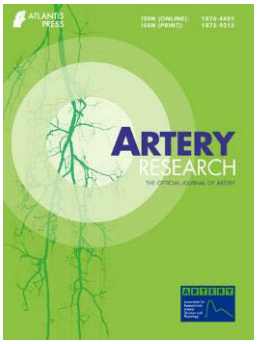

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3.5: HEART RATE DEPENDENCE OF REGIONAL AND LOCAL AORTIC PULSE WAVE VELOCITY IN RATS AS A FUNCTION OF BLOOD PRESSURE

Bart Spronck, Isabella Tan, Koen Reesink, Dana Georgevsky, Tammo Delhaas, Alberto Avolio, Mark Butlin

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(n = 30) was also associated with gothic arch (p = 0.01), and dilated ascending aorta but with no aortic root dilation (p = 0.02).
On multivariate regression analysis, gothic arch was indeed associated with coarctation and stenosis, and also with non-coronary valve fusion pattern (p = 0.03). Patients with aortic regurgitation tended to have larger aortas (p = 0.005).
Conclusion: The presence of aortic coarctation and stenosis may influence the amount of dilation and the overall arch architecture in BAV patients. Patients with BAV present profoundly different morphological phenotypes depending on the presence/absence of aortic coarctation (Fig. 1).

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3.4
RESERVOIR PRESSURE SEPARATION AT BRACHIAL, CAROTID AND RADIAL ARTERIES: A QUANTITATIVE COMPARISON AND EVALUATION

Michael Ebner [1], Kim Parker [2], Tom Vercauteren [3,1], Sébastien Ourselin [3,1], Siegfried Wassertheurer [4], Alun Hughes [5], Bernhard Hametner [4]
[1] *Translational Imaging Group, Centre for Medical Image Computing, Department of Medical Physics and Biomedical Engineering, University College London, London, UK*
[2] *Department of Bioengineering, Imperial College London, London, UK*
[3] *Wellcome/EPSRC Centre for Interventional and Surgical Sciences, University College London, London, UK*
[4] *Center for Health & Bioresources, AIT Austrian Institute of Technology, Vienna, Austria*
[5] *Institute of Cardiovascular Science, University College London, London, UK*

Background: At present, reservoir pressure parameters are derived from arterial pressure waveforms regardless of the location of measurement. However, a comparison between sites has not been made, and site-related differences may affect interpretation. In this study, we computed reservoir pressure waveform separations on hypertensive individuals where brachial, carotid and radial pressure measurements were available and quantitatively assessed their results.
Methods: 95 participants in the Anglo-Scandinavian Cardiac Outcomes Trial (ASCOT) had sequential measurements of pressure and flow velocity waveforms from carotid, brachial and radial arteries [1]. Pre-processing was performed to impose identical diastolic and mean blood pressures at all three arterial locations. Using pressure information only, reservoir pressure separation was performed [2, 3]. Systolic durations were estimated based on minimum pressure waveform derivatives.
Reservoir curves characterized by physiologically implausible parameters, i.e. a rate constant $b < 0$ or an asymptotic pressure $P\infty < 0$, were discarded, leaving 74 subjects with valid reservoir pressure waveforms at all three arterial locations.
Results: Estimated reservoir parameters are shown in Table 1. We observed significant differences between arteries in almost all parameters. A high correlation was observed between reservoir pulse pressure and reservoir pressure area at all locations, and the correlation between brachial and radial arteries was stronger for all parameter.

Table 1 Quantification of reservoir pressures at three arterial locations in the format of mean ± standard deviation based on 74 subjects whereby PP denotes the reservoir pulse pressure, A_p the area of reservoir pressure above diastolic blood pressure, P_∞ the asymptotic blood pressure and a, $b = 1/\tau$ the rate constants with the time constant τ describing the diastolic pressure decay. The correlation coefficient r is computer between relevant arterial locations. The statistical significance of the differences between locations was based on a paired t-test with * indicating $p < 0.05$.

Reservoir	Brachial Artery(B)	Carotid Artery(C)	Radial Artery(R)	*r*(B,C)	*r*(B,R)	*r*(C,R)
PP [mmHg]	37.1 ± 8.6	41.6 ± 9.0	36.1 ± 8.4	0.84*	0.95*	0.84*
A_p [mmHg s]	16.7 ± 5.0	19.0 ± 4.4	16.0 ± 4.3	0.91*	0.96*	0.91*
P_∞ [mmHg]	61.6 ± 14.2	66.6 ± 12.8	66.2 ± 11.2	0.50*	0.51*	0.46*
A [1/s]	8.3 ± 3.7	11.4 ± 2.7	7.0 ± 2.7	0.11*	0.91*	0.18*
B [1/s]	1.8 ± 0.6	2.2 ± 0.9	2.1 ± z0.7	0.30*	0.62*	0.40*

Conclusions: The results of this study indicate differences in parameters derived from reservoir pressure separation at different arterial locations. This suggests that interpretations cannot be made agnostic to the location of measurement.
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3.5
HEART RATE DEPENDENCE OF REGIONAL AND LOCAL AORTIC PULSE WAVE VELOCITY IN RATS AS A FUNCTION OF BLOOD PRESSURE

Bart Spronck [1], Isabella Tan [2], Koen Reesink [1], Dana Georgevsky [2], Tammo Delhaas [1], Alberto Avolio [2], Mark Butlin [2]
[1] *CARIM School for Cardiovascular Diseases, Maastricht University, Maastricht, The Netherlands*
[2] *Department of Biomedical Sciences, Faculty of Medicine and Health Sciences, Macquarie University, Australia*

Background: Pulse wave velocity (PWV) is quantified by time difference of arrival of the blood pressure (BP) wave at two sites along the arterial bed (transit time; TT-PWV), or by combining measured arterial pressure and diameter using the Bramwell-Hill equation (BH-PWV). Besides the dependence of PWV on BP, TT-PWV also depends on heart rate (HR). The present study aimed to also quantify the dependence of BH-PWV's on HR, as a function of diastolic BP (DBP).
Methods: Adult anaesthetised rats (n = 24) were randomly paced at 300—500 bpm, at 50-bpm steps. At each step, aortic TT-PWV (two pressure-tip catheters) and BH-PWV (pressure-tip catheter and ultrasound wall-tracking; abdominal aorta) were measured simultaneously, across a pharmacologically induced DBP range of 60—110 mmHg.
Data from 9142 heart beats was analysed using mixed-effects modelling.
Results: HR dependence of TT-PWV increased from 0.03 m/s/100 bpm at DBP = 60 mmHg to 0.06 m/s/100 bpm at DBP = 110 mmHg (both $p \leq 0.023$). HR dependence of BH-PWV was 0.11 m/s/100 bpm at DBP = 60 and 85 mmHg, but paradoxically decreased to 0 at DBP = 110 mmHg ($p = 0.686$). This decrease in dependence is explicable in that standard BH-PWV uses an approximate derivative of pressure to diameter, which overestimates PWV with increasing pulse pressure (PP). PP decreases as HR increases, potentially causing a BH-PWV decrease with HR. This effect can be overcome by estimating the full pressure-diameter curve for each HR, and calculating the true derivative at DBP, yielding a BH-PWV that no longer shows significant HR dependence ($p \geq 0.076$ at all DBPs).
Conclusions: BH-PWV and TT-PWV show a different HR dependence, affected by DBP.

3.6
NON-INVASIVE, MRI-BASED ESTIMATION OF PATIENT-SPECIFIC AORTIC BLOOD PRESSURE USING ONE-DIMENSIONAL BLOOD FLOW MODELLING

Jorge Mariscal Harana [1], Arna van Engelen [1], Torben Schneider [2], Mateusz Florkow [1,2], Peter Charlton [1], Bram Ruijsink [1], Hubrecht De Bliek [3], Israel Valverde [1], Marietta Carakida [1], Kuberan Pushparajah [1],