | 21 ± 6 | <0.001 |
| CBP (mmHg) | 131 ± 19 | 139 ± 17 | <0.001 |
| PWV (m/s) | 10.3 ± 2.6 | 10.05 ± 1.67 | <0.001 |



| | | Sphygmocor | | | | | |
|------|-------|----------------|-------|--|--|--|--|
| LVH | OR | 95% CI | р | | | | |
| АР | 1.038 | 1.008 - 1.063 | 0.011 | | | | |
| Alx | 1.028 | 1.003 - 1.05 3 | 0.03 | | | | |
| CBP* | 1.016 | 1.005 - 1.027 | 0.004 | | | | |
| PWV† | 0.871 | 0.779 - 0.973 | 0.015 | | | | |
| | | | | | | | |

Analyses adjusted for age, systolic blood pressure, total

cholesterol, HDL, glucose, BMI & smoking

*systolic blood pressure not included

Includes heart rate



| | Sphygmocor | | Vicorder | | | |
|------|------------|-----------------------------|--------------|-------|---------------|------|
| LVH | OR | 95% CI | р | OR | 95% CI | р |
| AP | 1.038 | 1.008 - 1.063 | 0.011 | 1.014 | 0.969 - 1.06 | 0.55 |
| Alx | 1.028 | 1.003 - 1.05 <mark>3</mark> | 0.03 | 1.01 | 0.973 - 1.048 | 0.60 |
| CBP* | 1.016 | 1.005 - 1.027 | 0.004 | 1.009 | 0.997 - 1.022 | 0.15 |
| PWV† | 0.871 | 0.779 - 0.973 | 0.015 | 0.912 | 0.778 - 1.07 | 0.26 |

Analyses adjusted for age, systolic blood pressure, total

cholesterol, HDL, glucose, BMI & smoking

*systolic blood pressure not included

† includes heart rate



| | Sphygmocor | | Vicorder | | | |
|-----------|------------|----------------|----------|-------|---------------|--------------------|
| NT-proBNP | В | 95% CI | р | В | 95% CI | р |
| АР | 0.014 | 0.004 - 0.024 | 0.005 | 0.040 | 0.025 - 0.05 | 5 <0.001 |
| Alx | 0.003 | -0.005 - 0.010 | 0.46 | 0.029 | 0.017 - 0.04 | 1 <0.001 |
| CBP\$ | 0.002 | -0.001 - 0.006 | 0.19 | 0.002 | -0.002 - 0.00 | 06 0.32 |
| PWV≠ | -0.007 | -0.040 - 0.025 | 0.66 | 0.010 | -0.042 - 0.06 | 52 0.70 |

Analyses adjusted for age, systolic blood pressure, total

cholesterol, HDL, glucose, BMI, previous MI, eGFR & smoking

\$ systolic blood pressure not included

≠Includes heart rate



| | Sphygmocor | | | Vicorder | | | |
|------------------|------------|----------------|------|----------|--------|----------------|-------|
| ІМТ | В | 95% CI | р | _ | В | 95% CI | р |
| АР | 0.000 | -0.001 - 0.001 | 0.92 | _ | 0.001 | -0.001 - 0.003 | 0.22 |
| Alx | -0.001 | -0.002 - 0.000 | 0.12 | | 0.000 | -0.001 - 0.002 | 0.98 |
| CBP* | 0.000 | 0.000 - 0.001 | 0.15 | | 0.001 | 0.000 - 0.001 | 0.044 |
| PWV [†] | -0.001 | -0.005 - 0.003 | 0.55 | | -0.003 | -0.010 - 0.003 | 0.30 |

Analyses adjusted for age, systolic blood pressure, total cholesterol, HDL,

glucose, BMI & smoking

*systolic blood pressure not included

+ includes heart rate



Conclusions

- Same measures from different devices were predictors of different indicators of CVD
- Sphygmocor derived arterial stiffness indices were a better predictor of LVH than Vicorder

measures



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