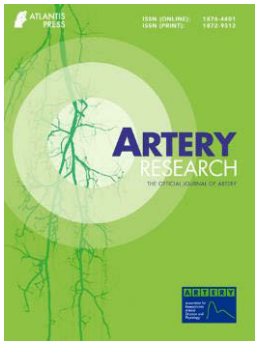

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P3.18: SHEAR WAVE ELASTOGRAPHY ASSESSMENT OF CAROTID ARTERY PLAQUE – HISTOLOGY FINDINGS

S. Nduwayo, R.B. Panerai, K.V. Ramnarine, A.R. Naylor, T.G. Robinson, K. West

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levels of TKE are undesirable, as the increased fluctuations removes energy from the mean flow.
Surgery was performed to widen the coarctation and catheter measurements showed a decrease in pressure drop, which resulted in an increased flow rate. As a consequence of the increased flow, the local Reynolds number also increased. The results from the CFD-simulations confirmed the pressure drop, but also showed that for the post-surgery model TKE levels increased at peak systole in the immediate downstream region of the coarctation.
The relationship between pressure drop, flow rate, coarctation diameter and Reynolds number is non-linear, and if both the flow rate and coarctation diameter increase as an outcome of surgery, the local Reynolds number may also increase. This, in turn, can result in an elevation of TKE levels after surgery.

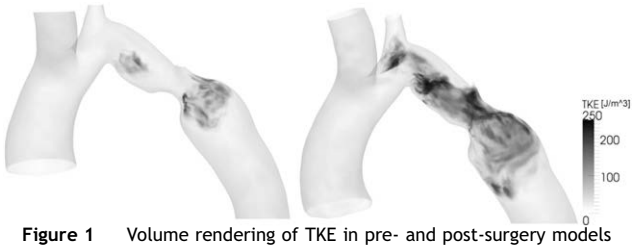

Figure 1 Volume rendering of TKE in pre- and post-surgery models

P3.16
EFFECTS OF SYMPATHETIC BLOCKADE ON PRESSURE DEPENDENT ABDOMINAL AORTIC STIFFNESS IN THE SPONTANEOUSLY HYPERTENSIVE RAT

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Background: Increased sympathetic nerve activity (SNA) is associated with development of hypertension in spontaneously hypertensive rats (SHR). Elevated SNA increases arteriolar smooth muscle tone affecting peripheral resistance, however, the effect on large arteries is not well established. This study aimed to assesses the effect of SNA on aortic stiffness in SHR using sympathetic blockade at different values of mean arterial pressure (MAP).
Methods: SHR of 10-15 weeks (n=15) were anaesthetized (urethane 1.3g/kg/ml) and ventilated. Aortic blood pressure and pulse wave velocity (PWV) were measured by two high fidelity catheter-tip pressure transducers in the abdominal aorta via the carotid and femoral arteries. Aortic diameters were measured using ultrasound (6.2 MHz) with vessel tracking software (ArtLab, Esaote). Aortic compliance was calculated from diameter and pressure signals. Measurements were taken at low (70 mmHg), intermediate (140 mmHg) and high (170 mmHg) values of basal MAP and following sympathetic blockade with hexamathonium (i.v 20mg/kg). Arterial pressure was varied by bolus injection of phenylephrine (i.v 30μg/kg).
Results: Increase in MAP was associated with increase in arterial stiffness indices. Following sympathetic blockade, there was a trend for reduction in compliance associated with a significant increase in pulse pressure at low MAP. There was no significant difference in parameters at other values of MAP.

MAP (mmHg)	Parameter	Control	Hex.	Difference %	P-value
70	C (ml/mmHg)	7.1 ± 1.6	6.2 ± 1.7	14.5	0.07
	PP (mmHg)	38.1 ± 5.6	42.3 ± 7.6	-9.9	0.03 *
	PWV (m/s)	2.9 ± 1.2	2.8 ± 1.1	3.6	0.14
140	C (ml/mmHg)	3.4 ± 1.0	3.3 ± 0.7	3.0	0.55
	PP (mmHg)	53.8 ± 4.8	54.8 ± 6.5	-1.8	0.43
	PWV (m/s)	5.3 ± 1.0	5.5 ± 1.0	-3.6	0.08
170	C (ml/mmHg)	2.0 ± 0.5	2.2 ± 0.4	-9.1	0.16
	PP (mmHg)	72.4±10.9	71.7±11.5	1.0	0.88
	PWV (m/s)	6.5 ± 1.3	7.0 ± 1.5	-7.14	0.13

C: compliance; PP: pulse pressure; PWV: pulse wave velocity; Hex: hexamathomium;

Conclusions: These data suggest that sympathetic blockade can potentiate a stiffening effect in the abdominal aorta at low MAP in the SHR. This may be due to reduction of smooth muscle tone transferring the load from elastin to collagen in the vessel wall.

P3.17
WALL TRACKING FOR THE ASSESSMENT OF AORTIC DISTENSIBILITY DURING A FOLLOW UP OF 49 DAYS IN ANGIOTENSIN II-INFUSED APOE-/- MICE

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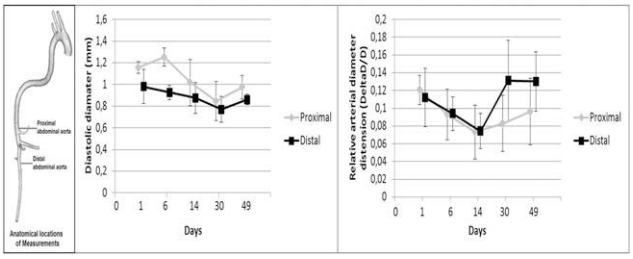
Introduction: Ultrasound wall tracking allows assessing the distension of superficial arteries. While the technique is well established in humans, wall tracking is challenging in mice due to the smaller size of the arteries. The aim of this study was to assess the feasibility of sequential distension measurements on the aorta of an aortic aneurysm mouse model.
Methods: In-house bred male ApoE -/- mice were implanted an osmotic pump filled with Angiotensin II. Ultrasound data were obtained with a high-frequency ultrasound apparatus equipped with a linear array probe. All measurements were performed by a single operator. M-mode images of proximal and distal abdominal aorta were obtained in 5 animals on day 1, 6, 14, 30 and 49. Dedicated software was employed for wall tracking using stored demodulated Radio Frequency (RF) data. Resulting curves were processed to calculate the diastolic diameter and the relative (DeltaD/D) arterial diameter distension.
Results: Proximal abdominal aorta diastolic diameter presented higher values than distal abdominal aorta, as expected. However, diameter values in both locations decreased through time, reaching a minimum at day 30. DeltaD/D progressively decreased from baseline until day 14 in both locations, after which values increased to near baseline levels at day 49.
Conclusion: RF-based Vessel wall tracking of the abdominal aorta in an aneurysmatic mouse model is feasible. Our data suggest an initial narrowing and stiffening of the abdominal aorta up to day 14, followed by an increase in diameter and distensibility, a phenomenon that is possibly due to Angiotensin II-induced smooth muscle contraction.



P3.18
SHEAR WAVE ELASTOGRAPHY ASSESSMENT OF CAROTID ARTERY PLAQUE — HISTOLOGY FINDINGS

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Introduction: Carotid atherosclerosis is a risk factor for ischaemic stroke. There is increasing interest in identifying and characterising high-risk unstable carotid plaques. Shear wave elastography (SWE) imaging is a new method of quantifying tissue stiffness with potential to provide additional information to help identify the unstable plaque and improve patient selection for surgical treatment. We evaluate this technique in assessing stiffness of carotid artery plaques by correlating histology findings to Young's modulus (YM) measured using SWE.
Method: 5 symptomatic patients undergoing carotid endarterectomy were recruited into the study. Prior to surgery, each patient underwent carotid ultrasound scan using SWE and B-mode. A longitudinal section of the carotid plaque was imaged. The YM of the plaques was compared to echogenicity and histological classification based on stability of the excised plaque.

Results: All patient presented with >80% stenosis in either of the internal carotid arteries. Mean YM was 108 (52-195) kPa. All five plaques varied in echogenicity classification. On histology, 2 plaques were 'probably or definitely' unstable and 2 were probably stable (Fig.1). There was better correlation between YM and histology finding compared to echogenicity.
Conclusion: This present insight into the role of novel ultrasonic based technique in providing further information in characterising carotid plaque properties which may be of value in identifying vulnerable plaques.

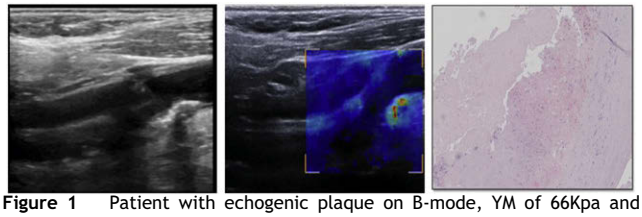

Figure 1 Patient with echogenic plaque on B-mode, YM of 66Kpa and histology classification of definitely unstable.

P3.19
ALTERED WSS IN THE HUMAN AORTA WITH AGE — IMPLICATIONS FOR WALL REMODELLING AND LESIONS?

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Arteries are continuously affected by pulsating blood flow resulting in a wall shear stress (WSS) load. WSS has been related both to the remodeling process in the arterial walls as well as atherosclerosis. These processes are both related to ageing.
10 young (23.5±1.4 years, BMI 21.8±1.4) and 8 old (58.0±2.8 years, BMI 24.0±2.3) subjects were studied. Computational fluid dynamics (CFD) together with magnetic resonance imaging (MRI) measurements were used to investigate the WSS in the healthy thoracic aorta (TA). MRI images (geometry and flow) were obtained and segmented to fit the CFD simulations. Time averaged WSS (TAWSS) and oscillating shear index (OSI) were extracted. In young and old subjects, the diameter of the descending TA was 26±2.2 mm vs. 36±3.7 mm ($p<0.001$), and cardiac output (CO) 6.75±1.04 L/min vs. 4.17±0.90 L/min ($p<0.001$). In the whole TA, the TAWSS in the old was lower than in the young, while OSI only showed small differences. Fig 1a and b show reduced TAWSS with age in a cross-section of TA, and to some extent also in OSI.
Conclusions: WSS show distinct age-related changes with a major reduction in TAWSS, while OSI show only minor changes. This is associated with an increase in aortic diameter as well as decrease in CO. The distinct WSS-alterations could be a contributing factor both to the remodeling and atherosclerosis process over age.

Figure 1a cross-section location.

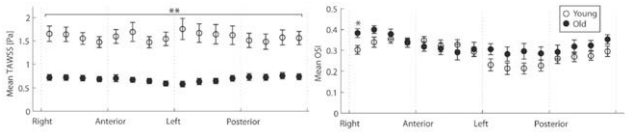

Figure 1b TAWSS and OSI distribution between the young and old subjects at a cross-section of the descending aorta (±SEM). Significance is indicated by * and ** ($p < 0.05$ and $p < 0.01$, respectively).

P3.20
ESTROGENS REGULATE ENDOTHELIAL NITRIC OXIDE PRODUCTION IN RATS ARTERIES DURING EARLY POSTNATAL PERIOD

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During maturation the vascular system undergoes structural and functional changes. Earlier we showed that endothelium of 1-2-week-old rats exerts an anticontractile effect due to tonic nitric oxide (NO) production which correlates with a higher eNOS expression level compared to adults. Estrogens are powerful regulators of eNOS expression and activity in arterial endothelium. This study tested the hypothesis that anticontractile effect of endothelium in young rats is associated with the influence of endogenous estrogens.
From the 2nd postnatal day male Wistar rats were daily treated with estrogen receptor blocker ICI182,780 (1 mg/kg/day, s.c.), age-matched control pups were treated with vehicle. On 10-12 postnatal days saphenous artery was isolated for measuring the levels of eNOS and aromatase mRNA expression (qRT-PCR) and contractions to methoxamine ($alpha_1$-adrenoceptor agonist) before and after eNOS inhibition (wire myograph, DMT A/S, Denmark).
Serum estradiol concentration (ELISA) in young rats was 20% higher than in adults. mRNA expression levels of eNOS and aromatase, the key enzyme of estradiol synthesis, in pup arteries were much higher than in adults. Importantly, chronic ICI182,780 treatment reduced the impact of endothelium on methoxamine-induced contraction: eNOS inhibitor L-NNA had small effect in "ICI" group, but strongly potentiated the contraction in control. mRNA expression level of eNOS in ICI-treated group tended to be lower compared to control.
Our results suggest that estrogens (both blood-delivered and locally produced in the arterial wall) are important determinants of endothelial secretion in postnatal rats. Effects of estrogens lead to tonic NO production which weakens arteries responses to contractile influences.

P3.21
CONDUCTANCE AND CAPACITANCE EFFECTS OF ACUTE, ELECTRICAL, CAROTID BAROREFLEX STIMULATION

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Introduction: Chronic baroreflex activation is a therapy for resistant hypertension and has potential as a therapy in heart failure.
We hypothesized that acute baroreflex activation therapy (CVRx, Inc.) would increase both the capacity of the abdominal venous circulation (lowering "preload") and aortic conductance (reducing "afterload").
Methods: Six 20-kg mongrel dogs were anaesthetized and ventilated. Arterial blood pressure (BP) and diaphragmatic aortic and caval flow (ultrasonic) were measured. Venous capacity changes were evaluated using a modified Brooksby-Donald technique*. A CVRx electrode was affixed to the right carotid sinus.
BP and flow data were collected under control conditions and during device activation and drug infusions. Angiotensin II (ANG II) was infused to raise BP to hypertensive levels; the current from the device was then increased.
Results: Device activation decreased mean aortic BP 22.5±1.3 mmHg, decreased heart rate 14.7±3.4% and cardiac output 10.8±3.9%, increased aortic conductance 16.2±4.9%, and increased abdominal blood volume at a rate of 2.2±0.6 mL/kg/min (5-minute activations). ANG II infusion increased BP 40.3±3.4 mmHg and reduced venous capacitance at a rate of 1.1±0.5 mL/kg/min. Subsequent electrical stimulation restored BP to baseline while aortic conductance only returned to 82.3±3.3% of control. Venous capacitance increased at a rate of 3.4±0.7 mL/kg/min, reversing the ANG II effects.
Conclusions: Acute electrical activation of the carotid baroreflex increases arterial conductance, decreases BP, and increases venous capacitance.