

## Micro-Doppler with 16 MHz

### Background:

Outcome of surgical treatment of cerebral aneurysms may be severely compromised by local cerebral ischaemia or infarction resulting from the inadvertent occlusion of an adjacent vessel by the aneurysm clip, or by incomplete aneurysm closure. It is therefore mandatory to optimise clip placement in situ to reduce the complication rate. In postoperative digital subtraction angiography (DSA), unexpected aneurysm residuals and vessel occlusions are frequently detected. Intraoperative Micro-Doppler (IMD) may help to optimize clip positioning and therefore reduce complications.

### Literature:

#### **Intraoperative Doppler and Duplex sonography in cerebral aneurysm surgery.**

Author	(Heiroth u. a., 2011)
Content/Summary	In 38 cases DDS allowed for visualisation of aneurysm localisation, neck and diameter, as well as associated vessels, in accordance to preoperative DSA. This was confirmed by Duplex sonography in 94.7%. Further evaluation of each associated vessel after clip positioning was then enabled by Doppler sonography in 84.8%. Visualisation in terms of B-mode sonography was not successful in six cases due to multiple clips.
Comment	A total of 44 aneurysms in 40 patients were investigated intraoperatively via B-mode and power Duplex sonography
Doppler-device	B- mode Duplex
<b>Quantification</b>	It is not yet able to replace DSA in aneurysms with complex configuration.

#### **Role of intraoperative microvascular Doppler (IMD) in the microsurgical management of intracranial aneurysms.**

Author	(Cui u. a., 2011)
Content/Summary	The findings of IMD helped in adjusting the clip placement. In 9 (10.6%) of the 85 aneurysms, IMD revealed a persistent blood flow through the aneurysmal sac after clip application and the clip was repositioned. IMD showed relevant stenosis of adjacent vessels induced by the clip positioning in 10 of 79 (12.7%) cases. In six cases (7.6%), a blood flow reduction in the artery feeding the aneurysm was evident after clipping; in the other four cases (5.1%), the clip produced a severe blood flow reduction in other adjacent vessels.
Comment	We conducted a retrospective analysis of 79 patients, with a total of 85 intracranial aneurysms, who were evaluated with IMD using a 20-MHz probe before and after clip application.

Doppler-device	Companion III; SciMed, Bristol, UK
Quantification	IMD is a safe, feasible, and very reliable technique and should be used routinely in intracranial aneurysm surgery. There were no complications related to the use of IMD.

### Near-infrared indocyanine green videoangiography versus microvascular Doppler sonography in aneurysm surgery.

Author	(Fischer u. a., 2010)
Content/Summary	Both techniques have specific drawbacks that could be compensated by each other. This study implicates that the combination of both applications on a routine basis assures the quality of aneurysm surgery by nearly noninvasive and cost-effective techniques However, DSA remains the gold standard for evaluation of aneurysm occlusion.
Comment	Intraoperative applicability of each technique was compared to each other and to postoperative digital subtraction angiography as standard evaluation technique.
Doppler-device	DWL Electronic Systems Inc.
Quantification	ICG-VA and mDs should not be considered competitive, but complementary.

### The role of intraoperative micro-Doppler ultrasound (MDU) in verifying proper clip placement in intracranial aneurysm surgery.

Author	(Kapsalaki u. a., 2008)
Content/Summary	Presence of SAH, anatomic location and size of the aneurysm were associated with improper clip placement in a statistically significant fashion. The false positive rate for MDU was 2% while there were no false negative findings in our study.
Comment	One hundred and thirty-four patients surgically treated for 147 intracranial aneurysms were studied.
Doppler-device	Conforma Micro-Doppler (Cook Vascular Inc., Leechburg, PA, USA)
Quantification	MDU appears to be a non-invasive, reliable alternative methodology to intra-operative angiography.

### Image-guided microneurosurgical management of small arteriovenous malformation: role of neuronavigation and intraoperative Doppler sonography.

Author	(Akdemir u. a., 2007)
Content/Summary	Complete removal of the AVMs was accomplished in 24 (96%) out of 25 patients which was confirmed with postoperative digital subtraction angiography (DSA). While there was no mortality, three patients (12%) had a worsening in their neurological status after surgery.
Comment	25 patients with small arteriovenous malformations (grades I-III) underwent microsurgical removal. A passive-marker-based neuronavigation system (Brain Lab, Munich, Germany), and an intraoperative MDS (Multi Dop X, DWL, Germany) were used in this surgery.
Doppler-device	DWL
<b>Quantification</b>	Image-guided microneurosurgery with intraoperative MDS is a safe, effective, and reliable method for identifying the afferent and efferent vessels and for confirming the complete resection of AVMs. These benefits of image-guided microsurgery were most apparent for small, deep-seated AVMs that were not visible on the surface of the brain. In addition these techniques reduce the operative time and blood loss during AVM resection.

### Intraoperative microvascular Doppler ultrasonography monitoring in intracranial aneurysm surgery

Author	(Tong u. a., 2007)
Content/Summary	MDU (micro doppler US) verified 6 cases of stenosis or occlusion of an adjacent vessel induced by clip positioning that had escaped detection by visual inspection (12.76%, 6/47). In addition, MDU demonstrated that one out of the 51 aneurysms failed to be occluded (1.96%).
Comment	Article in Chinese. 46 patients with 51 cerebral aneurysms undergoing 47 operations
Doppler-device	Not known
<b>Quantification</b>	MDU should be used routinely in cerebral aneurysm surgery, especially in cases of giant aneurysms and aneurysms without obvious neck. In cases of ACoA and ICA aneurysms, MDU is more useful.

### Intraoperative microvascular Doppler sonography in aneurysm surgery.

Author	(Akdemir u. a., 2006)
Content/Summary	The aneurysm clip was repositioned on the basis of the MDS findings in 12 out of 48 patients (25%). For 9 aneurysms (18.7%) MDS exposed a relevant stenosis of an adjacent vessel induced by clip positioning that had escaped detection by visual inspection. Clip repositioning resulted in complete occlusion of the aneurysms in 7 of 9 cases (14.5%). In two cases, additional wrapping became necessary as it was not possible to achieve complete clipping. The mean duration of MDS investigations was 5.3 minutes. There were no complications of intraoperative MDS probe use.
Comment	For 40 patients (21 men, 19 women, mean age 54.0 years, range 23-73 years) who underwent surgery for the treatment of 48 intracranial aneurysms, microvascular Doppler sonography was used.
Doppler-device	Not known
Quantification	Intraoperative MDS should be used routinely in cerebral aneurysm surgery, especially for large, complicated and giant aneurysms. Intraoperative MDS is a feasible, safe, and very reliable technique in aneurysm surgery.

### The value of micro-Doppler in stereotactic brain biopsy (SBB).

Author	(Hertel u. a., 2005)
Content/Summary	A signal of arterial vessels was detected in 22 (14 %) and a signal of venous vessels in 35 cases (23 %). Detection of a vessel in the micro-Doppler led to a change of the biopsy site in each case within the same trajectory. Biopsy-related bleedings were detected in 4 cases (2.6 %). Among these, the only bleeding which occurred without any signs of vessels in the micro-Doppler happened in a case of a melanoma. The overall biopsy-related permanent morbidity was 0.6 % (n = 1). The biopsy-related mortality was 0.
Comment	155 SBBs were performed in 153 patients with micro-Doppler (81 males, 72 females, mean age: 59 years). All operations were performed using a ZD-frame and a multiplanar computer tomography-guided trajectory planning system (Leibinger SPP). A 16 MHz micro-Doppler probe (diameter 1 mm, DWL) was used in all cases to explore the area of biopsy before the tissue probes were taken
Doppler-device	DWL
Quantification	Despite the overall high security of SBB, the use of intraoperative micro-Doppler may lead to an additional reduction of the risk for a biopsy-related bleeding without enormous expense.

## **Summary:**

IMD is a safe, feasible, and very reliable technique and should be used routinely in intracranial aneurysm surgery. Complications related to the use of IMD are rare. Furthermore its use in other surgical treatments, like brain biopsies, may reduce unexpected bleeding rates. Other intraoperative monitoring tools and mDs should not be considered competitive, but complementary.

## **Experts:**

Akdemir

## **Literature**

Akdemir H, Oktem IS, Tucer B, Menkü A, Başaslan K, Günaldi O. Intraoperative microvascular Doppler sonography in aneurysm surgery. *Minim Invasive Neurosurg* 2006; 49: 312-316.[zitiert 2011 Nov 29]

Akdemir H, Oktem S, Menkü A, Tucer B, Tuğcu B, Günaldi O. Image-guided microneurosurgical management of small arteriovenous malformation: role of neuronavigation and intraoperative Doppler sonography. *Minim Invasive Neurosurg* 2007; 50: 163-169.[zitiert 2011 Okt 29]

Cui H, Wang Y, Yin Y, Wan J, Fei Z, Gao W, u. a. Role of intraoperative microvascular Doppler in the microsurgical management of intracranial aneurysms. *J Clin Ultrasound* 2011; 39: 27-31.[zitiert 2011 Nov 29]

Fischer G, Stadie A, Oertel JMK. Near-infrared indocyanine green videoangiography versus microvascular Doppler sonography in aneurysm surgery. *Acta Neurochir (Wien)* 2010; 152: 1519-1525.[zitiert 2011 Nov 29]

Heiroth H-J, Etminan N, Steiger H-J, Hänggi D. Intraoperative Doppler and Duplex sonography in cerebral aneurysm surgery. *Br J Neurosurg* 2011; 25: 586-590.[zitiert 2011 Nov 29]

Hertel F, Feiden W, Bettag M. The value of micro-Doppler in stereotactic brain biopsy. *Minim Invasive Neurosurg* 2005; 48: 165-168.[zitiert 2011 Okt 29]

Kapsalaki EZ, Lee GP, Robinson JS 3rd, Grigorian AA, Fountas KN. The role of intraoperative micro-Doppler ultrasound in verifying proper clip placement in intracranial aneurysm surgery. *J Clin Neurosci* 2008; 15: 153-157.[zitiert 2011 Nov 29]

Tong J, Wang S, Zhao Y-li, Zhao J-zong. [Intraoperative microvascular Doppler ultrasonography monitoring in intracranial aneurysm surgery]. *Zhonghua Yi Xue Za Zhi* 2007; 87: 881-884.[zitiert 2011 Nov 29]