P2.8: IS THE GOLD-STANDARD FOOT-TO-FOOT PULSE WAVE VELOCITY A GOOD ESTIMATE FOR AORTIC STIFFNESS? A NUMERICAL ASSESSMENT

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Methods: We recruited 54 healthy volunteers and performed a complete echocardiographic exam. We included in the analysis a short axis view of the aortic arch, after the emergence of the brachiocephalic artery. The 2D-ST methodology was used to off-line calculate aortic arch mechanics (EchoPAQ, GE Healthcare®). The analysis was performed for circumferential aortic strain (CAS) and for early circumferential aortic strain rate (eCASR). We assessed the aortic pulse wave velocity (PVW) with the Complior®. Kolmogorov-Smirnov test was used for normality assessment.

Results: We included 50 controls with a gender balance and a mean age of 33 ± 9 years. Of the total 300 aortic wall segments, 278 had adequate waveforms for analysis. Global CAS had a normal distribution ($p = 0.20$); the mean and median CAS were $11.3 \pm 3.2\%$ and 11.5% (8.4 - 13.7) respectively. Global eCASR also had a normal distribution ($p = 0.10$); the mean and median eCASR were 1.5 ± 0.4 s-1 and 1.6 s-1 (1.3 - 1.7), respectively. There was a significant negative correlation between CAS, age ($r = -0.46$, $p < 0.01$), pulse pressure ($r = -0.40$, $p < 0.01$), PWV ($r = -0.52$, $p = 0.03$) and the vascular augmentation index ($r = -0.60$, $p = 0.01$). A similar association was identified for eCARS.

Conclusion: 2D-ST is a feasible methodology for the analysis of the aortic arch mechanics; in this study, we obtained reference values and normal distributions.

P2.5

WITHDRAWN

P2.6

ARTERY DISTENSION MEASURED WITH STANDARD B-MODE IMAGE ECHO-TRACKING HAS SIMILAR ABSOLUTE VALUES AND PRECISION AS MEASURED WITH RADIO-FREQUENCY PHASE-TRACKING

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Objectives: Artery distension, the difference between diastolic and systolic diameter, is an important measure in stiffness evaluation. Distension can be extracted with high precision and accuracy from radio-frequency ultrasound (US) measurements at a high frame-rate using phase-tracking. However, in daily practice processed B-mode images are collected with a lower frame-rate, but higher line density, and distension may only be assessed using echo-tracking. Therefore, the aim of this study is to evaluate the accuracy and precision of echo-tracking distension as compared to that of phase-tracking distension.

Methods: Longitudinal B-mode (40mm, 37fps) US-measurements (video clips 3-6 heartbeats) of the left common carotid artery were performed with a Philips IU22 scanner on 21 patients (age 45-88y) with a recent cerebrovascular accident. In addition, unprocessed radio-frequency US-measurements were performed with a Mylab70 scanner operating in Fast B-mode (31 lines covering 29mm, 300fps, 3-6 heartbeats). To extract the diameter waveform, semi-automatic wall echo-tracking and phase-tracking methods were applied to B-mode and Fast B-mode measurements respectively.

Results: One patient was excluded due to large out of plane motion. Although phase-tracking diameter waveforms showed more detail, both methods exhibit similar intra-subject precision (SD=34μm and SD=33μm, F-test: p-value=0.4). Echo-tracking and phase-tracking systolic-diastolic distension were similar (bias is 25$\pm$90μm, paired t-test: p-value=0.18).

Conclusion: Clinical scanners operating in B-mode can be used to measure distension with reasonable precision and accuracy in a relevant stroke population, although waveform details may be masked at lower frame-rates. This research was supported by the Center for Translational Molecular Medicine and the Dutch Heart Foundation.

P2.7

VALIDATION OF THE COMPLIOR® ANALYSE IN THE ASSESSMENT OF CENTRAL ARTERY PRESSURE CURVES AND AORTIC PULSE WAVE VELOCITY

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Introduction: The purpose of this study was to evaluate the accuracy of carotid pulse wave analysis (PWA) and aortic pulse wave velocity (PWV) with the new version of the Complior device - the Complior Analyse.

Methods: Two cross-sectional studies were implemented to address the reproducibility of the device (87 participants, 60% men, with a mean age of 34.26 ± 16.58 years), and its accuracy comparing it with invasive hemodynamic parameters (15 patients, 7 female gender, mean age 62.07 ± 10.59 years, referenced for cardiac catheterization).

Results: The analysis of concordance revealed a very good agreement for paired PWA and PWV values, regarding both the intra- and inter-observer variability. The intra-observer's intra-class correlation coefficients (ICC) were 0.99 (IC:0.95-1.00, $p < 0.0001$), 0.97 (IC:0.96-0.98, $p < 0.0001$), 0.98 (IC:0.97-0.99, $p < 0.0001$) and 0.86 (IC:0.77-0.90, $p < 0.0001$), respectively for PWV, central systolic (cSBP), pulse pressure (cPP) and augmentation index (AiX). For inter-observer analysis, the ICCs were 0.98 (IC:0.93-0.99, $p < 0.0001$), 0.98 (IC:0.97-0.99, $p < 0.0001$), 0.98 (IC:0.97-0.99, $p < 0.0001$) and 0.85 (IC:0.77-0.89, $p < 0.0001$).

A good concordance between Complior and invasive hemodynamic data was also obtained for all the measured parameters, with intraclass correlation (ICC) coefficients above 0.9. Bland-Altman's analysis also denoted a good accuracy profile of the Complior device, with small mean differences observed for all parameters and most values confined within 2 standard deviations of the mean difference.

Conclusion: The presented results and available research clearly indicate that the Complior Analyse device measures accurately carotid pressure waves, and has an excellent reproducibility when used in ideal conditions and by experienced observers.

P2.8

IS THE GOLD-STANDARD FOOT-TO-FOOT PULSE WAVE VELOCITY A GOOD ESTIMATE FOR AORTIC STIFFNESS? A NUMERICAL ASSESSMENT

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Arterial stiffness is an important predictor of cardiovascular events. In clinical practice, it is commonly evaluated non-invasively by central (carotid-femoral) or peripheral (femoral-ankle or brachial-ankle) foot-to-foot pulse wave velocities (PWV). Though, the efficiency of these indices as predictors of aortic stiffness in normal and pathological conditions has not been theoretically validated.

This study investigates the relation between aortic stiffness and central and peripheral PWV in normal and pathological conditions using a validated one-dimensional model of blood flow in the arterial network. The model allows us to (i) calculate the theoretical value of aortic stiffness from model parameters and (ii) investigate the effect of specific pathological changes in parameters on PWV estimates.

Our results show that in normal conditions, the central PWV over-estimates aortic stiffness by 8%. This error (e) tends to decrease with increased aortic (e=-0.5%) and global (e=2,3%) arterial stiffening (200% increase from baseline). However, in the presence of isolated lower-limb arterial stiffening, the central PWV over-estimates the aortic stiffness by up to 20%.

In normal conditions, peripheral PWV largely over-estimate aortic stiffness (42%< e<67%). Though, these errors drop to less than 3% with aortic stiffening.

Increased global arterial stiffening induces significant increases in all PWV. However, progressive increases in aortic stiffness are only detected by central PWV. Interestingly, increased peripheral vascular resistance and compliance only induce small changes in all PWV.

Our study suggests that central PWV is a good estimate of aortic stiffness, and that peripheral PWV can augment diagnosis by detecting the origin of vascular stiffening.

P2.9

ASSESSMENT OF CENTRAL AORTIC PRESSURE AND ITS ASSOCIATION TO ALL CAUSE MORTALITY CRITICALLY DEPENDS ON WAVE FORM CALIBRATION

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Background: The impact of different calibration methods on the prognostic power of aortic systolic pressure (aSBP) is only rarely reported in literature.

Objective: The aim of this work was therefore the prospective investigation of the association of brachial (bSBP) and aortic systolic blood pressures to all cause mortality with special emphasis on different calibration methods for central pressure estimates, in particular brachial systolic and diastolic as well as brachial mean and diastolic pressures.