

## **RUPTURE RISK ESTIMATION OF ATAA BASED ON IDENTIFICATION OF LOCAL MEMBRANE STIFFNESS**

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Ascending thoracic aortic aneurysm (ATAA) is a bulged area in the aorta growing slowly but without symptoms, making them difficult to detect. Small- and slow-growing thoracic aortic aneurysms may not ever rupture, but large- and fast-growing aneurysms may lead to death due to dissection or rupture of the aneurysm. Depending on the growth rate and size of the thoracic aortic aneurysm, treatment may vary from watchful waiting to emergency surgery. Surgery for an ATAA can be planned by replacement of the enlarged aortic segment with synthetic grafts if necessary. Surgical intervention is recommended when its diameter is larger than 5.5 cm or when it is considered as fast growing aneurysms [1]. It is proved that the diameter of 5.5 cm as a criterion for planning a surgical intervention is an inadequate factor. Our research group has established a rupture risk based on the in vitro extensibility of the tissue for a cohort of 31 patients and demonstrated that the rupture risk is strongly correlated with the physiological elastic modulus of the tissue [2]. In the next study they estimated volumetric and cross sectional distensibility using a preoperative dynamic CT scans on a cohort of 13 patients. The failure criteria based on in vitro ultimate stretch displayed a significant correlation with the membrane stiffness obtained from in vivo distensibility [3]. Recently, we developed a non-invasive inverse method to identify the patient-specific local membrane stiffness of aortic walls based on CT scans. Using these images, a structural mesh is generated across the aorta with a set of nodes attached to the same material points at different phases of the cardiac cycle. Fourier series is used to analyse time variations of the position of each node, providing the reconstruction of the local strain distribution. Subsequently, obtained strains are related to tensions with the membrane stiffness, by considering the local equilibrium, to estimate the local membrane stiffness at every position. In this study, the methodology is applied onto the ascending aorta of 13 patients. The mean values are identified for the in vivo and in vitro corresponding cuts. Afterwards we demonstrate the correlation between local membrane stiffness using aforementioned methodology and risk of rupture based on the in vitro ultimate stretch [2]. Finally, we compare the results with the results derived from in vivo distensibility and in vitro results obtained from bulge inflation test [2,3].

### **REFERENCES**

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