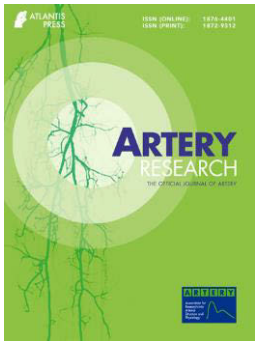

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P2.15: A COMPARISON OF SHEAR STRESS ESTIMATES IN THE COMMON CAROTID ARTERY IN HYPERTENSIVES

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Results: The overall mean (±SD) difference between cSBP and SBP_2 calibrated using the Omron 750IT was 1.4±11.8 mmHg. When SBP_2 was calibrated from aortic MAP and DBP the difference between cSBP and SBP_2 was -1.1±5.6 mmHg.
Conclusion: These results suggest non-invasive calibration does not produce a major systematic error in estimation of cSBP from SBP_2 but does introduce greater variability when compared to invasive calibration.

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P2.15
A COMPARISON OF SHEAR STRESS ESTIMATES IN THE COMMON CAROTID ARTERY IN HYPERTENSIVES

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Shear stress (SS) is associated with the formation of localised atherosclerosis. Due to the complexities of flow accurate determination of shear stress is difficult. Whilst 2D methods of deriving SS are widely used, computational fluid dynamic (CFD) modelling allows modelling of flow within complex geometry of the carotid bifurcation (CB).
This study compared mean SS using ultrasound based Womersley's solution and MRI based CFD.
9 untreated hypertensive subjects [median age 42 (range 35-52) yrs] in a double-blind, placebo controlled, randomised, 3 way crossover trial using amlodipine or lisinopril underwent ultrasound examination of the right common carotid (CC) using a 7.5 MHz ultrasound transducer (L12-5 scan-head, HDI 5000, ATL, Bothell, Washington). Pulse wave Doppler was performed using a 1.5mm sample volume placed in the centre of CC 2cm proximal from the carotid bulb. Mean Womersley shear stress was calculated from these data using custom written software.
MRI of the CB was performed (Siemens Magnetom Sonata 1.5 T scanner) using a 2D TOF protocol and 3D PC sequence for flow measurements. These data were combined with custom refined CFD codes (CFX4.4 (AEA Technology, Didcot, Oxfordshire UK).
Mean difference was -0.242 Pa (SD 0.314; 95% limits of agreement -0.856, 0.373]; Lin's concordance correlation coefficient (rho_c 0.16; SE 0.13; $p = 0.21$); Pearson's $r = 0.244$; $p = 0.219$.
Overall the data indicate poor agreement between WSS measured by ultrasound/Womersley and MRI/CFD and underscore the limits of using 2D methods in the investigation of the relationship between SS and atherosclerosis in the CC.

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P2.16
PRESSURE PROFILE ANALYSIS AT HEMODIALYSIS NEEDLE: A NEW METHOD FOR EARLY DETECTION OF VASCULAR ACCESS STENOSES

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Hemodialysis vascular access stenosis remains a frequent complication. However; early detection is challenging and costly. The aim of this in-vitro study was to assess the value of a new detection method based on pressure profile analysis at the hemodialysis needle.
A silicon model of a radio-cephalic arteriovenous fistula was built (4mm artery connected by an end-to-side anastomosis with a 7mm vein). A water-glycerine mixture was used as blood mimicking fluid. Pressure profiles were measured at the arterial hemodialysis needle (4cm downstream the anastomosis) and in the feeding artery 20cm upstream the anastomosis. Stenoses (50% diameter reduction) were created 10cm upstream the anastomosis (proximal artery (PA)) and 3.5cm and 8cm downstream the arterial needle (distal vein (DV) and proximal vein (PV) respectively). The pulse pressure (maximum minus minimum) at the needle was divided by the pulse pressure at the feeding artery to obtain a dimensionless ratio, %PP. Experiments were conducted at different blood flow (500 to 1200 ml/min) and heart rates (60 to 90 beats/minute) to test this new index over a wide range of hemodynamic conditions.
In the control model (no stenosis), %PP was 20.26±4.55%. PA stenosis significantly decreased %PP to 7.69±2.08% ($P<0.001$), while presence of stenosis in the distal (36.20±2.12%) and proximal (32.38±2.17%) vein lead to significantly higher values of %PP ($P<0.001$).
This in vitro study shows that the analysis of the pressure profile at the dialysis needle is useful for early detection and localization of hemodialysis vascular access stenosis, independent of heart rate and flow level.

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P2.17
ASSESSMENT OF THE BRACHIAL ARTERY FLOW-MEDIATED DILATION WITHOUT ECG GATING

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The methods commonly used for non-invasive ultrasound assessment of endothelium-dependent Flow-Mediated Dilation (FMD) require an ECG signal in order to synchronize the measurement with the cardiac cycle. In this study we present a method for assessing FMD which does not require ECG gating. The approach is based on filtering of the diameter-time curve, which is obtained by means of a B-mode image processing system. Since diameter changes due to vasodilation/vasoconstriction mechanisms and diameter changes induced by the cardiac cycle happen at different frequencies (fractions of Hz for the former; more than 1 Hz for the latter), frequency filtering was used to separate the two components and obtain only the desired information.
The method was tested on 22 healthy volunteers without cardiovascular risk factors and the measurements obtained with the proposed approach were compared with those obtained with ECG gating. Diameter values computed with the new method were very similar to those obtained with ECG gating (3.90±0.75mm and 3.88±0.75mm respectively). %FMD values obtained with the two methods were compared with Bland Altman plot: the bias was negligible (0.02%) and the SD of the difference was 0.24%, a value which is largely acceptable for this measurement.
In conclusion, the new method showed a good agreement with ECG gated measurements. Moreover, since it is based on a larger number of measurements, it provided a higher precision. Further advantages were also found both in terms of reliability of the measure and simplification of the instrumentation.

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P2.18
NON INVASIVE MEASUREMENT OF ENDOTHELIAL DYSFUNCTION BY DIGITAL VOLUME PULSE ANALYSIS TECHNIQUE: APPLICATION & UTILITY IN CLINICAL PRACTICE

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Background: The assessment of endothelial function has been accepted as an independent surrogate marker of cardiovascular disease (CVD), having both positive prognostic and diagnostic implications. The Digital Volume Pulse (DVP) analysis technique is a non—invasive approach to derive endothelial function. However, the utility and clinical application of this analysis technique has not been established.
Methods: we determined the discriminatory performance of the DVP analysis technique in identifying the people with established risk indices compared to a healthy population (West Midlands of the UK). Endothelial dependent and independent vessel function (Δ RI) was calculated by analyzing the change in digital pulse wave forms obtained by DVP photoplethysmography technique(Micro Medicals)
Results: Of our cohort of ($n=225$) (60.1% male; mean age 53.7 (SE 1.5) years), 155 had established CVD risk factors and had significantly ($P<0.001$) impaired endothelial function (Δ RI% (SE) [Diabetes : 4.6%(0.3), Hypertension: 6.9(0.6), hypercholesteremia 6.4(0.6)] compared to healthy controls [10.5(0.5)]. On univariate analysis, endothelial function was strongly associated with glycaemic status (R:-0.38, $P= <0.001$) In multivariate analysis, after adjusting for age and other risk factors, glycaemic status independently predicted endothelial function (Beta: -2.32(95% CI:-4.36—0.03), $P=0.04$) In ROC analysis Δ RI was a better discriminator (AUC(SE): 0.7(0.06) compared to individual CVD risk factors such as mean blood pressure, wait hip ratio and total serum cholesterol level.
Conclusion: Measurement of endothelial function by DVP analysis technique provides a non- invasive method of measuring endothelial function in clinical practice for the discrimination of people with established risk factors and may aid more precise cardiovascular risk stratification.

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