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MULTI-MODAL REGIONAL CHARACTERIZATION OF MATERIAL PROPERTIES ACROSS MURINE DISSECTING ANEURYSMS

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Previous work has shown that chronic infusion of angiotensin-II in atheroprone (ApoE-/-) mice provides a reproducible model of dissecting aortic aneurysm, often including a false lumen with intramural thrombosis. Such dissected aneurysms present complex morphologies, with regions characterized by localized changes in aortic wall composition and structure. Using this mouse model, the objective of this study is to quantify local mechanical properties in site-specific aneurysms by combining a tension-inflation test, multi-modality full-field strain measurements and a regional inverse analysis based on the virtual fields method.
The originality of the approach relies on the multimodality reconstruction of the strain fields. For that, deformations of the outer surface of the wall are measured by tracking the deformation of a (lightly painted) speckle pattern through a custom panoramic digital image correlation technique. The deformations across the thickest cross sections of the wall, including the thrombus, are measured using images obtained with an Optical Coherence Tomographic scanning system and processed using digital volume correlation. Both measurements are registered and combined to reconstruct completely the 3D strain fields across the whole dissected aneurysm.
Results obtained with the technique reveal that the wall has acquired a local material stiffness larger than 5 MPa on the dissected side of the artery where there is the thrombus, whereas the stiffness is about 1MPa on the side of the intact wall. This is the first time that regional variations of material properties have been characterized in such heterogeneous and complex arterial segments. Given that remodeling is critical to the formation and growth of these dissected aneurysms, it is expected that the obtained material properties constitute essential data to understand the pathologic biomechanical mechanisms. To that purpose, in the future, we plan to develop correlations between the identified regional mechanical properties and constituent area fractions obtained using quantitative histological analyses.

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