Artery Research

3.2: RESERVOIR PRESSURE INTEGRAL IS INDEPENDENTLY ASSOCIATED WITH THE REDUCTION IN RENAL FUNCTION IN AN OLDER POPULATION

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Introduction: Increased adiposity is associated with poorer left ventricular (LV) function but the mediating role of blood pressure (BP) and other cardiovascular measures is unknown. We investigated the roles of potential mediators in adolescents in a UK birth cohort, the Avon Longitudinal Study of Parents and Children.
Methods: Fat and lean mass were assessed by dual energy X-ray absorptiometry (DXA) in 2,068 individuals (age 17.7(SD 0.32) years; 45% male; weight 67(SD 13) kg). BP was measured and echocardiography performed. Tissue Doppler systolic (s'), early diastolic longitudinal function (e') and transmitral E/A were used as measures of LV systolic and diastolic function respectively. Mediation was estimated using structural equation modelling; height, sex, socioeconomic position, lean mass and smoking were included as potential confounders in all models.
Results: Table 1 shows the total and direct (total − indirect (mediated)) effects (standardized β) for each potential mediator, alongside %mediation. No convincing associations were found between fat mass and s' or e'.
Conclusions: MAP, HR and EDV, an indicator of preload, are important mediators of the effect of adiposity on diastolic function in adolescence, while TPR appears to account for none of the effect. Absence of mediation by PP, in combination with the mediation by TAC, suggests that stroke volume contributes some mediative effect. These findings emphasise the importance of adiposity and risk factor control in adolescence.

Table 1. Mediation of the association between fat mass and E/A

Mediator	Direct effect (standardized β)	Total effect (standardized β)	% mediation
None		-0.15 (95%CI -0.20, -0.10)	
Mean arterial pressure (MAP)	-0.11	-0.14	21
Pulse pressure (PP)	-0.13	-0.13	0
Heart rate (HR)	-0.11	-0.14	21
Total arterial elastance (TAE)	-0.15	-0.14	-7
Total peripheral resistance (TPR)	-0.15	-0.15	0
End-diastolic volume (EDV)	-0.17	-0.15	-13

Oral Session III — Clinical Aspects, Hypertension & Diabetes
3.1
STRAIN DISCONTINUITIES IN CAROTID ATHEROSCLEROTIC PLAQUES — A NOVEL MARKER FOR PLAQUE VULNERABILITY?

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Objective: Rupture of atherosclerotic plaques is ultimately a biomechanical event. We aim to develop and validate a novel method using ultrasound radiofrequency (RF) measurements to determine intraplaque inhomogeneities in the strain distribution with a high axial resolution which may identify rupture-prone plaques.
Methods: Ultrasound examinations were performed on CCAs and ICAs of 17 patients with recent stroke/TIA and 5 asymptomatic patients (39 CCAs and ICAs). Strain distribution was computed from RF data with a depth resolution <0.5 mm. In the plaque-free CCA, radial wall strain was compared with distension for validation. Two observers analyzed the data. In the ICAs, strain inhomogeneities in the plaque were studied.
Results: Within the CCA wall, the strain (observer 1: -7.4 ± 2.7%, observer 2: -6.4 ± 2.6%) had good intra-subject precision (1.6%), accuracy (correlation with relative distension, observer 1: r = 0.69; p < 0.0001, observer 2: r = 0.68; p < 0.0001) and intra-observer variability (ICC of 0.681). In the ICA, strain inhomogeneities demarcated in 58% of cases the plaque-adventitia boundary. The percentage of ICAs with ≥1 strain inhomogeneities was increasing with the degree of stenosis (p = 0.03, 95%-CI). Strain inhomogeneities were more frequent in ICAs at the symptomatic side of stroke/TIA (odd's-ratio = 4.7; p = 0.07). Strain in the deviating strain regions was higher at the symptomatic compared to the asymptomatic side (p = 0.02).
Conclusion: The proposed method to assess local radial strain distribution proved to be accurate and precise. In ICA, areas with high strain inhomogeneities were more frequent in symptomatic plaques vs asymptomatic

plaques. These strain inhomogeneities could be a promising novel marker for plaque vulnerability.
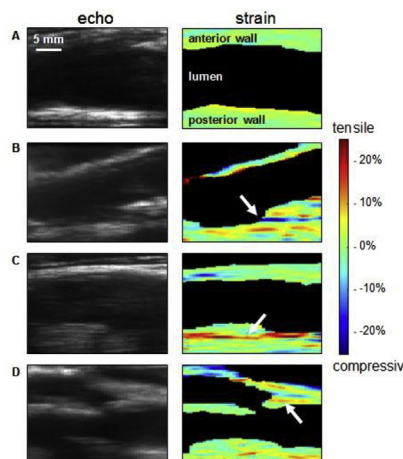

Figure 1. Examples of strain distribution in carotid plaques
Crude B-mode (echo, left panels) and corresponding strain distribution in the ICA (right panels); blood flow direction is from right to left. Note that in some cases the strain distribution is rather homogeneous (A), whereas in other cases a more heterogeneous distribution of strain is observed (B-D). Narrow but elongated regions with highly deviating strain (indicated by the white arrows) are often found near the boundary between the plaque and the supporting adventitia layer (B and D) and can appear either as diastolic-to-systolic wall compression (B) or as wall tension (C and D).

3.2
RESERVOIR PRESSURE INTEGRAL IS INDEPENDENTLY ASSOCIATED WITH THE REDUCTION IN RENAL FUNCTION IN AN OLDER POPULATION

Kunihiko Aizawa [1], Francesco Casanova [1], David M. Mawson [2], Kim M. Gooding [1], W. David Strain [1], Phillip E. Gates [1], Gerd Östling [3], Faisel Khan [4], Helen M. Colhoun [5], Carlo Palombo [6], Kim H. Parker [7], Jan Nilsson [3], Angela C. Shore [1], Alun D. Hughes [8]
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Background: Central haemodynamic parameters derived from reservoir pressure analysis (RPA-parameters) exhibit prognostic utility. Alterations in reservoir function could have an unfavourable influence on target organs, such as the kidneys. We determined in older adults whether these RPA-parameters would be associated with the reduction in estimated glomerular filtration rate (eGFR) during a 3-year follow-up period.
Methods: We studied 544 individuals (69.4 ± 7.9 yrs, 195F, 235CVD) at baseline and after 3 years. RPA-parameters including reservoir pressure integral (INTPR), peak reservoir pressure, excess pressure integral, systolic and diastolic rate constants were obtained by radial artery tonometry.
Results: After 3 years, 95 individuals (72.4 ± 7.6 yrs, 26F) had an eGFR reduction of more than 5 ml/min/1.73 m^2/year. A multivariate logistic regression analysis revealed that baseline INTPR was independently associated with the eGFR reduction after adjusting for conventional risk factors and baseline renal function [odds ratio 0.975 (95% CI, 0.958−0.993), p < 0.01]. When the eGFR reduction was expressed as a continuous variable, baseline INTPR was also independently associated with changes in eGFR (β = 0.115, *p* < 0.01; multivariate linear regression with adjustment for

conventional risk factors and baseline renal function). These associations remained unchanged after further adjustments for central artery stiffness or traditional central haemodynamic parameters. No other RPA-parameters exhibited significant associations.

Conclusions: These findings demonstrate that baseline INTPR is independently associated with the eGFR reduction in older adults, suggesting that INTPR may play a role in the functional decline of the kidneys.

3.3
ROLE OF ARTERIAL STIFFNESS AND BLOOD PRESSURE VARIABILITY IN THE DEFINITION OF SHATS (SYSTEMIC HEMODYNAMIC ATHEROTHROMBOTIC SYNDROME)

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Background: CV risk exponentially increases as the number of damaged organs increases The Systemic Hemodynamic Atherosclerotic Syndrome (SHATS) represents a novel conceptualization of the CV continuum focusing on simultaneous multi-organ alteration. This is the first study operationally defining SHATS and aimed at identifying its determinants.

Methods: Left Ventricular Hypertrophy (echocardiography), Common Carotid Artery plaque and increased thickness (ultrasound), and Chronic Kidney Disease (estimated Glomerular Filtration Rate) indexed selective target organ damage. SHATS was operationally defined as their simultaneous presence in a patient. PWV was measured by Sphygmocor® and BP variability by 24 h ABPM.

Results: SHATS affected 19.9% of the 367 studied subjects. Subjects with SHATS had a similar prevalence in diabetes mellitus, but a greater prevalence of very stiff artery (84.9 vs 64.3 %, p < 0.01) and use of antihypertensive medications. In the presence of similar office BP, SHATS was associated with higher 24 h SBP and lower 24 h DBP (a greater pulsatile pressure!), reduced nighttime SBP fall, and a twofold greater prevalence of reverse dipper status (48.2 vs 20.2 %, p < 0.001). BMI (positive correlation) and DBP (negative correlation) were the only traditional CV risk factors significantly associated with the odds of having SHATS. Very stiff artery and BP variability were significant independent determinants of SHATS, with highly predictive accuracy.

Conclusion: SHATS, the simultaneous damage of multiple target organs, may easily operationally defined. Very stiff artery and BP variability represent key factors for SHATS. The present results support the hypothesis of SHATS as a systemic condition, needing further characterization.

3.4
A CLINICAL SCORE TO PREDICT ELEVATED ARTERIAL STIFFNESS: DERIVATION AND VALIDATION IN 3,943 HYPERTENSIVE PATIENTS

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Purpose/Background/Objectives: Aortic stiffness assessed by carotid-femoral pulse wave velocity (PWV) is an important predictor to gauge the overall risk of hypertensive patients; nonetheless, it is underutilized in everyday practice. We derived a simple scoring system based on clinical variables that can identify patients with a priority for measurement of PWV, i.e. those with elevated PWV ($\geq$ 10 m/sec) and at higher risk for events.

Methods: Patient data from three outpatient clinics (n = 3,943) were used to form a derivation, internal and external validation cohort. For derivation, independent predictors of high PWV from a binary logistic regression model were dichotomized and implemented in a clinical prediction scoring system with the acronym SAGE (office systolic blood pressure $\geq$160 mmHg: 4 points,

age $\geq$ 60 years: 4 points, glycemia [blood glucose $\geq$126 mg/dl]: 1 point, eGFR $\leq$60: 2 points).

Results: Its performance was validated at the internal and external validation cohorts with c-statistics being 0.781 (95% CI: 0.753–0.808) and 0.718 (95% CI: 0.682–0.755) respectively (Figure 1). A cut-off of 5 points to identify patients with high PWV in the external validation cohort yielded a positive predictive value, negative predictive value, sensitivity and specificity of 60.7%, 84.8%, 51.9% and 78.3% respectively.

Conclusions: The SAGE score that takes into account easily measured clinical variables (systolic blood pressure, age, glucose and eGFR) can be used to predict elevated levels of PWV and prioritize its measurement in specific patients. Its use will result in greater acknowledgement of the role of aortic stiffness and aid physicians in implementing it in clinical practice.
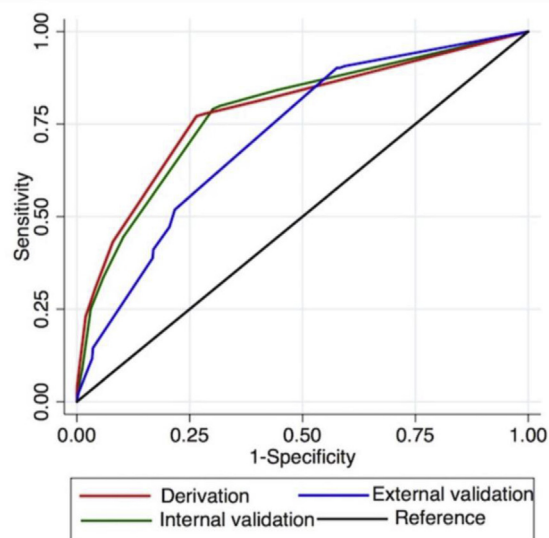
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3.5
CUFF BLOOD PRESSURE IS PROGRESSIVELY MORE BIASED WITH INCREASING AGE: INDIVIDUAL PARTICIPANT LEVEL ANALYSIS FROM THE INSPECT CONSORTIUM

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