

# ACUTE STROKE and emergency carotid intervention

Hans-Henning Eckstein, Munich, Germany, and Hernan Bazan, New Orleans, USA, will participate in a session focusing on exciting progress in the treatment of acute strokes at the VEITHsymposium (17–21 November, New York, USA). Eckstein will discuss emergency carotid endarterectomy for stroke in evolution, when it is indicated and how it should be done; and Bazan will maintain that urgent endarterectomy and stenting are safe and without a bleeding risk after a small-to-moderate sized stroke is treated by thrombolysis. They summarised the two topics for *Vascular News*.

## Emergency carotid endarterectomy for stroke in evolution



HANS-HENNING ECKSTEIN

### COMMENT & ANALYSIS

**Stroke in evolution is defined as an acute neurological deficit progressing within hours or days after the initial diagnosis to a greater deficit after waxing and waning of signs without disappearance of the deficit. Since 10% to 20% of all ischaemic strokes are associated with a stenosis or an occlusion of the extracranial carotid artery the question whether an emergency treatment of an acute embolising or occluding extracranial carotid lesion is clinically reasonable arises.**

The organisation of stroke units have considerably improved stroke care over the last decades. One key point is the availability of high quality brain imaging tools, which can visualise very nicely the mismatch between the already established ischaemic core if the brain infarction and surrounding areas which are hyperperfused but not definitely lost. The area of this ischaemic penumbra could therefore be diagnosed much better than it used to be only a couple of years ago. The further prognosis of the patient could therefore be assessed much better now. Typically the penumbra region occurs when blood flow is below 20ml/100g/min. At this point electrical communication between neurons fails to exist. If blood flow is below 10 to 12ml/100g/min neuronal death will occur inevitably.

However, any decision making in these patients is still hampered by a significant delay of a precise diagnosis, which usually lasts several hours (cerebral ischaemia does not hurt). This implies that a relevant portion of patients still present with an already established major ischaemic brain infarction. Due to a very high risk of cerebral bleeding, these patients are unfortunately no candidates for any revascularisation option (e.g. systemic or local thrombolysis or emergency thrombectomy).

Based on very disappointing surgical experiences from the 1960s and 1970s any concept of emergency revascularisation of acute occlusions of the internal carotid artery is still considered with great scepticism. However, recent randomised trials on stent retriever systems (ESCAPE, EXTEND-IA, MR CLEAN, REVASCAT, SWIFT PRIME) have demonstrated unanimously that patients with an acute ischaemic stroke could benefit significantly from systemic thrombolysis plus early endovascular thrombectomy if the procedure is done within six to eight hours after the initial onset of symptoms. Key for success was an overall recanalisation rate of 80% and more, regardless of whether the internal carotid artery was occluded or not.

Since the advantage of early revascularisation in the treatment of ischaemic strokes is evident now, the question arises whether emergency carotid endarterectomy still plays a role in this field. In Germany all carotid interventions (both endarterectomy and stenting) have to be documented in a nationwide carotid registry. Out of 182,033 procedures performed between 2009 and 2014, 5,058 patients (68% male) were diagnosed with a stroke in evolution. Of these, 3,176 patients were treated by endarterectomy (mean age 71 years) and 1,882 by carotid artery stenting (documented only between

2012 and 2014, mean age 66.5 years). The in-hospital rates of any strokes and deaths were 9% in the endarterectomy group and 11.7% in the patient group treated by stenting. The vast majority of strokes were assessed as being major (modified Rankin Scale of 3 or more).

Based on our own experiences with emergency carotid endarterectomies in more than 200 patients the following technical rules should be respected: general anaesthesia is preferred, because stroke patients are often not able to cooperate in a proper way. Whether general anaesthesia has also positive effects on brain tissue is still a matter of debate. After skin incision a “no-touch-technique” of the carotid bifurcation is absolutely mandatory to prevent any intraoperative embolisation. Clamping of the common carotid artery should be applied as soon as possible. The carotid bifurcation should be opened by a standard longitudinal incision. The systolic blood pressure should be elevated up to 180mmHg to support the collateral blood flow and to increase the back flow from the intracranial internal carotid artery which supports the retrograde flushing of a distal internal carotid artery thrombus. Catheter thrombectomies have to be done very carefully to avoid any damage to the distal internal carotid artery (eg. local dissection, arteriovenous fistula to the jugular vein). If there is any suspicion of remaining clots an on-table angiography is recommended before removing the common carotid artery clamp. In general a carotid shunt should be inserted as soon as possible to restore proper antegrade blood flow to the brain. After that, endarterectomy of the embolising/occluding lesion and patch closure can be performed in a standard fashion. In any case a completion on-table angiography in an

antegrade and a lateral view is necessary. If possible, this angiography should be assessed by the operating surgeon and collaborating neuroradiologists together, to prove that the internal carotid artery and the first segments of the anterior and middle cerebral arteries are patent. If there are any doubts a selective catheter angiography should be performed immediately, possibly in conjunction with catheter thrombectomy. If emergency endarterectomy is performed in a hybrid OR, these optional steps could also be done intraoperatively.

In summary emergency carotid endarterectomy still has a place in the modern armamentarium of the treatment of carotid-related stroke in evolution. Patients with a small ischaemic core and surrounding zones of critical hypoperfusion might be proper candidates. Furthermore the following features qualify for an emergency endarterectomy: known high-grade severely calcified internal carotid artery stenosis, floating thrombus at the carotid bifurcation, failed endovascular therapy, contraindications for thrombolysis, evidence of a patent M1 segment of the middle cerebral artery, unavailability of an endovascular specialist with neuroradiological expertise. Since neurologists have a better insight into the natural history of these patients all steps have to be taken in close cooperations with stroke physicians. Further clinical trials and registries should focus on more specific clinical and morphological variables to even better define the optimal choice for open or endovascular emergency treatment of carotid-related strokes.

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“Emergency carotid endarterectomy still has a place in the modern armamentarium of the treatment of carotid-related stroke in evolution.”

## Urgent revascularisation safe after tPA in patients with minor-to-moderate stroke



HERNAN BAZAN

### COMMENT & ANALYSIS

Expanding use of tPA by stroke centres, together with increasing enthusiasm for early carotid interventions, is likely to grow the number of patients who will benefit from carotid intervention after tPA, says Hernan Bazan, New Orleans, USA.

One of the most important advances in the management of carotid disease in the past decade has been the recognition that an “urgent” or “expedited” carotid endarterectomy is safe in select patients in the hyperacute period after an acute neurological event. Carotid disease accounts for over 20% of all ischaemic strokes and the early risk of an ischaemic stroke following an antecedent transient ischaemic attack is >10% within seven days. The risk of a recurrent stroke following an initial minor stroke is even higher. Work by neurologist Peter Rothwell (Oxford, UK) and vascular surgeon Ross Naylor (Leicester, UK) has highlighted this natural history data over the past few years and, as a result, carotid intervention shortly after an acute neurological ischaemic event is being performed more frequently in stroke centres to reduce the early risk of recurrent stroke. Several groups, including ours at the Ochsner Clinic, have demonstrated that urgent carotid endarterectomies (and in select cases carotid artery stenting) can be safely performed in patients with minor or moderate strokes who have a good neurological recovery. We have found outcomes comparable to electively performed carotid endarterectomy in these urgent patients when the National Institutes of Health Stroke Scale (NIHSS) is less than 10, representing minor- and moderate-sized strokes.

As the only FDA-approved drug for the treatment of an acute ischaemic stroke remains recombinant tissue plasminogen activator (tPA), the next question is whether it is safe to perform an urgent endarterectomy/stenting following thrombolysis for an acute stroke. We have found that a strong collaboration with a dedicated stroke/vascular neurology service with telemedicine capabilities is key to timely evaluation of such acute carotid cases. The stroke team assesses all patients with acute neurological symptoms on admission and those presenting

within 4.5 hours are administered intravenous tPA at a dose of 0.9mg/kg (maximum dose of 90mg). Systemic thrombolysis is employed to recanalise thrombosed intracranial vessels once intracranial bleeding and other exclusion criteria are ruled out. Of note, although FDA approval for the administration of tPA is three hours from symptom onset, off-label use of tPA extending this window to 4.5 hours for an acute stroke is performed in many comprehensive stroke centres in the USA in order to treat more patients. In doing so, we have seen tPA utilisation rates of nearly 20% (compared to 3–5% reported in other series).

However, tPA has up to a 6% risk of intracerebral haemorrhage and there is scant data whether tPA followed by urgent carotid endarterectomy/stenting has an increased risk of complications, particularly intracerebral haemorrhage and neck or access site haematomas. Moreover, there are few data regarding patient selection, timing and safety of urgent carotid interventions for acute strokes after tPA.

From 2009–2015, 762 patients underwent carotid interventions (endarterectomy, n=440; stenting, n=322) at our centre; of these, 165 patients (21.6%) were urgent endarterectomy/stenting (intervention during the index hospitalisation) for an acute transient ischaemic attack/stroke. Due to the well-described lower periprocedural risk of stroke of endarterectomy compared to stenting (CREST and ICSS randomised controlled trials), the majority of the acute carotid interventions were endarterectomies (n=135; stenting, n=30). Carotid artery stenting was reserved for patients unfit for endarterectomy due to severe ischaemic cardiac disease (eg. ejection fraction <20%) or prohibitive pulmonary disease (eg. chronic obstructive pulmonary disease/home oxygen). When stenting is to be performed in the acutely symptomatic

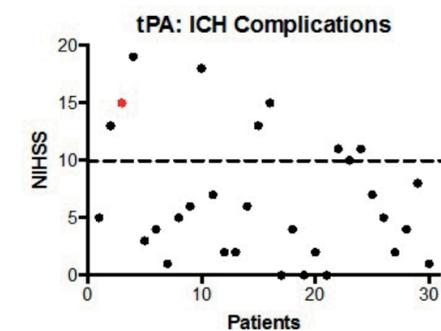


Figure A

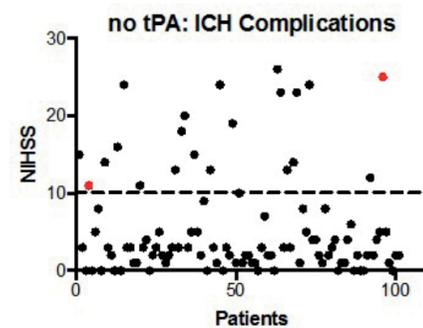


Figure B

**Figure:** Cohort dataset highlighting the occurrence of intracranial haemorrhage and stroke severity in patients who received tPA (A) and those who did not receive tPA (B). A dashed line denotes a moderate stroke with an NIHSS score of 10 (red dot denotes occurrence of intracerebral haemorrhage). Note, there were no intracranial haemorrhages in patients with NIHSS <10. Bazan HA et al. Urgent carotid intervention is safe after thrombolysis for minor to moderate acute ischemic stroke. *J Vasc Surg* 2015 (in press).

patient, I believe stenting with proximal protection is ideal to minimise embolisation from the vulnerable carotid plaques, which are often found in this group of patients.

We compared the effect of thrombolysis on 30-day complications, including intracerebral haemorrhage, for acute carotid interventions. Of these 165 acute carotid interventions, 19% (31 patients [endarterectomy, n=25; stenting, n=6]) had tPA for an acute stroke; the remaining (134 patients [endarterectomy, n=110; stenting, n=24]) fell outside of the tPA time window. Most strokes were minor or moderate with a mean NIHSS score of 6.6 (range 0–19) and the mean time to intervention for both groups was 2.4 days. There was no difference in the 30-day combined stroke, death, intracerebral haemorrhage and myocardial infarction rates in the tPA (3/31) compared to the no tPA cohort (8/134), p=0.43. With regards to risk of intracerebral haemorrhage, no increased rates of bleeding were noted within the tPA (2/31) compared to the no tPA group 4/134; p=0.32.

Thrombolysis for an acute stroke followed by urgent endarterectomy/stenting is not associated with an increased risk of complications in select patients. However, patient selection is important. There were no incidences of intracerebral haemorrhage and only one death in each group for patients with minor to moderate stroke (NIHSS <10, Figure).

Expanding use of tPA by stroke centres, together with increasing enthusiasm for early carotid interventions, is likely to grow the number of patients who will benefit from carotid intervention after tPA. In the future, CT brain perfusion may be a useful tool for patient selection in order to determine whether there is salvageable brain tissue for those presenting with a high NIHSS score (> 10), prompting consideration for an urgent carotid intervention in this group of patients as well.

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