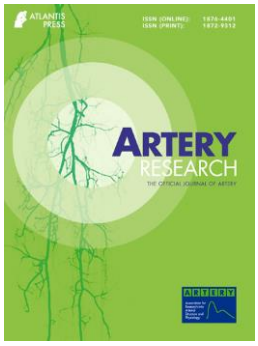


Artery Research

ISSN (Online): 1876-4401 **ISSN (Print): 1872-9312**
Journal Home Page: https://www.atlantis-press.com/journals/artres

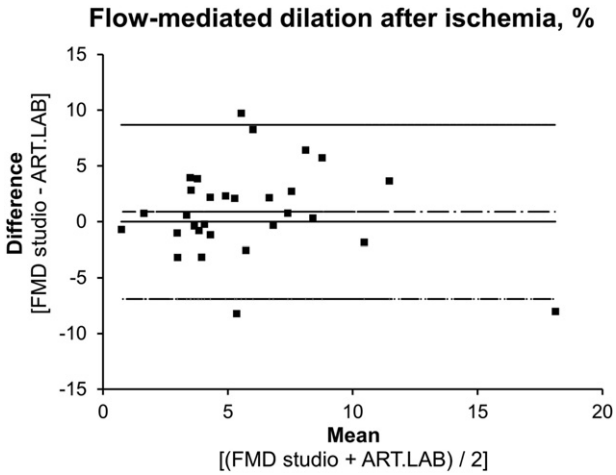
P2.40: TENSILE MEASUREMENTS ON VERY SMALL BLOOD VESSELS AND VASCULAR GRAFTS

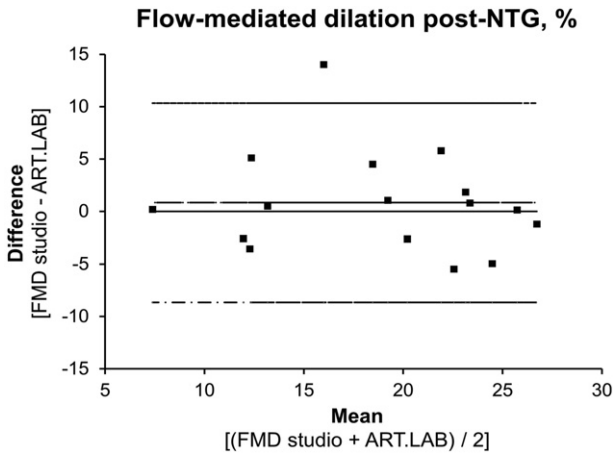
M.S. Stoiber, C.G. Grasl, K.K. Kessler, B.M. Messner, D.B. Bernhard, V.G. Gschlad, H.S. Schima

To cite this article: M.S. Stoiber, C.G. Grasl, K.K. Kessler, B.M. Messner, D.B. Bernhard, V.G. Gschlad, H.S. Schima (2012) P2.40: TENSILE MEASUREMENTS ON VERY SMALL BLOOD VESSELS AND VASCULAR GRAFTS, Artery Research6:4, 175–175, DOI: https://doi.org/10.1016/j.artres.2012.09.120

To link to this article: https://doi.org/10.1016/j.artres.2012.09.120

Published online: 21 December 2019





P2.40

TENSILE MEASUREMENTS ON VERY SMALL BLOOD VESSELS AND VASCULAR GRAFTS

M. S. Stoiber [1,4], C. G. Grasl [1,4], K. K. Kessler [3], B. M. Messner [3], D. B. Bernhard [3], V. G. Gschlad [1,2], H. S. Schima [1,2,4]
[1]*Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria*
[2]*Deptartment of Cardiac Surgery, Medical University of Vienna, Vienna, Austria*
[3]*Cardiac Surgery Research Laboratories, Department of Surgery, Medical University of Vienna, Vienna, Austria*
[4]*Ludwig-Boltzmann-Cluster for Cardiovascular Research, Vienna, Austria*

Aims: Biomechanical evaluation of small blood vessels and vascular grafts is an important task. In this work a method is presented for testing mechanical behaviour of very small tubular structures with less than 1mm diameter.
Methods: For the tensile measurements a BOSE ElectroForce system (Bose Corp. MN, USA) with a controllable linear motor for static and dynamic measurements was used. To measure very small ring-shaped specimens the system was modified with a cantilever and a special designed probe fixation.
Firstly, tensile behaviour on thoracic mice aortae after 19 weeks high-fat-diet (group 1) and a control group (group 2) were analyzed. Secondly, on electrospun vascular grafts repeated loading-unloading measurements were performed to obtain the dynamic behaviour in the physiological range.
Results: The modified system allowed measurements on very small specimen (0.7mm inner diameter in case of the mice aortae) and the use of very sensitive load cells of 10N and up to 0.5N.
For the mice aortae significant higher maximum tear forces in group 1 with 0.41 +/- 0.12N, than in group 2 with 0.34 +/- 0.10N were measured. Diverse tear forces and braking strains at different zones of the aorta could be observed. For the vascular grafts hysteresis curves could be recorded with peak-to-valley forces of 0.03 to 0.08N, corresponding to 80 and 120mmHg.
Conclusion: The established method enables a reproducible and sensible measurement of static and dynamic mechanical properties in small ring-shaped specimen of arteries and vascular prostheses.

P2.41

ACUTE RESPIRATORY CHANGES IN AUGMENTATION INDEX ARE RELATED TO AORTIC RESERVOIR FUNCTION

M. G. Schultz [1], J. E. Davies [2], A. D. Hughes [2], J. E. Sharman [1]
[1]*Menzies Research Institute Tasmania, Hobart, Australia*
[2]*International Centre for Circulatory Health, Imperial College, London, United Kingdom*

Background: Augmentation index (AIx) is an independent predictor of mortality. Current theory states augmented pressure (AP) is principally due to wave reflection. Subtle changes in AP occur with respiration, but the mechanisms are not fully understood. This study aimed to determine the possible contribution of wave reflection and aortic reservoir function to respiratory changes in AP.
Methods: Simultaneous invasive pressure and Doppler flow velocity were recorded in the ascending aorta via intra-arterial wire in 24 consecutive participants undergoing cardiac catheterisation or surgery. We performed wave intensity analysis to derive forward and reflected waves, and calculated reservoir pressure in five patients displaying marked respiratory AP changes (see figure). Data was compared between four respiratory cycles of expiration (high AP) with inspiration (low AP) in each individual.
Results: AP and AIx were raised during expiration compared to inspiration (5±6mmHg, 10±13% vs.-1±2mmHg, -6±9%, $P<0.001$ for both). Despite this, wave reflection was not significantly changed ($-7x10^6 \pm 9x10^6$ vs. $-6x10^6 \pm 5x10^6$ $W.m^{-2}s^{-2}$, $P=0.50$). However, reservoir pressure was significantly higher during expiration compared with inspiration (95±23 vs. 88±20 mmHg, $P<0.001$), as were forward compression waves ($41x10^6 \pm 27x10^6$ vs. $36x10^6 \pm 24x10^6$ $W.m^{-2}s^{-2}$, $P=0.04$). The change in AP between inspiration and expiration correlated with change in reservoir pressure ($r=0.81$, $P<0.001$), but not reflected wave intensity ($r=-0.19$, $P=0.41$) or heart rate ($r=-0.33$, $P=0.15$).
Conclusions: Acute changes in AP and AIx occur during normal respiration. These changes appear related to aortic reservoir function and cannot be explained by conventional wave reflection theory.

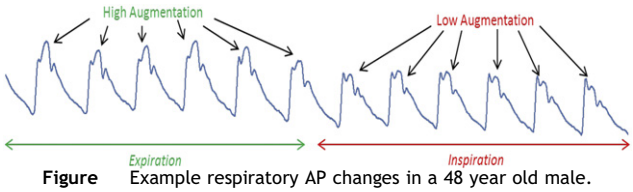


Figure Example respiratory AP changes in a 48 year old male.

P2.42

A NEW BLOOD PRESSURE-INDEPENDENT ARTERIAL STIFFNESS INDEX, CARDIO-ANKLE VASCULAR INDEX (CAVI)

K. Shirai
Sakura Hospital, Toho University, Sakura, Chiba, Japan

The Cardio-Ankle Vascular Index (CAVI) is a new indicator of the stiffness of arteries from the origin of the aorta to the ankle of the lower leg. The theory is based on the stiffness parameter β. CAVI is essentially independent of blood pressure at a measuring time. This is confirmed by the study using adrenergic β1 receptor-blocking agent, metoprolol in human. When metoprolol is administered to men, blood pressure decreased and pulse wave velocity is decreased. But, CAVI remains constant. This result was also confirmed by the study on the rabbits using same apparatus.
CAVI increased with aging and showed higher values in males than in females. CAVI showed high value in patients with cerebral infarction, coronary stenosis, and chronic kidney disease.
As for the risks of coronary artery disease, CAVI showed high value in hypertension, diabetes mellitus, dyslipidemia, smoking, and metabolic syndrome. Furthermore, improvement of those risk factors by drugs or lifestyle changes reduced CAVI in most cases. In other words, CAVI is a useful indicator for the management of coronary risk factors.