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Case Report

Carotid endarterectomy for acute carotid thrombosis after carotid artery stenting with CASPER Rx® stent: A case report

Masafumi Segawa[1], Tomohiro Inoue[1], Sho Tsunoda[1], Takuya Kanamaru[2], Seiji Okubo[2]

Departments of [1]Neurosurgery, and [2]Cerebrovascular Medicine, NTT Medical Center Tokyo, Tokyo, Japan.

E-mail: *Masafumi Segawa - segawa.neuro.m@outlook.jp, Tomohiro Inoue - t.inouenttnsu@gmail.com, Sho Tsunoda - s.tsunoda1024@gmail.com, Takuya Kanamaru - shimotaku@nms.ac.jp, Seiji Okubo - okubosei@nms.ac.jp

***Corresponding author:**
Masafumi Segawa,
Department of Neurosurgery,
NTT Medical Center Tokyo,
Tokyo, Japan.

segawa.neuro.m@outlook.jp

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ABSTRACT

Background: Acute carotid stent thrombosis (ACST) is a rare but devastating complication for carotid artery stenting (CAS). That requires early diagnosis and immediate treatment. Although administration of drugs or endovascular treatment is the most widely used approach for patients with ACST, there is no consensus on the standard treatment of this disease.

Case Description: The present study reports on an 80-year-old female patient with the right internal carotid artery stenosis (ICS) that had been followed up by ultrasonography for 8 years. Although the optimal medical treatment was followed, the patient's right ICS worsened, and the patient was subsequently hospitalized for CAS. On the 12th day after CAS, left paralysis and dysarthria were observed. Head magnetic resonance imaging (MRI) showed acute obstruction of the stent and scattered cerebral infarction in the right cerebral hemisphere caused possibly by the discontinuation of temporary antiplatelet drug therapy as a means to prepare for embolectomy of the femoral artery. Stent removal and carotid endarterectomy (CEA) were selected as the appropriate treatment approach. CEA was performed with the precaution of stent removal and distal embolism, and complete recanalization was obtained. Postoperative head MRI showed no new findings of cerebral infarction, and the patients remained symptom-free after 6 months of postoperative follow-up.

Conclusion: Stent removal with CEA could be an appropriate curative option in some cases with ACST except in patients at high risk of CEA and in the chronic phase after CAS.

Keywords: Carotid artery stenting, Carotid endarterectomy, External carotid artery, Internal carotid artery stenosis, Stent thrombosis

INTRODUCTION

Carotid artery stenting (CAS) is a well-known treatment for carotid artery stenosis. The number of CAS cases has been increasing in Japan during the past years. Acute carotid stent thrombosis (ACST) is a rare condition with devastating complications requiring urgent treatment,[3] which is primarily caused by the obstruction of the protection device, plaque protrusion, antiplatelet drug resistance, and antiplatelet drug discontinuation.[4,10] Although administration of drugs, such as argatroban, thrombolytic therapy, and endovascular treatment, is currently the treatment of choice for patients with ACST, there is no consensus on the standard treatment of this disease.

In this case report, we describe a successful revascularization case by carotid endarterectomy (CEA) in a patient with ACST.

CASE DESCRIPTION

An 80-year-old female patient with hypertension and dyslipidemia had been followed-up by carotid ultrasonography of the right internal carotid artery stenosis (ICS) for 8 years. Although an optimal drug treatment was employed, consisting of aspirin (100 mg/day) and clopidogrel (75 mg/day), ICS gradually worsened, and the patient was eventually hospitalized for CAS. Magnetic resonance imaging (MRI) showed severe stenosis at the right carotid bifurcation [Figure 1]. Black-blood T1-weighted imaging demonstrated slightly high-intensity plaque at right ICS, with a signal intensity ratio of the plaque to the sternocleidomastoid muscle, indicating moderate-grade vulnerable plaque. Digital subtraction angiography (DSA) revealed severe stenosis of the right ICS (North American Symptomatic Carotid Endarterectomy Trial, 70%) and near occlusion of the external carotid artery (ECA) [Figure 2a]. Right common carotid angiography revealed that the diameters of mid-common carotid artery (CCA), stenotic site, and distal internal carotid artery (ICA) were 6.3, 1.7, and 5.4 mm, respectively. Following the application of proximal (8Fr OPTIMO EPD® balloon guiding catheter) and distal protection (Guardwire PS®) devices, the stenosis of the right ICS was predilated with a 3 × 20 mm balloon (Coyote balloon dilatation catheter, 6 atm*30 s) [Figure 2b]. In addition, a 7 × 25 mm self-expandable carotid stent (CASPER Rx®) was poorly dilated [Figure 2c], and the stent was dilated twice by a balloon (4 × 30 mm and 4.5 × 30 mm Sterling balloon dilatation catheter). After post-dilation, DSA demonstrated that the most narrow area measured 2.4 mm [Figure 2d]. The right common femoral artery puncture site was closed with an 8-Fr AngioSeal® device, and the right dorsal artery of the right foot was poorly palpated after CAS. The patient presented with the right intermittent claudication after leaving the bed on postoperative day 1 (POD1). Computed tomography angiography revealed occlusion of the right femoral artery after hemostasis on POD3 [Figure 3]. Clopidogrel was discontinued on POD4 as a means to prepare for surgery to remove the thrombosis of the femoral artery, and argatroban infusion was subsequently started as an alternative treatment, extending APTT from 28.8 s to 38.4 s. On POD9, argatroban infusion was discontinued and femoral artery thrombectomy was performed at the department of cardiovascular surgery.

Figure 1: Initial magnetic resonance angiography revealed severe stenosis of the right internal and external carotid artery on patient admission (white arrow).

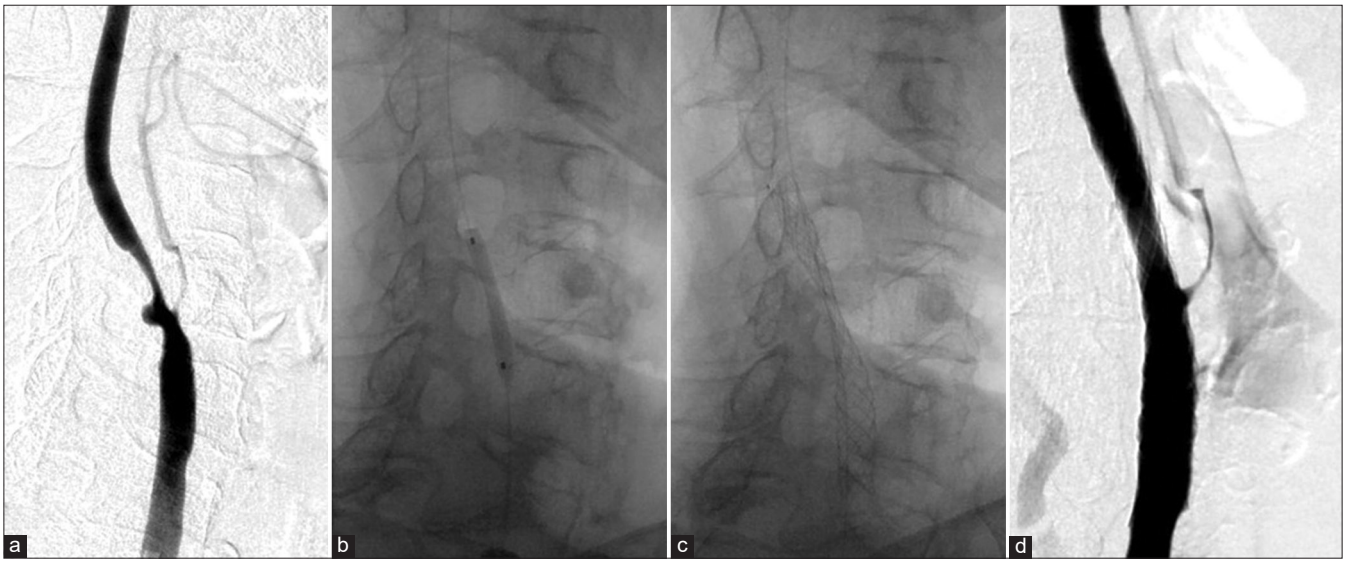

Figure 2: (a) Lateral view of the right common carotid artery on a preoperative angiogram focused on the neck. (b) The stenosis of the right internal carotid artery was predilated with a 3 × 20 mm dilation balloon. (c) A 7 × 25 mm self-expandable carotid stent (CASPER Rx®) was placed. (d) After post-dilation, the angiogram revealed good revascularization.

Administration of clopidogrel was resumed on POD10. On POD12, left hemiplegia and dysarthria were suddenly observed (National Institute Health of Stroke Scale, scores 6), and MRI showed scattered infarctions of the right cerebral hemisphere and occlusion of the CCA [Figure 4a]. Just before the proximal part of the stent, occlusion of the right CCA was observed on angiography [Figure 4b]. In addition, collateral circulation from the left CCA and right posterior communicating artery to the right CCA was found. Patency of the distal part of the right cavernous ICA was confirmed [Figure 4c]. Since it was difficult to increase the clinical dose of antithrombotics in the early postoperative period after thrombus removal in the femoral artery, stent removal with CEA was selected as an early intervention. Under general anesthesia, the back plate was raised to 15° and fixed in the cervical extension position. An S-shaped skin incision was performed along the anterior edge of the sternocleidomastoid muscle, the sternocleidomastoid muscle was expanded posterolaterally, and the ansa cervicalis, CCA, and internal jugular vein were identified proximally. To secure the CCA, the carotid sheath was opened. We expanded the internal jugular vein posterolaterally while reaching the ansa cervicalis to the distal point where it joins the hypoglossal nerve. We followed the CCA to secure the ECA and superior thyroid artery (STA). Subsequently, the ICA on the distal carotid stent was secured, and a bolus of heparin (5000 units) was administered before ICA clamping. In addition, 30 mg of edaravone (Radicut®; Mitsubishi Pharma Corp, Tokyo, Japan) was administered through drip infusion for 30 min before ICA clamping and ICA, STA, and ECA were temporarily clamped in order [Figure 5a]. The stent was cut with Potts-Smith angled scissors along the thickened endometrium [Figure 5b], and a thrombus in the stent was observed directly below [Figure 5c]. After stent removal, the thickened vascular intima was peeled off. Compression marks due to the stent were observed on the intima of the blood vessels [Figure 5d] and a sufficient backflow was confirmed immediately from the distal declumped ICA. Furthermore, a T-shaped intraluminal shunt was inserted into the ICA and CCA, while arteriotomy was performed in the ECA, and the thickened intima was peeled off to confirm that patency had been reached [Figure 6a]. The temporary clamp was released in the same order, and the artery was sutured with 6-0 proline [Figure 6b]. A part of the intima and media was collected for histopathological analysis, and there was no evidence of plaque protrusion into the stent [Figures 6c and d]. The actual surgical procedure is demonstrated below and can also be viewed in the supplemental online video. Postoperative head MRI revealed no new findings of cerebral infarction, and improvement in the depiction of ICA and ECA was noted [Figures 7a and b]. Left hemiplegia and dysarthria improved within a few days and the patient was discharged home with a modified Rankin scale score of 1. At the 8-month postoperative follow-up, the patient remained symptom-free.

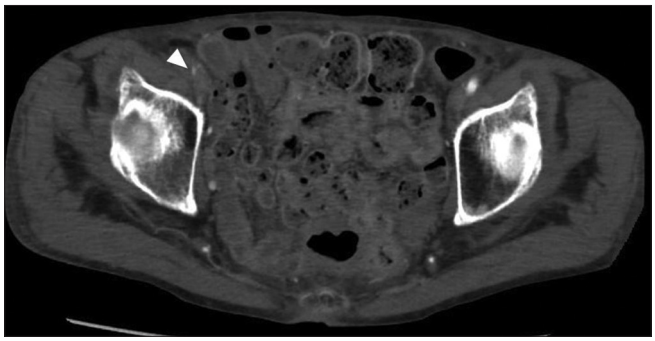

Figure 3: Computed tomography angiography (CTA) showed an occlusion of the right femoral artery after hemostasis. White arrow head denotes right femoral artery.

DISCUSSION

CEA was performed to treat in-stent thrombosis after CAS, and our findings revealed that a good clinical outcome was achieved. At present, CAS is used as an alternative treatment to CEA for carotid artery stenosis. The efficacy and safety of CAS have increased according to the results of randomized

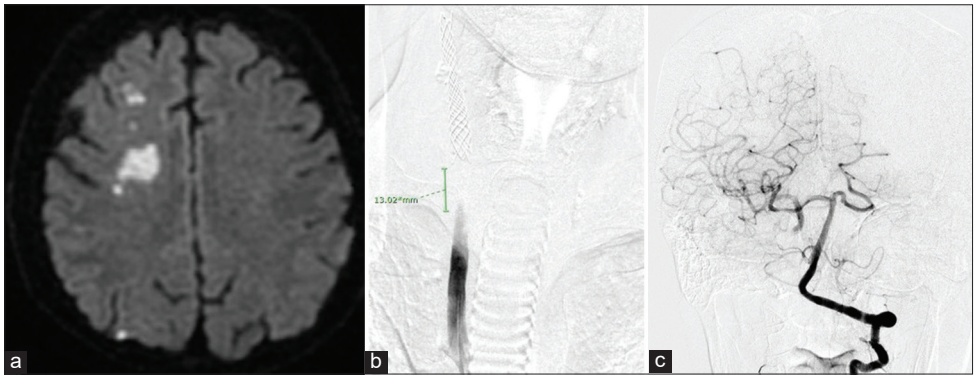

Figure 4: (a) MRI showed scattered infarction of the right cerebral hemisphere and (b) the occlusion of the right common carotid artery was (CCA) observed on angiography. (c) A patency of the distal part of the right internal carotid artery (cavernous portion) was confirmed on a preoperative angiogram.

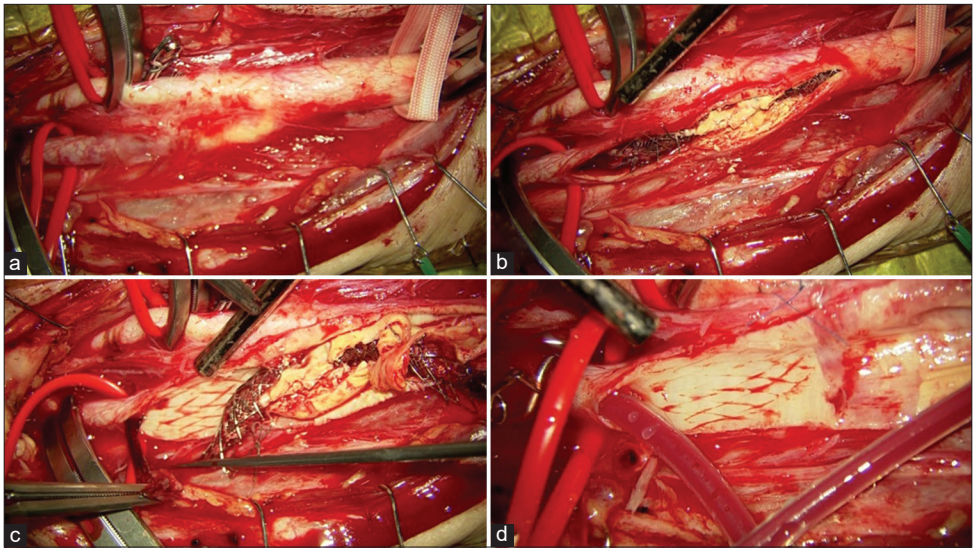

Figure 5: Operative view. (a) The right common carotid artery, internal carotid artery, external carotid artery, and superior thyroid artery were clamped temporally before arteriotomy. (b) The carotid stent was cut with arteriotomy. (c) A thrombus in the stent was observed. (d) Compression marks due to the stent were observed on the intima of the blood vessel.

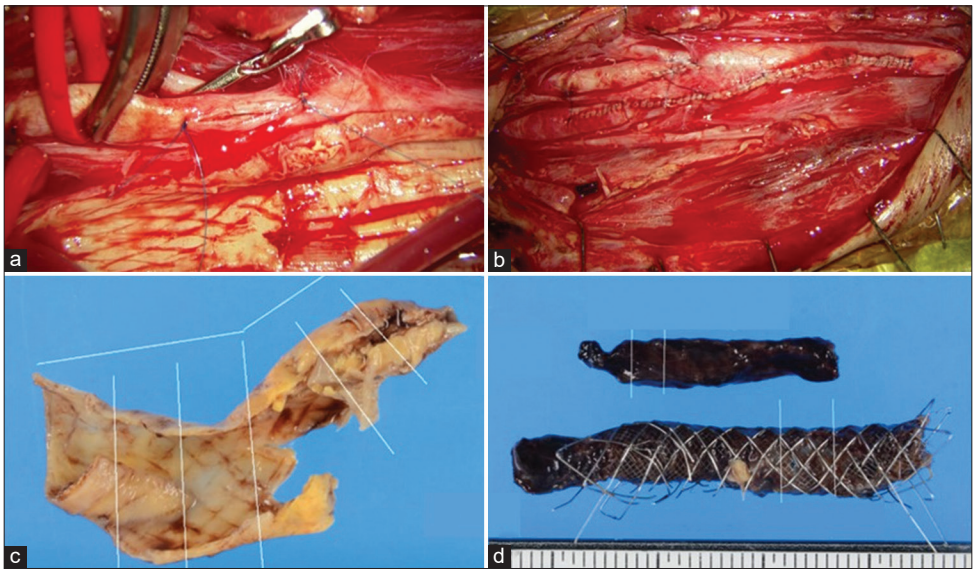

Figure 6: Operative view. (a) An arteriotomy was also performed in the external carotid artery. (b) The artery was sutured continuously with 6-0 proline on both sides. (c and d) Histopathologically, a part of the intima and media was collected, and there was no evidence of plaque protrusion into the stent.

controlled trials.[1] The incidence of ACST is 0.5–0.8%,[3,5,6,10,11] with serious complications requiring early diagnoses and recanalization. The causes of ACST in the procedure include obstruction of the embolic protection device, plaque protrusion, vasospasm, dissection, and inadequate stent dilation. The causes of ACST occur within a few hours to a few days after CAS, including antiplatelet drug resistance, antiplatelet drug discontinuation, coagulation abnormalities in cancer-bearing patients, and blood disorders such as essential thrombocythemia. In this case, discontinuation of perioperative antiplatelet drugs might have been the underlying cause of ACST.

Possible coping strategies for ACST include the following: (1) administration of additional drugs such as argatroban; (2) thrombolytic therapy with rt-PA and urokinase; (3) endovascular treatment such as thrombus recovery; (4) re-angioplasty such as percutaneous transluminal angioplasty

Table 1: Reported cases of stent removal with CEA for ACST.

Authors	Year	Age	Time from CAS to onset of symptoms	Stent	Cause of ACST
Setacci *et al*.	2005	82	2 days	Carotid Wallstent, Boston Scientific	Plaque prolapse
		78	4 days	Carotid Wallstent, Boston Scientific	Discontinuation of antiplatelet drugs
Markatis *et al*.	2015	67	2 days	Abbott Vascular, Cedex, France	Loss of taking antiplatelet therapy
Moulakakis and Lazaris	2018	66	30 min	X-act 9-7 mm	Plaque protrusion
		72	1 h	None	Severe coiling of the distal ICA
Present case	2022	80	12 days	CASPER Rx® stent	Discontinuation of antiplatelet drugs

ACST: Acute carotid stent thrombosis, CAS: Carotid artery stenting, CEA: Carotid endarterectomy, ICA: Internal carotid artery

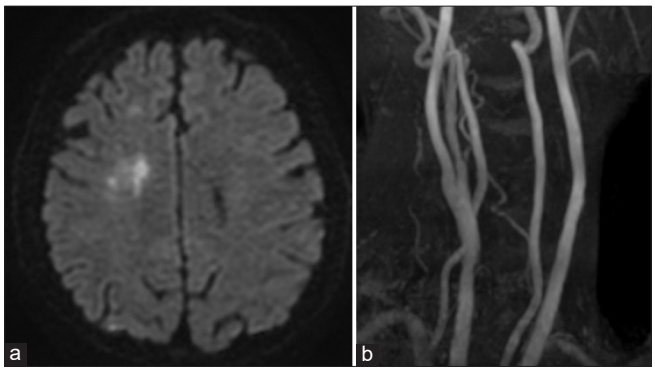

Figure 7: (a) Postoperative MR imaging revealed no new cerebral infarction. (b) Preoperative MR angiography of the neck showed the patency of the right internal carotid artery (ICA) and external carotid artery (ECA).

(PTA) and re-CAS; and (5) stent removal and carotid thromboendarterectomy. Complications of re-angioplasty include the possibility of distal embolism and re-thrombosis associated with deterioration of the stent structure. Although the long-term prognosis after revascularization for ACST is not clear, Masuo *et al.* reported a case of 60% re-stenosis 9 months after the PTA.[7] Acute thrombosis after the intervention is the result of the aggregation of activated platelets. Therefore, postprocedural intensive management after recanalization is needed to prevent re-thrombosis and restenosis. To the best of our knowledge, only five cases of stent removal and thromboendarterectomy have been documented in the literature [Table 1].[6,9,11] All patients were diagnosed with ACST within 30 min–4 days after CAS for severe ICS and underwent thromboendarterectomy within 24 h of diagnosis. The assumed causes of ACST were plaque prolapse in-stent, hypercoagulable state, such as thrombocytosis, discontinuation of antiplatelet drugs at the patient's discretion, incidental loss of antiplatelet therapy, and severe coiling of the distal ICA. All cases had a good clinical outcome after thromboendarterectomy. Herein, we achieved complete recanalization and patient's favorable outcome for the following reasons: First, CEA could be more advantageous for obtaining complete recanalization compared to endovascular treatments as swift clamp of the proximal portion without touching the distal embolus could prevent distal migration or fragmentation of the embolus more safely. Successful complete recanalization without distal embolism would contribute to more favorable patient outcomes. Second, CEA could achieve the two goals of removing thrombus stent and thickened intima with a single treatment. Long-term dual antiplatelet therapy is no longer necessary if the stent is removed. Consequently, the benefits to patients who discontinue dual antiplatelet therapy are great.

We must evaluate the patency of distal ICA for ICA occlusion in cases of CEA. In the present case, the ipsilateral retrograde cavernous to petrous ICA opacification was noted through cross-flow in delayed arterial phase of contralateral carotid injection. In the series of CEA for ICA occlusion (with patent CCA and ECA), the retrograde reflux visualization of occluded ICA back to the cavernous portion or further back to the petrous portion in preoperative angiography has been associated with 50% and 71% successful reopening of ICA, respectively.[8]

Meanwhile, endovascular treatments might be advantageous compared to CEA from the standpoint of time, because treatments can be performed as soon as the diagnosis is made. If angiography detects an intracranial artery occlusion, endovascular surgery should be the first choice for ACST. However, re-angioplasty or CEA should also be considered depending on the available manpower, endovascular staff, etc.

The CASPER Rx® (TCD-15152) stent (Terumo Co, Tokyo, Japan) is a self-expandable nitinol stent with a dual-layer structure of tubular mesh.[12] The outer layer consists of a braided closed-cell structure with close vessel wall apposition and good conformability, and the inner layer has a closed-cell design with a small micromesh to limit plaque prolapse and embolic release. According to Broussalis *et al*., a longer-term dual antiplatelet therapy is recommended after CAS using a CASPER Rx® stent.[2] Considering that the double-mesh stent structure is metallic, periprocedural dual antiplatelet therapy should be continued for at least 1 month, as the time required for in-stent re-endothelialization.[11]

CONCLUSION

Stent removal with CEA could be an appropriate curative option in some suitable cases with ACST. Indication should be carefully considered in patients at high risk of CEA and in the chronic phase after CAS. Long-term surveillance is necessary to assess the durability of this procedure.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Brott TG, Howard G, Roubin GS, Meschia JF, Mackey A, Brooks W, *et al*. Long-term results of stenting versus endarterectomy for carotid-artery stenosis. N Engl J Med 2016;374:1021-31.
2. Broussalis E, Griessenauer C, Mutzenbach S, Pikija S, Jansen H, Stevanovic V, *et al*. Reduction of cerebral DWI lesion burden after carotid artery stenting using the casper stent system. J Neurointerv Surg 2019;11:62-7.
3. Chaturvedi S, Sohrab S, Tselis A. Carotid stent thrombosis: Report of 2 fatal cases. Stroke 2001;32:2700-2.
4. Cheneau E, Leborgne L, Mintz GS, Kotani J, Pichard AD, Satler LF, *et al*. Predictors of subacute stent thrombosis: Results of a systematic intravascular ultrasound study. Circulation 2003;108:43-7.
5. Hu W, Wang L, Wang G. Acute in-stent thrombosis after carotid angioplasty and stenting: A case report and literature review. Interv Neurol 2018;7:265-70.
6. Markatis F, Petrosyan A, Abdulamit T, Bergeron P. Acute carotid stent thrombosis: A case of surgical revascularization and review of treatment options. Vascular 2012;20:217-20.
7. Masuo O, Terada T, Matsuda Y, Ogura M, Tsumoto T, Yamaga H, *et al*. Successful recanalization by in-stent percutaneous transluminal angioplasty with distal protection for acute carotid stent thrombosis. Neurol Med Chir (Tokyo) 2006;46:495-9.
8. McCormick PW, Spetzler RF, Bailes JE, Zabramski JM, Frey JL. Thromboendarterectomy of the symptomatic occluded internal carotid artery. J Neurosurg 1992;76:752-8.
9. Moulakakis KG, Lazaris AM. Emergent carotid stent removal after carotid stent thrombosis. Ann Vasc Surg 2018;46:401-6.
10. Moulakakis KG, Mylonas SN, Lazaris A, Tsivgoulis G, Kakisis J, Sfyroeras GS, *et al*. Acute carotid stent thrombosis: A comprehensive review. Vasc Endovasc Surg 2016;50:511-21.
11. Setacci C, de Donato G, Setacci F, Chisci E, Cappelli A, Pieraccini M, *et al*. Surgical management of acute carotid thrombosis after carotid stenting: A report of three cases. J Vasc Surg 2005;42:993-6.
12. Wissgott C, Schmidt W, Brandt C, Behrens P, Andresen R. Preliminary clinical results and mechanical behavior of a new double-layer carotid stent. J Endovasc Ther 2015;22:634-9.

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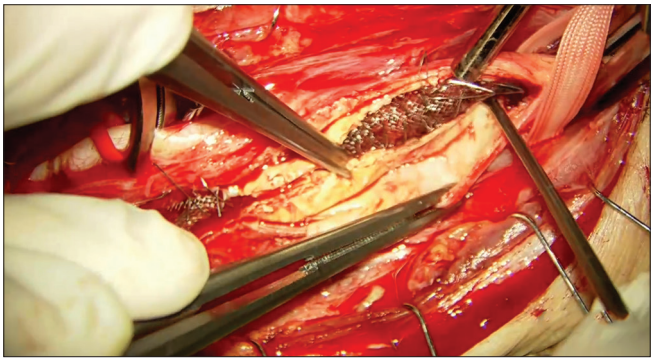
SUPPLEMENTARY VIDEO



Supplementary Video: Video demonstrating technique of CEA for acute carotid stent thrombosis.