Online May 20, 2020
Journal of Neuroendovascular Therapy 2020; 14: 307–312 DOI: 10.5797/jnet.cr.2019-0077

Case Report

A Patient Who Underwent Mechanical Thrombectomy for Acute Occlusion of the Vertebral and Radial Arteries

Yuyo Maeda, Yoshihiro Kiura, Hiroshi Kondo, Tetsuhiko Sakoguchi, Takuro Magaki, Shinichiro Takeshita, and Atsushi Tominaga

Objective: We report a case of acute occlusion of the vertebral artery and radial artery. We performed mechanical thrombectomy for the radial artery following mechanical thrombectomy for the vertebral artery.

Case Presentation: A 73-year-old woman developed sudden-onset dizziness and dysesthesia of the left finger, and was taken to our hospital. Atrial fibrillation was observed. Image inspection revealed acute cerebral infarction of the left lateral medulla and left cerebellar hemisphere, and occlusion of the vertebral and radial arteries. Mechanical thrombectomy for the left vertebral artery occlusion was performed after intravenous recombinant tissue plasminogen activator (rt-PA), and then mechanical thrombectomy was performed for the left radial artery occlusion.

Conclusion: This case suggests that it is possible to guide the system to the radial artery and to perform thrombectomy using existing intracranial endovascular treatment devices.

Keywords ▶ cardiogenic cerebral embolism, mechanical thrombectomy, acute arterial occlusion

Introduction

Cardiogenic cerebral embolism may be complicated by systemic embolism such as acute arterial occlusion of the limbs. Currently, mechanical thrombectomy for acute occlusion of the main intracranial artery is routinely performed. However, few studies have reported mechanical thrombectomy for acute arterial occlusion of the limbs.[1)] We report a patient with acute occlusion of the vertebral and radial arteries in whom mechanical thrombectomy for radial artery occlusion was performed following the same procedure for intracranial occlusion.

Department of Neurosurgery and Neuroendovascular Therapy, Hiroshima Prefectural Hospital, Hiroshima, Hiroshima, Japan

Received: August 18, 2019; Accepted: April 13, 2020
Corresponding author: Yuyo Maeda. Department of Neurosurgery and Neuroendovascular Therapy, Hiroshima Prefectural Hospital, 1-5-54, Ujina Kanda, Minami-ku, Hiroshima, Hiroshima 734-8530, Japan
Email: maedayuyo4.18@gmail.com

Case Presentation

Patient: A 73-year-old female.

Complaints: Dizziness, dysesthesia of the left fingers.

Present illness: At 13:00 on the day of emergency transport, dizziness and dysesthesia of the left fingers suddenly developed while she was doing housework at home. She was brought to the emergency outpatient unit of our hospital by ambulance at 13:55.

Physical findings: The blood pressure on the left and right sides was 149/89 and 142/93 mmHg, respectively, demonstrating no laterality. However, the left radial artery was not palpable. The heart rate was 115 beats/min, suggesting tachycardia. The R-R interval was irregular. The body temperature was 36.5 °C, and the SpO_2 for the right upper limb was 100% (under 5-L oxygen administration).

Neurological findings: Concerning consciousness, the Japan Coma Scale (JCS) score was zero. The left and right pupils measured 3 mm/3 mm, respectively, demonstrating no laterality. Light reflex was prompt on the bilateral sides. There was no headache, convulsion, or vomiting. Neurological deficits included dysarthria, articulation difficulty, left incomplete hemiplegia (MMT: 3/5), Barre's sign of the left upper limb, a positive reaction of the lower limbs on Mingazzini's test of the right half body, thermal hypoalgesia, dizziness, and left abnormalities on the finger-nose test. The

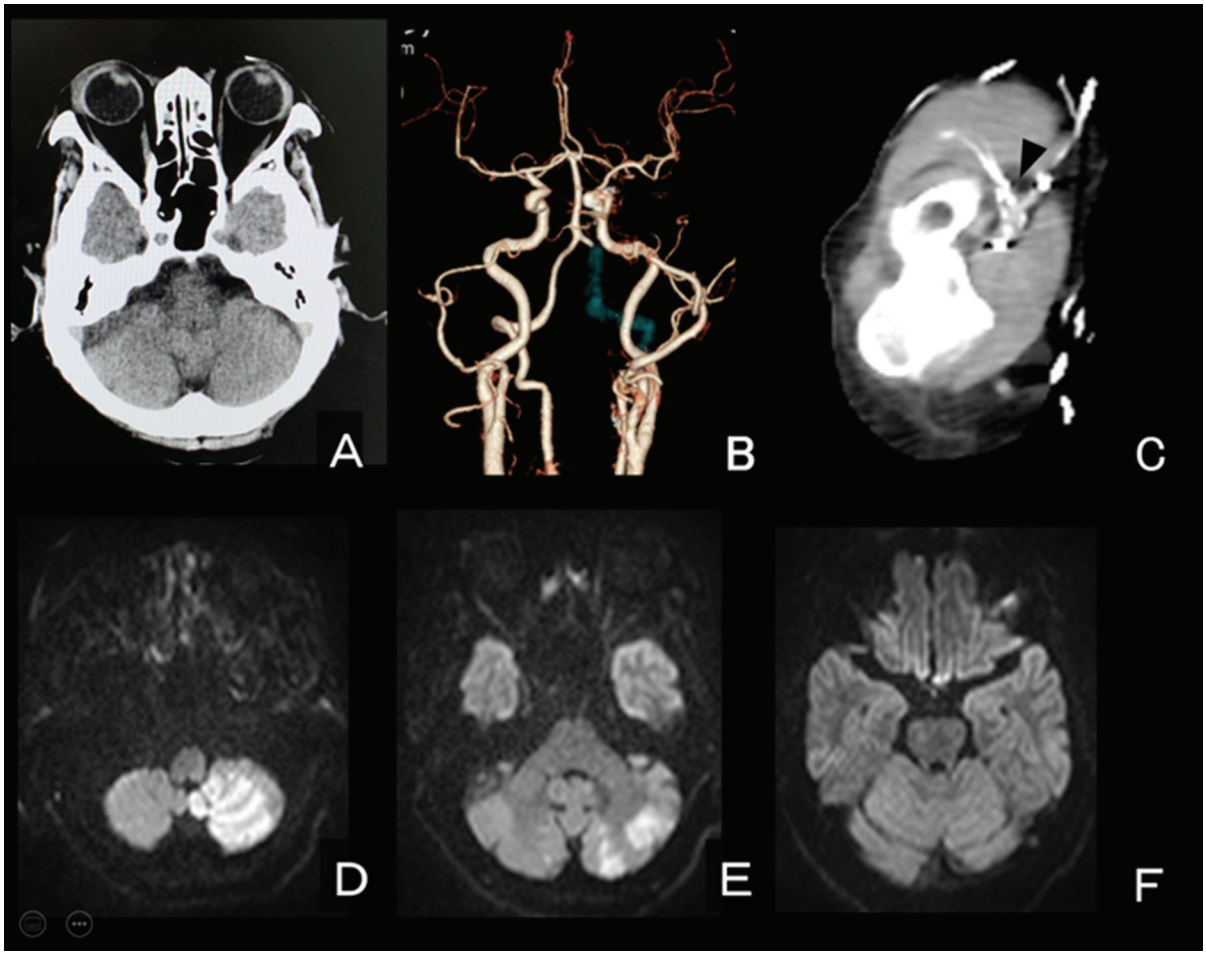

Fig. 1 Preoperative imaging findings: (**A**) CT and (**B**) contrast-enhanced CT revealed left vertebral artery occlusion and no cerebral hemorrhage. (**C**) Contrast-enhanced CT of the left arm revealed acute occlusion of the left radial artery (▼). (**D–F**) Diffusion-weighted MRI showed high-signal areas, suggesting acute cerebral infarction of the left lateral medulla oblongata and the left cerebellar hemisphere. CT: computed tomography; MRI: magnetic resonance imaging

National Institutes of Health Stroke Scale (NIHSS) score was 7. Furthermore, pain involving the left forearm to fingers, dysesthesia, hypaesthesia, paleness of the left fingers, and pulselessness were noted.

Electrocardiographic findings: Atrial fibrillation was observed.

Hematological data: The D-dimer level was 1.9 IU/mL, being high.

Radiological findings: Head computed tomography (CT) did not reveal intracranial hemorrhage. Contrast-enhanced CT revealed occlusion of the left vertebral artery (**Fig. 1A** and **1B**). Subsequently, systemic CT for detailed examination of the entire body did not reveal aortic dissection. Acute arterial occlusion of the left upper limb was suspected based on physical examination findings. Contrast-enhanced CT of the left upper limb demonstrated a thrombus in the left radial artery, leading to a diagnosis of acute radial artery occlusion (**Fig. 1C**). Brain magnetic resonance imaging (MRI) revealed acute-phase cerebral infarction involving the left cerebellar hemisphere to lateral medulla oblongata, with high-signal intensity on diffusion-weighted images and low signal intensity on ADC (**Fig. 1D, 1E,** and **1F**).

Course after admission: Based on the patient's medical history, examination findings, and examination results, a diagnosis of acute occlusion of the left vertebral and radial arteries related to atrial fibrillation was made. To treat acute-phase cerebral infarction, treatment with recombinant tissue plasminogen activator (rt-PA) was selected, and rt-PA was administered 3 hours and 4 minutes after onset. Subsequently, the patient was admitted to the endovascular therapy room 3 hours and 30 minutes after onset (at 16:30). Puncture was performed at 16:40, and mechanical thrombectomy for acute-phase cerebral infarction was started.

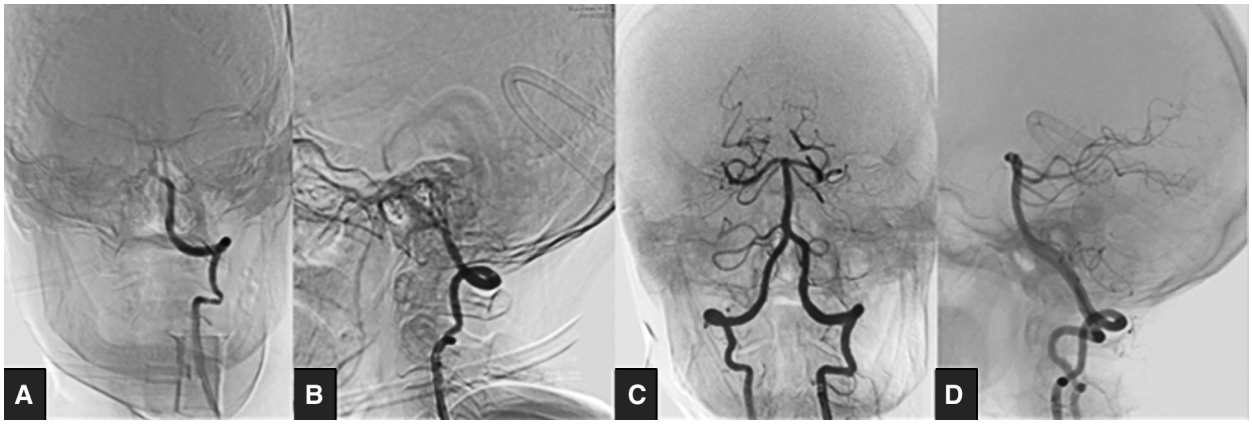

Fig. 2 Endovascular mechanical thrombectomy of cerebral infarction: (**A**) Preoperative DSA front view. (**B**) The lateral view revealed distal migration of the thrombus and occlusion of the basilar artery. (**C**) Postoperative DSA front view. (**D**) The lateral view showed recanalization of TICI grade IIB. DSA: digital subtraction angiography; TICI: thrombolysis in cerebral infarction

Intraoperative findings: The right femoral artery was punctured, and a Fubuki Dilator kit (Asahi Intecc, Tokyo, Japan) was inserted as a 6Fr guiding catheter. Using a coaxial system consisting of a 6Fr JB2 (Medikit, Tokyo, Japan) and 0.035-inch stiff Radifocus Guidewire M Stiff type (Terumo Interventional Systems, Tokyo, Japan), the Fubuki Dilator kit was guided to the V5 proximal region of the left vertebral artery. Left vertebral arteriography revealed that the left vertebral artery thrombus confirmed on preoperative examination had migrated to the peripheral side, suggesting acute occlusion of the basilar artery (**Fig. 2A** and **2B**). To treat the thrombus at the basilar artery end, a Penumbra 5 MAX ACE68 (Penumbra Inc., Alameda, CA, USA) was guided to the site of occlusion using a Marksman (Medtronic, Minneapolis, MN, USA) and 0.014-inch CHIKAI 200 cm (Asahi Intecc). Furthermore, a Trevo Provue Retriever (Stryker, Kalamazoo, MI, USA, stent diameter: 6 mm, effective stent length: 25 mm) was prepared on the table, considering the possibility of a combined technique. Initially, a direct aspiration first pass technique (ADAPT) was conducted through the Penumbra 5 MAX ACE68 guided to the central side of the occluded site. Subsequently, angiography confirmed recanalization at the basilar artery end, but thrombus scattering in the P1 region of the right posterior cerebral artery was noted. After placing the Penumbra 5 MAX ACE68 at the basilar artery end, a Penumbra 3 MAX (Penumbra Inc.) was guided to the site of occlusion, and ADAPT was additionally conducted. Angiography demonstrated thrombus scattering at the P2 level of the right posterior cerebral artery, and ADAPT was additionally conducted using a similar system. Finally, thrombolysis in cerebral infarction (TICI) grade IIB recanalization was achieved 4 hours and 10 minutes after onset (at 17:10) (**Fig. 2C** and **2D**). Following mechanical thrombectomy for acute occlusion of the intracranial artery, the same procedure for acute occlusion of the left radial artery was performed. A Fubuki Dilator kit was guided into the brachial artery using a 6Fr JB2 and 0.035-inch stiff Radifocus Guidewire M Stiff type. Subsequently, a Penumbra 5 MAX ACE68 was guided to the central side of the occluded site using a Marksman and 0.014-inch CHIKAI 200 cm. Initially, ADAPT with the Penumbra 5 MAX ACE68 was conducted, but recanalization was not achieved. Thrombectomy with an aspiration device alone was considered to be difficult, and a combined technique with a Trevo Provue Retriever, which had been prepared on the table for intracranial thrombectomy, was selected. The Marksman was guided to the peripheral side of the occluded site using the 0.014-inch CHIKAI 200 cm. Angiography through the Marksman and Fubuki Dilator kit confirmed lesion crossing (**Fig. 3A** and **3B**). The Trevo Provue Retriever was deployed through the Marksman. Angiography immediately after deployment confirmed flow restoration (**Fig. 3C**), and thrombectomy was performed. Subsequently, angiography confirmed the resumption of radial artery blood flow (**Fig. 3D**). The interval from onset until intracranial artery recanalization was 4 hours and 10 minutes, and that until left radial artery recanalization was 4 hours and 40 minutes. The NIHSS score immediately after surgery was 3 (paralysis/ataxia of the left upper limb), having improved in comparison with the preoperative value. All symptoms related to left radial artery occlusion subsided. During the course of admission, walking and oral ingestion became possible. The patient was

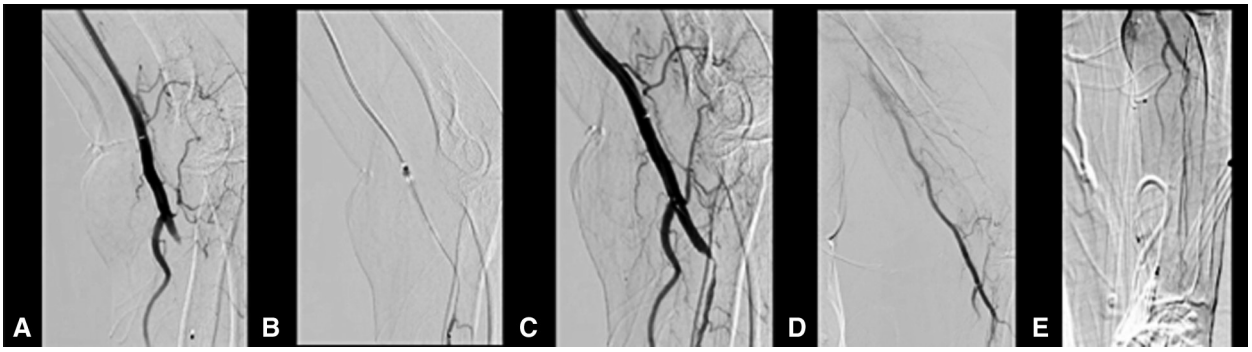

Fig. 3 Endovascular mechanical thrombectomy of acute radial artery occlusion: (**A** and **B**) A 6Fr Fubuki Dilator kit was placed in the brachial artery with a system comprising a 6Fr JB2 and 0.035-inch stiff Radifocus Guidewire M Stiff type. The lesion cross was confirmed by contrast imaging from the Marksman and the guiding catheter. (**C**) Contrast imaging after stent deployment confirmed flow restoration in the occluded area. (**D** and **E**) After mechanical thrombectomy, recanalization of the radial artery was confirmed.

referred to another hospital for rehabilitation on the 30 days after thrombectomy (mRS score on discharge: 3).

Discussion

Clinical characteristics of acute arterial occlusion of the limbs

Several studies reported that acute arterial occlusion of the upper limbs was related to heart-derived embolism in 33%–90% of patients.[2–4] Vohra et al.[3] observed occlusion peripheral to the elbow in 11% of the subjects. Acute arterial occlusion of the limbs induces six Ps: pallor, pain, pulselessness, paresthesia, paralysis, and prostration as ischemic symptoms. The golden hour is 6 hours, and prompt diagnosis and treatment may be necessary, as indicated for acute-phase cerebral infarction.

Acute arterial occlusion of the limbs is classified into thrombosis and embolism based on the condition. Embolism refers to thrombus formation at the stenosis-free vascular bifurcation; therefore, its onset is rapid, and symptoms are marked, whereas another study reported that thrombectomy alone led to a high cure rate.[5] Furthermore, there is no stenotic lesion, and the postoperative course or prognosis is favorable in the absence of neuropathy or muscular tissue damage.[5] In the present case, embolism was suspected based on the condition, and recanalization therapy early after onset was considered to be effective in reducing the symptoms.

Acute-phase cerebral infarction complicated by acute arterial occlusion of the limbs

A previous study presented a patient with cardiogenic cerebral infarction complicated by acute arterial occlusion of the limbs during the long-term course of cardiogenic embolism.[6] On the other hand, no study has reported the treatment of cardiogenic cerebral infarction complicated by acute arterial occlusion of the limbs. As one of the reasons, symptoms of intracranial disease are mixed with those of acute arterial occlusion of the limbs in patients with such a condition; therefore, the latter may have been masked and overlooked. For diagnosis, detailed examination is useful. In the present case, symptoms suggestive of acute arterial occlusion of the limbs, such as pain localized in the left forearm, pulselessness, dysesthesia, and paleness, were observed apart from focal symptoms related to cerebral infarction, aiding in the diagnosis. As another factor, loops at the arterial periphery level, such as the deep and superficial palmar arches, are present in arterial dominance at the limb periphery, and blood flow is doubly predominated. Due to such ischemia resistance, ischemia-related symptoms are not readily recognized by the patients themselves, and this may lead to overlooking. According to a survey by Martin et al.[7] involving intensive care unit (ICU) patients with acute occlusion of the radial artery, there was no ischemic symptom in any patient. On the other hand, symptom appearance in a patient with incomplete double loop dominance was reported. Previous studies indicated that the incidence ranged from 1% to 27%, and that the modified Allen's test was useful for assessment.[8–10] In the present case, a positive reaction was observed on the modified Allen's test during admission. A collateral pathway from the ulnar artery to the radial artery was undeveloped, confirming low-level ischemia resistance. Considering this, positive recanalization therapy for acute arterial occlusion of the limbs was necessary in the present case.

Treatment of acute arterial occlusion of the limbs

Treatment methods for acute arterial occlusion of the limbs, such as thrombectomy using a Fogarty catheter, surgical revascularization, and thrombolysis with urokinase, have

been reported.[2,11] In patients with limb artery occlusion alone, the above conventional treatment methods should be selected. However, no study has reported treatment for acute arterial occlusion of the limbs complicated by acute-phase cerebral infarction, as demonstrated in the present case. Furthermore, rt-PA has been increasingly administered to patients with acute-phase cerebral embolism, but no study has examined the safety or efficacy of the above conventional treatment methods in rt-PA-treated patients with acute arterial occlusion of the limbs complicated by acute-phase cerebral infarction. Thus, no treatment method has been established. In the present case, mechanical thrombectomy for acute limb artery occlusion was performed for the following reasons: the risk of complications, such as intraoperative hemorrhage related to a Fogarty catheter or surgical treatment, in rt-PA-treated patients was unclear; and we considered that recanalization may be achieved in a shorter time because the device that had been used for the mechanical thrombectomy for the cerebral infarction helps shorten the time required for consultation in other departments, the preparation of surgical instruments, and change of surgical environments such as the posture. As a result, recanalization of the occluded blood vessel was achieved 30 minutes after intracranial thrombectomy, and there was no complication such as treatment-related hemorrhage.

Case reports on the use of neuroendovascular treatment device for acute arterial occlusion of the limbs are rare. Recent studies reported mechanical thrombectomy at the brachiocephalic artery level,[1,12] but no study has reported treatment on the side peripheral to the brachiocephalic artery. When adopting a device for the head for the treatment of acute limb artery occlusion, it is important to confirm that the system length reaches the site of occlusion. Takenari et al. reported that a system consisting of a 10Fr OPTIMO (Tokai Medical Products, Nagoya, Aichi, Japan), 5Fr JB2 (Medikit, Tokyo), and 0.035-inch stiff Radifocus Guidewire (Terumo Interventional Systems, Tokyo, Japan) facilitated system guiding to the brachiocephalic artery level and treatment. In the present case, it was possible to guide a system consisting of a 6Fr Fubuki Dilator kit, 6Fr JB2, 0.035-inch stiff Radifocus Guidewire, and Marksman to the radial artery level and conduct lesion crossing. The system length was sufficient. On the other hand, the effective device length required in each patient may depend on the physical status or sex. In such cases, a Y connector to be installed in a guiding catheter should be changed to a T connector or hemostatic valve, and the effective length of a system must be extended.

In the treatment of systemic embolism, which induces many conditions, mechanical thrombectomy using a conventional neuroendovascular treatment device may be considered as a treatment option in patients with acute arterial occlusion of the limbs complicated by acute-phase cerebral infarction, as demonstrated in the present case. In the future, data on similar patients should be accumulated, and the safety must be compared with that of conventional treatment methods. In addition, treatment methods for patients with acute-phase cerebral infarction or rt-PA-treated patients should be established.

Conclusion

We reported a patient in whom two sessions of mechanical thrombectomy were performed to treat acute occlusion of the vertebral and radial arteries, respectively. The use of a conventional neuroendovascular treatment device facilitated device guidance to the radial artery level and mechanical thrombectomy.

Disclosure Statement

We declare no conflict of interest.

References

1) Okamoto T, Imai K, Hamanaka M, et al: A case of acute embolic occlusion of the brachiocephalic artery recanalized with endovascular thrombectomy. *JNET J Neuroendovasc Ther* 2017; 11: 315–321.
2) Lin G, Kais H, Negri M, et al: Surgery for acute arterial emboli to the arm. *Harefuah* 1994; 126: 245–247. (in Hebrew)
3) Vohra R, Lieberman DP: Arterial emboli to the arm. *J R Coll Surg Edinb* 1991; 36: 83–85.
4) Katz SG, Kohl RD: Direct revascularization for the treatment of forearm and hand ischemia. *Am J Surg* 1993; 165: 312–316.
5) Nakazawa T, Yamamoto S, Miyahara K, et al: Acute thromboembolism of the extremities. *J Jpn Coll Angiol* 2003; 43: 219–223.
6) Kitazono I, Yamashita M, Motodaka H, et al: A resected case of biventricular thrombi with cardiac sarcoidosis. *Jpn J Cardiovasc Surg* 2007; 36: 261–264. (in Japanese)
7) Martin C, Saux P, Papazian L, et al: Long-term arterial cannulation in ICU patients using the radial artery or dorsalis pedis artery. *Chest* 2001; 119: 901–906.
8) Matsumoto Y, Hongo K, Toriyama T, et al: Transradial approach for diagnostic selective cerebral angiography: results of a consecutive series of 166 cases. *AJNR Am J Neuroradiol* 2001; 22: 704–708.

9) Matsumoto Y, Hokama M, Nagashima H, et al: Transradial approach for selective cerebral angiography: technical note. *Neurol Res* 2000; 22: 605–608.
10) Paul BZ, Feeney CM: Combining the modified Allen's test and pulse oximetry for evaluating ulnar collateral circulation to the hand for radial artery catheterization of the ED patient. *Cal J Emerg Med* 2003; 4: 89–91.
11) Nomura S, Katsura S, Kuga T, et al: A study on acute arterial obstruction of the upper extremity. *J Jpn Surg Assoc* 2003; 64: 570–574. (in Japanese)
12) Chisci E, Ercolini L, Romano E, et al: Successful hybrid management of extensive thromboembolism of the innominate trunk, right subclavian artery, bilateral common carotid artery, and pulmonary embolism. *Ann Vasc Surg* 2014; 28: 1556e1–5.