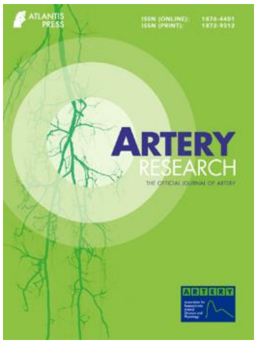

Artery Research

ISSN (Online): 1876-4401 ISSN (Print): 1872-9312
Journal Home Page: https://www.atlantis-press.com/journals/artres

P1.04: DETERMINATION OF BOTH NEAR AND FAR WALL BEHAVIOUR OF THE CAROTID ARTERY IN HYPERTENSIVE AND NORMOTENSIVE SUBJECTS

H. Beaussier, J.P. Aben, I. Masson, E. Bozec, P. Brands, P. Boutouyrie, S. Laurent

To cite this article: H. Beaussier, J.P. Aben, I. Masson, E. Bozec, P. Brands, P. Boutouyrie, S. Laurent (2010) P1.04: DETERMINATION OF BOTH NEAR AND FAR WALL BEHAVIOUR OF THE CAROTID ARTERY IN HYPERTENSIVE AND NORMOTENSIVE SUBJECTS, Artery Research 4:4, 153–154, DOI: https://doi.org/10.1016/j.artres.2010.10.009

To link to this article: https://doi.org/10.1016/j.artres.2010.10.009

Published online: 21 December 2019

Artery Research (2010) 4, 153—188

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/artres

Poster Presentation Abstracts

Methodology 1

P1.01
VALIDATION OF A BRACHIAL CUFF-BASED METHOD FOR ASSESSING CENTRAL BLOOD PRESSURE

T. Weber [1], S. Wassertheurer [2], C. Mayer [2], B. Hametner [2], J. Kropf [2], B. Eber [1]
[1]*Cardiology Department Klinikum Wels-Grieskirchen, Wels, Austria*
[2]*Austrian Institute of Technology, Vienna, Austria*

Background: The prognostic value of central blood pressure has been recently established, and the important role of cuff-based ambulatory blood pressure measurement has been clarified. An algorithm enabling conventional automated oscillatory upper-arm cuffs to assess central pressures in addition to brachial measurements could be of clinical value.
Methods: We compared central systolic blood pressure (cSBP), calculated with the ARCSolver method (Austrian Institute of Technology, Vienna, Austria) using waveforms recorded with a regular oscillatory brachial cuff suitable for ambulatory measurement (mobil-o-graph, IEM, Germany), with simultaneous high-fidelity invasive recordings using Millar catheters during routine coronary angiography, and with non-invasive estimations using a FDA-approved validated device (SphygmoCor, AtCor medical, Sydney, Australia).
Results: Both studies revealed a good agreement between the ARCSolver-based cSBP and the comparator. In the invasive study, comprising 18 patients, mean difference between cSBP (ARCSolver) and cSBP (invasive) was -0.3 mm Hg with a standard deviation of 4.5 mm Hg — Figure. In the non-invasive study, comprising 103 patients, mean difference between cSBP (ARCSolver) and cSBP (SphygmoCor) was -0.5 mm Hg with a standard deviation of 4.6 mm Hg. Both results pass the AAMI limits for blood pressure measurement devices.
Conclusion: The ARCSolver algorithm, using brachial cuff-based waveform recordings, is suited to provide a realistic estimation of cSBP.

P1.02
IN VIVO QUANTIFICATION OF CAROTID ARTERY WALL DIMENSIONS: 3.0 TESLA MRI VERSUS B-MODE ULTRASOUND IMAGING

R. Duivenvoorden [1], E. de Groot [1,3], B. M. Elsen [1], J. S. Lameris [2], R. J. van der Geest [4], E. S. G. Stroes [1], J. J. P. Kastelein [1], A. J. Nederveen [2]
[1]*AMC Dept of Vascular Medicine, Amsterdam, Netherlands*
[2]*AMC Dept of Radiology, Amsterdam, Netherlands*
[3]*AMC Vascular Imaging, Amsterdam, Netherlands*
[4]*LUMC Dept of Radiology, Leiden, Netherlands*

Background: We compared 3.0 Tesla MRI (3T MRI) common carotid Mean Wall Thickness (MWT) to B-mode ultrasound (US) common carotid intima-media thickness (CCIMT) measurements.
Methods and results: 3T MRI and B-mode US scans of the left and right common carotid arteries were performed three times in 15 healthy younger volunteers (aged 26±2.6 years), 15 healthy older volunteers (aged 57±3.2 years) and 15 subjects with CVD and carotid atherosclerosis (aged 63 ± 9.8 years). MWT was 0.711(SD 0.229) mm; CCIMT was 0.800 (SD0.206)mm. MWT and CCIMT were highly correlated ($r = 0.89$, $p < 0.001$). ICC's for inter-scan and inter- and intraobserver agreements of MRI MWT measurements were >0.95 with small confidence intervals. Power calculations indicated that 89 subjects per group are required to detect 4% difference in MRI MWT, compared to 469 subjects per group for a similar CCIMT change.
Conclusion: Carotid MRI MWT and ultrasound CCIMT measurements showed strong agreements. MRI showed smaller variability that may allow sample sizes and potentially shorter study duration in cardiovascular prevention trials.

P1.03
BRACHIAL SYSTOLIC AND DIASTOLIC BLOOD PRESSURE AT DIFFERENT ARM HEIGHTS: A NOVEL INDEX OF ARTERIAL FUNCTION

G. Schillaci [1], G. Pucci [1], B. Gavish [2], R. Hijazi [1], L. Settimi [1], M. Pirro [1], E. Mannarino [1]
[1]*University of Perugia, Perugia, Italy*
[2]*InterCure Ltd, Lod, Israel*

Systolic and diastolic blood pressure (BP) changes over different mean pressure levels has been used to generate the (ambulatory) arterial stiffness index, and may reflect functional arterial properties. We hypothesized that pressure changes obtained by changing arm position may represent a tool to investigate arterial function at bedside.
In 56 healthy subjects (age 48±18 years, BP 125/71±18/10 mmHg), we measured carotid-radial pulse wave velocity (PWV) and sitting brachial BP (12 readings with the arm in 4 different positions, 3 readings per position). SBP-on-DBP slope, estimated by the ratio of their standard deviations, was defined as BPVR (BP variability ratio). Recent model expresses BPVR as the systolic-to-diastolic stiffness ratio. Diastolic stiffness was expressed by PWV^2 (Bramwell-Hill formula).
As expected from Stevin's law, mean pressure changed linearly with the cuff-heart vertical distance (-14 mmHg, -8 mmHg, and +9 mmHg, respectively, at +20, +10 and -15 cm; p for linear trend <0.001). Diastolic PWV^2 had a linear relationship with DBP ($r = 0.40$, $p = 0.005$). Also, calculated systolic stiffness (BPVR $\times$ diastolic PWV^2) had a direct relationship with SBP ($r = 0.60$, $p < 0.05$). BPVR had no relation with PWV^2 ($r = -0.18$, p=n.s.), and a strong one with age ($r = 0.45$, $p < 0.01$) and Framingham coronary risk ($r = 0.60$, $p < 0.001$).
In conclusion, SBP/DBP changes at different arm heights may provide a novel measure of arterial function. The resulting SBP-on-DBP slope had no correlation with diastolic arterial stiffness, and increased with increasing SBP, age and estimated coronary risk. Results support the theoretical expression of SBP-on-DBP slope as the ratio between systolic and diastolic stiffnesses.

P1.04
DETERMINATION OF BOTH NEAR AND FAR WALL BEHAVIOUR OF THE CAROTID ARTERY IN HYPERTENSIVE AND NORMOTENSIVE SUBJECTS

H. Beaussier [1], J. P. Aben [2], I. Masson [4], E. Bozec [1], P. Brands [3], P. Boutouyrie [1], S. Laurent [1]
[1]*Hôpital Européen Georges Pompidou INSERM U970, Paris, France*
[2]*Pie Medical Imaging, Maastricht, Netherlands*
[3]*Esaote Europe, Maastricht, Netherlands*
[4]*Université Paris-Est CNRS EAC 4396, Créteil, France*

Introduction: Although the Artlab® echotracking device (Artlab, Esaote) determines common carotid artery (CCA) far wall thickness (FW-IMT) with

1872-9312/$ — see front matter
doi:10.1016/j.artres.2010.10.009

high resolution, the near wall thickness (NW-IMT) is still challenging. New ultrasound software (CAAS-US, Pie medical Imaging) was developed for NW-FW-IMT measurement from radiofrequency signal.

Objectives: To compare CCA IMT between CAAS-US and standard Artlab, and to assess CAAS-US determination of NW-IMT and both near and far wall IMT variations during the cardiac cycle, in 38 treated hypertensive (HT) and 18 normotensive (NT) patients.

Methods: Diastolic outer diameter (Dd) and FW-IMT were determined with CAAS-US and Artlab. Bland-Altman test and Pearson's correlation coefficient (R) were used to compare methodologies. With CAAS-US, NW-IMT and FW-IMT were compared. Systolo(s)-diastolic(d) variations of IMT and outer D were calculated: ΔIMT ((IMTs - IMTd)/IMTd) of NW and FW were compared to ΔD ((Ds - Dd)/Dd).

Results: No significant differences in CCA Dd and FW-IMTd were observed between two methods ($R=0.97$, $RMSE=0.124$ mm and $R=0.91$, $RMSE=0.065$ mm, respectively $p<0.0001$). IMTd between near and far wall are significantly correlated ($R=0.73$, $RMSE=0.117$ mm, $p<0.0001$). FW ΔIMT is significantly correlated to ΔD ($R=0.57$, $RMSE=0.036$ mm, $p=0.0002$) whereas NW ΔIMT is not ($R=0.30$, $RMSE=0.073$ mm, $p=0.065$).

Conclusion: CAAS-US allows determination of both near and far wall CCA IMT. Whereas FW-IMT variation during the cardiac cycle is measurable, NW-IMT is less precise and remains a challenging. These findings added to CAAS-US plaque contours ability may be useful to estimate more completely the real state of the carotid artery atherosclerotic process.

P1.05
COMPARING AORTIC PULSE WAVE VELOCITY BY MAGNETIC RESONANCE IMAGING AND THE NEW OSCILLOMETRIC METHOD ARTERIOGRAPH

M. Rezai [1], N. Sherratt [2], J. K. Cruickshank [1]
[1]*Cardiovascular Research Group, University of Manchester, Manchester, United Kingdom*
[2]*Wellcome Trust Clinical Research Facility, Manchester, United Kingdom*

Aims: Comparing aortic pulse wave transit time (TT) and velocity (aPWV) between magnetic resonance imaging (MR) and the oscillometric method Arteriograph (AG) that has potential for outpatient use.

Methods: MR phase-contrast transverse slices were sequentially taken at aortic arch (pulmonary bifurcation level), and 2 cm above aortic bifurcation in 49 men (age: 53±6 yr). TT was calculated using 10% of the MR flow wave amplitudes as wave-feet. The aortic root to bifurcation (aoLength) was measured in 3D volumes rendered from serial sagittal slices. Supine left-arm AG measurements were made post-MR, estimating aoLength from suprasternal-notch to symphysis-pubis surface length. Results are mean differences (95%CI).

Results: TT_{MR} and $aPWV_{MR}$ covered a mean 85% of aoLength partly omitting the proximal ascending aorta. TT_{AG} (71±10 ms) was 6.6(3.8-9.3) ms (10%) higher than TT_{MR} (64±10 ms) and correlated ($r=0.54$, $p<0.001$). $aPWV_{AG}$ (7.9±1.4) was 1.3(0.9-1.7) m/s higher than $aPWV_{MR}$ (6.6±1.3) and correlated ($r=0.50$, $p<0.001$). AG's sternum-pubis length was 70(59-81) mm higher than MR's aoLength ($r=0.55$, $p<0.001$).

A regression model was derived from 29 cases predicting measured $aoLength_{MR}$ using age and height. When tested in the remaining 20 cases, the *predicted* $aoLength_{MR}$ was within 5.3(-22-11) mm of that *measured* by MR. Compared with original $aPWV_{AG}$, recalculated $aPWV_{AG}$ using TT_{AG} and the regression-predicted aoLength was less different (0.31(0.01-0.61) m/s – $p=0.02$), and more closely correlated with $aPWV_{MR}$ ($r=0.62$).

Conclusions: TT estimations by AG and MR are close, given omitted proximal lengths by MR. More accurate length estimation can significantly improve AG's aPWV measurement using MR as a reference.

P1.06
THE ARTERIOGRAPH: CORRELATED TO AORTIC STIFFNESS, BUT MEASURING AXILLO-BRACHIAL ARTERY STIFFNESS?

B. Trachet [1], P. Reymond [4], J. Kips [1], A. Swillens [1], M. L. De Buyzere [2], B. Suys [3], N. Stergiopulos [4], P. Segers [1]
[1]*bioMMeda - IBiTech, Ghent University, Gent, Belgium*
[2]*Department of Cardiovascular Diseases, Ghent University Hospital, Gent, Belgium*
[3]*Department of Pediatrics, Antwerp University, Antwerp, Belgium*
[4]*Laboratory of Hemodynamics and Cardiovascular Technology, Swiss Federal Institute of Technology, Lausanne, Switzerland*

The Arteriograph (Tensiomed) is a device that determines aortic pulse wave velocity (PWV) by recording a brachial blood pressure waveform during supra-systolic inflation of a brachial cuff. We validated the working principle of the Arteriograph in a validated 1D computer model of the arterial tree, and found an excellent correlation between Arteriograph (PWV_{ATG}) and carotid-femoral ($PWV_{car\text{-}fem}$) PWV ($r = 0.98$, $p<0.01$) when homogenously altering stiffness parameters over the complete arterial network. However, selectively altering the stiffness of the aortic or axillo-brachial pathway demonstrated that PWV_{ATG} is determined solely by axillo-brachial stiffness and not by aortic stiffness. Furthermore, wave intensity analysis shows that the secondary forward compression wave picked up by the Arteriograph and used to assess the travel time of the pressure wave over the aorta is not caused by a reflection from the lower body. Instead, this wave is the result of "trapping" of the initial forward compression wave between the occluding cuff and the axillo-aortic junction. Thus the Arteriograph measures axillo-brachial stiffness, and the good correlation between PWV_{ATG} and $PWV_{car\text{-}fem}$ is driven by the fact that axillo-brachial and central stiffness were changed to the same extent in the model. Combining these results with earlier findings in literature of good in vivo correlations between PWV_{ATG} and $PWV_{car\text{-}fem}$, axillo-brachial and aortic stiffness are likely to be related. However, this does not necessarily imply that axillo-brachial and aortic segments change similarly with age (or disease). We conclude that PWV_{ATG} is, at best, an indirect and unspecific estimate of aortic stiffness.

P1.07
ULTRASOUND EVALUATION OF CAROTID STIFFNESS IN HEALTHY VOLUNTEERS DURING EXERCISE: A PILOT STUDY

E. Bianchini [1], R. M. Bruno [2], A. I. Corciu [1], V. Gemignani [1], F. Faita [1], M. Demi [1], L. Ghiadoni [2], R. Sicari [1]
[1]*Institute of Clinical Physiology-CNR, Pisa, Italy*
[2]*Department of Internal Medicine, University of Pisa, Pisa, Italy*

The study of cardiovascular parameters in exercise is intriguing, since this evaluation could provide information about dynamic conditions, mimicking patient's real life. Therefore, we evaluated carotid cross-sectional distensibility coefficient (DC), systemic vascular resistance corrected by cardiac frequency ($SVRI_T$), arterial elastance (Ea) and left-ventricular elastance (Elv) during graded bicycle semi-supine exercise test.

In 18 healthy subjects (9 men, 34±3 years) cardiac volumes were estimated from 2D transthoracic echocardiography, right carotid diameter and distension by an automatic system (Carotid Studio, IFC-CNR) applied to ultrasound B-mode image sequences and central pressures by tonometry. All measurements were performed at 60%, 70%, 80% and 85% (peak) of the age-dependent maximal heart rate.

During exercise DC decreased (peak versus rest: -17.8% and $p<0.05$), and $SVRI_T$ did not significantly change. Ea increased (+21.3%, $p<0.01$) and, since Elv presented a greater variation (+69.2%, $p<0.001$), arterial ventricular coupling (Ea/Elv) decreased (-22.6%, $p<0.05$). As expected, central pulse pressure was significantly increased (+81.8%, $p<0.01$).

In conclusion, carotid stiffness increased during exercise, possibly due to the recruitment of more collagen fibers and the consequent different mechanical behavior of arterial walls at higher pressures. Since $SVRI_T$ did not change significantly, the increased arterial stiffness, observed at carotid site, might represent the main determinant of Ea variation. Finally, a decrease in arterial-ventricular coupling during exercise was confirmed.

Our results show the feasibility of a simultaneous multi-sites approach that could help in the understanding of arterial physiology and patho-physiology in stress conditions.

P1.08
THE BRACHIO-TO-RADIAL PULSE PRESSURE AMPLIFICATION AND ITS CONTRIBUTION TO CENTRAL-TO-PERIPHERAL PULSE PRESSURE AMPLIFICATION

G. Pucci [1,2], J. Cheriyan [2], L. Whittaker [2], S. S. Hickson [2], G. Schillaci [1], C. M. McEniery [2], I. B. Wilkinson [2]
[1]*Clinical and Experimental Medicine, University of Perugia, Perugia, Italy*
[2]*Clinical Pharmacology Unit, University of Cambridge, Cambridge, United Kingdom*

Pulse pressure amplification (PPa) is the phenomenon by which systolic blood pressure (SBP) increases from aorta to periphery, whether mean (MAP) and diastolic pressure (DBP) remain constant along the arterial tree. Controversy exist in defining the extent of brachio-radial PPa and how much it contributes central-to-peripheral PPa. The SphygmoCor estimates central PP (cPP) by a transfer function applied to the radial waveform calibrated to brachial SBP/DBP, or to brachial MAP/DBP. If brachio-radial PPa was irrelevant, calibrating radial waveform to bSBP/bDBP or to bMAP/bDBP would have no measurable impact on estimated cPP.

In order to assess brachio-radial PPa and its determinants, 93 healthy subjects (42±20 years, 53% men) were studied after 10 minutes of supine rest.