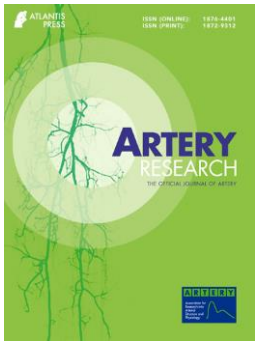

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P2.22: ASSESSMENT OF CAROTID PULSE WAVE VELOCITY CHANGES OVER CARDIAC CYCLE: AN ACCELEROMETRIC APPROACH

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Comparison between MRI aPWV (mean: 4.78±1.41 m/s) values and cfPWV (mean: 7.76±0.90 m/s) values showed a good correlation (R^2=0.73). MRI cPWV (mean 1.99±0.74 m/s) values were positively correlated (R^2=0.90) with CS (mean: 4.88±0.86 m/s) values and showed a lower correlation with cfPWV ones (R^2=0.14).
In conclusion, this preliminary study shows a multi-technique approach for regional and local PWV calculation aimed to realize a reference database that could be used when developing and validating new algorithms and techniques for PWV evaluation.

P2.22
ASSESSMENT OF CAROTID PULSE WAVE VELOCITY CHANGES OVER CARDIAC CYCLE: AN ACCELEROMETRIC APPROACH

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Great attention has been placed on the role of carotid elasticity in cardiovascular risk evaluation. Since carotid pulse wave velocity (cPWV) value changes over cardiac cycle, non-invasive cPWV measurements at different cardiac cycle moments could be helpful for a full characterization of vascular behaviour. Aim of this study is to test a new accelerometric system for cPWV assessment able to estimate three different cPWV values. Moreover, preliminary results regarding their comparison with ultrasound carotid stiffness (CS) evaluation are presented.
Twelve healthy subjects (33.4±7.2 years, 50% males, BMI 22.7±3.5 kg/m^2) have been recruited. CS values were obtained from ultrasound B-mode images analysed by contour tracking techniques together with tonometric local pulse pressure estimation and Bramwhell-Hill equation. A small device, with two percutaneous accelerometers (distance: 2.4 cm) placed on a soft bracket allowed to vibrate freely, was put on the neck of each subject. Temporal shifts between the two accelerometric signals were assessed on beat-to-beat temporal basis with correlation techniques. These temporal values allowed cPWV assessment for the whole cycle (allcPWV), diastolic (dcPWV) and dicrotic notch (dncPWV) phase.
Accelerometic allcPWV (3.81±0.70 m/s) values showed a good correlation with CS measurements (r=0.41) while dcPWV (3.26±0.97 m/s) and dncPWV (3.74±0.59 m/s) where less correlated with them (r=-0.17 and r=0.04 respectively). As we could expect dcPWV values were smaller than dncPWV ones.
In conclusion, the proposed system is easy-to-use and it could be useful for the evaluation of cPWV values characterizing the entire cardiac cycle, as well as diastolic and dicrotic notch phases.

P2.23
NONLINEAR ARTERIAL PROPERTIES: PRESSURE-INDEPENDENT CHARACTERIZATION

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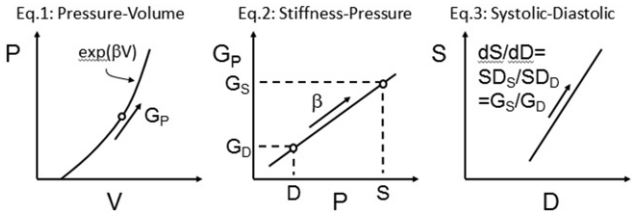
The pressure-volume relationship in real arteries is nonlinear. As a result, stiffness is pressure-dependent. Hereby, I propose a model-based pressure-independent and measurable characterization for such arteries. Literature shows that under normal conditions arterial pressure P, as measured in vitro or in vivo at the systolic pressure (S) and diastolic pressure (D), increases exponentially with the absolute or relative arterial volume V, lumen area or diameter (Eq.1&Figure). The *pressure-independent* exponent β ('stiffness constant') has diagnostic and prognostic significance. Defining arterial stiffness G_P by dP/dV, Eq.1 shows that G_P equals to βP plus a constant (Eq.2&Figure). Thus, β expresses the stiffness change per 1mmHg increase of pressure. Eq.2 predicts a linear relationship between repeatedly measured S and D, (Eq.3&Figure). Eq.2 shows that the change in S per 1mmHg increase in D ('dS/dD') is the mean relative increase in arterial stiffness during the systole G_S/G_D (Eq.3&Figure), i.e. 'stiffening', where dS/dD=1 for elastic arteries. The statistical estimate of dS/dD is given by SD_S/SD_D, where SD is the standard deviation (Figure). Using 24hABP data of 1,247 hypertensive patients (age 57±26 and 50% males) Eq.3 was confirmed with r=0.76±0.14 and dS/dD=1.4±0.3 with 90% of values in the range 1.0-2.0. Eq.2 was confirmed by Schillaci et al 2011 by measuring the diastolic pulse wave velocity (PWV_D) at different arm positions (since $G_D \sim PWV_D^2$), and Eq.3 was used to determine the systolic PWV or G_S. In conclusion, nonlinear arterial properties are strongly expressed during the cardiac cycle. Its modelling may be useful in interpreting stiffness measured by different methods.



P2.24
SEMI-INVASIVE CARDIAC OUTPUT MEASUREMENT BASED ON PULSE CONTOUR ANALYSIS: A REVIEW AND META-ANALYSIS

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Background: Different methods and several devices exist for measuring cardiac output by minimal invasive techniques, all based on arterial pulse contour analysis (FloTrac®/Vigileo®, Edwards Lifesciences; PiCCO®, Pulsion Medical Systems; LiDCO®/PulseCO®, LiDCO Ltd; PRAM/Mostcare, FIAB SpA; Modelflow®, Finapres Medical Systems). However, their measurement accuracy, especially during changing patient conditions, remains under discussion. The underlying CO measurement methods and their limitations will be presented in detail and the results of recent comparative studies between these devices and the "gold standard", pulmonary artery catheter thermodilution (PAC TD), will be discussed.
Methods: Prospective studies and available reviews on the comparison of the pulse contour approach with the established PAC TD technique were enclosed in our meta-analysis. As far as available, the relevant results (data for the range of cardiac output, bias, percentage error) and the software versions used were included.
Results: Studies comparing the available systems for CO measurement have been performed in a variety of clinical settings. For instance, out of 53 analysed studies of CO determination by arterial pulse contour analysis, the majority shows acceptable accuracy during stable hemodynamic conditions. However, the studies under varying hemodynamic situations (vasoactive drug administration, loss of fluids etc). demonstrate insufficient accuracy (with percentage errors exceeding the 30% limit as suggested by Critchley&Critchley).
Conclusions: Under stable hemodynamic conditions CO measurements based on intermittent bolus TD and arterial pulse contour analysis seem to yield comparable **Results:** Further improvement and validation studies are needed to prove the reliability of CO determination in unstable patients with the systems presently available.
Keywords: Cardiac output, arterial pulse contour, thermodilution, FloTrac™/Vigileo™, PiCCO®

P2.25
THE EFFECT OF MUSCULARITY AND HANDEDNESS ON RADIAL ARTERIAL PULSE WAVE VELOCITY IN HEALTHY VOLUNTEERS

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Introduction. Despite current interest in conduit artery stiffness, no in-vivo studies have reported its relationship to surrounding muscle and the possible effects of tethering. We investigated the effect of musculature and handedness on radial artery pulse wave velocity (raPWV) in each arm to test three hypotheses. Is there: 1) a difference in raPWV between the dominant and non-dominant arm? 2) an association between arm muscularity and raPWV? and 3) a difference in raPWV between left and right handers?
Methods: Handedness was assessed by questionnaire and examination of signatures in 54 healthy volunteers (18-40yr; 22 left-handed, male/female 12/10; 32 right-handed, male/female 17/15). Muscularity was defined by arm circumference measurements. raPWV was measured between the distal end of the brachial artery (8MHz Huntleigh Doppler) and the tip of the ring finger (Nelcor clip-on pulse-oximetry sensor). Data were sampled for 30s at 1kHz and analysed off-line.
Results: 1)There was no significant difference between dominant and non-dominant raPWV (paired t-test) and no sex differences in either arm. 2)