FLOW-INDUCED ADAPTATION OF CAROTID ARTERY BIOMECHANICAL PROPERTIES, STRUCTURE, AND ZERO-STRESS STATE IN THE ARTERIOVENOUS SHUNT

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Abstract

Numerous studies have provided evidence of morphological adaptation secondary to flow-overload, but information on biomechanical aspects of arterial adaptation is rather incomplete. We examined large-artery biomechanical adaptation elicited by long-term moderate flow-overload in a porcine shunt model between the right carotid artery and ipsilateral jugular vein. The arterial segments, including the contralateral counterpart, were submitted to inflation/extension testing and histomorphometric analysis, coupled with optical and confocal microscopy. Post-shunting, flow at the proximal arterial part was doubled and retained so until euthanasia, without pressure change. Blood flow elevation was accompanied by lumen diameter enlargement and wall mass growth, accommodated by elastin fragmentation and connective tissue accumulation, while wall thickness was preserved at control values and the thickness to radius ratio dropped. These observations were also associated with a decline in residual strains and opening angle. The morphological changes in shunted arteries led to shear and intramural-stress normalization within fourteen days. The elastic properties of shunted arteries were also modified, with the diameter-pressure curves shifted to higher diameters in the entire pressure range. Compliance and distensibility were augmented in shunted arteries at mean *in vivo* pressure, while incremental elastic modulus was reduced. We infer that the biomechanical adaptation seems relevant with the alterations in connective tissue composition, in particular the fragmented elastin and increased collagen content. Our findings provide evidence that biomechanical adaptation in moderate flow-overload leads to normalization of intimal shear without, however, restoring compliance to control levels.

Keywords: Arteriovenous shunt, remodeling, biomechanical properties, opening angle, elastin, collagen.

Submitted

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