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Conference Abstract

P.08 Biomechanical Characterization of Ascending Thoracic Aortic Aneurysms in Humans: A Continuum Approach to *in vivo* Deformations

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Keywords

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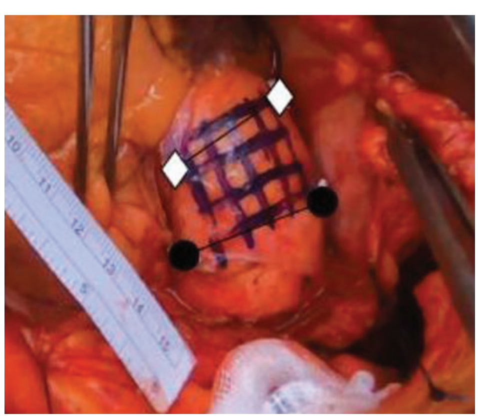
ABSTRACT

Background: Dysfunctional cellular mechanosensing appears central to aneurysm formation [1]. We aimed to derive material parameters of aneurysm tissue from *in vivo* deformations, which may increase insight into the underlying structural integrity of the pathological tissue.

Methods: Videos of tracking markers (example **Video** in supplement, screenshot in Figure) placed on ascending aortic segments were captured alongside radial arterial blood pressure in patients undergoing open-thorax ascending thoracic aorta aneurysm (ATAA) repair (n = 5) and coronary bypass (controls; n = 2). Normalised cross-correlation was used to determine marker displacements, resulting in estimates of systolic/diastolic diameters, distensibility, and cyclic axial engineering strain. A thin-walled, cylindrical geometry was assumed, with amorphous (Neo-Hookean) and fibrous (two-family) constitutive contributions [2]. This framework was fitted to individual patient measurements, by varying parameters c (amorphous material constant), k_1 and k_2 (fiber stiffness and strain stiffening parameter), β (fiber angle w.r.t. circumferential direction), unloaded intact length (L), and internal radius (R_1).

Results: Axial strain tended to be lower (expected) and distensibility larger (unexpected) in aneurysm than controls (Figure). However, the intrinsic pressure-dependence of distensibility must be considered when drawing conclusions related to differences in structural stiffness between both groups [3]. Material stiffness parameters (c and k_1) appeared higher in aneurysm patients than in controls which is in line with previous studies in mice [4].

Conclusion: We are developing a method to determine ATAA material properties from *in vivo* deformations and observed increased material stiffness in ATAA.



		Aneurysm	Control
Measured outcomes			
Diastolic diameter	[mm]	40 ± 5	23 ± 3
DBP	[mmHg]	58 ± 11	34 ± 2
SBP	[mmHg]	90 ± 18	93 ± 7
Distensibility	[MPa^{-1}]	4.3 ± 3.0	3.7 ± 1.1
Axial strain	[%]	4.3 ± 2.1	7.6 ± 3.5
Estimated properties			
c	[kPa]	37 ± 29	15 ± 13
k_1	[kPa]	43 ± 26	24 ± 24
R_1	[mm]	17 ± 1	10 ± 1
β	[degrees]	35 ± 3	36 ± 2
k_2	–	34 ± 9	37 ± 3
L	[mm]	24 ± 5	15 ± 2

Figure | Left: Example of ascending aortic region of interest with tracking markers. Right: Data presented as mean ± standard deviation. SBP/DBP, systolic/diastolic blood pressure. Estimated properties are defined in the text.

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