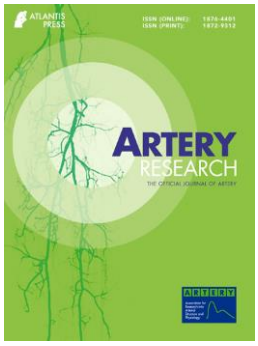

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P11.02: INFLAMMATION AND PRE-ATHEROSCLEROTIC VASCULAR CHANGES IN HEALTHY 5 YEAR OLD CHILDREN

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and Newtonian fluid and arterial wall assumed to be elastic, incompressible and isotropic. The governing equations were, continuity and Navier-Stokes equations for fluid domain and equilibrium equations and Hooke's Law for arterial wall. The flow was steady and motion was applied to the arterial wall. Simulations were carried out using the commercially availed finite element software. The effect of wall motion on flow patterns and wall shear stress, strain and effective stress distributions have been discussed. The results show that arterial wall motion doesn't change the magnitude of major hemodynamic factors and wall stress and strain distributions considerably and won't lead to aneurismal rupture directly, but obviously affects the blood flow patterns in cerebral aneurysms.

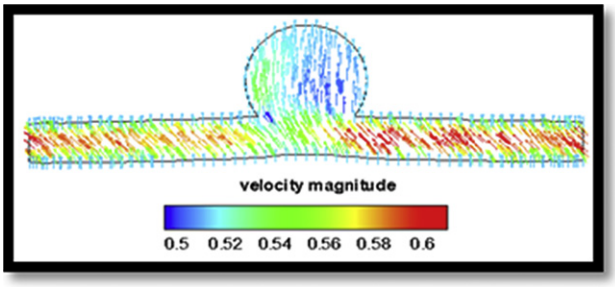

Figure 1 Velocity vectors in model with arterial wall motion

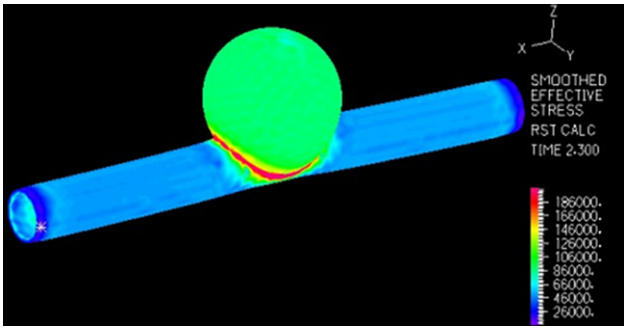

Figure 2 Effective stresses distribution in model with artery wall motion

P10.12
COMBINED B-MODE, ACOUSTIC RADIATION FORCE (ARF), AND DOPPLER REAL-TIME IMAGING SYSTEM FOR ASSESSING CARDIOVASCULAR MECHANICS AND BLOOD FLOW HEMODYNAMICS

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In efforts to monitor the progression of atherosclerosis using ultrasound, Acoustic Radiation Force Impulse (ARFI[1]) and Shear Wave Elasticity Imaging (SWEI[2]) have been implemented to measure the mechanical stiffness of vascular tissue while colorflow Doppler and spectral Doppler techniques have been used to monitor the associated blood flow hemodynamics.

Towards creating an imaging system capable of collecting both the mechanical and hemodynamic information within one acquisition, a series of combined Bmode/ARFI/Doppler imaging tools were developed. These tools acquire multiple frames of co-registered Bmode echogenicity, ARF induced on-axis displacements and transverse wave velocities, along with blood flow velocity estimates and wall-shear rate (WSR) at frame rates up to 20 Hz over several cardiac cycles. Implemented on a diagnostic ultrasound scanner connected to a laptop for off-line processing, the carotid arteries of patients with and without known carotid artery plaques were scanned.

Processed images were temporally and spatially stable across multiple frames and acquisitions. Cyclic variations across the cardiac cycle were observed, depicting increased vessel wall stiffness and increased WSR during systole compared to diastole. For combined Bmode/ARFI configurations, overall data acquisition and image processing frame rates of 1 Hz were achieved, enabling feedback during the exam. A series of acquired *in vivo* image sequences will be presented.

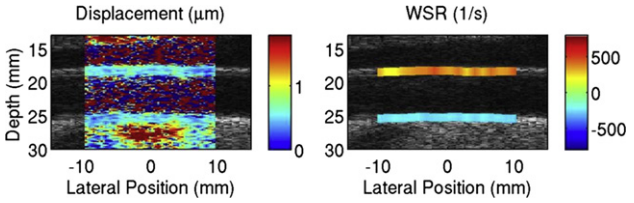

Figure 1 Co-registered ARFI displacement image (left) and WSR image (right) shown overlaid on a B-mode image obtained *in vivo* using a combined B-mode/ARFI/Doppler system.

[1]Nightingale et al. J. Acoust Soc Am. 110(1). 2001, 625-634.
[2]Sarvazyan et al. Ultrasound Med Biol. 24(9). 1998, 1419-1435.

P11 — Clinical Science 2

P11.01
AUGMENTED AORTIC FORWARD PRESSURE WAVE AMPLITUDE CONTRIBUTES TO INCREASED LEFT VENTRICULAR MASS IN OVERWEIGHT ADOLESCENTS

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We hypothesized that aortic forward pressure wave amplitude, which is determined by characteristic impedance (Zc) and peak flow in the proximal aorta, contributes to increased left ventricular (LV) mass observed in overweight (OW) adolescents. Aortic pulsatile hemodynamics were measured non-invasively in sixty healthy adolescents (age 14-19 yrs; 42% male) by sequential recordings of pulse waveforms via tonometry, brachial BP, and pulsed Doppler and diameter of aortic outflow tract using 2D echocardiography. LV structure and function was assessed by 2D echo. OW adolescents ($n=23$; age 16.0 ± 0.3 yrs; BMI $\geq 85^{th}$ percentile) had higher LV mass index (LVMI), brachial and carotid systolic BP and PP (all $P<0.05$), but not mean BP, carotid-femoral PWV or augmentation index compared with normal-weight (NW, $n=37$; 16.7 ± 0.3 yrs; BMI $<85^{th}$ percentile) ($P>0.05$). OW demonstrated lower resistance (Z0, 1512 ± 91 vs. 1786 ± 70 dyne x sec/cm^5) and higher Zc normalized to Z0 (0.13 ± 0.01 vs. 0.11 ± 0.01) and forward wave amplitude (Pf, 48 ± 3 vs. 40 ± 2, mmHg) compared with NW (all $P<0.05$). Adjusting for age and sex, LVMI correlated with brachial and carotid systolic BP and PP ($r=0.26$-0.30), Z0 ($r=-0.27$), Zc normalized for Z0 ($r=0.29$), and Pf ($r=0.32$) (all $P<0.05$). Stepwise multiple regression revealed that BMI ($\beta \pm$ SE; 0.69 ± 0.19; $R^2=0.26$) and Pf (0.23 ± 0.07; R^2 change $=0.11$) were the best predictors of LVMI (total $R^2=0.37$, $P<0.01$). These findings suggest that augmented Pf is a major hemodynamic determinant of increased LV mass with obesity in adolescents.

P11.02
INFLAMMATION AND PRE-ATHEROSCLEROTIC VASCULAR CHANGES IN HEALTHY 5 YEAR OLD CHILDREN

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Background: Inflammation is important in atherosclerosis development. Whether common causes of inflammation, like common infections and allergies, contribute to vascular changes already in childhood remains unknown.
Methods: In the first 345 five-year-olds of the WHISTLER birth cohort, carotid intima media thickness (CIMT), distensibility and Elastic Modulus (EM) were obtained ultrasonographically. Information on primary health care consumption for infections and allergies was obtained from the general practitioners' electronic files. Moreover, parental history of allergies was collected.
Results: Neither lifetime nor recent consultations for infections, nor the number of visits for more severe infections was associated with vascular measures (adjusted for age, gender, BMI, parental smoking, gestational age, infant feeding and allergies). Lifetime prescription of antibiotics was not related to vasculature, but antibiotic prescription in the last 3 months was associated with a 18.1 μm increased CIMT (95%-confidence interval (CI): 1.2 — 35.1).

Children for whom primary care consultation for allergic disease had been sought, had a 14.9 μm (95%CI: 5.3 — 24.4) higher CIMT compared to children without allergies (adjusted for age, gender, parental smoking, gestational age, infant feeding and infections). Lifetime anti-histamine prescription was associated with a 11.7 MPa^{-1} (95%CI: -20.9 - -2.5) lower distensibility and a 23.4 kPa (95% CI: 6.9 — 39.9) higher EM. Recent anti-histamine prescription was associated with a 30.2 μm (95%CI: 10.2 — 50.2) higher CIMT. A positive parental allergy history was associated with a 8.4 μm (95%CI: 1.3 — 15.6) higher CIMT per allergic parent.
Conclusion: Allergies are associated with pre-atherosclerotic vascular changes in healthy young children.

P11.03
AORTIC STIFFNESS INDICES IN FIRST-EVER AND RECURRENT ISCHEMIC STROKE — A PRELIMINARY REPORT

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Background: Patients with acute ischemic stroke have higher aortic stiffness estimated by carotid-femoral pulse wave velocity (CF-PWV) and central augmentation index (cAIx) than control hypertensives. Whether CF-PWV and cAIx may distinguish patients with first-ever (FES) from those with recurrent ischemic stroke (RS) is unknown.
The aim of the study was to evaluate CF-PWV and cAIx in patients with the FES and RS as compared to control hypertensives, and to evaluate the relationship between these indexes and other clinical variables.
Methods: We studied 113 patients (82 males, 62.9±12.7yrs) with acute ischemic stroke, including 17 subjects with RS (13 males, 67.6±10.8yrs) and 71 controls (52 males, age 62.7±12.6yrs).CF-PWV, and cAIx were measured (SphygmoCor®) one week after stroke onset. Data were analysed with multivariate analysis.
Results: The mean CF-PWV was significantly higher in both RS and FES than in controls (12.5±3.5 vs. 8.6±1.3m/s, $P<0.00001$, and 10.2±2.8 vs. 8.6±1.3m/s, $P=0.004$ respectively). Moreover, the mean CF-PWV was significantly higher in RS compared to FES (12.5±3.5 vs. 10.0±2.8m/s, $P=0.01$). cAIx in RS (32.3±14.3mmHg) was similar to that in FES (28.5±11.7mmHg, $P=0.49$), but it was significantly higher compared to controls (25.2±10.3mmHg, $P=0.02$). In multivariate logistic regression analysis, higher CF-PWV remained significant after adjustment for age, SBP or HR, separately (Table).

Model	OR	95% CI	P value
Model 1 ($R^2=0.02$)			
Age	1.01	0.96 — 1.07	0.65
CF-PWV	1.23	1.01 — 1.50	0.04
Model 2 ($R^2=0.12$)			
SBP	0.97	0.93 — 1.01	0.1
CF-PWV	1.45	1.12 — 1.89	0.005
Model 3 ($R^2=0.08$)			
HR	1.01	0.96 — 1.06	0.75
CF-PWV	1.24	1.04 — 1.47	0.02

Conclusion: CF-PWV is higher in patients with recurrent stroke than in those with first-ever event independently of age and BP levels. These findings suggest that aortic stiffness might be implicated in progression of cerebrovascular disease in post-stroke patients.

P11.04
AORTIC AND VISCERAL FAT INFLAMMATION DETECTED BY POSITRON EMISSION TOMOGRAPHY/COMPUTED TOMOGRAPHY (PET/CT) DOES NOT CORRELATE WITH ARTERIAL STIFFNESS IN PATIENTS WITH A HISTORY OF CARDIOVASCULAR DISEASE

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Background: Arterial and systemic inflammation are associated with increased arterial stiffness in several patient groups. Visceral fat has been shown to contain inflammatory cells and is associated with increased cardiovascular risk. In this study we sought to investigate whether the degree of arterial and visceral fat inflammation correlated with arterial stiffness.
Methods: 46 patients with a history of atherosclerotic disease were imaged using fluoro-deoxyglucose positron emission tomography (FDG-PET) with CT co-registration. Uptake of FDG, directly reflects metabolic activity and is shown to correlate with macrophage activity. Tracer uptake was analysed in various arterial segments and visceral fat by measuring maximum standard uptake values (SUV). Arterial stiffness was determined by pulse wave velocity (PWV) using the Sphygmacor™ system. Pulse wave analysis was used to determine central blood pressure.
Results: There was no correlation between aortic PWV and ascending aortic SUV ($r=0.003$, $p=0.99$). Aortic PWV also did not correlate with visceral fat SUV ($r=0.09$, $p=0.57$) or abdominal aortic SUV ($r=0.058$, $p=0.844$). These values remained unchanged with arterial SUV blood correction. There was also no correlation between central blood pressure and aortic inflammation ($r=0.07$, $p=0.64$).
Conclusions: There was no relationship between FDG uptake, a surrogate of inflammation, in the aorta and within visceral fat, and aortic pulse wave velocity in patients with known cardiovascular disease.

P11.05
ABDOMINAL AORTIC ANEURYSMS EXHIBIT GREATER METABOLIC ACTIVITY DETECTED BY POSITRON EMISSION TOMOGRAPHY/COMPUTED TOMOGRAPHY (PET/CT) COMPARED TO MATCHED CONTROLS

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[2]*Cambridge Universities Hospital NHS Trust, Cambridge, United Kingdom*

Background: Chronic inflammation is a hallmark characteristic in the pathophysiology of abdominal aortic aneurysms (AAA) and atherosclerosis. These two conditions also share a number of risk factors; however it is thought that their pathophysiologies are different. In this study we sought to prospectively investigate whether there was a greater degree of inflammation in the aortas of AAA patients compared to matched controls with atherosclerosis.
Methods: The aortas of 20 patients with infra-renal AAA and 20 age, sex and risk factor-matched controls with atherosclerotic disease were imaged using fluoro-deoxyglucose positron emission tomography (FDG-PET) with CT co-registration. Uptake of tracer directly reflects metabolic activity and has been shown to correlate with macrophage activity. Tracer uptake was analysed in various arterial segments by measuring maximum standard uptake values (SUV). Inflammatory biomarkers, including hsCRP, were also measured.
Results: The mean aneurysm diameter was 44mm (SD+/-9mm). Patients with AAA had higher uptake of FDG in the abdominal aorta compared with controls (SUV 2.19 vs. 1.99, $p=0.02$). The greatest uptake was seen in the aneurysmal sac (mean SUV 2.28 +/-0.55). AAA patients also had a higher level of serum inflammatory markers (hsCRP 2.76 vs. 1.74mg/L, $p=0.03$).
Conclusions: This study demonstrates there is greater in-vivo metabolic activity in patients with AAA. This suggests there is higher inflammatory cell load within the aortic wall in patients with AAA as reflected by higher levels of FDG uptake. This highlights the importance of targeting inflammation as a therapeutic strategy.

P11.06
COUPLING OF LEFT VENTRICULAR TWIST MECHANICS AND CENTRAL AUGMENTATION INDEX IN HEALTHY INDIVIDUALS

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Objectives: To explore the influence of aerobic fitness ($VO_{2\ max}$) on the relationship between left ventricular (LV) twist and vascular augmentation index (AIx) in young healthy individuals.
Background: Systolic LV twist and central vascular wave reflection (AIx) likely interact, however, the relationship between LV twist and AIx is not known. We hypothesised that the lower LV twist previously shown in endurance athletes with high $VO_{2\ max}$ would be associated with a lower AIx.
Methods: 28 healthy males (21±2 yrs) were split into a moderate and high aerobic fitness group ($VO_{2\ max}$: 49.0±4.9 and 62.7±6.8 ml/kg/min, respectively, $p<0.0001$). Heart rate, blood pressure, LV twist and AIx were assessed at rest and during exercise (40% of peak power). Differences in dependent