Labor Windkanal/Strömungsmesstechnik

FACHHOCHSCHULE REGENSBURG
UNIVERSITY OF APPLIED SCIENCES
HOCHSCHULE FÜR TECHNIK WIRTSCHAFT SOZIALWESEN

Experimental determination of the velocity-field within an aneurysm model

Christian Klopsch

October 2004 to February 2005

e-mail: christian.klopsch@freenet.de

Mechanical engineering, Galgenbergstr. 30, D-93053 Regensburg - Germany, Head: Prof. Dr.-Ing. Stephan Lämmlein
http://www.fh-regensburg.de

Introduction

An aneurysm is defined as an enlargement of the human artery. The shape of the aneurysm can be compared with a balloon. The burst of an aneurysm is life-threatening for the patient. Approximately five percent of the population have at least one aneurysm of which about one fifth rupture. The mortality rate caused by the resulting cerebral hemorrhage is about fifty percent. Many survivors stay disabled for the rest of their lives.

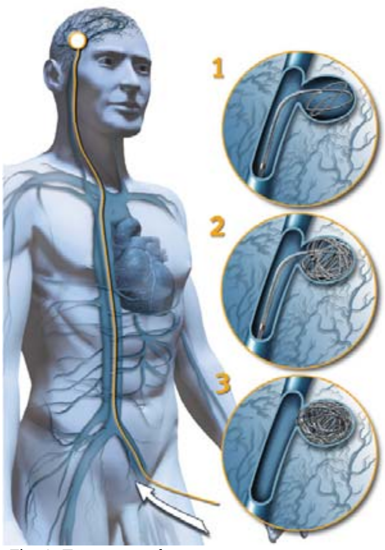

Fig. 1: Treatment of an aneurysm

Set-Up

A copy of the terminal cerebral aneurysm was built in form of a glass model (scale 7:1). The velocity was measured with a hot film probe (a). The pressure was indicated with a Prandtl's pitot tube (b) in combination with a differential pressure manometer. The model was streamed under steady state condition. The mean velocity and the mean pressure within the human artery were converted to model size and adjusted. The hot film probe was moved during the measurement on four straight lines (1 – 4), which are placed on two measurement planes (A and B).

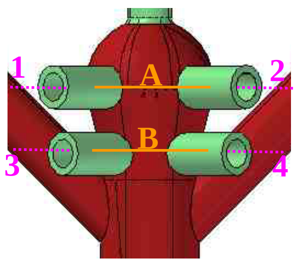

Fig. 3: Straight-lines and planes for measurement

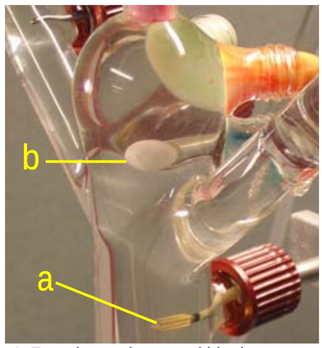

Fig. 4: Experimental setup within the aneurysm

Focus of Investigation

The goal is to acquire more knowledge about the flow conditions within the aneurysm. The hypothesis that the flow condition, aside from the weakness of the artery-wall, is responsible for the formation and rupture of aneurysms is to be confirmed. This will be proved by means of measuring the pressure and the velocity within a model of a human cerebral aneurysm.

The results of the flow measurements are used for

- basic investigations of velocities and pressures of the flow. Heart rate, size and shape of the aneurysm should be taken into account as additional information. A long-term objective is the creation of a criteria catalog.
- calibration of a numerical simulation. The flow within the aneurysm can be calculated via PC by means of CFD programs. The goal is to adapt the CFD results to the experimental measurements (see fig. 2).

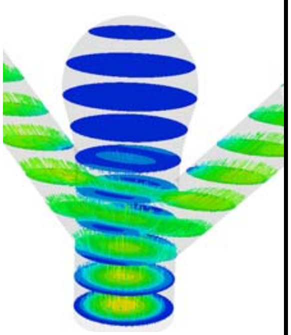

Fig. 2: CFD-calculation

Conclusion

The conclusion was reached that fluctuation can only be recognized in measurement plane B.
At measurement line 4 the U-component of the velocity is between 0,009 to 0,014 m/s and the V-component between 0 and -0,005 m/s (see fig. 5). Results of the same kind appear on measurement line 3. This was to be expected on account of the symmetry of both axis. Furthermore it could be observed that the velocity of the flow decreases when measurements closer to the wall are taken. The explanation for this fact is that the friction between the wall and the fluid is zero.

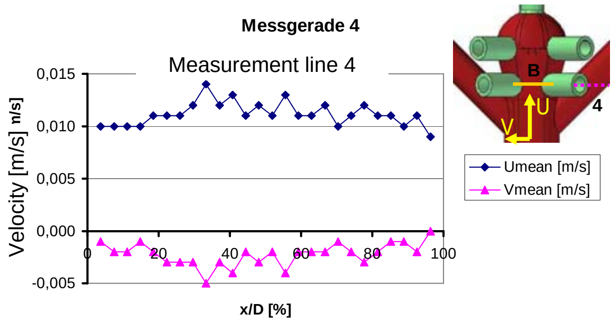

Fig. 5: Results of the velocity detection with the film probe

References: - Amendt, M.: *Versuchsaufbau und experimentelle Erprobung eines Aneurysma-Versuchstandes*. Diplomarbeit FH Regensburg, FB Maschinenbau, 2004
- Lämmlein, S: *Technische Strömungsmechanik mit Formelsammlung*. FH Regensburg 2002
- http://www.aktion-meditech.de/techno_hirn.php?id=techno_hirn_spirale (triage date 08.11.2004)