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Repeated laser-assisted high-flow bypass for recurrent giant intracranial aneurysm

Case report

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Summary

The treatment of intracranial aneurysms is changing as endovascular obliteration possibilities and long-term results are being published in regard to outcome. However, not all aneurysms are amenable to direct endovascular or surgical treatment. In such situations, a high flow bypass for flow preservation can be considered as indirect treatment alternative, enabling a trapping of the aneurysm or occlusion of the feeding artery. We present the case history of a 57 year-old patient suffering of a recurrent giant intracranial carotid aneurysm. The aneurysm could be excluded using a new cerebral high-flow bypass technique for which no temporary occlusion of any intracranial vessels is required. This technique reduces the risks of perioperative neurological complications.

Key words: cerebral revascularization; ELANA; aneurysm

Introduction

In the International Subarachnoid Aneurysm Trial (ISAT), patients with a ruptured intracranial aneurysm suitable for either endovascular treatment or surgical clipping had a better independent survival at 1 year in the endovascular group [1, 2]. These results support the fact that an endovascular approach has become a valuable alternative option to open microsurgery in this patient group. However, the rate of recurrent haemorrhage was slightly higher in the endovascular treated group (0.75–1.75 relative risk) and in some endovascularly treated aneurysms a recanalisation/reperfusion of the aneurysm without rupture was observed.

Not all aneurysms are suitable for endovascular coiling. This may be the case when the endovasal route to the intracranial structures is technically dangerous, or in case of high risks for embolic or occlusive events, resulting in ischaemic neurological deficits. In such a situation, alternative surgical methods or combined endovascular/surgical approaches need to be envisioned.

We present the history of a patient suffering of a complex intracranial aneurysm not amenable to endovascular treatment or surgical clipping alone. Bypass surgery and trapping of the carotid artery resulted in closure of the aneurysm with improvement of the preoperative neurological deficits.

Case report

A 57-year-old male presented first in July 2004 with a partial homonymous hemianopia to the right resulting from a giant aneurysm of the left intracranial segment of the internal carotid artery (figure 1 and figure 2a). No further neurological deficits were observed. The patient was otherwise in an age-specific good general condition without any positive family history or previous serious disease. The progressive visual deficit was an indication for treatment of the aneurysm. A cerebral angiography and a balloon test occlusion for assessment of the intracranial collateralisation revealed that endovascular therapy was impossible; the large neck of the aneurysm enclosed the initial segments of the middle cerebral and anterior cerebral arteries. Direct clip application was also not feasible. A cerebral bypass was conceived as treatment alternative. Basically, two types of cerebral bypass with sufficient high blood flow were possible in this situation. A bypass from an intracranial to an intracranial vessel jumping over the aneurysm, or a bypass from an extracranial to an intracranial blood vessel. We decided that a purely intracranial

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Figure 1

A T_1-weighted Gadolinium-enhanced MRI of the skull showing a large mass lesion in the left temporobasal region. The mass was perfused and corresponded to a giant aneurysm.
B 3D CT-angiography demonstrated the origin of the giant aneurysm at the birfurcation of the internal carotid artery (thin arrow: anterior cerebral artery; thick arrow: middle cerebral artery; double arrow: internal carotid artery end segment).

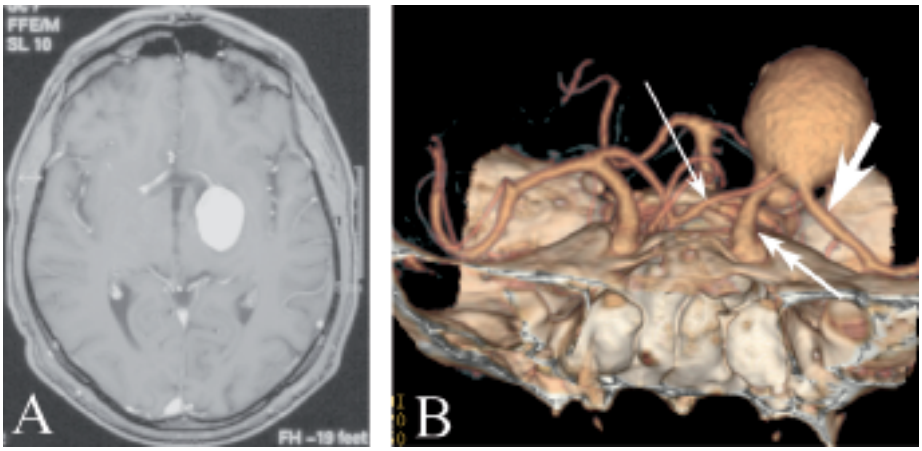


Figure 2

A Schematic overview of the aneurysm location (*) in respect to extracranial and intracranial arteries
B Schematic view of the aneurysm and its first intracranial to intracranial ELANA bypass (*)
C Schematic view of the aneurysm and its second extracranial to intracranial ELANA bypass (*)

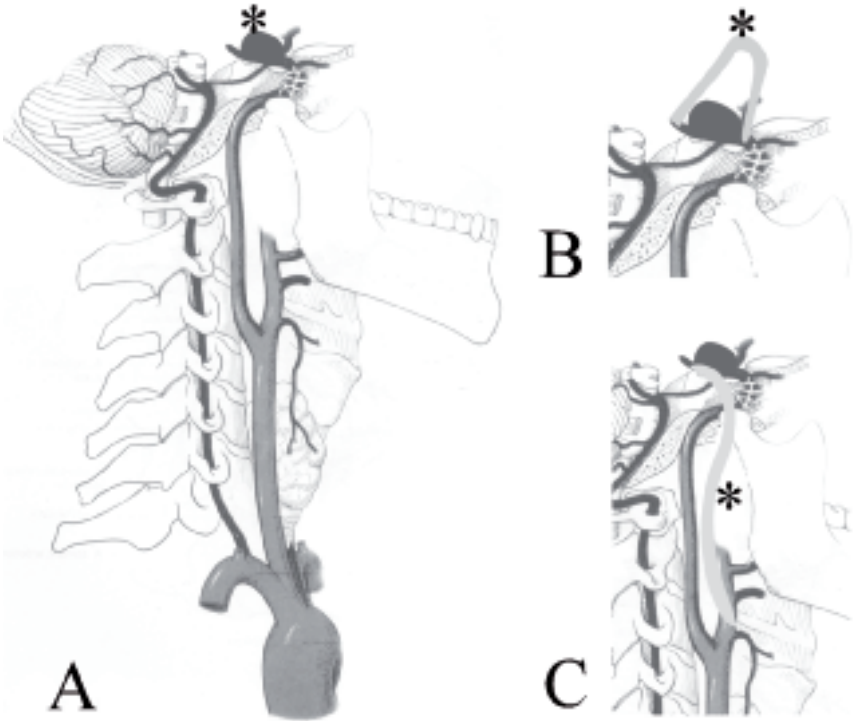


Figure 3

Schematic drawing of the ELANA bypass procedure. A) Suturing of the platinum ring to the artery with 8 micro-stitches, in order to flatten the vessel in between the platinum ring for symmetric contact with the laser catheter.
B and C) Suturung of the graft vessel to the platinum ring with another 8 micro-stitches.
D) Introduction of the laser catheter into the graft vessel up to the platinum ring.
E) Activation of the vacuum suction to aspirate the arterial vessel wall for improvement of the contact of the laser catheter.
F) Activation of the laser catheter to punch out a flap into the vessel wall.
G) Retrieval of the laser catheter and the aspirated vessel flap.

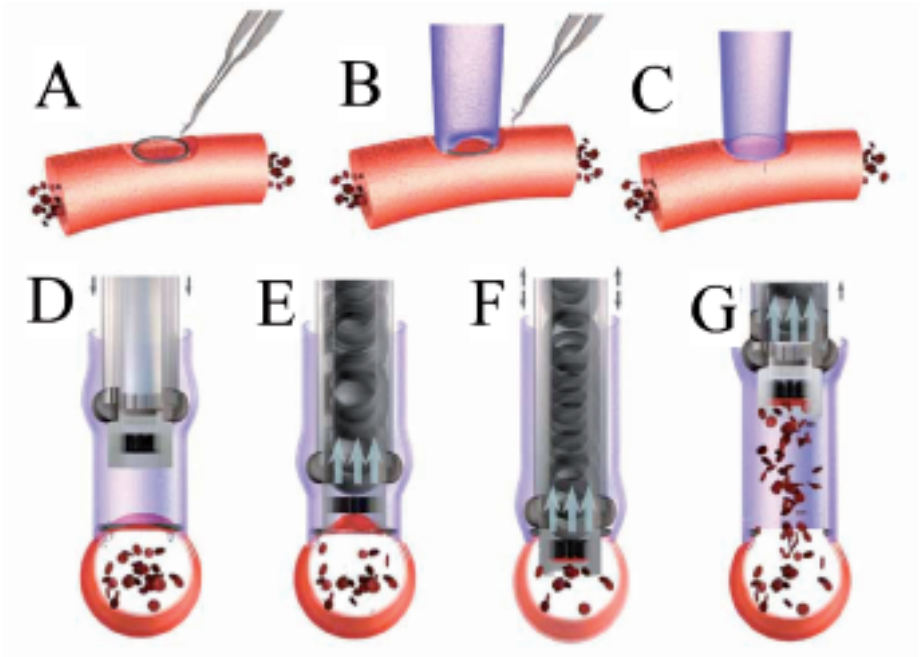


Figure 4

A Lateral view of cerebral angiography showing the first intracranial high-flow bypass (white arrow) between the internal carotid artery (dark arrow) and middle cerebral artery. As proximal trapping of the internal carotid artery was not performed, the giant aneurysm showed initial residual filling (*).
B Two months later, control angiography showed an almost complete thrombosis of the aneurysm (*) due to derivation of blood flow through the high-flow bypass.

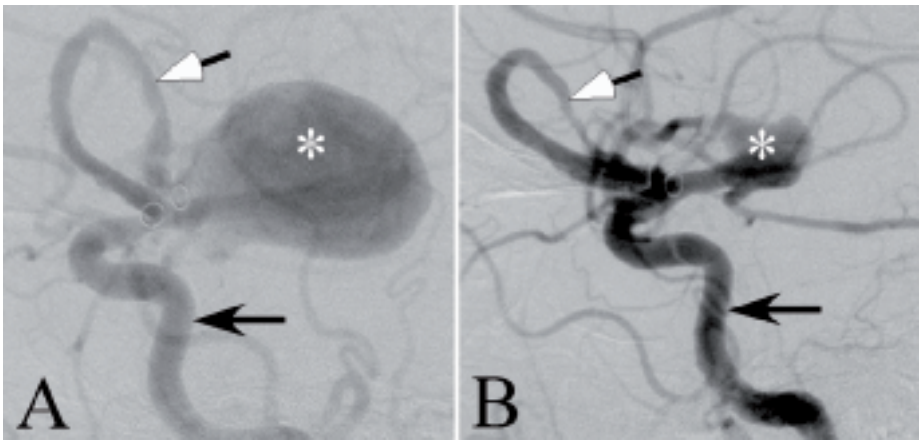
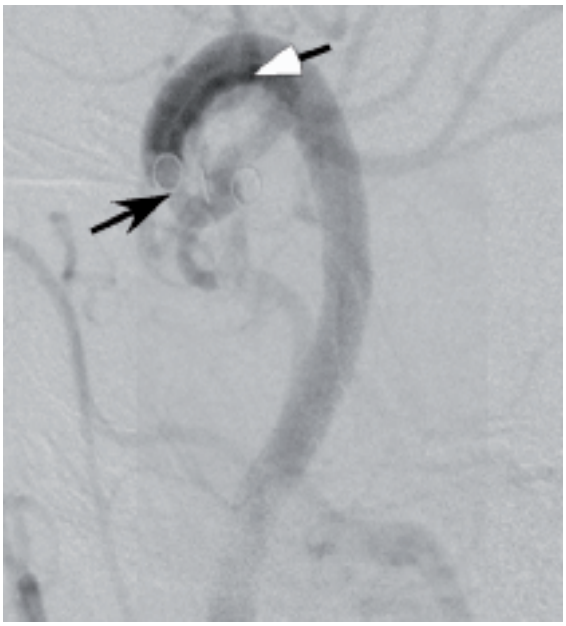


Figure 5

Second extra-intracranial bypass establishing a direct communication between the external carotid artery (white arrow) at the neck and the middle cerebral artery (dark arrow). The internal carotid artery was clipped intracranially proximal to the giant aneurysm, which totally thrombosed after the second operation.



bypass was suitable in this situation and proposed to perform an excimer laser-assisted non-occlusive anastomosis (ELANA) from the intracranial carotid artery proximally to the aneurysm to the middle cerebral artery (figure 3). We assumed that the blood flow through the bypass would progressively lead to thrombosis of the aneurysm, and therefore did not plan a trapping of the aneurysm or occlusion of the carotid artery. To perform this bypass, a saphenous vein graft was used. The immediate and 2 months postoperative angiograms showed that the bypass finally took over the complete blood flow to the middle cerebral artery territory resulting in an almost complete thrombosis of the aneurysm (figure 2b and figure 4). During this early postoperative phase, the patient was under aspirin (300 mg/d). In the following weeks, the patient developed transient ischaemic attacks with motor aphasia. Oral anticoagulation was started under assumption of recurrent emboli out of the residual aneurysm. As the homonymous hemianopia was again progressive, we performed a new angiogram where a recurrent perfusion of the aneurysm with an occlusion of the bypass was demonstrated. The remaining surgical option was thus a new extracranial to intracranial bypass from the external carotid artery at the neck to the middle cerebral artery with an occlusion of the carotid artery intracranially distal to the ophthalmic artery. The second surgical intervention was tolerated without additional neurological deficits; the final angiogram documented patency of the second bypass with complete occlusion of the aneurysm (figure 2c and figure 5). The neurological status improved after the second operation considerably. No further transient ischaemic attacks were observed and memory function improved to an age specific normal function.

Discussion

Cerebral ischaemia with consequent permanent neurological deficits is the most feared complication of cerebrovascular procedures. ELANA has been developed by Tulleken and colleagues in Utrecht in order to treat particularly difficult clinical situations where the cerebral blood flow to certain brain areas has to be preserved because of insufficient collateral circulation [3, 4]. ELANA does not influence the general risks of perioperative ischaemic complications, but has the advantage to suppress those related to temporary occlusion of the parent vessel [5]. It has mainly gained acceptance in the management of giant intracranial aneurysms that are not amenable to conventional microsurgical or endovascular treatment. Further technical developments include the possibility of sutureless non-occlusive anastomoses to facilitate the access to deep-seated intracranial vessels. In the future, ELANA could also be envisaged as a safety measure assuring intracerebral blood flow before performing high-risk microsurgical/endovascular interventions.

The presented case illustrates new current treatment possibilities of difficult intracranial vascular pathologies. Neither endovascular coiling nor surgical clipping were suitable to exclude safely this giant aneurysm from the bloodstream.

In addition to an important logistical organisation, ELANA requires expertise and involvement of a multidisciplinary stroke team specialised

in the treatment of complex cerebrovascular lesions. For this reason, its use should be concentrated in a few centres.

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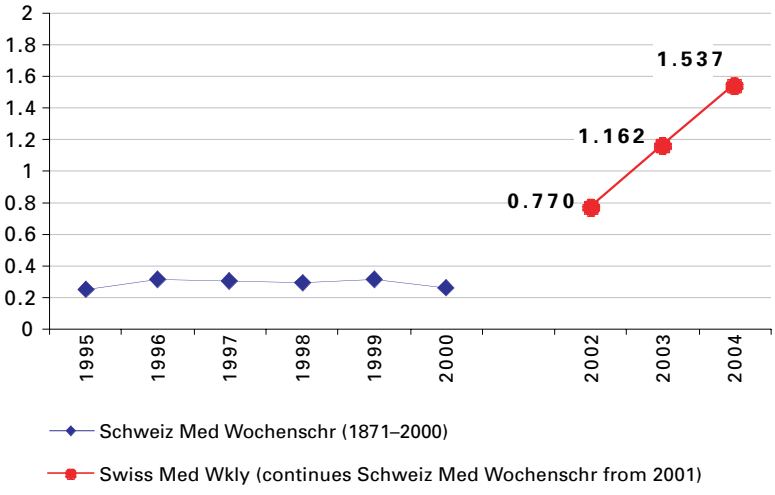

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