Dear Member,

I am happy to introduce to you the second edition of our newsletter. The second edition is always an important step, because it marks the beginning of continuity and I am very optimistic that we are now able to establish this newsletter as a regular publication for you members of the section. Again, the editors of this newsletter have put together a nice collection of up to date information and educational aspects.

I would like to point out particularly the upcoming vascular section meeting in September in Nice, which will again take place in conjunction with our friends and collaborators from ESMINT. It would be an ideal opportunity especially for younger neurosurgeons, interested in cerebrovascular diseases, to attend and present their work. It is the definite goal of the organizers to accept not only the opinion leaders, but also the next generation at the level of young faculty and residence.

I hope you enjoy this newsletter and find interesting information. I would like to encourage you to write to the Editorial team if you have any suggestions for future editions. Otherwise I wish you a relaxing and enjoyable remaining summer.

All suggestions of publication in any part of the newsletter can be addressed by email to peter.vajkoczy@charite.de and nils.hecht@charite.de.

Sincerely,

Peter Vajkoczy, on behalf of the Neurovascular Section
Nils Hecht, Newsletter Editorial Office
Comments

Please do let us know if you have something for comment, or would like to comment yourself.

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**First Vascular section Webinar**

**Tuesday 4th September 2018 at 1600 (CET)**

Francesco Signorelli has kindly arranged for Prof. Marco Fontanella, chairman of the Neurosurgical Dept. of the University of Brescia to speak on the topic of Brain Cavernous Malformations.

Further information and the link to join the meeting will follow towards the end of August.

But for now please...

**Save the date!**

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**Don't forget to register for the 5th Annual EANS Vascular section meeting!**

**EANS Vascular Section Annual Meeting**

7th and 8th September 2018 in Nice, France

For all information, registration, and details of CME accreditation please visit the [meeting website](#).
Technological Developments and Featured Cases

Augmented Reality in Vascular Neurosurgery
Lima Sprenger, MD, Gregory Zegarek, MD, Karl Schaller, MD, Karima Tizi, MD, Philippe Bijlenga MD-PhD
Geneva University Hospital, Geneva, Switzerland

Introduction
Augmented reality (AR) is an innovative and computer-mediated tool which has become more and more prominent over the years in our society to improve one’s perception of reality in a variety of domains. Applied to neurosurgery, where the use of neuronavigation has become standard for a growing number of procedures, AR allows the surgeon to integrate the neuronavigation while keeping his focus on the operative field. In AR navigated interventions, the information is delivered to the surgeon through the eyepiece of the microscope rather than being presented on a separate navigation monitor. However, it is important to keep in mind when relying on navigation, augmented or otherwise, that there are inherent limitations to this technology due to the indirect nature of the tracking devices and the elastic nature of the brain. Recognizing that navigation data needs to be constantly controlled and updated, AR offers a live control over navigation inconsistencies and allows real-time adjustments. In addition, AR also represents a modern teaching tool for beginner surgeons and enables tailored key-hole craniotomies with more focused trajectories. As described in detail in our previous published works (1-3), we present our experience using AR in vascular neurosurgery.

Workflow
Imaging modalities such as Cerebral Angio-CT, MRI Time Of Flight (TOF) sequences or Digital Rotational Angiography may be used for preoperative segmentation using iPlan® or Elements surgical apps (Brainlab, Feldkirchen, Germany). First, the skin surface of the head, the skull and its sutures, and vascular structures that might be seen along the surgical dissection are segmented as reference objects. Aneurysms with the dome and neck as well as perforator arteries are identified as target objects. In arteriovenous malformation (AVM) surgeries, the nidus, the feeders, draining veins and “en passant” feeders are segmented and used as target objects. In dural fistulas, the fistula point is marked with the feeder and venous drainage. In the operating theater, surface matching registration is performed and the microscope is
calibrated. Accuracy is checked with 3D volumes displayed over the real structures. The human eye is easily able to recognize offsets which are then corrected on the touch screen monitor by sliding the segmented reference object to match the real reference structure. Precision registration is performed in every axis with the skin mask perfectly overlaying the patient nose, eyes and ears. 

The target object (e.g. aneurysm, AVM) and optimal surgical trajectory is then displayed in the microscope to plan the skin incision and craniotomy. Then the surgeon proceeds with dissection of the approach with constant re-adjustment of the registration using reference augmented structures (e.g. signature vascular structures, cortex-white matter interface, ventricles) along the way.

**Pearls and Pitfalls**

AR facilitates the surgeons’ mental task of combining segmented navigation data with real anatomy and therefore reduces attention shifts. (4) A touch-screen based matching of augmented volumes with real structures on the monitor allows a millimetric re-registration of the navigation, thus increasing the reliability of the navigation. Microscopically, through the use of pre-segmented reference structures, AR allows also a live control with the human eye. AR-planned and tailored key-hole craniotomies are more accurate. Preoperative segmentation allows identification and anticipation of key structures, thus allowing a comprehensive preoperative planning and teaching.

**Featured Cases**

AR is used in our department for many types of surgeries. However, vascular neurosurgery is especially suited for AR and permits a nice illustration of the concept and benefits of AR. One of our AVM cases performed in a hybrid OR setting with the use of augmented reality has been the subject of a published case report (5): A 40 years-old patient presented with left hemiplegia and right mydriasis. Imaging showed a hematoma of the right basal ganglia and the internal capsule with mass effect on surrounding structures. An emergency decompressive hemicraniectomy was performed. An AVM was suspected and post operative angiography showed a very ill-defined striatal AVM Spetzler-Martin grade III. One single tortuous feeding lenticulostriate artery was identified with a pre-nidal aneurysm-like dilatation and the drainage was deep through the inferior striatal vein into the Rosenthal vein. Endovascular arterial embolization was not feasible. Thus, a hybrid strategy with venous embolization combined with AR guided surgery was performed to avoid rupture of the aneurysm-like formation. With AR guidance, a tailored key-hole craniotomy was created over the Sylvian fissure, which was precisely dissected to reach the lenticulostriate perforator arteries. Further dissection was performed to identify the feeders of the AVM buried in the tangle of vessels (Figure 1). A clip was placed on the feeding artery and the AVM was embolized via the venous circulation by the interventional neuroradiologist (Figure 2). Transarterial intraoperative angiography showed a perfect exclusion of the AVM. With the use of AR, the surgeon was able to maintain his focus on the operative field. Target objects were
identified and navigation mismatches were recognized. Readjustments using reference structures and anatomical landmarks along the dissection were easy and accurate.

Figure 1: Surgeon’s view of the Sylvian fissure. Left: virtual surface rendering objects showing the distal portion Sylvian artery at the bottom of the image, the lenticulostriate artery, the carotid artery on the upper left and the target location (green dot). Right: AR vessels contours (semi transparent orange) and target location (green dot) are superimposed to the actual anatomy viewed through the microscope.

Figure 2: Hybrid OR setting
Further, AR permits recording of operative photographs and videos in relation with the 3D pre-operative imaging, which is shown in this second case of of an unruptured parieto-occipital AVM in contact with the optic radiation (Figure 3): After precise re-registration, white matter stimulation point coordinates are recorded and correlated to electrical signals for electrophysiological
Figure 3: The surgeon’s view (Augmented Volumes) shows the AVM surface vessels with superimposed segmented vessels below (dim) and within (bold) the focal plane. The “Probe’s Eye” view shows the microscope field projection of the Maximum Intensity Projection of the TOF MRI. The “Target” shows the 3D volume rendering of the AVM from the surgeon’s point of view. The “Overview” shows the microscope optic axis (interrupted blue line) and field of view (blue circle) as well as the focal plan and surgical image projection within the pre-operative imaging.
Figure 4: Surface rendering of the optic radiation (green) is displayed in the surgical field. The coordinates of the white matter stimulation position are recorded and displayed on the traditional orthogonal views of the navigation monitor (microscope optical axis: solid blue line, stimulator: dotted blue line).

References
Restenosis and risk of stroke after stenting or endarterectomy for symptomatic carotid stenosis in the International Carotid Stenting Study (ICSS): secondary analysis of a randomised trial

In this study, published in a high-impact journal, the authors present results of a randomized trial at 50 tertiary care centers in Europe, Australia, New Zealand, and Canada including patients aged 40 years or older with symptomatic carotid stenosis measuring 50% or more, assigned either stenting or endarterectomy in a 1:1 ratio. The International Carotid Stenting Study (ICSS) is the largest randomized trial reporting long-term restenosis of various severity and subsequent risks of stroke after stenting versus endarterectomy for treatment of symptomatic carotid stenosis.

Methods:
Randomization was computer-generated and done centrally, with allocation by telephone or fax, stratified by center, and with minimization for sex, age, side of stenosis, and occlusion of the contralateral carotid artery. Patients were followed up both clinically and with carotid duplex ultrasound at baseline, 30 days after treatment, 6 months after randomization, then annually for up to 10 years. Restenosis was defined as any narrowing of the treated artery measuring 50% or more (moderate) or 70% or more (severe), or occlusion of the artery. The degree of restenosis based on ultrasound velocities and clinical outcome events were adjudicated centrally; assessors were masked to treatment assignment so that bias is minimized.

Results:
The results of the current analysis show that moderate or higher (≥50%) restenosis is significantly more frequent after stenting compared with endarterectomy, but severe (≥70%) restenosis rates did not differ. These findings are in accordance with previous data. ICSS is the first trial to show that the presence of at least moderate (≥50%) restenosis increases the risk for subsequent ipsilateral stroke and for stroke in any territory. This increased stroke risk was only significant in the endarterectomy group.

Author’s conclusion:
In conclusion, carotid artery stenting is associated with a higher long-term risk for moderate or higher restenosis (leading to 50% or more luminal narrowing) than endarterectomy. Carotid restenosis increases the risk for stroke, and this risk gain might be
more pronounced after endarterectomy than after stenting. Further evidence is needed to assess the usefulness of regular follow-up of patients after carotid revascularization with duplex ultrasound and to ascertain whether repeat revascularization is beneficial in those with restenosis.

**Journal club comments:**
Results of long-term follow-up of CREST and ICSS studies comparing carotid endarterectomy and carotid artery stenting for carotid steno-occlusive disease showed that long-term functional outcome is similar in both treatment arms. However, both studies found a significantly higher frequency of periprocedural strokes. The majority of these events happened in the periprocedural period. These facts and their interpretation was discussed in our previously published papers concluding that CAS compared to CEA carries higher risk of ischemic peri-procedural complications (either silent or manifested stroke), which prefers CEA as the method of choice for the treatment of carotid stenosis, although during longer follow-up, stenting was proven to be stable and effective.

This approach is further underlined by significantly higher frequency of restenosis above 50% after carotid artery stenting found in this paper. Similar results were found in previous studies as discussed by the authors. The important finding is the correlation between restenosis occurrence and risk of subsequent stroke. Because this correlation is pronounced not only in the ipsilateral territory, but also across territories, further research in restenosis formation and risk factors, similarly as repeated treatment procedures, is definitely justified.

As it stands, this paper is another brick in the wall of arguments for preference of carotid endarterectomy over carotid artery stenting.

**By: Thanasis D. Paschalis, Larissa, Greece (Journal Club) and Ondrej Bradac (Comments)**

You can view and read the original article [here](#).

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**Journal clubs** are open to volunteer suggestions to feature the latest interesting articles in the field of neurovascular surgery and dedicated to critical discussion and short review.

Get in touch to volunteer your assistance!
Interview with Joost De Vries, M.D., Ph.D.
Neurochirurgisch Centrum Nijmegen,
Department of Neurosurgery,
Radboudumc, Nijmegen
The Netherlands

Joost de Vries is a dual trained vascular neurosurgeon at Radboudumc, Nijmegen, The Netherlands. He was the first neurosurgeon in The Netherlands practicing endovascular neurosurgery. After obtaining his medical degree from Leiden University, The Netherlands he completed his residency in neurosurgery at Albert-Ludwig University Hospital in Freiburg, Germany. A couple of years later he completed his endovascular fellowship at Karolinska University Hospital, Sweden.

1) In your opinion, what makes a good vascular neurosurgeon?
A good vascular neurosurgeon is made by a proper training program and after that training he or she should work in a center with a continuous high case load. The question is: what is a high case load? That question is difficult to answer. As in most larger neurovascular centers approximately 75% of the aneurysms are being treated by endovascular means there are less aneurysms left for clipping. This is getting more and more problematic especially for younger neurosurgeons. I think, to keep up ones skills one should clip an aneurysm at least every other week or even better every week or more. To have a realistic share of weekend calls for acute cases every center would need 4 neurosurgeons that can clip an aneurysm. This means that only very large centers with probably at least 400 aneurysm cases can provide good and experienced vascular neurosurgeons. This can be reached by further centralization or by regional cooperation between different hospitals. I think a good way to solve this issue is to dual train young vascular neurosurgeon both in open as well as in endovascular techniques. By doing this there will be an important increase in personal aneurysm treatment exposure. Most dual trained neurosurgeons will confirm that there is a clear cross-pollination between the two techniques. Another option is that an open vascular neurosurgeon combines the vascular subspecialty with skull base surgery.

For treatment of arteriovenous malformations (AVM) case load is even more problematic. For this, I think, intense centralization is needed. The same counts for bypass surgery. European neurosurgeons should not forget that endovascular treatment for acute ischemic stroke is a new but important neuroendovascular therapy, with an increasing number of patients. Already more patients are treated for acute ischemic stroke than for a ruptured aneurysm. There is also a spectacular development in treatment techniques for stroke.
2) Which factors influenced your decision to pursue neurosurgical training and eventually practice in the Netherlands?

I was trained in the south of Germany (Freiburg im Breisgau, head: Prof dr Wolfgang Seeger). At the Department of Neurosurgery neurosurgical residents would perform preoperative diagnostic cerebral angiograms. In the early nineties a preoperative angiogram was felt indicated for any intracranial procedure (f.e. any tumor surgery). Therefore I performed several hundreds of angiograms during my residency.

At the same time I was involved in the first study on flow diversion as an alternative treatment for aneurysms. So for me the hybrid approach started very early.

After having returned to the Netherlands it took a while to find a fellowship for endovascular training as there were a lot of political barriers.

3) How is your microsurgical and endovascular caseload divided as a dual-trained ("hybrid") vascular neurosurgeon? Which aneurysm treatment option do you choose when both microsurgery and endovascular treatment is feasible?

We treat approximately 70% of the aneurysms by endovascular means. Most of the middle cerebral artery aneurysms will be treated by open surgery. We do this in our hybrid room with intraoperative diagnostic angiography to confirm optimal clip position. Aneurysms at other locations with an unfavorable dome to neck ratio will also be treated by open surgery, especially when it concerns young patients. So for us age is an important factor to choose for open surgery.

AVMs will mostly be treated with combined modalities. If they are more complex we will first try to embolize as much as possible before we remove the AVM by surgical excision.

4) What is your opinion regarding endovascular training in Europe based on the increasing number of endovascular cases especially for the treatment of acute stroke? Do you think neurosurgeons should be more routinely trained in endovascular procedures, particularly due to competition from other specialties, such as cardiology or perhaps even neurology?

All over the world, except for Europe, dual trained vascular neurosurgeons are very active in endovascular treatments and these neurosurgeons enjoy the spectacular innovation in acute stroke treatment. This treatment is one of the most important innovative therapies in neurosurgery in the last decades. There is clear Level 1 evidence for this therapy. I think it is very sad to conclude that until now European neurosurgeons are hardly participating in this development. In Europe there still is a demand for properly trained neurointerventionalists as lots of them are needed for treatment of acute ischemic stroke. Now at several centers body interventional radiologists or cardiologists are treating acute ischemic stroke to compensate for the shortage of neurointerventionalists. Here, indeed, young dedicated dual trained neurosurgeons could play an important role.

5) How do you see the future of vascular neurosurgery and in particular open
microsurgery with the recent technical developments such intra-saccular devises (WEB), aneurysm neck bridging devices (eCLIPs) or flow diverter to treat traditionally surgical aneurysm cases?

I have no doubt that endovascular techniques will make important improvements in the near future and thus I see a further shift away from open vascular neurosurgery. Indeed there are several interesting new endovascular devices but more evidence on their safety and efficacy is needed. Several trials are now conducted and most of them are single arm studies. It might be worthwhile, however, to conduct head-to-head prospective studies as well. For example in treatment of middle cerebral artery aneurysms endovascular against open surgery could be studied. Neurosurgeons should take the lead in organizing such trials.

6) If a young resident is thinking about going into vascular neurosurgery and is asking for your advice, what would you recommend?

Considering the abovementioned shift towards endovascular techniques I strongly recommend young neurosurgeons that want to specialize in the neurovascular field to consider becoming a dual trained vascular neurosurgeon. At our institution we have a fellowship that is open for young neurosurgeons. To my knowledge such a fellowship is still rare in Europe and therefore it is difficult for young neurosurgeons to find a site to be trained in endovascular techniques. I think it would be of utmost importance to offer plenty of opportunities in Europe for such a training.

Don't forget to join our EANS Vascular Section Discussion Group and share your cases!

Case discussions are a great opportunity to debate and obtain second opinions for your cases in a secure and helpful group comprised of your fellow Vascular Section members. We're currently running this facility on Medshr.

Join now!

Upcoming Events from the Vascular Section
Upcoming Events from the Vascular Section will detail any relevant subspecialty events run by the EANS, any event run by a member of the subspecialty committee, and even relevant events outside Europe, together with a brief explanation why it would be good to attend. We'll be featuring three events at any one time.

**EANS Session at the ESC Congress 2018**

26 August 2018  
Munich, Germany  


Speakers: V Aboyans, A H P Linke, B Meyer, P Vajkoczy

Further information can be found [here](#).

**EANS Vascular Section and WFNS Skull Base Surgery Committee Hands-On Dissection Course 2018**

23 - 24 September 2018  
Usti nad Labem, Czech Republic  

Further information can be found [here](#).

**EANS Microvascular HandsOn Course 2018**

7 November — 11 November 2018  
Cluj Napoca, Romania

Further information can be found [here](#).

For more subspecialty events from the EANS’ complete listing, please click [here](#).
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