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Case Report

Ulnar artery access for intracranial mechanical thrombectomy procedure: A salvage option after failed trans-femoral and trans-radial access

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84 years old gentle man with past medical history of hypertension and diabetes presented with sudden onset right sided weakness and aphasia for two hours. Initial neurological assessment revealed National Institute of Health Stroke Scale (NIHSS) 17. Computed tomography (CT) scan demonstrated minimal early ischemic changes along left insular cortex with occlusion of left middle cerebral artery (MCA). Based on clinical and imaging findings, decision was made to perform mechanical thrombectomy procedure. Initially, right common femoral artery approach was utilized. However, due to unfavorable type-III bovine arch, left internal carotid artery could not be engaged via this approach. Subsequently, access was switched to right radial artery. Angiogram revealed small caliber radial artery, with larger caliber ulnar artery. Attempt was made to advance the guide catheter through the radial artery, however significant vasospasm was encountered. Subsequently, ulnar artery was accessed and successful thrombolysis in cerebral infarction (TICI) III left MCA reperfusion was achieved with a single pass of mechanical thrombectomy via this approach. Post procedure neurological examination demonstrated significant clinical improvement. Doppler ultrasound 48 hours after the procedure demonstrated patent flow in radial and ulnar arteries with no evidence of dissection.

Keywords Ulnar artery access, Radial artery, Mechanical thrombectomy, Acute stroke intervention, Interventional neuroradiology

INTRODUCTION

Endovascular thrombectomy is currently considered the gold standard treatment for acute ischemic stroke associated with large vessel occlusion.[14] The primary aim of procedure is to achieve complete reperfusion in a timely manner. Recent advancements

in techniques and equipment have resulted in high success rate for such procedures. Most common approach for mechanical thrombectomy procedures is via trans-femoral access (TFA).[6] Large caliber and vast familiarity with this traditional route make it suitable for most of acute stroke interventional procedures. However, certain anatomic challenges particularly, bovine arch and type III aortic arch can pose significant technical challenges and result in failure of this approach.[13] For time sensitive procedures, particularly stroke interventions, any delay or procedure failure is associated with worse clinical outcomes.[12][13]

Several alternate approaches including radial and brachial artery access as well as direct carotid puncture have been successfully employed to overcome anatomic challenges associated with failed TFA.[2][3][4][7] Although, alternate access routes bypass certain anatomic hurdles, they can pose inherent challenges. Recently, trans-ulnar access (TUA) has been described as a safe and feasible alternate option for neurointerventional procedures.[9] Although various procedures have been performed via this approach, no previous case of intracranial mechanical thrombectomy procedure utilizing this access is described in literature. We report first case of intracranial mechanical thrombectomy successfully completed via TUA after failed TFA and trans radial access (TRA).

CASE DESCRIPTION

84 years old gentleman with past medical history of hypertension and diabetes, presented with acute onset of right sided weakness and global aphasia. Imaging findings were favorable for mechanical thrombectomy procedure with minimal early ischemic changes along the left insula. Review of computed tomography angiogram demonstrated occlusion of proximal M2 superior division of left middle cerebral artery with good collaterals. Assessment of aortic arch revealed a type-III combined with bovine arch variation (Fig. 1A). Initial access was obtained in the right common femoral artery using 8 French vascular sheath (Terumo, Tokyo, Japan). Considering the type-III Bovine arch, a combination of 6 French 90 cm Neuron Max guide catheter (Penumbra, Inc., Alameda, CA, USA) and 5 French 120 cm Simmons 2 Select catheter (Penumbra) was advanced over a 0.035 guidewire. Simmons 2 catheter was shaped in left subclavian artery and utilized to engage left common carotid artery (Fig. 1B). However, due to acute angulation at the origin of left internal carotid artery multiple attempts to advance guidewire were unsuccessful via this approach. Subsequently after failed femoral approach, access was secured in the right radial artery with a 6 French Slender Glidesheath (Terumo). Radial artery angiogram demonstrated small caliber radial artery with vasospasm and larger caliber ulnar artery (Fig. 1C). A combination of 6 French guide catheter along with Simmons 2 catheter was advanced into the right radial artery. However, significant resistance was encountered while advancing the guide catheter in the mid arm region due to ensuing vasospasm. Subsequently, decision was made to switch access to the ulnar artery. Initial ultrasound demonstrated right ulnar artery diameter of 3.2 mm, which was accessed under ultrasound guidance and a 6 French Glidesheath (Terumo) was placed. Subsequently the combination of Benchmark guide catheter (Penumbra) along with Simmons 2 catheter over a 0.035 guidewire was advanced through the right ulnar artery into the brachiocephalic trunk. Angiogram demonstrated bovine arch with common origin of the brachiocephalic trunk and left common carotid artery (Fig. 1D). Left internal carotid artery was easily engaged via this approach using a combination of guidewire and catheter. Initial angiogram of the left internal carotid artery demonstrated occlusion of the proximal superior M2 segment of left middle cerebral artery (Fig. 1E). Subsequently, mechanical thrombectomy was performed using SOLUMBRA technique with a combination of 4 mm×20 mm stent retriever (Solitaire revascularization device, Medtronic Neurovascular, Irvine, CA, USA) and 5 French SOFIA aspiration catheter (Microvention, Aliso Viejo, CA, USA). Thrombolysis in cerebral infarction (TICI) III reperfusion was achieved with a single pass with no evidence of distal emboli (Fig. 1F). The guide catheter

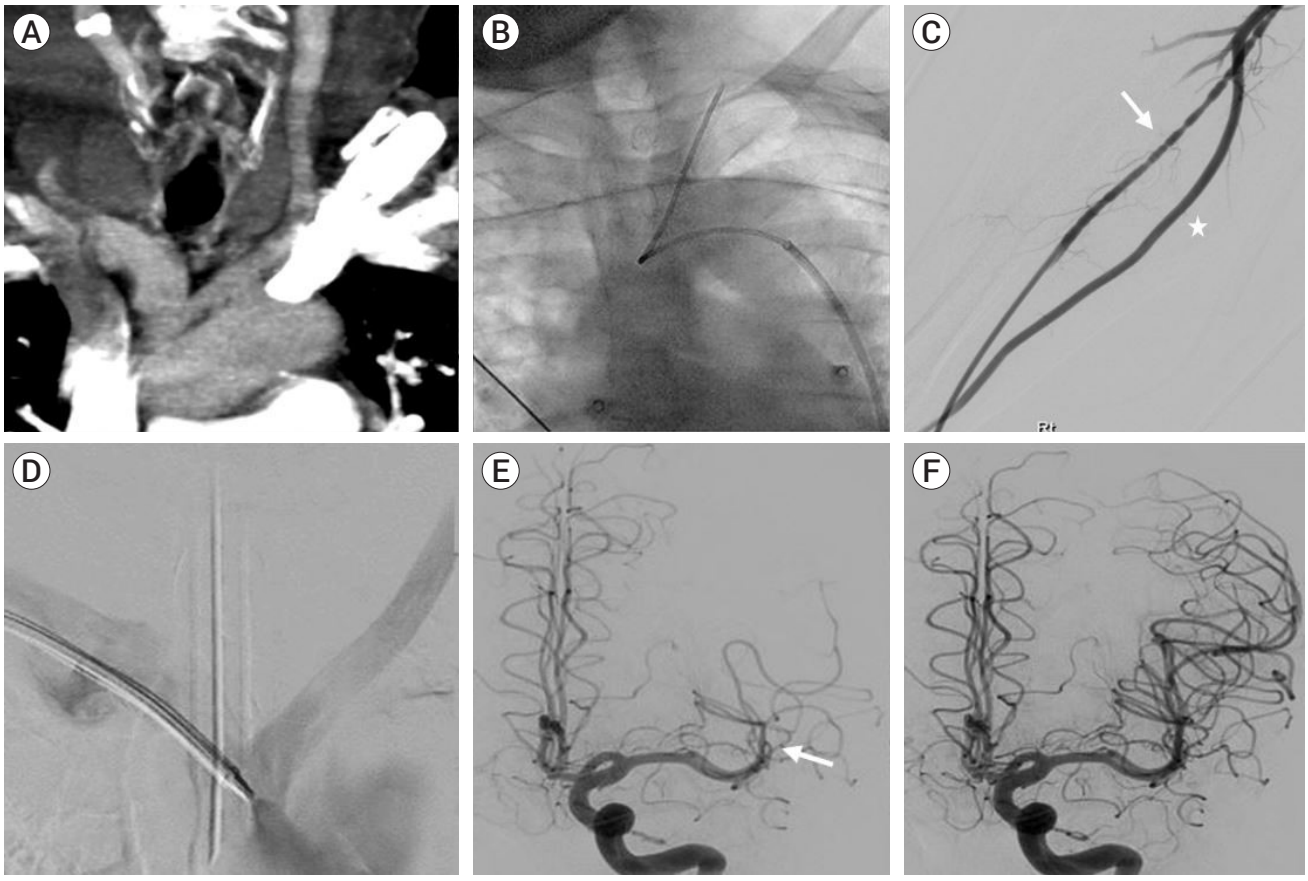

Fig. 1. (A) Coronal computed tomography angiogram at aortic arch level, demonstrating a bovine arch. (B) Simmons II catheter is advanced in the left common carotid artery. (C) Radial artery angiogram demonstrates vasospasm along radial artery (white arrow) and larger caliber ulnar artery (white asterisk). (D) Angiogram through the Simmons II catheter placed via right ulnar artery approach, demonstrating bovine arch. (E) Left internal carotid artery angiogram demonstrating proximal M2 superior division occlusion (white arrow). (F) Post mechanical thrombectomy angiogram shows complete reperfusion of the left middle cerebral artery (MCA) territory.

and sheath were removed from the ulnar artery and non-occlusive hemostasis was secured using pneumatic wrist band. No evidence of hand ischemia was noted during or immediately after the procedure. 24 hours post procedure computed tomography demonstrated no evidence of intracranial hemorrhage and no extension of ischemic infarct. Neurological exam showed significant clinical recovery with National Institute of Health Stroke Scale (NIHSS) drop from 17 to 3. Patient was transferred to acute rehabilitation unit after 3 days. Doppler ultrasound of the distal forearm before discharge demonstrated patent flow in radial as well as ulnar artery with no evidence of dissection.

DISCUSSION

Trans-femoral artery (TFA) approach is widely accepted as the primary access choice for stroke interventions. Although, it provides a safe and quick route for most stroke interventions, certain patients can have challenging vascular access via this traditional route.[3)4)] Cord et al. recently demonstrated approximately 10% out of 352 consecutive mechanical thrombectomy patients had prohibitive vascular access via femoral approach.[4)] During time sensitive stroke thrombectomy procedures, any such delay or failure of conventional trans-femoral access can significantly delay in reperfusion.[12)] A rapid switch to an alternate access is necessary to overcome the anatomic challenges and salvage the situation.

Direct carotid puncture (DCP) has been utilized to perform successful mechanical thrombectomy.[4)5)] It provides direct access to the target intracranial vasculature, bypassing the peripheral vascular and aortic arch anatomic hurdles. Although, direct carotid puncture is a feasible option, it is scarcely utilized for mechanical thrombectomy procedures. Victor et al. described the use of DCP in only 0.39% (108/28149) mechanical thrombectomy procedures.[5)] Currently, DCP is mostly reserved as a salvage rescue option after failure of conventional access sites.[11)] The reluctance for primary use of direct carotid puncture is mainly due to high complication rates (18-20%), which can be fatal in some instances.[5)15)]

There is scarce data regarding utilization of brachial artery access to perform endovascular mechanical thrombectomy procedures.[7)] The main reason for scarce utility of this access site is higher incidence (12-16%) of morbid complications associated with this access site.[1)] Hematoma and arterial dissection in this location can have significant morbidity in terms of hand ischemia. Since, other arm access sites including TRA and TUA provide similar advantages, with significantly less complications, they are preferred over brachial artery access.

Recently, trans radial access (TRA) has been successfully utilized to perform intracranial mechanical thrombectomy procedures. The main advantage of arm access is to overcome vascular anatomic challenges posed by peripheral vessels as well as aortic arch. Type III and Bovine arch, which are considered a significant limiting factor for trans-femoral access is readily accessible via the arm access.[3)10)] The main limitation of this access site is relatively small size of the artery, which can limit the type of equipment used for mechanical thrombectomy procedures.[1)2)] Vasospasm and radial artery occlusion are other pertinent disadvantages of TRA.[9)]

Ulnar artery is the companion forearm artery with similar advantages as TRA. However, due to its deeper location and steeper learning curve, it is scarcely used as a primary access for endovascular procedures. At the level of wrist, ulnar artery courses between tendons of flexor digitorum superficialis and flexor carpi ulnaris with ulnar nerve running medial to the artery. It is important to recognize the close proximity of ulnar nerve and avoid medial puncture while accessing the ulnar artery. Although there is a concern of hand ischemia with TUA in case of radial artery vasospasm or occlusion. Previous reports have suggested safety of TUA in such scenarios. Recently we have described the safety and feasibility of TUA for various neuro interventional procedures.[9)] Past familiarity with this rarely used access site, enabled us to utilize TUA as a salvage option to successfully perform stroke thrombectomy procedure after failed conventional access sites.

We are a "Distal Radial first" center but for stroke interventions which are time sensitive, we still prefer TFA as first choice. In this particular case, TFA failed to engage the left internal carotid artery due to unfavorable type III and bovine aortic arch. Although, rescue maneuvers including use of 0.035" stiff wire or a 0.038" wire could be attempted, but their success was uncertain. Considering urgent time sensitive situation, rapid switch to trans-radial access was preferred by the operator. Subsequently switch to TRA was made which failed due to severe radial artery vasospasm. In this scenario, the remaining access options were limited including a direct carotid puncture or TUA. Considering the morbid complications associated with DCP, we opted to utilize TUA. Once access was secured in the ulnar artery, we were able to bypass aortic arch anatomic limitations and access the intracranial vasculature swiftly. Successfully mechanical thrombectomy with complete reperfusion was achieved via this approach. We believe, familiarity with this access option is inevitable in the era of 'radial first'. This can provide a rapid alternate access option in case of radial artery vasospasm.

CONCLUSIONS

TUA is a feasible option for performing intracranial mechanical thrombectomy procedures. It can be utilized in cases of failed traditional approaches, before switching to the more invasive direct carotid puncture.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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