P8.11: ADIPOKINE DYSREGULATION IS ASSOCIATED WITH ARTERIAL STIFFNESS IN A MODEL OF DIET-INDUCED OBESITY IN MICE

M. Gil-Ortega, M. Martín-Ramos, S. Arribas, M. González, I. Aránguez, M Ruiz-Gayo, M. Fernández-Alfonso, B. Somoza


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Abstracts

P8.7 PRESERVATION OF BIOMECHANICAL PROPERTIES OF ARTERIES IN EMBALMED BODIES

V. Cunha, V. Vassilenko, D. Casal, J. O’Neill
CEFITEC, New University of Lisbon, Caparica, Lisbon, Portugal
NFMT, S.A., Caparica, Lisbon, Portugal

Minimally invasive surgery techniques such as laparoscopic, endoscopic and thoracoscopic procedures became current practice and recently have revolutionized the specialty of vascular surgery. However, the practice and skills of surgeons are crucial to perform correctly the numerous highly sophisticated and delicate procedures of this surgical specialty. Normally for training are used simulators, which have a known limitations. Sometimes, there are also using very expensive and not always available fresh cadavers, due to the importance of biomechanical properties of arteries for the training.

The use of embalmed cadavers assumes the better results in the surgeon comprehension of complex anatomic and vascular exposures and can improves their operative confidence. However, a traditional formaldehyde-embalming method cannot preserve the structure and properties of the vascular system.

In order to remove these limitations we have developed a new embalming perfusion method aiming to satisfy the needs to support the embalmed bodies as true simulator for vascular surgery.

In this study, we present results of histological analysis and evaluation of mechanical properties of the arteries, achieved with our perfusion system, and its comparison with formaldehyde-embalming method. Other important features, such as the authenticity of colour, tissue consistency and elasticity (flexibility) of the vascular vessels, are also discussed.

P8.8 APELIN/APJ RECEPTOR SYSTEM INVOLVEMENT IN OBESITY-RELATED VASCULAR REACTIVITY CHANGES

I. Gurzu, F. Zugun-Eloaie, B. Gurzu
Scripion Clinical Emergency Hospital, Iasi, Romania

Background: Obesity associated changes of vascular reactivity could be related to inadequate secretion of adipokines. Apelin is an adipokine with cardiovascular, endocrine and metabolic actions. We aimed to investigate the possible modulator actions of apelin on obesity induced changes of vascular reactivity.

Methods: Obese prone (OP-CD) rats and obese resistant (OR-CD) rats were fed high-fat diets. After 4 weeks the pulmonary and mesenteric arteries were used to comparatively analyse the contractile (induced by phenylephrine - Phe) and relaxant (induced by acetylcholine - Ach) responses. Localization of apelin and its APJ receptor was determined using immunohistochemistry.

Results: The Phe -induced contractation was amplified on PA and Ach -induced relaxation was reduced on both PA (with 62%) and MA (with almost a half) in OP-CD as compare with OR-CD. Pre-treatment with apelin 13 (AP13) improve Ach effect on PA rings form OP-CD. Administration of apelin-13(F13A) recepetor antagonist increase the Emax of Phe MA from OP-CD with 26% and decreased the Ach effect on all rings from both OP-CD and OR-CD rats.

Conclusion: The apelin/APJ peptidergic system could be involved in obesity related reactivity alteration of arteries from both pulmonary and systemic circulation.

P8.9 MECHANICAL BEHAVIOR OF THE ABDOMINAL AORTIC ANEURYSM OBTAINED FROM THE RAT XENOGRAFT MODEL AND TREATED BY MESENCHYMAL STEM CELLS

L. Marais, J. Dai, E. Allaire, M. Zidi
CNRS EAC 4396 - Université Paris Est Créteil, Créteil, France

To prevent rupture of abdominal aortic aneurysms (AAAs), current preventive treatments involve surgery or the deployment of an endovascular stent. The development of gene or cell therapies as alternative therapeutics to stabilize AAAs represents a challenge. In the present contribution, we investigate the effect of a mesenchymal stem cell therapy on the mechanical properties of the rat xenograft model of AAA. This model reproduces the arterial dilatation of the aneurismal disease and has been much used to study the biological impact of different approaches therapies. The arterial structure of healthy native rat abdominal aortas, diseased untreated and treated AAAs were subjected to axial extension and pressurization tests (biaxial mechanical tests) in a pressure myograph device. A nonlinear hyperelastic and incompressible mechanical model was used to identify and compare the material parameters for the three specimen types. Histopathological analysis enabled a better correlation between the results and the microstructure of the arterial tissue and particularly the presence of a thrombus or a neointima layer. Stress distributions within the arterial wall should then be computed by finite element modeling in order to predict the risk of rupture of aneurysms.

P8.10 VASCULAR CHARACTERIZATION BY MEANS OF WAVE INTENSITY ANALYSIS: A PRELIMINARY STUDY IN MICE

N. Di Lascio, F. Stea, C. Kusmic, R. Sicari, F. Faita
National Research Council, Pisa, Italy

Mouse models are increasingly employed in the comprehension of cardiovascular disease. Vascular characterization could be enriched with Wave Intensity Analysis (WIA), which provides additional information about the vascular system and its interaction with the heart. We investigated age-associated changes in vascular parameters of mice in different arterial sites and explored the role of WIA.

Five adult (5 months) and five old (16 months) wild type male mice (strain C57BL/6) were examined. Instantaneous values of diameter and flow velocity were automatically achieved from carotid and abdominal aorta B-mode PW-Doppler images and elaborated to provide the InV-loop; pulse wave velocity values (PWCar and PWab) and relative distension measurements (relDcar and relDabd) were calculated for both carotid artery and abdominal aorta. The WIA, as introduced by Parker in 2009, was performed: the amplitudes of the first local maximum (W1_car and W1_abd) and minimum (Wb_car and Wb_abd) were calculated.

PWCar (adult: 1.41±0.37, old: 2.19±0.49 m/s), PWab (1.89±0.63 vs 2.89±0.68 m/s), relDcar (27%±5% vs 19.7%±3.6%) and relDabd (26.2%±4.1% vs 15.4%±3.6%) values were significantly different (p<0.05) in the two age groups. W1_abd amplitude was higher in adult than in old mice (12.9±6.7×10^-7 m^2/s vs 5.5±2.2×10^-7 m^2/s, p<0.05); the same trend was found in Wb_abd amplitude (4.07±1.8×10^-6 vs 4.27±1.24×10^-6 m^2/s), even if the difference was not significant (p=0.09).

The age-associated decrease in W1_abd may suggest a change in cardiac contractility, while that in Wb_abd may be related to alterations in reflected waves from cerebral circulation. Therefore, WIA might provide additional information to standard vascular biomarkers.

P8.11 ADIPOKINE DYSREGULATION IS ASSOCIATED WITH ARTERIAL STIFFNESS IN A MODEL OF DIET-INDUCED OBESITY IN MICE

Universidad CEU-San Pablo, Madrid, Spain

The aim of this work was to analyze vascular remodeling and mechanical alterations in mesenteric arteries in a model of diet-induced obesity in mice, as well as the impact of adipokine dysregulation in those changes.

Four-week old C57BL/6J male mice were assigned either to a control (10% kcal from fat) or to a high-fat (HF) diet (45% kcal from fat). After 32 weeks of diet, HF animals weighed 30% more than controls (p<0.001). Moreover, HF animals exhibited an increase in leptin but a reduction in adiponectin plasma levels. Studies of arterial structure and mechanics, performed by pressure myography did not reveal a significant vascular remodeling in HF mice, as well as the impact of adipokine dysregulation in those changes.

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A 1-D MODEL OF THE SYSTEMIC ARTERIAL TREE IN MICE

C. Vayssettes-Courchay, C. Ragonnet, G. Lindey, S. Chimenti, M. Isabelle, J.-P. Vilaine
Servier Research Institute, Suresnes, France

Arterial wall viscosity (AWV) of central arteries, as well as distensibility, is important to properly buffer systolic ejection pressure. AWV is measured either by the area within the hysteresis of distension-pressure (DD-P) loop, defined as the viscous energy (AWV = Ve) or the ratio of Ve/We-energy stored during systole (=AWV%). We record DD-P loop via echotracking; averaged over 30 cardiac cycles, AWV and AWVs are calculated via MatLab software. Here we perform a post analysis of the DD-P loop in 12 groups of rats (n = 5-8): normo- or hypertensive, with and without arterial remodeling, at different operating blood pressures (BP), using different compounds. AWV decreases and DD-P loop is flattened with increased BP; moreover it is differently altered if pulse pressure (PP) is altered and remains low at any operating BP in models with vascular wall remodeling. However in all conditions the ratio AWV% is poorly modified. Our results suggest that the AWV as the Ve (hysteresis loop area) is the most relevant in defining the viscous properties of the artery; they indicate that mean operating BP, PP and structural distensibility independently participate in modifying the shape of the loop which is largely dependent on the delay between peak systolic pressure and peak systolic diameter, apparent in the higher BP of the loop. This suggests that isobaric distensibility cannot be compared in the lower and upper part of the loop but only at a similar mean BP. Further studies will aim to confirm these suggestions and determine how to improve loop hysteresis evaluation.