

## Aneurysms - Diagnosis and Personalized Treatment

**Commonly used acronym:** ADAPT

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### Partners and collaborations

Katholieke Universiteit Leuven (KUL), Katholieke Universiteit Leuven (KUL), Katholieke Universiteit Leuven (KUL)

## SCOPE OF THE METHOD

<b>The Method relates to</b>	Human health
<b>The Method is situated in</b>	Translational - Applied Research
<b>Type of method</b>	In silico

## DESCRIPTION

### Method keywords

aneurysm  
blood vessel  
finite element modeling  
tensile testing

### Scientific area keywords

continuum mechanics  
cardiovascular disorders  
mechanical testing  
nonlinear finite element analysis

### Method description

Aortic aneurysms consist of a localized dilatation of the aorta resulting from compromised structural integrity and are characterized by a diameter increase of at least 50% compared to a reference diameter. When left untreated, aneurysms tend to progressively enlarge, with an increased risk of catastrophic events, i.e. rupture or dissection. Given the dangers and expenses related to surgery, risk stratification is crucial. The current criterion provides a rough estimate of the rupture risk of aneurysms; however, it has been shown that adverse events can occur in aneurysms not meeting the surgery criteria, while a large aneurysm may remain stable for the patient's lifetime. We propose a biomechanics-based approach, in which the peak wall stress is calculated and compared to the aneurysm wall strength. CT scanning, uniaxial tensile testing, planar biaxial tensile testing, microstructural analysis and finite element modeling are needed to retrospectively estimate patient-specific values for peak wall stress and wall strength. Our current research is directed at correlating these retrospective findings to non-invasive patient parameters (general patient health parameters as well as compliance estimates from time-resolved CT scanning), such that a prospective risk index can be defined.

### **Lab equipment**

Planar biaxial testing device time-resolved CT scan.

### **Method status**

Still in development

Published in peer reviewed journal

## **PROS, CONS & FUTURE POTENTIAL**

### **Advantages**

The method will allow a non-invasive estimation of aneurysm rupture risk with increased predictive potential than the current geometry-based criterion.

### **Challenges**

The method is sensitive to patient-specific parameters that can only be obtained with a substantial degree of uncertainty.

### **Modifications**

The method is currently being expanded to also predict aneurysm growth for patients that do not yet meet the criterion for surgery.

## **REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION**

### **References**

Smoljkic M, Verbrugghe P, Larsson M, Widman E, Fehervary H, D'hooge J, Vander Sloten J, Famaey N. Comparison of in vivo vs. ex situ obtained material properties of sheep common carotid artery Medical Engineering & Physics Mar 2018 (Journal article)  
Farotto D, Segers P, Meuris B, Vander Sloten J, Famaey N. The role of biomechanics in aortic aneurysm management: requirements, open problems and future prospects Journal of the Mechanical Behavior of Biomedical Materials 77:295-307 Article number S1751-6161(17)30362-4 Jan 2018 (Journal article)  
Smoljkic M, Fehervary H, Van den Bergh P, Jorge Peñas A, Kluyskens L, Dymarkowski S, Verbrugghe P, Meuris B, Vander Sloten J, Famaey N. Biomechanical characterization of ascending aortic aneurysms Biomechanics and Modeling in Mechanobiology 16(2):705-720 2017 (Journal article)

Smoljkic M, Vander Sloten J, Segers P, Famaey N. Non-invasive, energy-based assessment of patient-specific material properties of arterial tissue Biomechanics and Modeling in Mechanobiology 14(5):1045-56 Oct 2015 (Journal article)

## Links

[Farotto 2018](#)  
[Smoljkic 2018](#)  
[Smoljkic 2017](#)  
[Smoljkic 2015](#)

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