Online September 30, 2020
Journal of Neuroendovascular Therapy 2021; 15: 170–174
DOI: 10.5797/jnet.cr.2020-0073

Case Report

Mechanical Thrombectomy via the Transfemoral Approach for Acute Middle Cerebral Artery M1 Occlusion That Occurred during Intra-Aortic Balloon Pumping Application

Futoshi Eto,[1] Yoichiro Nagao,[2] Yoji Kuramoto,[3] Toshinori Takagi,[3] Kazutaka Uchida,[3] and Shinichi Yoshimura[2,3]

Objective: We report a case of cardioembolic stroke treated by mechanical thrombectomy (MT) via the transfemoral approach under the assistance of intra-aortic balloon pumping (IABP).

Case Presentation: A 64-year-old man suddenly developed consciousness disturbance, aphasia, and left hemiparesis during intensive care for acute myocardial infarction (AMI) with IABP. The patient was transferred to our hospital and diagnosed with acute right middle cerebral artery (MCA) occlusion. We performed MT using a balloon-guiding catheter via the transfemoral approach and achieved complete recanalization.

Conclusion: Endovascular therapy for acute MCA M1 occlusion via the transfemoral route was safe even when the patient was treated using IABP.

Keywords ▶ intra-aortic balloon pumping, mechanical thrombectomy, cardioembolic stroke, intervention

Introduction

The effectiveness of mechanical thrombectomy (MT) for large vessel occlusion has been established and accepted drastically. Clinically, however, there is uncertainty in the treatment indications and choice of the approach depending on the patient background and other complicating disorders. We present a patient who developed a cardioembolic stroke during intra-aortic balloon pumping (IABP) application and achieved a favorable outcome by MT with the transfemoral approach.

[1]*Department of Neurology, National Cerebral and Cardiovascular Center, Suita, Osaka, Japan*
[2]*Stroke Center, Hyogo College of Medicine, Nishinomiya, Hyogo, Japan*
[3]*Department of Neurosurgery, Hyogo College of Medicine, Nishinomiya, Hyogo, Japan*

Received: April 6, 2020; Accepted: July 25, 2020
Corresponding author: Futoshi Eto. Department of Neurology, National Cerebral and Cardiovascular Center, 6-1, Kishibeshimmachi, Suita, Osaka 564-8565, Japan
Email: eto.futoshi86@ncvc.go.jp

Case Presentation

Patient: A 64-year-old man, left-handed.
Chief complaints: consciousness disturbance, right conjugate deviation, aphasia, and left hemiplegia
Medical history: Dyslipidemia (untreated)
Present illness: He occurred acute myocardial infarction (AMI) due to the left main coronary trunk occlusion and the left anterior descending artery stenosis 4 days before the onset of cerebral infarction. A drug-eluting stent was placed. As he exhibited severe left ventricular hypokinesis, he was introduced IABP (TOKAI 8 Fr; Tokai Medical Products, Aichi, Japan) for assisted circulation via the right common femoral artery. He administered intravenous medication such as heparin at 10000 units/day, carperitide at 0.084 mg/hr (0.02 µg/kg/min), furosemide at 40 mg/day and dobutamine at 17.6 mg/hr (4.2 µg/kg/min). Also, to prevent postoperative thrombosis, he had dual-antiplatelet therapy (DAPT) with aspirin at 100 mg and prasugrel at 3.75 mg. He has pointed out consciousness disturbance, left hemiplegia, and aphasia 30 minutes after the last known well time (LKWT). Head computed tomography (CT) showed no hemorrhagic change. He was transferred to our hospital 161 minutes after the LKWT.

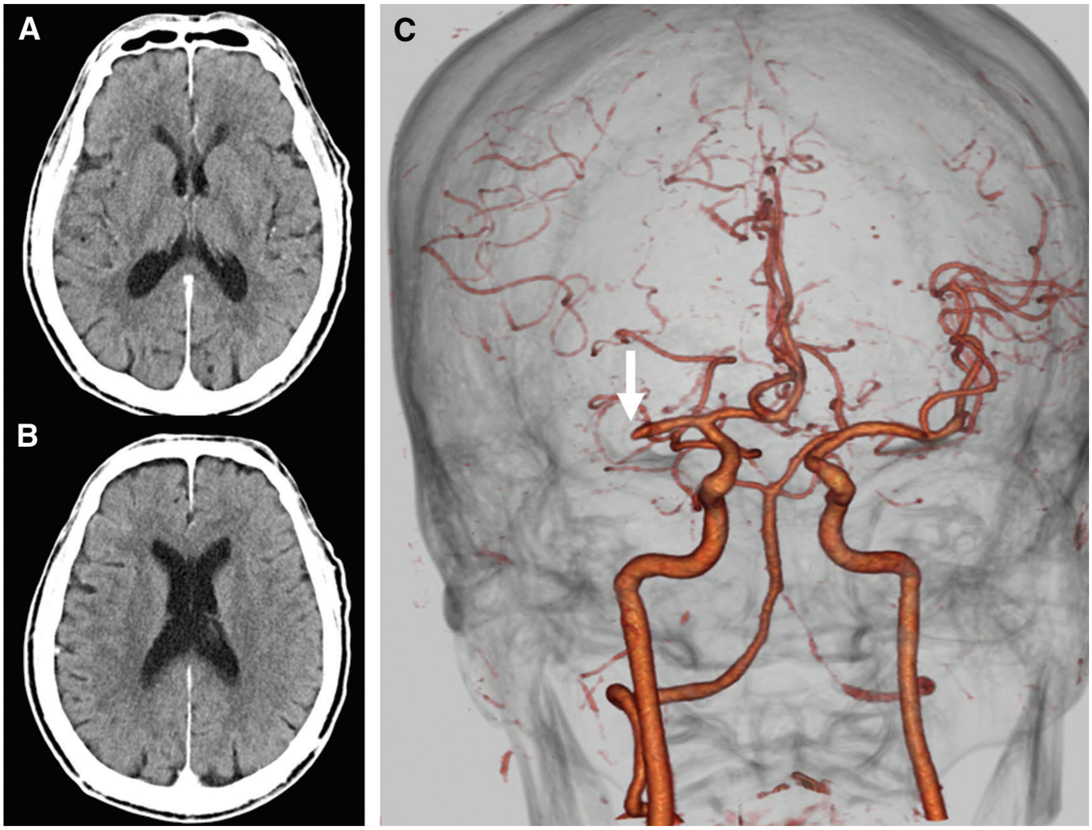

Fig. 1 Preoperative plain and contrast-enhanced head CT. (**A, B**) Axial view of the plain head CT (**A**: basal ganglion level, **B**: corona radiate level) We found the cortico-medullary junction devoid in the right insular cortex. The ASPECTS was 9. (**C**) CTA showed the distal M1 segment of the right MCA occlusion. ASPECTS: Alberta Stroke Program Early CT Score; CT: computed tomography; CTA: computed tomography angiography; MCA: middle cerebral artery

Physical findings on admission: height, 178 cm; body weight, 70 kg; blood pressure, 114/63 mmHg; heart rate, 91 bpm/sinus rhythm; body temperature, 36.4°C; Glasgow Coma Scale 8, E2V2M4. Motor aphasia, right concomitant deviation, and left hemiplegia were noted, and the National Institutes of Health Stroke Scale (NIHSS) score was 25.

Hematological findings: white blood cells, 8510/µL; creatine kinase (CK), 1740 mg/dL; CK-MB, 29 mg/dL; low-density lipoprotein, 120 mg/dL; high-density lipoprotein, 53 mg/dL; triglycerides, 163 mg/dL; C-reactive protein, 6.75 mg/dL; hemoglobin A1c, 5.4%; international normalized ratio of prothrombin time, 1.08; activated partial thromboplastin time, 31.7 sec; D-dimer, 2.61 µg/mL; brain natriuretic peptide, 714 pg/mL

Imaging examinations: Transthoracic echocardiography demonstrated diffuse left ventricular dysfunction and its ejection fraction rate was 25% (disk summation method). There was no thrombus detected in the left atrium. We took a head CT 210 minutes after LKWT. It showed the early ischemic change in the right temporal lobe but no high-intensity area. The Alberta Stroke Program Early CT Score (ASPECTS) was 9 (**Fig. 1A** and **1B**). On head CT angiography (CTA), the distal M1 segment of the middle cerebral artery (MCA) was occluded (**Fig. 1C**).

Clinical course: Although he arrived at our hospital within 4.5 hours from the onset, we did not administer intravenous tissue-plasminogen activator thrombolysis since he was already administered heparin. We performed MT 231 minutes after LKWT. Under local anesthesia, we placed a 9Fr long sheath in the left femoral artery. A 9Fr balloon-guiding catheter (Optimo, Tokai Medical Products, Aichi, Japan) a 6Fr inner catheter (COUNTDOWN JB2 catheter; Medikit, Tokyo, Japan) were coaxially inserted. First, we passed through a 0.035-inch Radifocus Guidewire standard-stiff 150 cm (Terumo, Tokyo, Japan) on the lateral side of the IABP balloon. Next, we used a 6Fr inner catheter guided to the right common carotid artery carefully (**Fig. 2**). IABP was operated at a 1:1 ratio during this period. We navigated a 9Fr balloon-guiding catheter and there was no resistance due to the IABP balloon and no reflux of blood into the IABP catheter. We confirmed the right M1 occlusion on right common carotid angiography

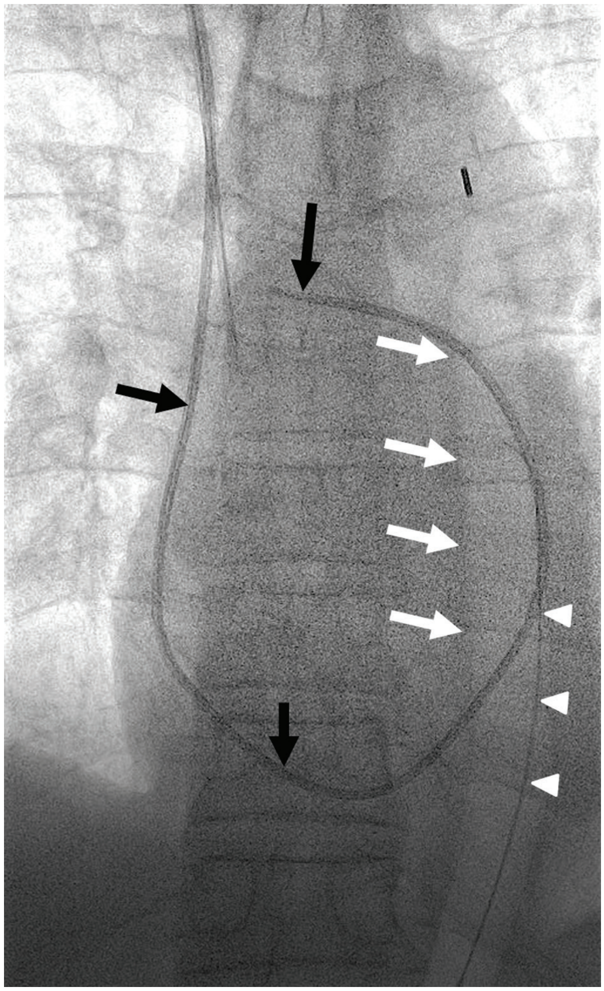

Fig. 2 Plain chest radiography. The guidewire passed by the IABP balloon. IABP balloon (white arrows), guidewire (white arrowheads), and Swan-Ganz catheter (black arrows). IABP: intra-aortic balloon pumping

(**Fig. 3A**). It also detected 35% stenosis at the right carotid bifurcation by the North American Symptomatic Carotid Endarterectomy Trial method, then we kept the 9Fr balloon-guiding catheter on the right common carotid artery (**Fig. 3B**). We navigated an aspiration catheter (Penumbra system JET7 XTRA FLEX; Penumbra, Alameda, CA, USA) to the proximal side of the occlusion (**Fig. 3C**) and achieved complete recanalization of the right MCA by a direct aspiration thrombectomy. We finished the procedure 258 minutes after LKWT (**Fig. 3D**).

After the procedure, his consciousness disturbance, right conjugate deviation, and left hemiplegia were diminished. The NIHSS score improved to 2 the next day. The IABP was also removed on the same day. Although we did not observe atrial fibrillation or intracardiac thrombi, we continued heparin, aspirin at 100 mg, and clopidogrel at 75 mg to prevent cardioembolic stroke based on low output syndrome due to AMI. On day 5, we administered warfarin and stopped using heparin. The pathological findings of the aspirated thrombus were fresh and consisted of fibrin, erythrocytes, and platelets. We diagnosed the etiology as cardioembolic stroke based on left ventricular dysfunction. He was transferred to the convalescent hospital for rehabilitation on day 8. The NIHSS score at discharge was 0.

Discussion

This patient was transferred to our hospital while IABP was maintained from the right common femoral artery. We consulted with a cardiologist in our hospital and decided to navigate a 9Fr balloon-guiding catheter from the left common femoral artery with operating 8Fr IABP in the thoracic descending aorta and to perform MT.

IABP is used to reduce the left ventricular stroke work by increasing the diastolic coronary artery blood flow and mitigating afterload. To operate this device, the IABP balloon should be placed in the descending thoracic aorta to synchronize with the pulse.[1)] We performed MT while maintaining IABP because we concerned the low output syndrome due to the decrease in the coronary artery blood flow. We suppose the milestone for obtaining a favorable outcome in this case was the gentle curvature of the approach route to the common carotid artery. Furthermore, the diameter of the descending thoracic aorta is commonly 30 mm,[2)] and the area ratio relative to the 9Fr balloon-guiding catheter was 100:1. We could guide the 9Fr balloon-guiding catheter without resistance during its passage by IABP. There was no change in heart rate, cardiac output, and pulmonary artery wedge pressure to be suspected of a decline in the effects of IABP. There is no previous report of MT by the transfemoral approach while maintaining IABP.

IABP is occasionally used, as in our patient, to maintain the hemodynamics in patients with left ventricular dysfunction due to AMI. Fuchs et al.[3)] reported that applying IABP was a factor related to the development of stroke after the percutaneous coronary intervention (PCI). According to their report, postoperative stroke was observed in 0.38% of the 9662 patients (12,407 cases) who received PCI. Stroke development was related to elderly patients, cardiac dysfunction, and medical history of diabetes mellitus. It was a common intraoperative complication in patients who emergently required IABP. In particular, the emergency use of IABP was demonstrated to be the greatest prognostic factor for stroke by multivariate analysis

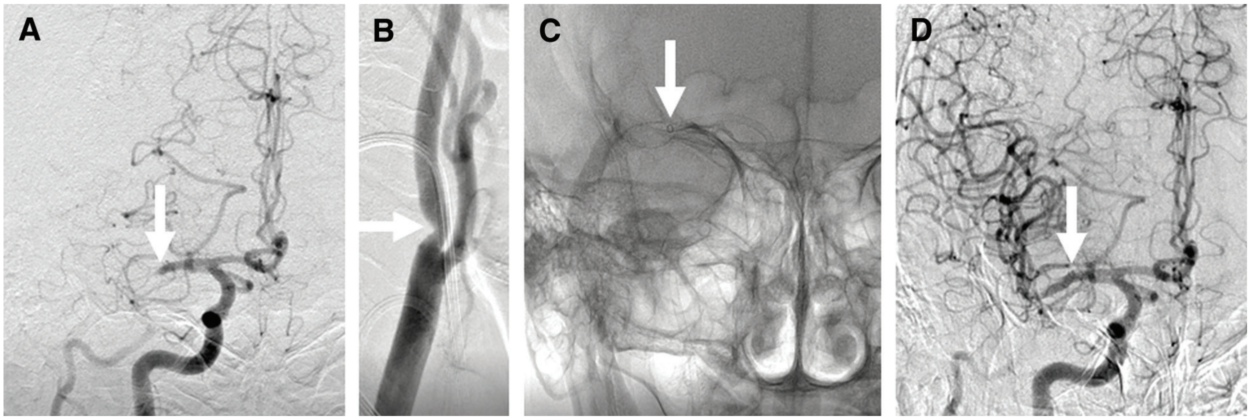

Fig. 3 MT for acute M1 segment of the MCA occlusion. (**A**) A-P view on right common carotid arteriography: The distal M1 portion of the right MCA is occluded (arrow). (**B**) Lateral view on right common carotid arteriography: We found the right internal carotid artery stenosis. (**C**) A-P view on non-contrast right common carotid arteriography (live image): The aspiration catheter is guided to the M1 segment of the right MCA (arrow). (**D**) A-P view on right common carotid arteriography after the MT: We confirmed complete recanalization of the right MCA (arrow). MCA: middle cerebral artery; MT: mechanical thrombectomy

(odds ratio: 9.6, 95% confidence interval: 3.9–23.9, $p < 0.001$). Of all the 41 stroke patients, the number of patients who had a hemorrhagic stroke was 20 and that of ischemic stroke was 21. They suggested the risk of hemorrhagic stroke due to heparin or DAPT after PCI and that of ischemic stroke due to activation of blood coagulation by the introduction of the IABP balloon and to damage the atherosclerotic lesion in the aortic arch during IABP catheter insertion. In addition to these risks, we should consider the risk of cardioembolic stroke due to left ventricular dysfunction with IABP such as our patient. It is important to evaluate the methods for patients who have developed cerebral infarction and have indications for MT.

We think there are four choices to perform MT while maintaining IABP in addition to (1) transfemoral approach, which was performed for our patient. (2) Changing the approach route of IABP to the brachial artery and inserting the MT device via the right common femoral artery; we need the time to reposition the IABP balloon to the brachial artery, this method is not useful for MT. (3) Interrupting IABP during MT; it may change the hemodynamics during the MT. (4) MT via the brachial artery; it is difficult to use a balloon-guiding catheter. (5) Direct puncture of the common carotid artery; it is also difficult to use a balloon-guiding catheter and may cause postoperative hemorrhage. Thus, among the five methods described above, (1) the transfemoral approach is the best way to perform MT. We can use a large-bore aspiration catheter in this method as in our patient.

We should pay attention to the complications, especially for IABP balloon rupture when we perform MT with IABP. The frequency of IABP balloon rupture is 1%–1.7%.[4–6] We know the causes of balloon rupture such as abrasion due to contact with calcified areas, damage due to excessive bending caused by tortuosity of the aorta, and damage during insertion. However, we do not know the rupture rate for the concomitant use of a guiding catheter. IABP balloon rupture may lead to complications such as air embolism caused by helium gas contained in the balloon and balloon entrapment (it is difficult to withdraw the IABP balloon since the blood flowed into the balloon and turned into clots or granules). In particular, when we encountered balloon entrapment, we should not attempt to withdraw the IABP balloon roughly. It may cause to damage the iliac artery and may require intervention by vascular surgery. To reduce the risk of IABP balloon rupture, we should evaluate the shape and rigidity of the tip of the guidewire, manipulate the guidewire after approaching the coaxial catheter to the proximal end of the IABP balloon, select the balloon-guiding catheter (flexibility of the catheter and the presence of the tip) appropriately, and adjust to the tortuosity of the aorta.

As mentioned above, there is no previous report of MT during IABP but are some reports of carotid artery stenting performed during IABP. A 6Fr guiding catheter was used in a case report from Japan,[7] but the diameter of the guiding catheter was not mentioned in other reports.[8,9] Thus, this is the first report to use a 9Fr balloon-guiding catheter with an 8Fr IABP balloon catheter concomitantly. However, in clinical practice, we should consider the indication carefully by evaluating the patient's physical characteristics such as humpback and scoliosis, sex, radiological findings on plain chest radiography (the tortuosity and calcification of the aorta), medical history, operation histories (aortic replacement and stent-grafting), and the occlusion site which is necessary to use a large-bore aspiration catheter. If it is difficult to perform MT via transfemoral approach while maintaining IABP, we should plan alternative methods such as transbrachial approach or transfemoral approach with the shortest IABP interruption.

Conclusion

We performed MT for acute M1 segment of MCA occlusion under maintaining IABP application. We could perform MT safely by the opposite side of the transfemoral artery approach.

Disclosure Statement

Shinichi Yoshimura received lecture fees from Medtronic Japan Co., Ltd., Daiichi Sankyo Co., Ltd., and Bayer Yakuhin, Ltd. The other authors have no conflicts of interest.

References

1) Trost JC, Hillis LD: Intra-aortic balloon counterpulsation. *Am J Cardiol* 2006; 97: 1391–1398.
2) Johnston KW, Rutherford RB, Tilson MD, et al: Suggested standards for reporting on arterial aneurysms. Subcommittee on Reporting Standards for Arterial Aneurysms, Ad Hoc Committee on Reporting Standards, Society for Vascular Surgery and North American Chapter, International Society for Cardiovascular Surgery. *J Vasc Surg* 1991; 13: 452–458.
3) Fuchs S, Stabile E, Kinnaird TD, et al: Stroke complicating percutaneous coronary interventions: incidence, predictors, and prognostic implications. *Circulation* 2002; 106: 86–91.
4) Lewis PA, Mullany DV, Townsend S, et al: Trends in intra-aortic balloon counterpulsation: comparison of a 669 record Australian dataset with the multinational Benchmark Counterpulsation Outcomes Registry. *Anaesth Intensive Care* 2007; 35: 13–19.
5) Nishida H, Koyanagi H, Abe T, et al: Comparative study of five types of IABP balloons in terms of incidence of balloon rupture and other complications: a multi-institutional study. *Artif Organs* 1994; 18: 746–751.
6) Alvarez JM, Brady PW, Mc Wilson RM: Intra-aortic balloon rupture causing femoral entrapment. *Aust N Z J Surg* 1993; 63: 72–74.
7) Ichiro S, Masayuki E, Takeshi S, et al: Carotid artery stenting with intra-aortic balloon counterpulsation. *JNET J Neuroendovasc Ther* 2013; 7: 207–214.
8) Anzuini A, Frigerio S, Bianchi M, et al: Hypotension during carotid artery stenting with severe aortic stenosis: the intra-aortic balloon pump option. *J Invasive Cardiol* 2011; 23: E202–204.
9) Hennen B, Gröschel-Guth A, Scheller B, et al: Intra-aortic counterpulsation during carotid stenting. *Catheter Cardiovasc Interv* 2001; 53: 546–548.