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P2.15: IDENTIFICATION OF FRAMEWORK CONDITIONS IN CUFF BASED BLOOD MEASUREMENT SYSTEMS

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Conclusions: Glomerular filtration rate independently correlates with pulse wave velocity in renal transplant patients, supporting the hypothesis that kidney function plays a predominant role in arterial stiffness.

P2.14

ESTIMATION OF AORTIC ARCH PULSE WAVE VELOCITY IN MRI USING COMPLEX WAVELET CROSS-SPECTRUM

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Aims: Pulse wave velocity (PWV) requires the length traveled between two aortic locations and the corresponding transit-time. This study aimed to: 1) design a new wavelet-based approach to estimate transit-time and aortic arch (aoPWV_w) from MRI ascending (AA) and descending (AD) aorta flow curves, and 2) compare its performances in terms of associations with: age, tonometric carotid-femoral PWV (cfPWV), and local AA Bramwell-Hill PWV (aaPWV_{BH}), against the time-domain aortic PWV (aoPWV_T), which is considered as the most relevant MRI approach.

Methods: We studied 74 healthy volunteers, (43±15years) who underwent MRI including: 1) multi-plane cine acquisitions to estimate aortic arch length and AA distensibility, converted into aaPWV_{BH}, and 2) through-plane velocity acquisitions which were automatically segmented to extract AA and AD flow curves, whose systolic-upslope was used to estimate transit-time using cross-correlation and the newly designed wavelet approach and subsequently to estimate aoPWV_T and aoPWV_w. First, cross-spectrum of AA and AD flow curves was calculated using wavelets which are more robust to insufficient temporal sampling of systolic-upslope than Fourier. Then the group delay was calculated by averaging the amplitude-weighted phases of systolic-upslope.

Results: Although strongly related ($r=0.82$, slope=1.15) associations with age, cfPWV and aaPWV_{BH} were stronger for the wavelet-based approach than aoPWV_T (aoPWV_w/aoPWV_T: $r=0.76/0.63$ with age; $r=0.60/0.57$ with cfPWV; $r=0.56/0.49$ with aaPWV_{BH}, $p<0.001$).

Conclusion: The wavelet-based arch PWV provides stronger associations with age and reference PWV than the previous time-domain estimate. These results suggest that considering supplementary signal information, results in a more reliable estimate of AA to AD transit time.

P2.15

IDENTIFICATION OF FRAMEWORK CONDITIONS IN CUFF BASED BLOOD MEASUREMENT SYSTEMS

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Background: Pulse wave analysis (PWA) using cuff based methods emerged within the last years. The combined analysis of PWA and magnetic resonance imaging (MRI) is very promising. Therefore long tubes from the cuff to the measurement system are needed. The aim of this work is the investigation of the effect of different cuffs and tubes with different lengths on the PWA results.

Methods: To evaluate the dynamic behavior of cuff based sensor chains we performed both tests on step response (similar to "pop test") as well as forced sinusoidal harmonic excitation by the means of a fully automated and standardized custom testing bench. The variation of cuff sizes, tube material and tube dimensions (diameter and length) was intended to account the influence of the framework conditions on the PWA results.

Results: The resonant frequencies of the evaluated cuff based systems are mainly based on the tube type and tube length. In detail the resonant frequency is reduced in proportion to the tube length. Furthermore in very large arrangements the pressure curve will be distorted. In particular PWA is very difficult with long tubes.

Conclusions: Based on our actual data especially the influence of the tube length has a major impact on the pressure measurement results. We suggest that a special design of the tubes can achieve proper results for PWA analysis also with long tubes.

P3.1

BENEFICIAL EFFECTS OF HYPERTRIGLYCERIDEMIA TREATMENT ON MICROVASCULAR ENDOTHELIAL FUNCTION IN TREATED HYPERTENSIVE PATIENTS

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Background: The relationship between increased levels of triglycerides (TG) and cardiovascular (CV) risk is controversial, and the effects on endothelial function are also unclear.

Objective: To investigate the effects of hypertriglyceridemia treatment on vascular function in treated hypertensive patients.

Methods: Thirty-six hypertensive patients with TG levels 150 to 499 mg/dl, both genders, aged 40-65 years, were randomized to receive active treatment (fish oil or fibrate) or placebo for 3 months. Systolic and diastolic blood pressure (SBP and DBP), brachial flow-mediated dilation (FMD), reactive hyperemia index (RHI) by peripheral artery tonometry, pulse wave velocity (PWV), carotid intima-media thickness (IMT) and central hemodynamic parameters were determined at baseline and after 3-month intervention.

Results: Treatment group presented significant decrease in SBP (139±17 to 134±12mmHg, $p<0.05$), DBP (86±11 to 81±9mmHg, $p<0.05$), TG levels (255±73 to 156±77mg/dl, $p<0.001$), carotid-radial PWV (10.9±1.8 to 10.2±1.2m/s, $p<0.05$) and aortic SBP (131±16 to 125±10mmHg, $p<0.05$) compared with control group. Treatment group showed significantly improvement in RHI (1.87±0.36 to 2.13±0.49 units, $p<0.05$). No significant effect was observed on FMD and carotid IMT. RHI increase was correlated with TG reduction ($r=-0.40$, $p=0.043$) and baseline TG/HDL ($r=0.44$, $p=0.023$), RHI ($r=0.40$, $p=0.041$) and aortic pulse pressure ($r=0.45$, $p=0.020$). After multiple linear regression, RHI improvement was only associated to TG decrease ($B=-0.001$, $p=0.043$) and baseline aortic pulse pressure ($B=-0.012$, $p=0.023$).

Conclusion: The treatment of hypertriglyceridemia was associated with improvement in microvascular endothelial function in treated hypertensive patients suggesting that TG levels reduction may have vascular protective effects in these patients.

P3.2

IMPAIRED SYSTOLIC FUNCTION IS ASSOCIATED WITH ALTERED FORWARD WAVE INTENSITY

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While parameters from pressure analysis could be related to arterial stiffness and prognosis in general populations, the results for patients with severely reduced ejection fraction (rEF) are rather puzzling. The aim of this study is to use wave intensity analysis (WIA), based on aortic pressure and velocity curves, and compare forward wave intensity in 61 patients with rEF and 122 controls with normal ejection fraction.

Typically WIA yields two distinct forward waves. The first (S-wave) is a compression wave (increasing pressure and flow) generated by systolic ventricular contraction. The second (D-wave) is an expansion wave (decreasing pressure and flow) occurring around valve closure. The ratio of these wave peaks (SDR) was calculated for patients matched for age, height, weight, gender, and brachial blood pressures with two methods: First, aortic pressure waves from the SphygmoCor system were aligned with Doppler velocity measurements from left ventricular outflow tract. Second, a flow model based on Windkessel theory was used to replace Doppler measurements.

In the whole group, SDRs, as calculated with both methods, showed highly significant direct relationships with measures of systolic function (ejection fraction, stroke volume, cardiac output, S' , invasive left ventricular dp/dt).

SDR, calculated using aortic pressure and Doppler velocity curves, was significantly reduced for the rEF group (2.9 vs. 5.3, $p<0.0001$). Using the flow model, a similar reduction could be found (2.9 vs. 4.8, $p<0.0001$).

These results suggest that peak forward wave intensity is capable to reflect reduced systolic ventricular function, even when Doppler flow measurements are omitted.