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Transradial Access Results in Faster Skin Puncture to Reperfusion Time than Transfemoral Access in Posterior Circulation Mechanical Thrombectomy

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Abstract

Background—Successful mechanical embolectomy for acute embolic arterial occlusion in the posterior cerebral circulation can potentially result in less neurologic disability and mortality. The transradial approach can potentially offer more direct navigation into the posterior circulation than the transfemoral approach and can result in faster recanalization time.

Objective—To compare procedural metrics and the technical and clinical outcomes of transradial versus transfemoral access for mechanical embolectomy in the posterior cerebral circulation.

Material and Methods—Single-center retrospective review of a prospectively maintained neurointerventional database from a large volume neurointerventional service in a tertiary academic center. Patients presenting with acute disabling symptoms due to embolic occlusion of a large intracranial artery in the posterior that underwent to endovascular treatment in our institution from January 2017 to January 2019 were included in the present study.

Results—Between January 2018 and January 2019 a total of 10 subjects underwent a mechanical embolectomy for acute embolic occlusion on the posterior circulation via transradial access; and between January 2017 and January 2018 a total of 10 subjects underwent a mechanical embolectomy for acute embolic occlusion on the posterior circulation via transfemoral access. Subjects in the transradial access group had a shorter skin puncture to recanalization time compared to the transfemoral group (29.2 ± 17.6 in the transradial group vs. 63.9 ± 56.7 in the transfemoral group respectively).

Conclusions—This is the first study comparing transradial versus transfemoral access for mechanical embolectomy in patients with acute embolic occlusion in the posterior cerebral circulation. Transradial access resulted in a safe, effective, and faster endovascular route for recanalization in the acute embolic occlusion of the posterior circulation.

Introduction

Acute embolic occlusion in the posterior cerebral circulation can potentially result in a severe neurologic disability and even higher mortality compared with the anterior circulation [1]. Mechanical thrombectomy in the posterior circulation presents several challenges including the reduce size and caliber of vertebral arteries as compared with the common and internal carotid arteries as well as the natural orientation and anatomic course of the vertebral artery origin from the subclavian arteries. The transradial approach can potentially offer more direct navigation into the posterior circulation than the transfemoral approach resulting in faster recanalization time.

Materials and Methods

This is a single center retrospective review of a prospectively maintained neurointerventional database from a large volume neurointerventional service in a tertiary academic center (University Medical Center of El Paso, Texas). In 2018, we significantly switched to transradial access for cerebral angiography. As we gained more proficiency with the transradial technique, we started to per-

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form more neurointerventional treatments via radial artery including mechanical embolectomy for acute ischemic stroke due to embolic occlusion of a large vessel in the posterior circulation. At the time of submission of this study, we performed almost 500 neurointerventional transradial accesses.

The objective of this study was to compare procedural metrics and the technical and clinical outcomes of transradial versus transfemoral access for mechanical embolectomy in the posterior cerebral circulation.

Patients presenting with acute disabling symptoms due to embolic occlusion of a large intracranial artery in the posterior circulation (basilar artery, basilar tip, P1/P1 segment of the posterior cerebral arteries and intracranial vertebral artery), which underwent endovascular treatment in our institution from January 2017 to January 2019, were included in the present study. Intravenous recombinant tissue plasminogen (IV t-PA) was offered to all patients presenting within the first 3 hours after symptoms onset unless specific contraindication for the use of intravenous thrombolysis. The study was approved by the local institutional review board.

Endovascular procedure

The endovascular procedures were performed by three neurointerventionists (AM, RK, and GR) in the same group. The use of general anesthesia versus conscious sedation was at the discretion of the operator. In our center the vast majority of mechanical embolectomies are performed with the patient awake and using the minimal amount of sedation. However, in acute embolic occlusion of the cerebral arteries, the posterior circulation decreases the level of consciousness causing acute severe dysphagia, which can compromise the patency of the upper airway requiring endotracheal intubation and general anesthesia. The use of intra-arterial thrombolytic medication (recombinant tissue plasminogen and/or glycoprotein 2b3a inhibitors) was also administered at the discretion of the treating physician.

Transradial access

The decision of puncturing the right versus the left radial artery was based in a quick review of the anatomy of the cervical and intracranial arteries proportionated by the computerized tomographic angiography during the acute stroke triage in the emergency department. Careful attention was given to the origin and anatomic course of the vertebral artery to make sure that ostial disease or severe hypoplasia would not potentially interfere with the endovascular navigation, or the ability of the operator to quickly remove the embolus from the posterior circulation. Barbeau testing was performed in all subjects. The radial artery was accessed under ultrasound guidance with a short 21 Gauge radial needle using the modified Seldinger technique. A 6 French short transradial introducer sheath (Glidesheath Slender, Terumo, and Somerset, New Jersey) was inserted over the wire. A radial cocktail containing 200 µg of nitroglycerin and 2.5 mg of verapamil was diluted in 8 ml of blood aspirated from the sheath, and the total amount of mixed blood and vasodilators (10 ml) was slowly infused in the artery. The use of Heparin was spared from the radial cocktail to avoid potential cerebral hemorrhagic complications. A coaxial system was used most of the time. This coaxial system included a 5 or 6 French guide catheter (Envoy guide catheter Codman Neuro, Raynham, Massachusetts, USA) or a 6 French large bore aspiration reperfusion catheter (Sofia Microvention Irvine California, USA) plus a microcatheter (Velocity Penumbra, Alameda, California, USA) navigated over a 0.014 inch microwire (Stryker Kalamazoo, California, USA). Occasionally, a transradial triaxial system was used combining a 6 French guide catheter, a 5 French large bore aspiration reperfusion catheter and the microcatheter. The stent retriever was deployed using standard technique and after 5 min the stent retriever and microcatheter were slowly removed while performing manual aspiration with a 20-ml syringe in the guide catheter. If the triaxial system was used, then the 5 French intermediate large bore aspiration reperfusion catheter was connected to an aspiration pump (Penumbra, Alameda, California, USA) and the microcatheter. The retrieval stent and the intermediate catheter were all slowly removed while performing active aspiration. Removal of the arterial sheath was performed immediately after the case was finished and radial artery hemostasis was achieved with a radial artery compression device (TR Band, Terumo, Somerset, New Jersey, USA).

Transfemoral access

Transfemoral access for mechanical embolectomy in the posterior circulation follows similar principles of the technique used mechanical embolectomy in the anterior circulation. A 9 French short femoral introducer sheath allows to advance a 9 French balloon guide catheter (MERCI Stryker, Kalamazoo, California, USA) into the right or left subclavian artery. One of our neurointerventional operator (RK) used a 6 French long guiding sheath (NeuronMax Penumbra Alameda, California, USA). Because of the discrepancy between the reduced diameter of the vertebral arteries and the big size of these guiding systems, the guiding system most of the time has to be parked in the proximal aspect of the subclavian artery. A coaxial or triaxial system was then

Table 1. Comparison of patient demographic characteristic, clinical presentation, and procedural characteristics in the transradial and transfemoral groups

Characteristics	Transradial (n = 10)	Transfemoral (n = 10)	p value
Age (mean ± SD)	77.90 ± 1.96	55.2 ± 15.7	0.004
Male sex	8 (80%)	6 (60%)	0.329
Initial NIHSS score (mean ± SD)	28.9 ± 14.5	30.2 ± 9.2	0.81
Last seen normal to hospital arrival (mean ± SD)	367.9 ± 324.72	139.40 ± 129.25	0.05
IV-tPA	3 (30%)	4 (40%)	0.22
General anesthesia	7 (70%)	9 (90%)	0.45
Vessel occlusion location:			
Basilar artery	4 (40%)	1 (10%)	
Basilar tip	2 (20%)	7 (70%)	
P1–P2 segment	4 (40%)	2 (20%)	
Triaxial system	2 (20%)	4 (40%)	0.628
Number of passes (avg.)	1.1	1.2	–
Single first effective pass	6 (60%)	7 (70%)	0.639
Successful recanalization (TICI 2b or higher)	80%	100%	0.136
TICI 3	6 (60%)	6 (60%)	1
sICH	None	None	–
mRs at discharge			
0	0	1 (10%)	0.51
1	0	0	
2	4 (40%)	3 (30%)	
3	3 (30%)	4 (40%)	
4	0	1 (10%)	
5	0	0	

SD, Standard Deviation; NIHSS, National Institute of Health Stroke Scale; IV-tPA, Intravenous tissue Plasminogen; TICI, Thrombolysis In Cerebral Ischemia; sICH, symptomatic Intracerebral hemorrhage; mRs, modified Rankin scale.

used and stent retriever was deployed using the standard technique.

Statistical Analysis

Statistical analysis was performed with Statistical Package for Social Sciences (SPSS) Version 25.0 statistic software package. Data are presented as mean and SD for continuous variables and as frequency (percentages) for categorical variables. A value of $p \leq 0.05$ was considered statistically significant.

Results

Between January 2018 and January 2019, a total of 10 subjects underwent mechanical embolectomy for acute embolic occlusion on the posterior circulation via transradial access,; between January 2017 and January 2018, a total of 10 subjects underwent mechanical embolectomy for acute embolic occlusion on the posterior circulation via transfemoral access. The demographic characteristics score from the National Institute of Health Stroke Scale (NIHSS), the location of large vessel occlusion and the concomitant use of IV t-PA in the transradial and transfemoral groups are presented in Table 1.

The majority of our subjects arrived with severe strokes in both groups as revealed by the median NIHSS score, and most of them arrive with a decrease in the level of arousal as reflected by the high use of general anesthesia and endotracheal intubation in both groups. Although the transfemoral access allows for navigation of large bore catheters including the 8 and 9 French balloon guide catheters and the 6 French long guiding sheath, these types of guiding catheters were only used in 4 out 10 subjects in the transfemoral access group.

In the transradial group, for all subjects, except for one, the radial artery was accessed on the right wrist. None of the patients in this group were treated with guiding catheters bigger than 6 French, and a triaxial system was used only in two subjects. The average number of passes of the retrieval stent was similar in both groups, and the number of patients successfully reanalyzed with only one single effective pass did not differ, in the transradial and transfemoral groups.

The time from arrival to the neuroangiography suite to the time of skin puncture was 10 min longer in the transradial access group. However, the most striking difference between the two groups was the time elapsed from the skin puncture until the recanalization was achieved and the procedure was concluded (29 min in the transradial access group vs. 64 min in the transfemoral group). None of the patients suffered from hemorrhagic complications at the puncture site in either group. No occlusion, hand ischemia, or other complications were recorded in the radial access group.

Discussion

Acute embolic occlusion of the cerebral arteries in the posterior circulation has a poor natural history. Basilar

artery embolism can lead to permanent pontine ischemia that can potentially result in coma or persistent vegetative state, and basilar tip embolism can lead to bithalamic and bihippocampal ischemia, which can result in acute confusion and hypersomnia (arousal deficit) and potential permanent amnestic syndromes [2]. The transradial access is becoming an emergent less invasive alternative for endovascular navigation in neurointervention [3]. The natural orientation of the vertebral artery origin to the subclavian artery makes the transradial approach a suitable and feasible alternative to the traditional transfemoral access for the treatment of cerebrovascular disease in the posterior circulation including mechanical thrombectomy for acute embolic arterial occlusion. The direct access of the vertebral arteries from the radial approach can potentially offer a nonstop and faster navigation to the vertebrobasilar arterial system. Haussen *et al*. [4] presented a case series of transradial access in acute ischemic stroke. Ten out of 15 patients were ischemic stroke in the posterior circulation. However, the radial access was only considered after failure of transfemoral access, which resulted in an excessively prolonged time from last seen normal to skin puncture (17 hours) [4].

Time from symptoms onset to reperfusion is one of the most important variables in the final outcome during acute cerebral reperfusion. In particular, the time from the skin puncture to the reperfusion is an important surrogate marker of the efficiency of the endovascular technique. In the present study, the transradial access was able to reduce this time in half of the amount of time as compared with the transfemoral access with similar proportions of successful recanalization rates and neurologic outcomes. Oselkin *et al*. [5] reported eight cases of transradial mechanical thrombectomy for acute embolic occlusion in the basilar artery. Their average skin puncture to recanalization time was 35.8 min with a high rate of successful recanalization [5]. The authors emphasized that transradial access should be considered as a first-line approach (as opposed to a bailout rescue technique for a failed transfemoral access) for acute revascularization of the basilar artery. Similarly, Rangel-Castilla *et al*. [6] recently reported successful results of mechanical embolectomy for acute large vessel occlusion in the posterior circulation with effective retrieval of the clot via transradial access in two patients with otherwise tortuous aortic arch and supra-aortic vessel trajectory that could potentially excessively prolong the reperfusion time via transfemoral approach [6].

The degree of invasiveness of the transradial access is substantially less when compared with the transfemoral access. This results in a reduced incidence of inguinal and retroperitoneal bleeds. Retroperitoneal hematoma, in particular, can be a potential devastating complication in acute ischemic stroke patients with concomitant intravenous infusion of thrombolytic medication. Moreover, the less invasive component of the transradial access can also potentially reduce the need for endotracheal intubation and the administration of general anesthesia during mechanical embolectomy.

The value of triaxial platforms (the combination of guiding catheter, large bore aspiration reperfusion catheter, and microcatheter) for mechanical thrombectomy in the posterior circulation is uncertain. In our initial experience with our first 10 cases of transradial mechanical embolectomy in the posterior circulation, two thirds of our subjected achieved a successful recanalization (TICI 2b or higher) using just a combination of a 6 French guiding catheter or a 6 French large bore aspiration reperfusion catheter, plus a microcatheter to deliver the retrieval stent (coaxial system). Snelling *et al*. [7] reported 29 cases of mechanical transradial mechanical thrombectomy, and only three cases were in the posterior circulation. All of the three patients with acute embolism in the posterior circulation were treated using a coaxial system and two of them were able to achieve a TICI 3 reperfusion score [7]. On the other hand, Chen *et al.* [8] reported a total of 18 transradial mechanical embolectomies for acute embolic occlusion in the anterior circulation in patients with unfavorable aortic arch and supra-aortic vessel patterns [8]. In only one-third of the patients, a balloon guide catheter was used via transradial approach as compared with more than 90% of the patients treated via transfemoral approach. The rate of successful recanalization defined as a TICI 2b, -2c and 3 did not differ between the groups. It is unknown how much is added to the effectiveness of mechanical embolectomy in the posterior circulation by the use of large balloon guide catheter and long guiding sheath systems.

Our study has several limitations. First, the sample size is small. We started to use transradial access in our center at the beginning of 2018. There is a learning curve with all the nuances of a new technique and the logistic of the neuroangiography suite setup. This is reflected in a more prolonged time from the neuroangiography suite arrival to the skin puncture in the transradial group. Second, the retrospective nature of this analysis can carry several potential biases, including patient selection for transradial versus transfemoral access. However, in the current study, the average age of the transradial group was more than two decades older than the transfemoral group, and they arrived to the hospital much later after

Table 2. Summary of technical and procedural metrics between the transradial and transfemoral groups

Technical aspects and procedural metrics	Transradial(n = 10)	Transfemoral(n = 10)	p value
Lab arrival and skin puncture in minutes(mean ± SD)	24.8 ± 19.3	15.1 ± 4.45	0.14
Skin puncture to reperfusion time in minutes(mean ± SD)	29.2 ± 17.6	63.9 ± 56.7	0.08
Amount of fluoroscopy time in minutes(mean ± SD)	20.0 ± 17.0	22.7 ± 19.3	0.746
Amount of contrast used in milliliters(mean ± SD)	108.5 ± 98.1	92.4 ± 55.2	0.657

last seen normal than the transfemoral-accessed patients. Third, the outcome assessment at discharge and the angiographic recanalization score was not assessed by a blinded investigator. Finally, there is no consensus regarding the role of heparin in the mixture of medication that are commonly infused intra-arterially (also known as radial cocktail), after the placement of the radial sheath, as well as the potential deleterious effect of the vasodilators in the compensatory effect of the retrograde collateral cerebral blood flow around the penumbra tissue.

Conclusion

This is the first study that compares transradial versus transfemoral access for mechanical embolectomy in patients with acute embolic occlusion in the posterior cerebral circulation. Transradial access resulted in a safe, effective, and faster endovascular route for recanalization in the acute embolic occlusion of the posterior circulation.

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