P142: AORTIC ROOT STIFFNESS AND MECHANICAL PROPERTIES OF HEALTHY ADULTS

Madalina Negoita, Alun D. Hughes, Kim H. Parker, Ashraf W. Khir


To link to this article: https://doi.org/10.1016/j.artres.2017.10.154

Published online: 7 December 2019
Conclusions: Our data suggest that AO has a substantial advantage over SLDF in terms of evaluation of microvascular morphology, since it is more closely correlated with the M/L of subcutaneous small arteries, considered a gold-standard approach.

P142
AORTIC ROOT STIFFNESS AND MECHANICAL PROPERTIES OF HEALTHY ADULTS

Madalina Negoita 1, Alun D. Hughes 2, Kim H. Parker 3, Ashraf W. Khir 1
1Brunel Institute of Bioengineering, Brunel University London, UK
2Institute of Cardiovascular Science, University College London, UK
3Department of Bioengineering, Imperial College London, UK

Background: Arterial stiffness, often expressed in terms of pulse wave velocity (PWV), is an important risk factor for cardiovascular disease. PWV can be determined locally and non-invasively, by means of ultrasound. Aim: To assess PWV, local compliance (Cs), distensibility (Ds) and Young’s modulus of the aortic root using non-invasive ultrasound measurements. Methods: 10 healthy volunteers aged 21 – 39, 1 male, were scanned using ultrasound (GE, Vivid E95) with a phased array transducer 1.5–4.5MHz. DICOM images were recorded from the parasternal long axis: M-mode for diameter and velocity waveforms were extracted offline in Matlab based on grey-scale thresholding. PWV was determined using the (n-D) U- loop method [1]. Wall thickness was extracted from the B-mode images used to measure the diameter. Distensibility and compliance were calculated as Ds = 1/ (p·PWV²), Cs = dA/dp = Ds A, where p = 1050g/m³ blood density, A is the cross-sectional area, and Young’s modulus was calculated as previously described [2] using the Bramwell-Hill and Moens-Kortweg equations.). Results: Across all patients mean PWV was 3 ± 0.8 m/s, mean distensibility was 1.3 ± 0.61·10⁻⁹ Pa⁻¹/cm, and mean compliance was 0.6 ± 0.31 m²Pa⁻¹. The average wall thickness was 0.4 ± 0.06 cm while Young’s modulus was 63.6 ± 40.4 kPa. These results are comparable to corresponding values reported in the literature using other techniques. Conclusions: Aortic root PWV, distensibility, compliance and Young’s modulus can be determined using ultrasound measurements of diameter and velocity. Further studies are required to investigate the potential clinical utility of aortic root parameters.

References

P143
VALIDITY OF PULSE WAVE VELOCITY AND AUGMENTATION INDEX MEASUREMENTS IN PATIENTS WITH ATRIAL FIBRILLATION

Rogier Caluwe 1, An S. De Vriese 2, Bruno Van Vliem 3, Francis Verbeke 3
1Department of Nephrology, Dialysis and Hypertension, OLV Hospital Aalst, Belgium
2Department of Nephrology and Infectious Diseases, St.-Jan Hospital Brugge, Belgium
3Department of Nephrology, University Hospital Gent, Belgium

Background: Individualized weighing of the risk-benefit of anticoagulation is recommended in patients with atrial fibrillation (AF) that have low established risk scores or, conversely, are at increased risk for bleeding. Parameters of arterial stiffness and wave reflectance could improve risk stratification, but their use has not been validated in arrhythmia²-4. Methods: We measured carotid-femoral pulse wave velocity (PWV), central augmentation index (AI) and central pulse pressure (CPP) using the Sphygmocor (ACor Medical, Sydney, Australia) system in 34 patients (53 to 85 years; 25 males) with AF before and after elective electrical cardioversion. Agreement was assessed using the intraclass correlation coefficient (ICC) and the coefficient of variation, completed with Bland-Altman plots. Results: Following cardioversion, mean arterial blood pressure (MAP) and heart rate (HR) decreased significantly by 7 mmHg and 18 bpm respectively. PWV decreased from 11.8 m/s to 10.7 m/s, AI increased from 24% to 29%, and CPP rose from 45 mmHg to 50 mmHg. The decrease in PWV was related to the decrease in MAP (β = 0.57; R² = 0.33), P < 0.001 whereas changes in AI and CPP were related to the decrease in HR (AI: β = -0.59; R² = 0.35; P < 0.001; CPP: β = -0.52; R² = 0.26; P = 0.001). After adjustment for changes in MAP and HR, reliability analysis showed an excellent agreement for PWV (ICC = 0.89; 95%CI: 0.79–0.95) but moderate agreement for AI (ICC = 0.59; 95%CI: 0.17–0.80). Excellent agreement was also found for CPP (ICC = 0.89; 95%CI: 0.78–0.94).

Conclusions: Aortic root PWV, distensibility, compliance and Young’s modulus can be determined using ultrasound measurements of diameter and velocity. Further studies are required to investigate the potential clinical utility of aortic root parameters.

References

Figure 1. A. Scatter plot showing PWV before (PWV₀) and after (PWV₁) cardioversion. The solid line is the line of identity, the broken line the regression line for PWV₁ vs PWV₀ (Passini & Bablok regression). B. Bland-Altman plot showing the proportional difference (%) between PWV₀ and PWV₁ before and after (PWV₁) cardioversion. The solid line represents the mean value of PWV and the dotted lines mean ± 2 SD.