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

The Method relates to	Human health
The Method is situated in	Translational - Applied Research
Type of method	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 vales 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

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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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