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Technical Note

Distal Transradial Approach in Mechanical Thrombectomy: Technical Note

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Objective: We report a case of mechanical thrombectomy (MT) via the distal transradial approach (dTRA) and technical tips.
Case Presentation: An 89-year-old woman was transferred to our hospital due to back pain after a fall and sudden-onset left hemiparesis. We performed MT because three-dimensional computed tomography angiography (3D-CTA) revealed right middle cerebral artery (MCA) occlusion. The access route was Type 3 aortic arch. The abdominal aorta and common iliac artery were tortuous and partially dissected, and she had a lumbar vertebra fracture. We selected dTRA in consideration of safety, ease of access, and less postoperative postural restriction. The first pass resulted in complete recanalization using an aspiration catheter and stent retriever. Her symptoms rapidly improved and she was discharged with a modified Rankin Scale score of 1.
Conclusion: dTRA in MT may be a treatment option.

Keywords▶ snuff box, radial artery, mechanical thrombectomy, anterior circulation, middle cerebral artery

Introduction

Although there are a few recent reports on the usefulness of neuroendovascular treatment through the transradial approach (TRA), transfemoral approach (TFA) is employed in more than 95% of cases.[1)] In the cardiovascular field, TRA has been actively performed from the viewpoint of puncture-site problems and stress reduction in patients. Additionally, the distal transradial approach (dTRA), in which puncture is applied through the anatomical snuff-box, has recently become employed as a less invasive method.[2)] In the neuroendovascular field, some cases can also be performed more safely and easily through the arm approach depending on the vascular distribution of the access route. Moreover, puncture-site complications are of concern in some cases due to difficulty in maintaining rest.

In this study, mechanical thrombectomy (MT) was performed through dTRA in a patient in whom difficult treatment through TFA was expected. We report the case with the technical details.

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Case Presentation

Patient: An 89-year-old woman.
Chief complaints: Low back pain and left hemiplegia
Past medical history: Atrial fibrillation (without oral anticoagulant medication), gastrointestinal hemorrhage, hypertension, and lumbar compression fracture.
History of present illness: The patient was transported to a hospital by ambulance for severe low back pain after staggering and falling. As left hemiplegia gradually developed during transport, stroke was suspected. The destination hospital was changed and the patient was transported to our hospital.
Neurological findings on admission: The consciousness level was Glasgow Coma Scale E3V4M6. Moderate dysarthria, moderate facial palsy, left hemiplegia (Manual Muscle Test 2 in both lower and upper limbs), and moderate sensory disturbance. The National Institutes of Health Stroke Scale (NIHSS) score was 12.
Neuroradiological findings on arrival Brain CT: No abnormal finding was noted.
Three-dimensional computed tomography angiography (3D-CTA): The proximal region of the right middle cerebral artery (MCA) was occluded (**Fig. 1**)
CT perfusion: The CBV-ASPECTS was 11. The T_{max} of the right MCA region was extended.

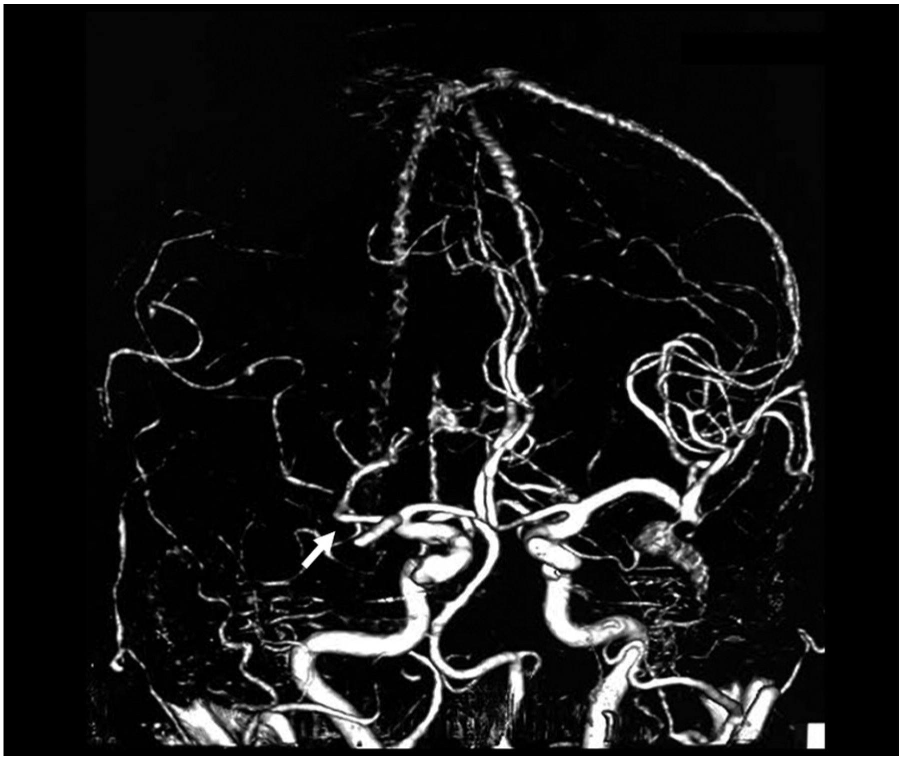

Fig. 1 Frontal view on cerebral arterial 3D-CTA (volume rendering) on arrival. The right MCA (M1) was occluded (arrow). 3D-CTA: three-dimensional computed tomography angiography; MCA: middle cerebral artery

Thoracoabdominal pelvic CT: The aortic arch was Type 3. The abdominal aorta and common iliac artery were markedly calcified and tortuous, and findings of vascular dissection were partially noted (**Fig. 2**). In addition, lumbar (L1) compression fracture was present.

Treatment course after admission: The time from onset to arrival was 74 minutes. As atrial fibrillation was also present, the patient was considered to have right MCA occlusion due to cardiogenic cerebral embolism, and indicated for intravenous thrombolysis with recombinant tissue plasminogen activator (rt-PA) and MT. The aorta was tortuous and the wall was calcified, being a Type 3 aortic arch; therefore, treatment through TFA was predicted to be difficult. Moreover, plaque was observed in the abdominal aortic wall. Thus, TFA was not selected. Furthermore, difficulty in maintaining rest after surgery was predicted because of low back pain accompanying compression fracture, dTRA not requiring postoperative limitation of movement, including movement of the wrist, was selected.

Endovascular treatment: Under mild sedation with diazepam at 10 mg and pentazocine at 15 mg, 2 mL of lidocaine was subcutaneously injected into the right anatomical snuffbox. Pulsation of the deep palmar branch was palpable in the same region and punctured with a 22-gauge needle. After angiography of the radial artery (RA), verapamil at 2.5 mg and isosorbide dinitrate at 1 mg were injected into the artery to prevent RA spasm (**Fig. 3A** and **3B**). In addition, intravenous thrombolysis with rt-PA was initiated immediately before puncture. Under the roadmap prepared based on the above RA angiography, a 4Fr 25-cm sheath was placed. A 4F 120-cm SIMMONS C catheter (Medikit, Tokyo, Japan) was placed in the right external carotid artery using a 0.035-inch guide wire and an Axcelguide 6Fr 83-cm STR (Medikit) was placed in the right common carotid artery employing the exchange method using Amplatz Extra Stiff Wire 035” 260 cm (Cook Medical, IN, USA). Selection of the right common carotid artery and external carotid artery was simple. Furthermore, an AXS Catalyst 6 (Stryker Neurovascular, Fremont, CA, USA) was guided to the proximal region of the MCA (**Fig. 3C**). As guiding to a more distal site was not possible, a Marksman 150 cm (Medtronic, Minneapolis, MN, USA)/CHIKAI 0.014-inch 200 cm (ASAHI, Aichi, Japan) was passed through the lesion. Under continuous suction using Catalyst 6, a Solitaire Platinum 6 mm × 40 mm (Medtronic) was deployed (**Fig. 3D**) and Thrombolysis in Cerebral Infarction (TICI) grade 3 was acquired by the first pass (**Fig. 3E**).

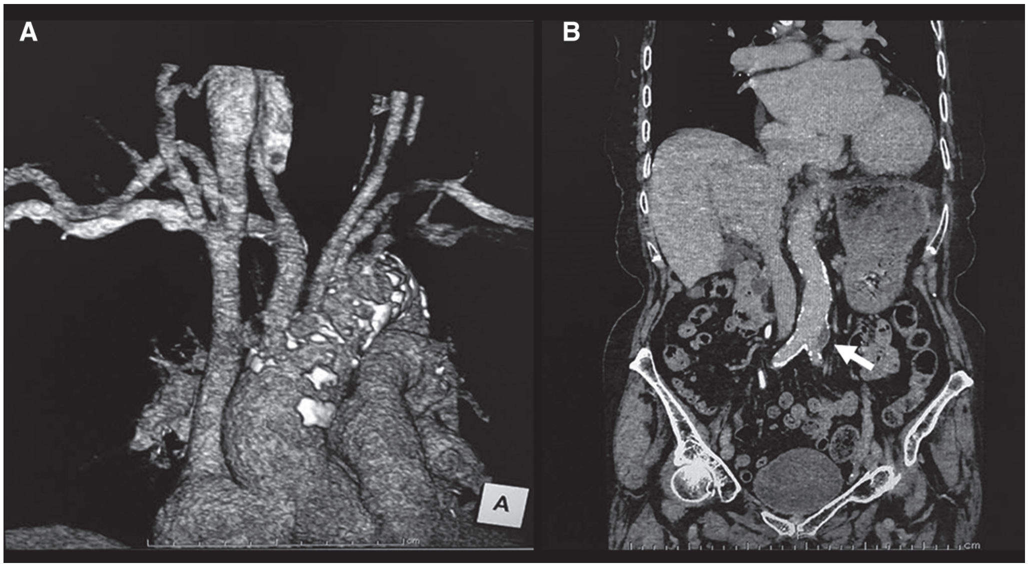

Fig. 2 Evaluation of the access route by CT of the thoracoabdominal pelvic region (plain CT performed immediately after CTA of the head). (**A**) Frontal view of 3D image of the aortic arch (volume rendering). The aortic arch was Type 3 and calcification of the aortic arch was marked. (**B**) Coronal view of the thoracoabdominal pelvic region. The abdominal aorta was strongly tortuous and calcified, and findings of chronic dissection were partially noted. CTA: computed tomography angiography

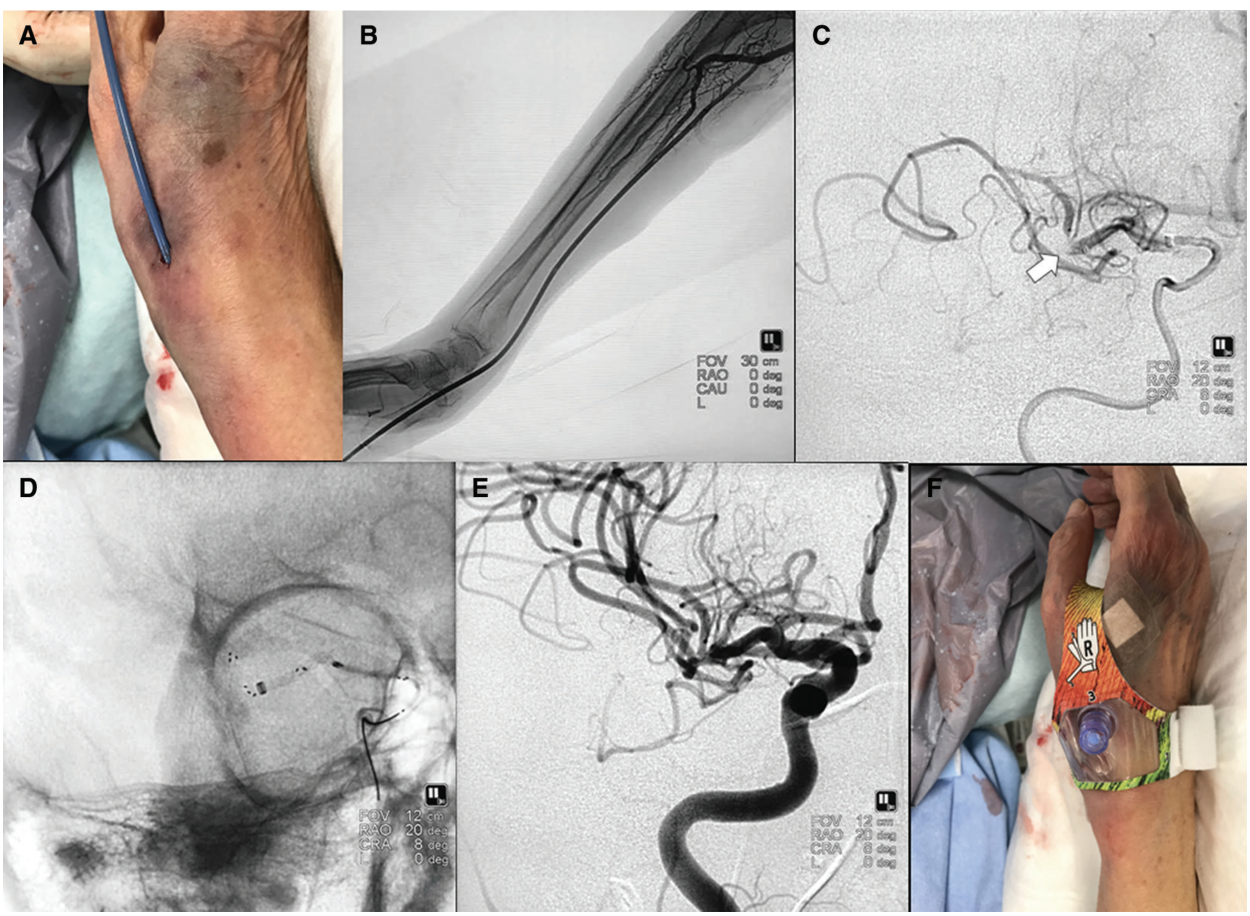

Fig. 3 Puncture site and treatment procedure (**A**) State with sheath insertion into rt. snuffbox. (**B**) Frontal view on radial arteriography from the sheath. (**C**) Internal carotid arteriography before thrombectomy (RAO 20/ CRA 0). Angiography through the aspiration catheter. The distal region of rt. M1 was occluded (arrow). (**D**) A stent retriever was deployed with continuous aspiration using an aspiration catheter. (**E**) Right internal carotid arteriography after thrombectomy (RAO 20/ CRA 0). TICI grade 3. (**F**) State after hemostasis using an exclusive hemostasis band. CRA: cranial; RAO: radial artery occlusion; TICI: Thrombolysis in Cerebral Infarction

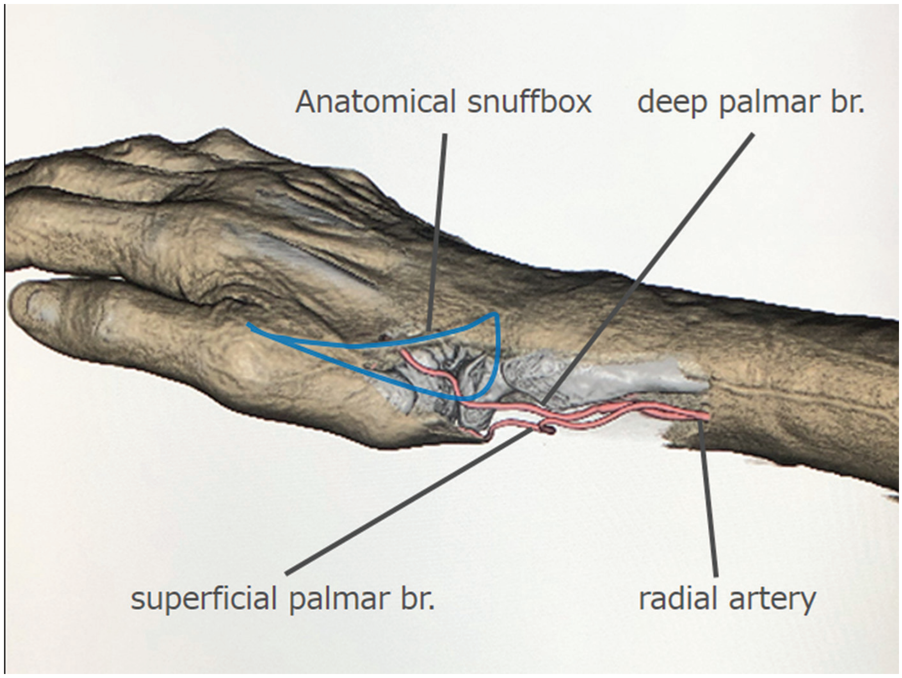

Fig. 4 Positional relationship between the anatomical snuffbox and punctured blood vessel The deep palmar branch from the RA was distributed as if running on the dorsum of the hand. RA: radial artery

At the puncture site, hemostasis was applied using the PreludeSYNC DISTAL radial compression device (Merit Medical, South Jordan, UT, USA) (**Fig. 3F**). The time from puncture to placement of the guiding catheter was 20 minutes and that to recanalization was 40 minutes. The time from onset to recanalization was 3 hours and 30 minutes.

Postoperative course: No complication was noted at the puncture site and neurological deficit markedly improved. The NIHSS became 2 on the following day and the patient was discharged with a modified Rankin Scale score of 1 on day 30 after onset.

Discussion

In MT, TFA is regarded as the first choice because a sheath/catheter with a wide diameter is used. Vascular selection is easier via TFA than other access routes and catheter stability is also high, being advantageous, but puncture-site complications are sometimes problematic.[1] In MT, patients must stay in the same position for a prolonged period to prevent postoperative puncture-site complications because strong antithrombotic therapy, such as intravenous thrombolysis with rt-PA and systemic heparinization, is performed, in addition to the use of a sheath with a large diameter; therefore, resting is not possible due to disturbance of consciousness in many cases. From the medical staff side, it is desirable to avoid sedation for postoperative neurological evaluation. On the other hand, appropriate sedation and physical restriction are necessary in consideration of puncture-site complications, but their adjustment may be difficult in some cases. The use of hemostasis devices enabled shortening of the hemostatic time and rest time, but no significant difference was noted in the frequency of puncture-site complications compared with that in manual compression-applied cases.[3] Moreover, a sheath with a wide diameter and delirium were included among risk factors for complications of the use of hemostasis devices,[4] demonstrating that hemostasis devices do not necessarily resolve puncture-site complications in TFA. The frequency of serious puncture-site complications in MT and that including mild cases were reported to be 1.67 and 4.59%, respectively,[5] but both the patient and medical staff may have postoperative physical and mental stresses that increase these values.

In a large-scale study on the puncture region involving patients with acute coronary syndrome in the cardiovascular field,[6] large hematomas formed in the puncture region in 3.0 and 1.2% of patients treated through TFA and TRA, respectively, and pseudoaneurysms requiring treatment formed in 0.6 and 0.2% of TFA and TRA cases, respectively, demonstrating the incidence of puncture-site complications to be significantly lower in patients treated through TRA, suggesting that it is safer than TFA. In a questionnaire survey of 98 patients examined by diagnostic cerebral

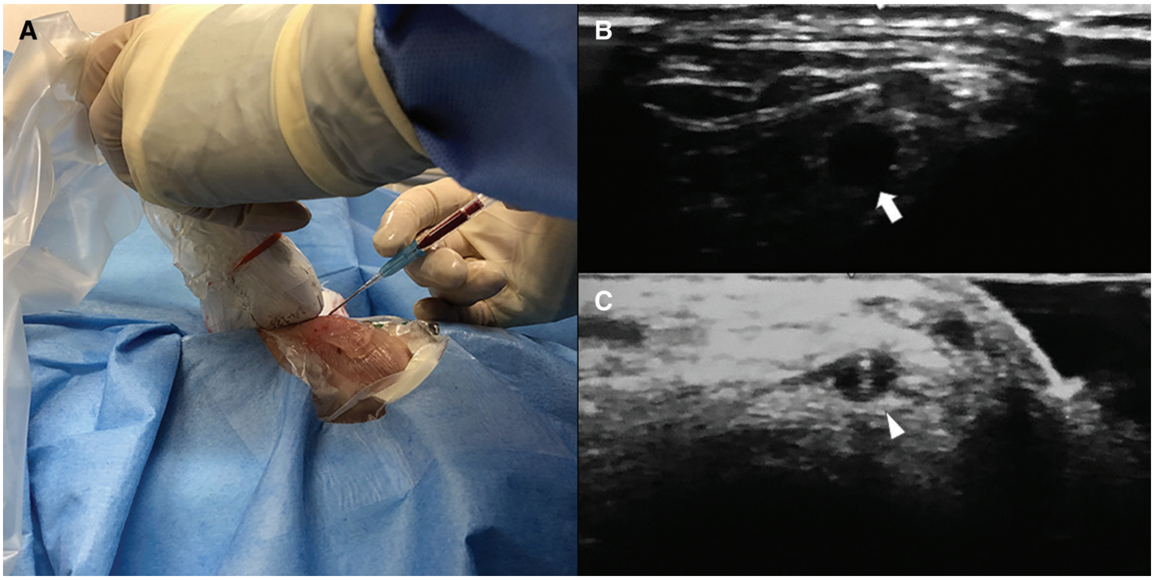

Fig. 5 Echo-guided puncture. (**A**) An echo probe was applied to visualize the short axis view of the blood vessel and the blood vessel was punctured with a puncture needle to penetrate the blood vessel right below the probe. (**B**) Echo image. Distal RA before puncture (arrow). (**C**) Echo image. The puncture needle (arrow head) penetrated the blood vessel. RA: radial artery

angiography through both TFA and TRA, 94% responded that TRA was better in terms of pain, postoperative rest, and complications,[7] suggesting it to be an approach with high patient satisfaction. On the other hand, in patients treated through the transbrachial approach (TBA), which is also an approach through the upper limb, the incidence of serious complications (brachial arterial occlusion-induced forearm ischemia, pseudoaneurysm and hematoma requiring surgery, and neuropathy) was 2.3%–5.5% and that of slight complications was 14%, being not recommended as the first choice by the Society of Neurointerventional Surgery (SNIS).[1] As the vascular diameter of the brachial artery is greater than that of the RA, devices thicker than the RA are applicable, but considering the incidence of serious complications, it may be better not to select TBA.

Snelling et al.[8] performed MT through TFA, taking 24 minutes on average from puncture to the first pass, but age >65 years, bovine or Type II/III aortic arch, and tortuous blood vessel often require 20 minutes or longer, extending the procedure time. Furthermore, the blood vessel may be damaged while passing a device in patients with aortic dissection,[9] past medical histories of iliac arterial stenting and bypass, and femoral arterial stenosis/occlusion. Moreover, it is difficult to manually touch the blood vessel in obese patients, which may lead to difficulty in puncture and compression hemostasis. Accordingly, the advantages of TRA can be more easily utilized under these conditions than those of TFA. However, hemorrhagic complications may develop with TRA and wrist movement is limited after hemostasis. In addition, radial artery occlusion (RAO) may develop.[1] Thus, dTRA has recently become applied at a more peripheral site, mainly in the cardiovascular field, and favorable results have been reported (success rate of the procedure: 88%–98%, incidence of puncture-site complications: 0%–1%).[2]

dTRA is a method of approaching through the deep palmar branch, a branch of the RA present in the anatomical snuffbox surrounded by the extensor pollicis longus and brevis muscle tendons[2] (**Fig. 4**). To apply dTRA, only positioning of the hand to make the thumb naturally up is necessary; therefore, preparation is simple compared with that for TRA requiring fixation of the hand. Hemostasis of the puncture site is easy because it is surrounded by ligaments and bones, and located at a site more peripheral to the RA, reducing the possibility of postoperative puncture-site problems to an incidence of 0%–1%, as described above.[2] Furthermore, patients do not have to restrict movement, including wrist movement, from immediately after treatment, suggesting that it reduces postoperative stress for both the patient and medical staff.

These advantages were maximally utilized in this case.

However, the problems below must considered for treatment through dTRA:

- Vascular thinness
- RA spasm and postoperative occlusion
- Success rate of the procedure and technical difficulty

Vascular thinness

The mean diameter of the deep palmar br. is 2.4 mm, being thinner than the RA (mean: 2.7 mm).[2] For treatment, a vascular diameter of 2 mm or larger is necessary, and when the diameter is smaller than this, it may be better to select a different access route.[10] In addition, some experience is necessary because puncture is difficult due to the thin diameter.[10] However, using echo, not only can the vascular diameter be confirmed but also puncture becomes easy. TRA using echo shortens the time for puncture compared with that without the use of echo.[11] We actively employ echo (**Fig. 5**), and when the vascular diameter is insufficient or puncture fails even though it was guided by echo, we rapidly switch the procedure to TRA.

Applicable sheaths are also limited to those with a maximum size of 6-7Fr due to a thin vascular diameter.[10] It was recently suggested that the use of a balloon guiding catheter (BGC) improves the recanalization rate,[12] but they are difficult to use in dTRA. To use a BGC in the current MT through dTRA, one with a thin diameter may be used with a thin BGC and stent retriever[13] or a sheathless BGC with a wide diameter..[14] In the former, an aspiration catheter cannot be concomitantly used when it is necessary, whereas in the latter, even though it is used sheathlessly, applicable cases are limited because the outer diameter of the BGC is large (outer diameter of a 9Fr BGC is approximately 3.0 mm[14]) in consideration of the mean vascular diameter of the deep palmar br. Therefore, the use of a guiding catheter is limited, being the weakest point of MT through dTRA.

RA spasm and postoperative occlusion

RA spasm was reported to occur in 15%–30% at the time of puncture.[1] As treatment cannot be performed thereafter due to spasm, this is an important problem whose cause is physical and mental stresses on blood vessels and patients themselves.[15] Accordingly, the incidence can be reduced to 6%–10% by appropriate sedation and local pain relief. Furthermore, the use of RA spasm preventive drugs termed "radial cocktail" (nitroglycerin is used overseas, but our hospital substitutes isosorbide dinitrate) reduces the incidence to 6%–10%.[1]

Postoperative RAO is a serious problem and TRA has been habitually avoided when collateral circulation was judged as insufficient on Allen's test,[1] but in a large-scale study involving more than 4000 cases,[16] regardless of the presence of collateral circulation, the incidence of postoperative symptomatic RAO was 0% and symptomatic cases were rare. Considering that RAO is less frequent in dTRA than in TRA,[2] and the branch to the palmar arch is present on the side proximal to the puncture site, a symptomatic ischemic state may be more unlikely. Therefore, no contraindication of dTRA has been established. Another problem is that RAO makes subsequent angiography and treatment impossible, but TRA is applicable in cases with dTRA because the RA is patent even if the punctured blood vessel is occluded.

Success rate of the procedure and technical difficulty

Regarding the success rate of the procedure and technical difficulty, there is a learning curve.[17] For example, approaching a left internal carotid arterial lesion is difficult because curvature and tortuosity of the access route to the target blood vessel are strong. In addition, the access route is extended anatomically and a longer guiding catheter than that in TFA is necessary. If a guiding catheter cannot be placed at a sufficiently high level, such as petrous bone, due to problems with the access route, the length of the extracorporeal part of the catheter may increase, reducing the aspiration catheter length. Although we have not experienced insufficient length when a stent retriever was used even though M2 was occluded, we use a long microcatheter for stent deployment.

Based on these technical difficulties and limitation of applicable devices, extension of the procedure time is of concern for MT through dTRA. In MT in a hurry, extension of the procedure time leads to a poor outcome.[8] Therefore, until the procedure is established, it may be better to employ dTRA in cases with the following conditions for which dTRA is judged as easier to apply than TFA: Elderly patients and those with the aortic arch type described above or vascular tortuosity. On comparison between MT through TRA and TFA, the success rate of treatment was comparable with no significant difference in the procedure time,[18] and the procedure time was reported to be shorter in the posterior circulation,[19] suggesting that dTRA may become a useful approach after gaining experience.

Conclusion

A case in which MT through dTRA was effective was reported. dTRA in MT may be a new approach route.

Disclosure Statement

The authors declare no conflict of interest.

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