In Vitro Therapy Planning after a Failed Coiling of the Basilar Artery Aneurysm

Leonid Goubergrits, Nils Wiegmann, Jens Schaller, André Berthé, Ulrich Kertzscher, Christoph Petz, Hans-Christian Hege, Heiner Hoch, Andreas Spuler

Introduction
Hemodynamics plays a significant role in formation and growth of cerebral aneurysms and influences the effectiveness of therapy. We present the case of an aneurysm at a fenestrated basilar artery. Control angiography (6 months later the coiling procedure) revealed partial refilling of the aneurysm (see fig. 1, left). In this situation, incomplete Hunterian ligation i.e. clipping of one of the two vertebral arteries would be a surgical option. The flow changes due to such a procedure were investigated experimentally.

Methods
Three-dimensional Rotational Angiography was performed after the failed coiling procedure. Geometry of the aneurysm rest and the corresponding arteries was reconstructed (see fig. 1, right) from data with an isotropic voxel size of 0.222 mm³ using software ZIB-Amira (Berlin, Germany). From these data a two-fold enlarged transparent silicone model was fabricated.

Flow changes due to clipping of the left or the right vertebral artery under pulsatile flow conditions for two different (low and high) flow rates were studied by means of particle image velocimetry (PIV).

Results
Vector fields revealed remarkable differences between the simulated flow patterns in the original setting and after partial Hunterian ligation (fig. 2). Clipping of the left or right vertebral artery causes either an increase or a decrease of the flow in the aneurysm baring segment of the parent vessel. Flow increase, however, may be accompanied by an unwanted increase of flow irregularities, which may promote thrombus formations.

Conclusions
Hunterian ligation may change the flow near the aneurysmal neck thus preventing further aneurysmal growth. The selection of the site for clipping is, however, challenging and requires further studies.