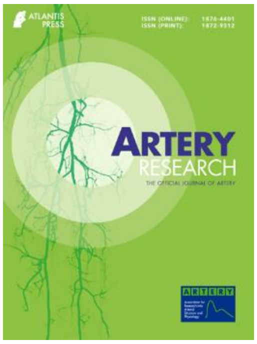

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P6.13: ADULT GUIDE-LINES ARE NOT APPLICABLE TO MEASURE PWV PATH LENGTH IN PAEDIATRICS

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The method used for pulse transit time (PTT) estimation, affects critically the accuracy of pulse wave velocity (PWV) measurements. The existing methods for PTT estimation yield often substantially different PWV values. Since there is no analytical way to determine PTT in vivo, these methods cannot be validated except by using in silico or in vitro models of known PWV and PTT. We aimed to validate and compare the most commonly used "foot-to-foot" methods: "diastole-minimum", "tangential", "maximum 1st derivative" and "maximum 2nd derivative". Also, we propose a new "diastole-patching" algorithm aiming to increase the accuracy and precision in PWV measurement. Methods: We simulated 2000 cases under a range of different hemodynamic conditions using a validated, distributed 1-D arterial model. The new algorithm "matches" a specific region of the pressure-wave foot between the proximal (i.e. carotid) and distal (i.e. femoral) waveforms. Intraclass correlation coefficient (ICC), mean difference (bias) and standard deviation of differences (SDD) were used to assess accuracy and precision. Results: The " diastole-minimum" and the " diastole-patching" methods showed an excellent agreement compared to the "real" PWV values of the model, as indicated by high values of ICC(>0.86).
The "diastole patching" method resulted in low bias (0.26m/s). In contrast, PWV estimated by 1st or 2nd derivatives and the "tangential" method presented a low to moderate agreement and poor accuracy (ICC<0.79, bias>0.9 m/s). The "diastole-patching" method yielded PWV measurements with the highest agreement, accuracy, precision and the lowest variability and its validity remains to be further examined in vivo.

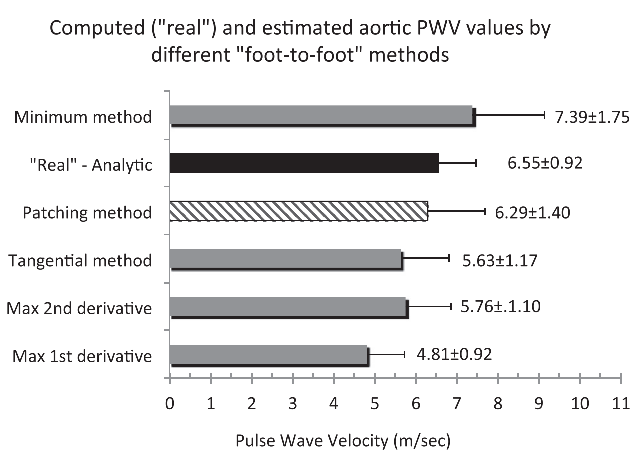

Figure 1 Mean and standard deviation for the aortic PWV estimations of the 5 validated algorithms. Bar in black represents the "real" PWV of the model.

P6.12

WAVE INTENSITY ANALYSIS OF REFLECTIONS IN THE BRACHIAL ARTERY FOLLOWING CUFF OCCLUSION AND HAND WARMING

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Background: Wave intensity analysis (WIA) is a mathematical tool used to study wave reflections in the arteries. Reflections are believed to contribute to BP augmentation and are also independent predictors of cardiovascular risk. Until now, the use of this technique has been largely confined to the aorta and carotid arteries.
Methods: 8 healthy subjects (age 30 ± 7.1) underwent wrist occlusion using a cuff inflated to >50mmHg suprasystolic pressure for 5min and hand warming at 55°C for 12min. Brachial artery diameter and blood flow velocity were measured using wall tracking and doppler ultrasound with an ALOKA SSD-5550 equipped with a 7.5 MHz probe. Wave intensity was calculated and reflections were quantified as the energy of the reflected wave/energy incident wave (WRI, %). Central aortic pressure following hand warming was also estimated using applanation tonometry (Sphygmocor) in separate studies.
Results: Cuff inflation resulted in a significant increment in WRI from 12.4 ± 4.15% to 26.8 ± 8.34% (p=0.001) whereas a marked reduction from 16.3 ± 6.60% to 4.09 ± 1.62% followed hand warming (p=0.0017). Cuff release was immediately associated with a significant attenuation in WRI (p=0.01). Hand-warming had no significant effect on the contralateral brachial or aortic SBP or DBP compared to baseline (p=0.3, 0.08 respectively).
Conclusion: Radial artery occlusion and hand warming respectively led to an augmentation and reduction in the reflected wave in the brachial artery. Hand warming was not associated with a significant change in peripheral or central BP.

P6.13

ADULT GUIDE-LINES ARE NOT APPLICABLE TO MEASURE PWV PATH LENGTH IN PAEDIATRICS

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Aortic pulse wave velocity (PWV) is a sensitive marker of arterial stiffness in children. In our previous study we have presented reference tables for PWV normal values in children. A recent consensus document provides arguments for the use of 80% of the direct carotid femoral distance as the most accurate distance estimate in adults. In the present work we aimed to assess if a transposition of the adult PWV measurement method is valid in childhood. Data of children participating to our previous work establishing age and height specific PWV normal values were re-evaluated. A total of 1008 healthy children (mean age:15.2 years, 495 males) were included in the study. We have recalculated PWV values using the subtractive method path length (L(SM)) and 80% of direct path length (L(0.8)). We have constructed Bland-Altman (BA) plots to assess the difference between PWV(SM) and PWV(0.8), and the distances L(SM) and L(0.8) in different age groups. The concordance between PWV(SM) and PWV(0.8) is excellent in children below 14 years (BA, ΔPWV mean:0.19 m/s, SD:0.40).However, in children >14 years, the difference increases (BA, ΔPWV mean:0.57 m/s, SD:0.36), and there is a proportional error between PWV(SM) and PWV(0.8) (BA, r:0.18; p<0.001), and in parallel there is also a proportional error between L(SM) and L(0.8) (BA, r:-0.24;p<0.001). The path length measurement suggested for adults may not be transponible to children throughout all age groups without reservation. Thus we propose to keep the current tables and values, unless the validity of a particular measurement is proved.
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P6.14

THE EFFECT OF TEMPORAL RESOLUTION ON MR ASSESSMENT OF PULSE WAVE VELOCITY

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Objectives: PWV can be measured by velocity-encoded phase-contrast magnetic resonance imaging (PC-MR) in a single location. One method utilises the change in flow (ΔQ) divided by the change in area (ΔA) at the beginning of systole, when it is assumed that only forward running waves are present. However, the duration of a reflection free period is short (~30ms) and therefore a high sampling frequency is required to interrogate this period. Most PC-MR is performed with a low TR of approximately 30-40ms. In this study, we compared PWV calculated using high TR (10ms) and simulated low TR (30ms).
Methods: High TR (10ms) PC-MR was performed in 20 volunteers in the ascending aorta. TR reduction to 30ms was simulated by filtering the flow and area waveforms using a zero-phase, low-pass, high-order Butterworth filter with normalized cut-off frequency of 0.33 in Matlab. PWV was calculated from the gradient of the flow-area line at the onset of ejection, corresponding to the first 3 points of the foot of the area curve.
Results: There was a significant difference (p<0.0004) between PWV calculated using high TR mean 3.89m/s (SD 1.31) compared with simulated low TR, mean 7.30m/s (SD 3.64), Figure A. The mean bias between methods was 3.4m/s with wide limits of agreement (Figure B).
Conclusion: PWV calculated using a single location method is significantly inflated when data is acquired at low TR, as simulated using low-pass filtering. This suggests that conventional PC-MR may produce erroneous results in clinical studies.