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P10.15: THE RELATION BETWEEN HYPERTENSION AND DIFFERENT DEMOGRAPHIC DATA AMONG HYPERTENSIVE SUDANESE PATIENTS

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Conclusions: The presence of more classical RFs is associated with accelerated progression of vascular aging.

P10.11

MEAN ARTERIAL PRESSURE IS A STRONGER PREDICTOR OF STROKE IN SOUTH ASIAN THAN EUROPEAN MEN, INDEPENDENT OF OTHER CARDIOMETABOLIC RISK FACTORS; THE SABRE STUDY

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Background: Stroke risk is greater in South Asians than Europeans. We sought to compare associations between blood pressure (BP) and stroke by ethnicity and determine how BP contributes to ethnic differences in disease.

Methods: Population sample of 1510 European and 1195 South Asian men recruited between 1988-1991, mean age 52±7yrs. Incident fatal and non-fatal strokes were captured over 20 years of follow-up. Cox models demonstrated associations between mean arterial BP (MAP) and stroke.

Results: South Asians had more incident strokes than Europeans (5.6 (4.7,6.7) versus 4.7 (4.0,5.6) per 1000 person years, age-adjusted hazard ratio: 1.40 (1.08,1.76), $p=0.01$) and higher MAPs than Europeans (97±12 versus 93±12mmHg, $p<0.0001$).

MAP was more strongly associated with stroke in South Asians than Europeans, (HR (95% CI): 1.59(1.35,1.86) versus 1.19(1.00,1.43) respectively, ethnicity interaction $p=0.03$), even accounting for receipt of anti-hypertensive medication (1.57(1.32,1.86 versus 1.10(0.91,1.32), interaction $p=0.03$). The ethnic difference in impact of MAP diminished after further adjustment for smoking, waist circumference, HDL, fasting glucose, HOMA2-IR, HbA_{1c} and heart rate (1.40(1.12,1.75) versus 1.15(0.92,1.42), interaction $p=0.24$). However, the greater effect of MAP on stroke in South Asians persisted when this latter model was restricted to people not receiving anti-hypertensive medications, (1.57(1.26,1.96) versus 1.08(0.85,1.37), interaction $p=0.02$).

Adjustment for MAP could not account for the excess stroke risk in South Asians (1.27 (1.00, 1.62) $p=0.05$), nor could other risk factors.

Conclusions: MAP had a greater impact on stroke risk in South Asians than Europeans, but could not account for their excess stroke risk, alone or in conjunction with additional risk factors.

P10.12

AORTIC STIFFNESS IS AN INDEPENDENT DETERMINANT OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION IN METABOLIC SYNDROME PATIENTS

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Aim: Of this study was to evaluate the relationship of arterial stiffness and left ventricular diastolic dysfunction(LVDD) in metabolic syndrome(MetS) patients.

Methods: A cross-sectional study was carried among 1208 MetS subjects (aged 54±6, 65% women, 92% hypertensive). According to the heart ultrasound findings, patients were divided into three groups: with relaxation abnormalities (GR1, n=406, LV end-diastolic diameter(LVdd) 5.02±0.49cm), with pseudonormalisation (GR2, n=713, LVdd 5.09±0.5cm) and without LVDD (LVDD-, n=89, LVdd 4.95±0.43cm). Arterial stiffness parameters (carotid to femoral pulse wave velocity (cfPWV) and aortic augmentation index (AlxHR75) were assessed by applanation tonometry.

Results: In comparison to LVDD- patients, LVDD+ patients were older (55±6vs 51±6), had higher cfPWV (GR1 8.9±1.66, GR2 8.77±1.57vs 7.9±1.34m/s), AlxHR75 (GR1 25.5±10.42; GR2 24.7±10.2vs 19.7±10), mean arterial pressure(MAP) (GR1 108±12.7; GR2 107.6±12.2vs 101±10mmHg), mean carotid intima-media thickness(IMTmean) (GR1 0.651±0.098; GR2 0.656 ±0.107vs. 0.619±0.09mm), heart rate (LVDD+ 66±10vs. 61±9bpm), left ventricular mass index(LVMI) (LVDD+ 109±24vs. 97.1±22g/m²), body mass index(BMI) (LVDD+ 32±5vs 30±4 kg/m², all $p<0.05$).

We found significant correlations between arterial stiffness and diastolic function parameters, such as ratio of early to late transmitral pulse Doppler velocities(E/A) (rcfPWV=-0.19, rAlxHR75=-0.15, $p<0.05$), early diastolic

mitral annular velocity(E') (rcfPWV=-0.25, rAlxHR75=-0.18, $p<0.05$), and E/E' ratio (rcfPWV=0.17, rAlxHR75=0.14, $p<0.05$). In multiple regression analysis, gender, MAP, LVMI, heart rate and cfPWV remained significant determinants of E/E'parameter, explaining 18% of its variability($p<0.05$).

Conclusion: Carotid to femoral pulse wave velocity, an index of aortic stiffness, is a significant and independent determinant of the LVDD in subjects with metabolic syndrome.

P10.13

WITHDRAWN

P10.14

AORTIC PULSE WAVE VELOCITY IS AN INDEPENDENT CARDIOVASCULAR EVENT PREDICTOR IN HIGH CARDIOMETABOLIC RISK GROUP

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Aims: The aim was to assess if arterial stiffness, indexed as aortic pulse wave velocity (PWV), is a viable CVD risk prediction variable in high cardio-metabolic risk population.

Methods and results: We studied 4259 high-risk patients (36.2% male), on average having 3,49±1,05 metabolic syndrome components(18% having 5), as per NCEP ATPIII criteria. Starting from 2007, patients were observed and investigated in a single specialized cardiology center. The outcome follow-up was performed using national death registry and national healthcare fund database. CVD events during the follow-up included fatal or non-fatal myocardial infarction (MI) or stroke. Mean age of the study population was 54,13±6,23 with no significant difference between the event free group(EFG) vs. the event group(EG) with at least one CVD event(n= 129) during the follow-up, which was 1389,3±625,73 days. Comparing the two groups, aortic PWV was 8,8±1,6(EFG) vs. 9,41±2(EG), $p<0.001$, mean aortic pulse pressure(Ao_PP)43,28±11,02(EFG) vs. 46,25±12,32(EG), $p=0.003$, mean aortic blood pressure(MeanBP_Ao) 106,69±12,45(EFG) vs. 111,07±16,6(EG), $p<0.001$.

In logistic regression model, aortic PWV remained a strong independent CVD event predictor. Odds ratio (OR) for CV event is 1.387(95% CI 1,182; 1,627, $p<0,001$). Comparing cumulative proportion survival rate between the 3rd vs. 1st tertile(PWV <8m/s vs. PWV ≥9.3m/s) of aortic PWV the OR for CVD event was 1,748 (95% CI 1,135; 2,691, $p=0,011$).

Conclusion: Aortic PWV remained a strong CVD event predictor in univariate as well as multivariate stepwise logistic regression models. Survival analysis confirmed it as a viable CVD prediction indicator, to be considered including it into widely used CVD risk assessment tools, especially for high CVD risk group.

P10.15

THE RELATION BETWEEN HYPERTENSION AND DIFFERENT DEMOGRAPHIC DATA AMONG HYPERTENSIVE SUDANESE PATIENTS

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According WHO data April 2011Hypertension Deaths in Sudan reached12,281of total deaths. The age adjusted Death Rate is 67.67per100,000of population and ranks Sudan#17 in the world.

Objective: aimed to detect the relation between hypertension and certain demographic data in Sudanese hypertensive patients.

Method: Data was collected from222 hypertensive patients via structured questionnaire and analyzed using SPSS.

Results: males are more than females(males 66.2%).The most affected age group was 41- 60(61.1%). The most affected geographical area North(62.3%) followed by the East(23.9%), and the least affected region was found to be the South(6.6 %). Married subjects were more than singles(89.2%)of the total study population, study doesn't denote whether the diagnosis of hypertension was made before or after marriage. 93.2% of the study sample lived with their families. The study revealed that only 71.6%of the study sample had good compliance to treatment, patients with negative family history (who constituted 28.4%)showed better compliance to treatment and scheduled follow up visits(78.04%of the patients with negative family history) than those with positive family history where 67.8% of them showed better compliance. The study shows

that married patients showed better levels of compliance 73.13% than single patients. patients originating from the north showed better compliance (70.45%) than those living in other regions of the Sudan. Disregard to origin most patients lived in desert environments 97.67% of those originating from the North and (66.66%) of these originating from the East).

Conclusion: Patients originating from the East showed lower compliance and therefore must be targeted for health to increase awareness

P11.1

THE PU AND QA LOOP METHODS OVER- AND UNDERESTIMATE LOCAL CAROTID WAVE SPEED: A CONSISTENT EXPLANATION AND SOLUTION TO THE PROBLEM

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Single-point methods such as the PU- and QA-loop methods are used to estimate local pulse wave velocity (PWV-PU and PWV-QA) in arteries from a combination of pressure (P), flow (Q), velocity (U) or cross-sectional area (A) waveforms. Available data indicate that the PU-loop method tends to overestimate PWV, while the QA-loop method tends to underestimate. Wave reflection has been suggested as a factor playing a role in the agreement between different methods. In this work, we (i) demonstrate the interference of wave reflection with the PU-loop method for both solitary sinusoidal waves as well as physiological waveforms; (ii) develop an operator-independent method to correct for the presence of reflections. Fluid-structure interaction simulations in a tube and carotid artery model with known mechanical properties confirm the theory. For the carotid artery model, PWV-PU severely overestimates PWV, while PWV-QA underestimates PWV. Correction (leading to an estimate termed PWV-corr) eliminates the impact of reflections. Finally, methods are applied in vivo in a subsample of the Asklepios population. Compared to PWV-PU and PWV-QA, PWV-corr leads to significantly better correlations of carotid PWV with PWV derived from carotid distensibility based on the Bramwell-Hill equation (with r^2 improving from about 0.25 to 0.91). Neither the PU-loop nor the QA-loop method provides reliable estimates of local PWV in settings where wave reflections are present - even when the PU- or QA-loops show a linear segment. They offer no alternative for the Bramwell-Hill based approach and their application should therefore be discouraged, especially for the carotid artery.

P11.2

A 1D-MODEL FOR THE SIMULATION OF THE ARTERIAL WALL DISPLACEMENT

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Background: Nowadays, a great emphasis has been placed on the modeling of the cardiovascular system. In 1d-models, the arterial diameter is generally deduced from the arterial pulse pressure by considering a stress-strain relationship. However, this assumption remains simplistic in nature since no interaction among elastic layers constituting the arterial wall is considered. Moreover, 3d-models offer generally a better description of the physiology of the arterial wall but are often too complex to be embedded in other 1d-arterial models.

Methods: In the present study, we propose a novel and simple 1d-model to simulate the arterial wall displacement in large arteries. This one relies on a system of coupled differential equations from the interactions among the elastic fibers of the arterial wall and the surrounding tissues. Thereafter, the common carotid arterial wall displacement is reproduced and compared to experimental data obtained from a high-resolution echo tracking ultrasound system in 10 patients.

Results: The model shows a distensibility of the carotid artery (5.6 10⁻³ mmHg⁻¹ with the simulation) in the same range as observed for experimental data in 10 patients (4.5 10⁻³ mmHg⁻¹). Moreover, the results suggest that the carotid diameter waveform cannot be directly substituted to the arterial pulse pressure as observed in other 1d-models and differs significantly during the systolic phase.

Conclusions: Subsequently, our model could give a reliable and useful tool for the simulation of the arterial wall displacement which could be easily embedded in other 1d-models treating of arterial system.

P11.3

DEVELOPMENT AND VALIDATION OF REALISTIC AORTIC PHANTOM TAILORED FOR EACH PATIENT

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The microstructure evolution of the aortic tissue in cardiovascular pathologies, such as aneurysm or atherosclerosis, leads to an overall change of biomechanical properties. Successful treatment (e.g endovascular) of these pathologies depends on the comprehension of these properties and on the surgeon expertise. Many investigators have created general-purpose aortic replicas called "phantoms", for the preoperative training and/or the studies of surgical and radiological processes. However, the importance of the used material properties was generally neglected. Moreover, the specific shape and the mechanical behavior of each patient's aorta were not taken into account. Our work aims to create patient-specific phantoms able to accurately mimic each individual case.

We use a mechanical model comprising both hyperelastic and viscoelastic behaviors which can be scrutinized to predict aneurysm rupture and to diagnose the atherosclerosis, respectively. To identify the model parameters, we performed steady and dynamic ex-vivo experiments. Results were used to develop a large range of materials able to replicate real healthy and pathologic aortic mechanical behavior. For that purpose, different Bluesil® silicone materials from Bluestar Silicones Company were used and suitably formulated. After adjusting the material formulation, the specific aorta shape given by medical imaging is encoded in a finite element model in order to manufacture the specific phantom by 3D prototyping. The whole process results in a quick production of a specific phantom that can be positioned in a hydro-dynamic test bench, in which physiological hemodynamic conditions can be simulated and the model parameters can be verified from ultrasound images and pressure measurements.

P11.4

INVESTIGATION OF THE ARTERIAL AGEING AND ISOLATED SYSTOLIC HYPERTENSION BY FLUID DYNAMICS-BASED MODELLING

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Arterial and left-ventricular ageing strongly affects morbidity and mortality. It is characterized by stiffening, dilation and lengthening of large arteries, microcirculation changes, and alteration of heart contracting capacity and timing. The scientific community is debating the evaluation, impact, and interaction among these fundamental processes. As fluid dynamics play a key-role, our aim is to use a physically-based model of the heart-arterial tree hemodynamics to investigate quantitatively these processes.

Our multi-scale mathematical model considers lumped descriptions of left ventricle, aortic valve dynamics and microcirculatory distal volumes, and the 1D characterization of large-to-medium arteries. Notice that model has been validated in patient-specific settings against a population of six healthy young men. In the present work, starting from parameters statistically representing a healthy young man, the ageing of both heart and arterial tree is simulated by changing the diameter, length, wall thickness and mechanical properties of large arteries, and the left-ventricular force of contraction and its activation time. Once the main features of the ageing heart-arterial interaction are simulated, our efforts are focused to reproduce the isolated systolic hypertension (ISH) coherently with the most advanced literature data about this pathology. With the aim to elucidate the links between ISH and "healthy" ageing, the key-role of aortic stiffening and remodeling as well as the consequent early-return of reflected pressure wave and the different ventricular ejection pattern are investigated and discussed, paying attention to the physical process identification and understanding.

P11.5

CARDIAC AND VASCULAR TISSUE PROPERTIES DETERMINE THE CENTRAL BLOOD PRESSURE WAVEFORM: CONSEQUENCES FOR PULSE WAVE ANALYSIS

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Various methods exist to estimate central blood pressure (BP) waveforms from noninvasive peripheral BP measurements. Most methods consider only