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Experimental Aneurysm Rig

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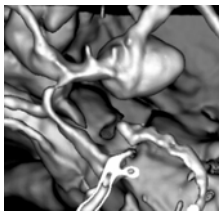
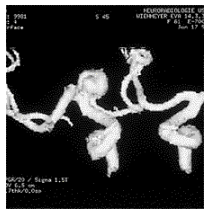
Introduction

Cerebral-aneurysms are antrums in the blood vessels of the human brain. Whenever a aneurysm bursts in the brain, there is danger of life of the patient. That is called “rupture“ in the medical terminology.



Diagnosis of aneurysms with 3D-angiographie

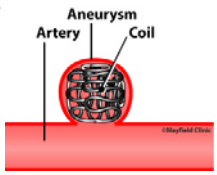


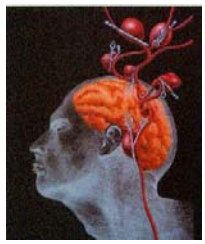
Diagnosis of several aneurysms with magnetic-resonance-tomographie

The better and better growing diagnostic procedures enables more detailed statements about the characteristic features of the available aneurysms. These statements are very helpful for the decision of the best therapy method.

Basically, there are two kinds of therapy:

- coiling
- clipping





Clipped aneurysms charting

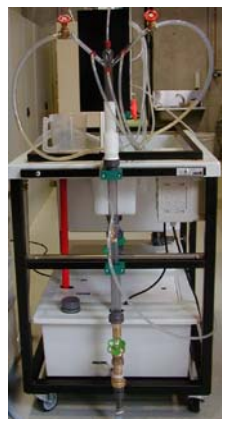
Set-Up

For simplification of the measuring problem and for well defined boundary conditions for numerical as well as physical simulations, a glass model is used.

Blood ís a non-Newtonian fluid. Even though water is a Newtonian fluid, it can be used in the attempt as a first approximation, because the influence of the blood cells on the viscosity is worth mentioning only if vascular diameters and dimension of the blood cells have the same scale.

The glass model of the aneurysm is based on the „terminal“ aneurysm, which is the most frequently occurrence of aneurysm in the brain.

The experimental set-up guaranties that very low flow velocities can be simulated in the model of the aneurysm, as they can be found in brain vessels.



Complete experimental rig of the aneurysm

CAD-model of the „terminal“ aneurysm for the experimental rig, with the carrier to measure velocities and preassures at different locations in the aneurysm.

Focus of Investigation

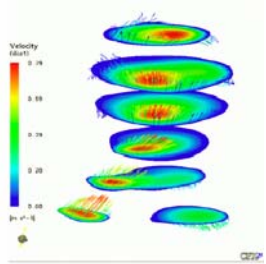
- Collection of explanations about current behavior and current flow speeds in the aneurysm model. From there we want to confirm the hypothesis that the current behavior has influence on the origin and rupture of aneurysms.

  These results can be incorporated in a catalogue of attributes.

Visualisation of flow using the hydrogen bubble method

- For the verification (calibration) of numerical simulations of aneurysms, *Computational Fluid Dynamics* (CFD) are used.

  Therefore, a defined model of an aneurysm is used, that will be transfered into a CFD model.

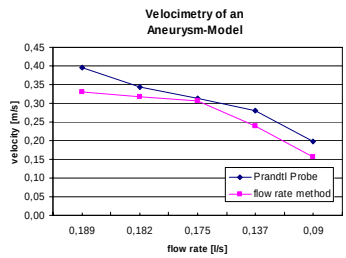


Numerical simulation of an array of velocities in a model of an aneurysm, using CFD

Conclusion

The velocity in the aneurysm-model is determined, using the Prandtl probe.
The flow-rate-method approves these results.

In the next step a 2D vector of velocities is recorded, using a hot-wire anemometer (CTA).
The results will be compared with the numerical simulation of the aneurysm-model.



Comparison of Prandt probe and flow-rate-method for the determination of velocity.

Different experiments have been in progress, to visualize the flow and to get further information about the flow in aneurysm-models.

Visualization of flow using the dye injection method

Visualisation of flow using the hydrogen bubble method

References: http://www.hirn-aneurysma.de/index.php

Tong-Miin Liou, Shuenn-Nan Liou: A review on in vitro studies of hermodynamics characteristics in terminal and lateral aneurysm models. Department of Power Mechanical Engineering National Tsing Hua University Hsinchu, Taiwan 30.11.1998