EJVES Vascular Forum (2020) 47, 31–34

TECHNICAL NOTE

Acute Hemispheric Stroke: Full Remission Following Surgical Thrombectomy

Alberto M. Settembrini [a,b,*], **Catharina Gronert** [b], **Eike Sebastian Debus** [b]

[a] Fondazione IRCCS Ca'Granda Policlinico, Milan, Italy
[b] Department for Vascular Medicine, Vascular Surgery, Angiology and Endovascular Therapy, University Heart and Vascular Centre, Hamburg-Eppendorf, Hamburg, Germany

Introduction: Carotid occlusion because of embolisation or as a distal extension of thrombus formation in an ulcerated plaque can be the cause of a devastating stroke, caused by sudden occlusion of the internal carotid artery (ICA). Often, invasive treatments are not an option because of the limited time frame. In rare situations of acute stroke onset and admission to therapy within six hours however, aggressive recanalisation may be considered. This technical note demonstrates surgical transcatheter embolectomy of intra-extra cranial ICA by reducing inflow by placing a clamp on the common carotid artery (CCA) before puncture cranial to the clamp.
Patient and technique: A 67 year old man was admitted as an emergency seven hours after an acute hemispheric stroke with paraplegia of his left arm and full consciousness. An immediate duplex scan showed more than 90% stenosis of the carotid bifurcation with low echolucent plaque material extending proximally up to the intracranial ICA. CT angiography confirmed the stenosis and a sub-occlusive thrombosis of the ICA up to the M1 segment of the middle cerebral artery (MCA). Because the onset of clinical symptoms was more than six hours previously, the patient was not within the clinical window for endovascular therapy. Following interdisciplinary consensus, surgical over the wire thrombectomy with endarterectomy with complete removal of the thrombus and subsequent thrombo-endarterectomy of the carotid bifurcation and bovine patch plasty was performed. The patient was discharged with statin and antiplatelet treatment on the second post-operative day with full remission of symptoms.
Conclusions: Immediate surgical transcatheter recanalisation of acute intra-extracerebral ICA thrombus with inflow reduction can be a valid procedure to improve cerebral circulation, leading to full remission of stroke symptoms.

Article history: Received 8 January 2020, Revised 2 March 2020, Accepted 9 March 2020
Keywords: Balloon, Carotid endarterectomy, Carotid stenosis, Carotid thrombosis, Embolectomy, Thrombolysis

INTRODUCTION

Carotid stenosis as a result of atherosclerotic disease is the cause of about 20% of ischaemic strokes.[1] Previous studies have shown that the annual stroke incidence rate is < 3–5% in patients with carotid artery occlusion on best medical treatment, but stroke recurrence rate is 20% in patients with poor collateral circulation.[2,3] Thrombus or embolus formation may cause acute carotid occlusion. Intravenous thrombolysis is considered the first choice if applied within the first six hours from symptom onset.[4] Besides intracranial haemorrhage, this procedure carries a risk of distal embolisation from detachment of the thrombus, which explains why it is not indicated in thrombus formation longer than 8 cm in the ICA. Carotid-cavernous fistula has been also described as a complication of this kind of treatment.[5] In such situations, immediate anticoagulation followed by carotid thrombectomy may be the therapy of choice.[6] The aim of this technical note is to show how surgical transcatheter thrombectomy of the intra-extracranial ICA can be performed as a valid and safe procedure to achieve full neurological recovery after ischaemic stroke caused by carotid stenosis and extensive post-stenotic thrombus formation.

SURGICAL TECHNIQUE

A 67 year old Caucasian man was admitted with acute left hemiparesis with complete paralysis of the arm and the hand, which had occurred seven hours prior to admission (Video). In the emergency room a neurological evaluation confirmed a NIHSS (National Institute of Health Stroke Scale) 5a for left arm hemiparesis. Immediate vascular workup with a duplex ultrasound revealed significant stenosis of the right internal carotid artery (ICA) from a soft, non-calcified plaque of the carotid bifurcation, with proximal thrombus formation. CT angiography confirmed more than 90% stenosis of the ICA with subsequent thrombus

* Corresponding author. Via Borgazzi 2/A, 20122, Milano, Italy.
E-mail address: amsettembrini@gmail.com (Alberto M. Settembrini).

https://doi.org/10.1016/j.ejvsvf.2020.03.002

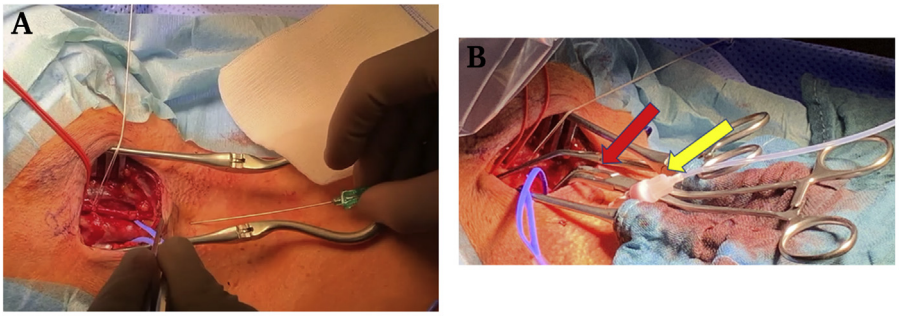

Figure 1. (A) Direct puncture of the common carotid artery after surgical preparation. **(B)** Clamping of the common carotid artery (red arrow) below the endovascular introducer (yellow arrow).

formation, extending to the M1 segment of the MCA, without dissection (Video).

Following interdisciplinary consensus, involving the vascular surgeon, neurologist, and neuroradiologist, a surgical approach including mechanical thrombectomy and local endarterectomy of the carotid bifurcation was considered to be the immediate treatment of choice. The patient was prepared with evoked sensory potentials for neuromonitoring under general anaesthesia. Through a cervicotomy medial to sternocleidomastoid, careful dissection of the common carotid artery (CCA) and carotid bifurcation was performed. Following systemic heparinisation (5000 UI), the CCA was clamped proximal to the plaque to reduce the antegrade flow and to lower the risk of cerebral embolisation during catheterisation and thrombectomy (Fig. 1A and B). After two minutes of clamping, no deterioration of evoked potentials was seen, allowing the surgical approach to proceed without shunting. Then, direct puncture of the CCA was performed cranial to the clamp.

Angiography showed the presence of a long thrombus (Fig. 2). A 0.18 inch guidewire was placed in the ICA under fluoroscopic guidance, carefully passing the thrombus. A 4 $\times$ 20 mm angioplasty balloon was carefully placed over the wire distal to the thrombus, to perform thrombectomy (Passeo Biotronik, Switzerland) (Fig. 3A and B): a fresh apposition thrombus $>$10 cm long was harvested, followed by immediate backflow from the ICA (Video).

The intervention was then completed by classical endarterectomy and bovine pericardium patch plasty, after clamping the ICA (Fig. 4). No shunting was needed during the entire procedure. Intra-operative completion control (duplex scan, angiography, and flowmetry) showed a good result without residual thrombosis (Fig. 5A,B,C). On post-op.

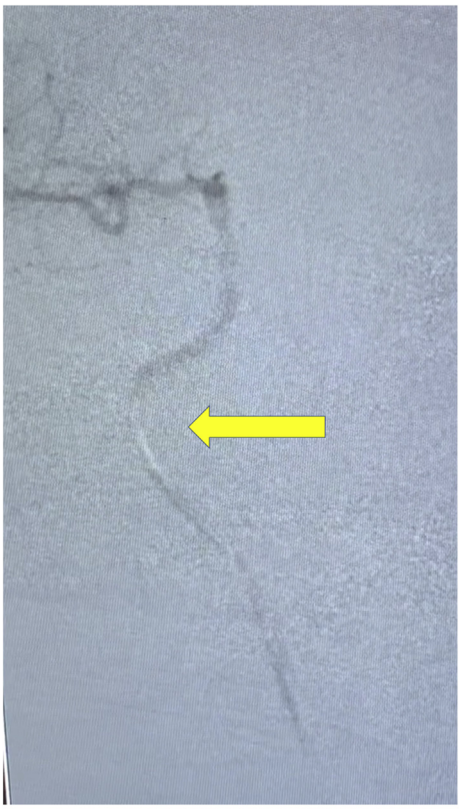

Figure 2. Angiography shows the thrombus in the distal part of the internal carotid artery (yellow arrow).

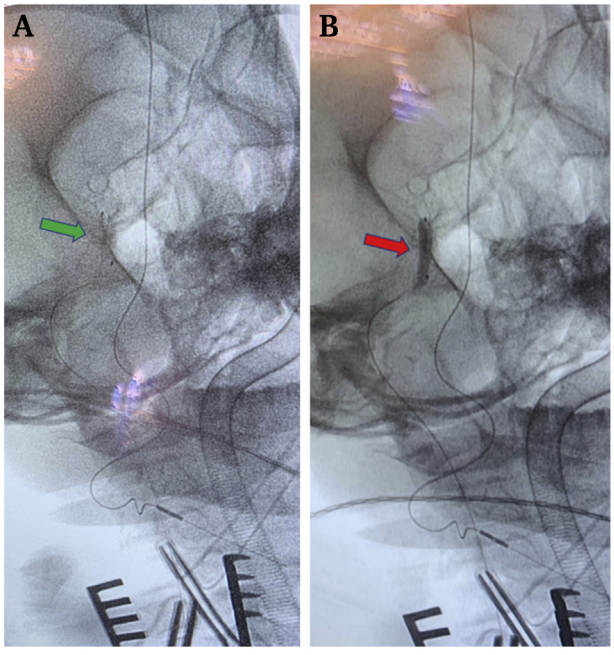

Figure 3. (A) Deflated angioplasty balloon over the 0.18 wire downstream of the thrombosis. **(B)** Inflated balloon before the embolectomy.

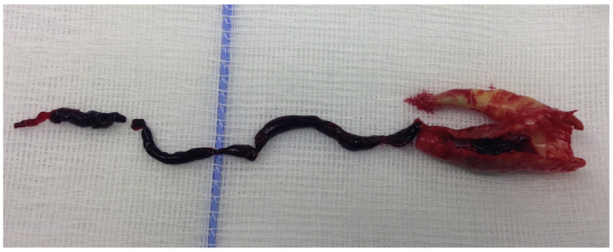

Figure 4. Excellent result of the embolectomy: long thrombus and plaque removed with presence of ulcer.

day 1, the patient was able to move his left arm (Video) and he was discharged after two days with a NIHSS 0.

The following is the supplementary data related to this article: Video DescriptionThe video starts showing the paralysis of the left arm of the patient at the arrival in the emergency room.
At 10 seconds, the computed tomogram proves the tight stenosis of the right internal carotid artery and the thrombus in the internal carotid artery to medial cerebral artery.
At 50 seconds, the operator is performing carotid arteriotomy and embolectomy through the balloon, removing all the thrombus.
At one minute and 53 seconds, the patient moves his hand after surgery.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.ejvsvf.2020.03.002.

DISCUSSION

This case shows a peculiar picture of an ischaemic stroke resulting from a long thrombus originating in the ICA, extending to MCA. The patient was admitted outside the time window for endovascular therapy by thrombolysis. The patient had no prior medication, and symptoms had remained stable since onset.

Acute intravenous thrombolysis is agreed as first line therapy if started within six hours of onset and followed by anticoagulation and delayed carotid endarterectomy.[7] Mechanical thrombectomy was not considered in this situation, as risk of thrombus dislodgment and further embolisation from mechanical manipulation was considered to be too risky.[8] However, since 2010 various technical aspects have come into practice, including mechanical therapies such as endovascular treatment after thrombolysis.[9] In case of no significant improvement of the patients after thrombolytic therapy, immediate carotid endarterectomy with satisfying results is proposed.[10]

Moreover, in the present case, there was an issue with the delay between the patient's presentation and symptom onset. In this situation it may be advisable to perform mechanical thrombectomy as soon as possible, within 24 hours of stroke development.[11,12] Xu et al. reported successful endovascular treatment with carotid artery stenting for carotid stump syndrome in a patient with long lasting symptoms and occlusion of the ICA with downstream recanalisation of the cerebral arteries.[13]

Accordingly, in the present case, an immediate surgical transcatheter approach was considered, even allowing for the delay. Recent guidelines[14] exclude endovascular thrombolytic treatment in cases of large anterior vessel

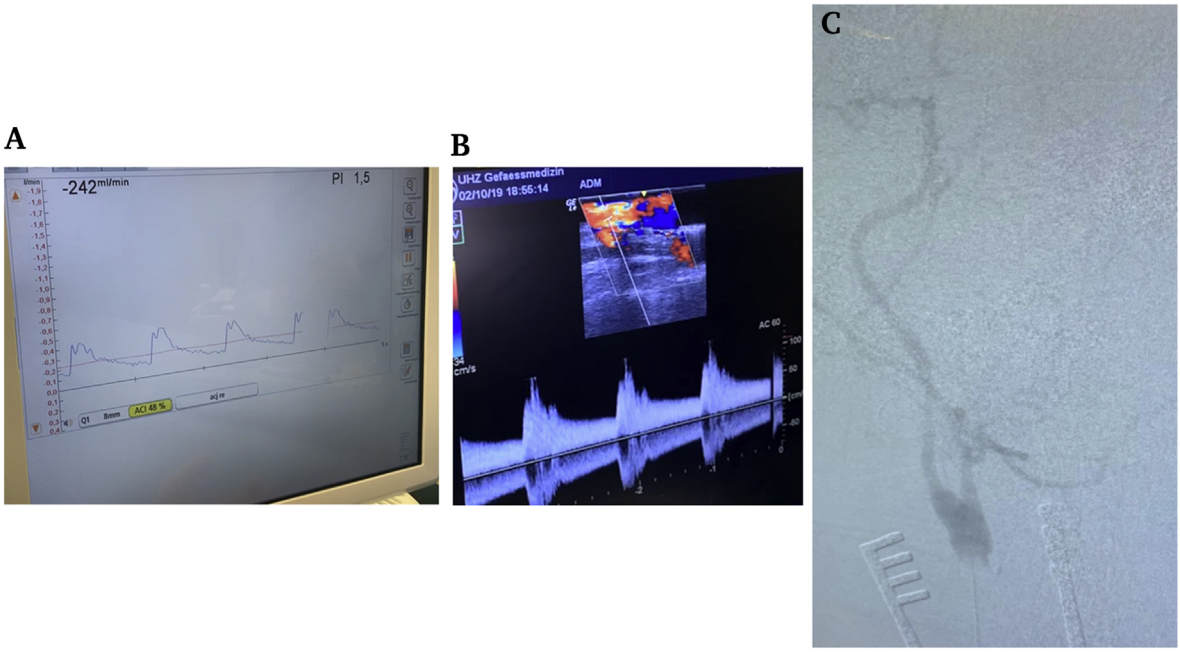

Figure 5. Post-operative controls confirmed the good result of endarterectomy. **(A)** Flowmetry shows good signal. **(B)** Duplex ultrasound confirming good peripheral revascularisation. **(C)** Angiography did not show any residual thrombus on the wall.

occlusion; thrombo-aspiration would have required surgical preparation of the carotid artery. Carotid artery stenting was not considered for the extended length of the thrombus because it would not have been possible to deploy a carotid filter. ICA flow reversal could bring additional safety, but clinical data in this specific situation are still lacking.[15]

With awareness that the surgical approach can cause harm from distal embolus formation, cranial inflow was reduced by placing a clamp on the CCA. To avoid arterial wall damage or dissection during the procedure, the procedure was performed under fluoroscopic guidance. A 20 mm angioplasty balloon can remove the entire thrombus in one maneuver because its length is longer than a standard Fogarty catheter. In summary, this procedure led to full neurological recovery and early discharge. In addition, lifelong antiplatelet therapy and lipid lowering therapy together with control of hypertension are mandatory for long term success.

CONCLUSIONS

This case highlights the complex situation of an active and young patient showing symptoms of ischaemic stroke, with risk of clinical worsening, but who was unsuitable for a less invasive endovascular approach. Although the patient was outside the window for thrombolytic treatment, taking into consideration that his symptoms were not improving, aggressive surgical treatment was justified in this skilled high volume centre.

CONFLICTS OF INTEREST

None.

FUNDING

None.

REFERENCES

1 Grotta JC. Clinical practice. Carotid stenosis. *N Engl J Med* 2013;**369**:1143—50.
2 Kuroda S, Houkin K, Kamiyama H, Mitsumori K, Iwasaki Y, Abe H. Long-term prognosis of medically treated patients with internal carotid or middle cerebral artery occlusion: can acetazolamide test predict it? *Stroke* 2001;**32**:2110—6.
3 Morris-Stiff G, Teli M, Khan PY, Ogunbiyi SO, Champ CS, Hibberd R, et al. Internal carotid artery occlusion: its natural history including recanalization and subsequent neurological events. *Vasc Endovascular Surg* 2013;**47**:603—7.
4 Hacke W, Kaste M, Bluhmki E, Brozman M, Dávalos A, Guidetti D, et al. Thrombolysis with alteplase 3 to 4.5 h after acute ischemic stroke. *N Engl J Med* 2008;**359**:1317—29.
5 Henderson AD, Miller NR. Carotid-cavernous fistula: current concepts in aetiology, investigation, and management. *Eye (Lond)* 2018;**32**:164—72.
6 Vellimana AK, Kadkhodayan Y, Rich KM, Cross 3rd DT, Moran CJ, Zazulia AR, et al. Symptomatic patients with intraluminal carotid artery thrombus: outcome with a strategy of initial anticoagulation. *J Neurosurg* 2013;**118**:34—41.
7 Scharf EL, Fugate JL, Hocker SE. Extensive mobile thrombus of the internal carotid discovered after intravenous thrombolysis: what do I do now? *Neurohospitalist* 2017;**7**:96—9.
8 Roche A, Griffin E, Looby S, Brennan P, O'Hare A, Thornton J, et al. Direct carotid puncture for endovascular thrombectomy in acute ischemic stroke. *J Neurointerv Surg* 2019;**11**:647—52.
9 Holodinsky JK, Williamson TS, Demchuk AM, Zhao H, Zhu L, Francis MJ, et al. Modeling stroke patient transport for all patients with suspected large-vessel occlusion. *JAMA Neurol* 2018;**75**:1477—86.
10 Curtzea S, Putaala J, Saarela M, Vikatmaa P, Kantonen I, Tatlisumaka T. Carotid embolectomy and endarterectomy for symptomatic complete occlusion of the carotid artery as a rescue therapy in acute ischemic stroke. *Case Rep Neurol* 2011;**3**:301—8.
11 Román LS, Menon BK, Blasco J, Hernández-Pérez M, Dávalos A, Majoie CBLM, et al. Imaging features and safety and efficacy of endovascular stroke treatment: a meta-analysis of individual patient-level data. *Lancet Neurol* 2018;**17**:895—904.
12 Albers GW, Marks MP, Kemp S, Christensen S, Tsai JP, Ortega-Gutierrez S, et al. Thrombectomy for stroke at 6 to 16 hours with selection by perfusion imaging. *N Engl J Med* 2018;**378**(8):708—18.
13 Xu Z, Wang J, Luo B. Interventional recanalization as a treatment of carotid stump syndrome caused by right internal carotid artery occlusion A case report. *Medicine* 2019;**98**:39.
14 Powers WJ, Rabinstein AA, Ackerson T, Adeoye OA, Bambakidis NC, Becker K, et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update to the 2018 guidelines for the early management of acute ischemic stroke A guideline for healthcare professionals from the American heart association/American stroke association. *Stroke* 2019;**50**:e344—418.
15 Ascher E, Markevich N, Hingorani AP, Kallakuri S, Gunduz Y. Internal carotid artery flow volume measurement and other intraoperative duplex scanning parameters as predictors of stroke after carotid endarterectomy. *J Vasc Surg* 2002;**35**:439—44.