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ORIGINAL ARTICLE

Transradial Access for Neurointervention: A Case Series from a Tertiary Centre in Hong Kong

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ABSTRACT

Introduction: *Despite several retrospective studies showing the safety and efficacy of transradial access (TRA) for a variety of neurointerventions, the evidence in Asian populations is limited. The smaller size of the radial artery in Asians could cause technical difficulty in access as well as access site complications. This study aimed to assess the feasibility and safety of TRA for neurointervention in an Asian population.*

Methods: *We performed a retrospective review of neurointerventions performed with TRA in our hospital between January 2018 and June 2021. Technical success was defined as TRA with insertion of the sheath and completion of the intervention without crossover to conventional transfemoral access (TFA). The primary endpoint was the in-hospital stay plus the 30-day incidence of access site haematoma requiring surgical treatment or transfusion, symptomatic radial artery occlusion, hand ischaemia, arteriovenous fistula, pseudoaneurysm, and wound infection. The secondary endpoints were procedure-related complications including intra-operative vessel injury, cerebral thromboembolism, and haemorrhagic complications.*

Results: *A total of 45 patients underwent neurointerventions (transcatheter embolisation of aneurysms/arteriovenous malformations/tumours, and extracranial carotid stenting) via TRA. The technical success rate was 93.3%. There were no significant access site complications. The overall procedure-related complication rate was 11.1%.*

Conclusion: *In an Asian population, neurointervention via TRA is feasible, with a low crossover rate and low incidence of access site complications. In this case series, there was no increase in the procedure-related complication rate when compared with TFA.*

Key Words: *Aneurysm; Arteriovenous malformations; Carotid stenosis; Radial artery*

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Ethics Approval: This research was approved by the Research Ethics Committee (Kowloon Central/Kowloon East) of Hospital Authority, Hong Kong (Ref No.: KC/KE-21-0225/ER-1). Patient consent was waived by the Committee due to the retrospective nature of the research.

中文摘要

神經介入的橈動脈入路：來自香港一所三級醫療中心的病例系列

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引言：儘管多項回顧性研究表明經橈動脈入路用於各種神經介入的安全性和有效性，但亞洲人群的證據有限。亞洲人的橈動脈較小可能會導致導管插入困難以及插入部位併發症。本研究旨在評估經橈動脈入路在亞洲人群中進行神經介入的可行性和安全性。

方法：我們對2018年1月至2021年6月期間在本院使用經橈動脈入路進行的神經介入進行了回顧性分析。技術成功的定義為經橈動脈入路插入鞘管並完成介入而無需採用傳統經股動脈通路。主要終點是住院時間加上需要手術治療或輸血的穿刺部位血腫、有症狀的橈動脈閉塞、手部缺血、動靜脈瘺、假性動脈瘤和傷口感染的30天發生率。次要終點是手術相關併發症，包括術中血管損傷、腦血栓栓塞和出血併發症。

結果：共有45名患者通過經橈動脈入路接受了神經介入（動脈瘤／動靜脈畸形／腫瘤的經導管栓塞，以及顱外頸動脈支架置入術）。技術成功率為93.3%。沒有明顯的插入部位併發症。總體手術相關併發症發生率為11.1%。

結論：在亞洲人群中通過經橈動脈入路進行神經介入是可行的，需採用經橈動脈入路的手術率低，穿刺部位併發症發生率亦低。在本病例系列中，與經股動脈通路相比，手術相關併發症的發生率沒有增加。

INTRODUCTION

Transradial access (TRA) has evolved as the standard approach for cardiac interventions. Compared to conventional transfemoral access (TFA), TRA has a demonstrated lower rate of access site complications, improved postprocedural quality of life, and reduced hospital costs in large-scale randomised trials.[1-9] At first, TRA was not widely used in neurointervention due to technical challenges in puncturing and obtaining access for a large-bore sheath in the small radial artery. In recent years, TRA has been gaining popularity for neurointerventions due to two major advantages. First, the superficial location and compressibility of the radial artery can reduce access site bleeding and related complications, especially when large-bore vascular access is needed together with the need to administer dual antiplatelet treatment. Second, TRA has anatomical and technical advantage in patients with type III and bovine arch morphology.[10]

There are reports from Western countries demonstrating low rates of access site complications and crossover to TFA in TRA neurointerventions.[11-13] However, there are limited reports on TRA for neurointervention in Asian populations. There are differences in the size of the radial arteries between patients of various ethnicities. The mean internal diameter of the radial artery has been reported to be 3.64 ± 0.74 mm in the Western population[14] compared to 2.63 ± 0.35 mm in the Asian population.[15] The smaller radial artery diameter in Asians could potentially affect arterial accessibility of and also the rate of access site complications.

The aim of our study was to assess our experience with TRA in 45 neurointerventions in a tertiary neurointervention centre with a predominant Asian patient population.

METHODS

This was a retrospective study performed in a tertiary neurointervention centre in Hong Kong. Our patient population is primarily Asian and predominantly Chinese. We reviewed consecutive neurointerventional cases performed with TRA in Queen Elizabeth Hospital between January 2018 and June 2021. The neurointerventions performed include carotid stenting,

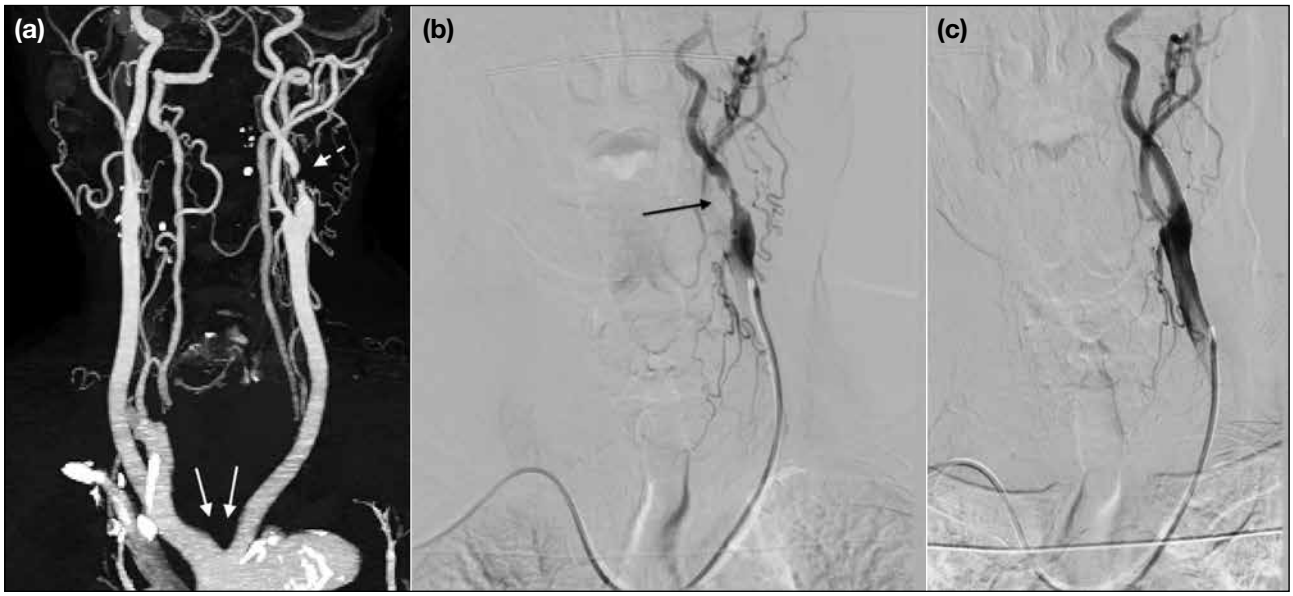

Figure 1. (a) Computed tomography angiogram of the neck showing severe left proximal internal carotid artery (ICA) stenosis (dashed arrow) in a patient with bovine arch (arrows). (b) Left ICA angiogram with transradial access (TRA) showing severe left proximal cervical ICA stenosis (arrow). (c) Left carotid stent performed with TRA. Post–carotid stent angiogram showed satisfactory angiographic result.

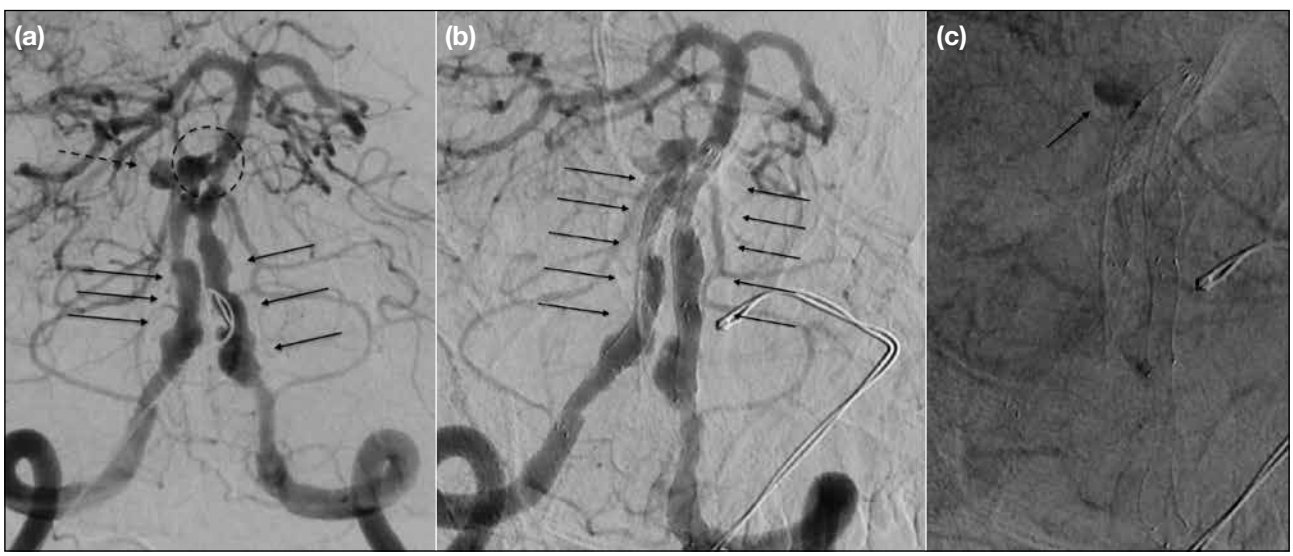

Figure 2. (a) Bilateral vertebral angiogram shows dissection along intradural segment of both vertebral arteries with alternating segments of stenoses and dilatations (arrows). Fenestration of right vertebrobasilar junction is shown (dashed circle). There is an aneurysm arising from the right vertebrobasilar junction (dashed arrow). (b) Two flow diverters were deployed from the right vertebrobasilar junction to the right vertebral artery proximal V4 segment, followed by deployment of two flow diverters from the left vertebrobasilar junction to left vertebral artery distal V3 segment. Bilateral flow diverters (arrows) were patent. (c) Post–flow diverter deployment angiogram showing contrast stasis in the right vertebrobasilar junction aneurysm (arrow).

transcatheter embolisation (TCE) of intracranial aneurysms, stenting of intracranial arteries, TCE of arteriovenous malformations, and tumour TCE.

The decision to perform neurointervention using TRA was made prior to the procedure in cases with factors reported to favour TRA, which include but are not limited to type II/III aortic arch, bovine arch (Figure 1), posterior circulation vascular lesions (Figure 2), high bleeding risk due to use of dual antiplatelet therapy, obesity, and failed

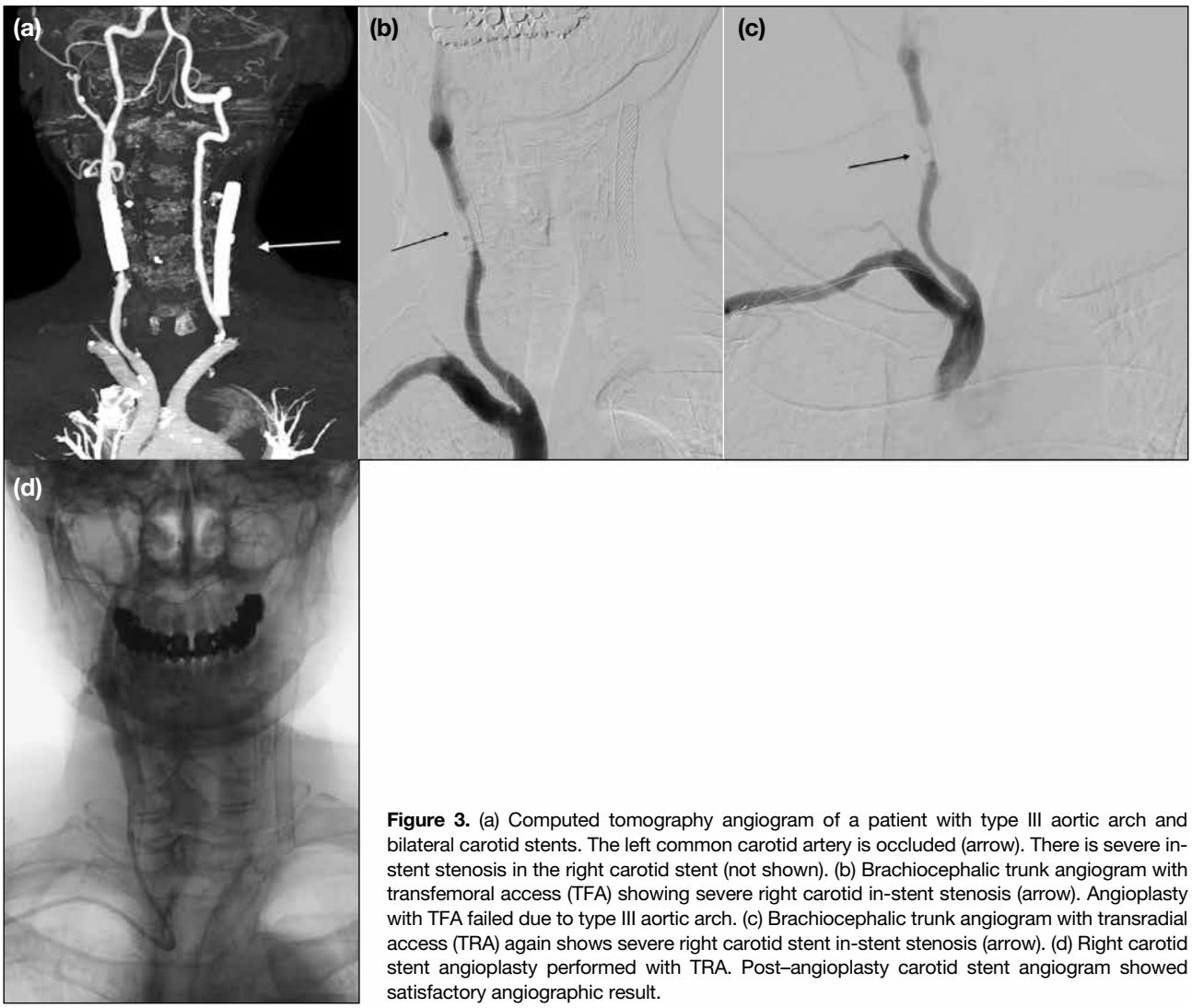

Figure 3. (a) Computed tomography angiogram of a patient with type III aortic arch and bilateral carotid stents. The left common carotid artery is occluded (arrow). There is severe in-stent stenosis in the right carotid stent (not shown). (b) Brachiocephalic trunk angiogram with transfemoral access (TFA) showing severe right carotid in-stent stenosis (arrow). Angioplasty with TFA failed due to type III aortic arch. (c) Brachiocephalic trunk angiogram with transradial access (TRA) again shows severe right carotid stent in-stent stenosis (arrow). (d) Right carotid stent angioplasty performed with TRA. Post–angioplasty carotid stent angiogram showed satisfactory angiographic result.

TFA (Figure 3). All cases meeting the inclusion criteria were included in this study except there was one case excluded as the patient was observed with Barbeau type D waveform. The list of factors was based on medical knowledge and neurointervention experience, and the decision was made by neurointervention operators.

Endovascular Procedure

Our standard approach was to perform the Barbeau test prior to radial artery puncture. For Barbeau types A, B and C, the neurointervention would proceed with TRA; for Barbeau type D, neurointervention would be performed with TFA.

The puncture site of the radial artery was either at the wrist (2 to 3 cm proximal to palmar wrist crease) or the distal radial artery (at the anatomical snuffbox). The choice of access site was based on the calibre of the radial artery measured with ultrasound at the respective sites and also operators' preference. The choice of right or left radial artery depended on the location of the target lesion. For example, for right vertebral artery or right internal carotid artery lesion, right transradial approach was used; for left vertebral artery lesion, left transradial approach was used.

TRA was achieved with a single-wall puncture under ultrasound guidance, followed by insertion of a 6-F sheath (Radifocus Introducer II Transradial Kit; Terumo, Tokyo, Japan). An antispasmodic cocktail (2.5 mg of verapamil and 200 μg of nitroglycerin) was administered via the radial sheath; this became our standard practice and was

administered in the last 38 cases in this series with close monitoring of blood pressure. Haemodilution (aspirating a substantial amount [a few mm] of blood into syringe) and slow injection of the antispasmodic cocktail were adopted to mitigate the burning sensation associated with the cocktail and to avoid a sudden drop in blood pressure. A bolus of heparin (50 units/kg) and heparin infusion (600 units/h) were administered intravenously.

The supra-aortic vessels were catheterised by advancing a guide catheter (Benchmark 071; Penumbra, Alameda [CA], US; Neuron 053, Penumbra, Alameda [CA], US; or Mach 1; Boston Scientific, Natick [MA], US), over a standard hydrophilic angled 0.035-inch guidewire (Terumo, Tokyo, Japan), with or without the aid of a 5-Fr diagnostic catheters such as a Simmons 2–shaped catheter (Terumo, Tokyo, Japan), Torcon NB Advantage Catheter (Cook Medical, Bloomington [IN], US) or JB2 catheter (Cordis, Miami [FL], US). The guide catheter could be preloaded with the diagnostic catheter or exchanged for a diagnostic catheter over a guidewire.

Upon completion of the procedure, the radial artery puncture site was closed with application of a haemostatic bandage (Stepty P; Nichiban, Tokyo, Japan) for 4 hours. Patients were then examined for access site haematoma and for distal perfusion. All patients were reviewed for access site complications during the hospital stay and underwent follow-up in the outpatient clinic.

Outcome

Technical success was defined as TRA with insertion of the sheath and completion of neurointervention without crossover to conventional TFA for intervention. The primary endpoint was the in-hospital stay plus 30-day incidence of significant access site complications including access site haematoma requiring surgical treatment or transfusion, symptomatic radial artery occlusion, hand ischaemia, arteriovenous fistula, pseudoaneurysm, or wound infection. The secondary endpoints were procedure-related complications including intraoperative vessel injury, and cerebral thromboembolic and haemorrhagic complications.

RESULTS

Between January 2018 and June 2021, 45 neurointerventions were performed with TRA in our institution. Patient demographics, neurointervention performed, target lesion, rationale for TRA, and location of radial artery puncture are listed in the online supplementary Table.

All 45 patients were Asian and 43 of them (95.6%) were Chinese. There were 17 cases (37.8%) of TCE of aneurysm(s) in the anterior circulation, 16 cases (35.6%) of TCE of aneurysm(s) in the posterior circulation (Figure 2), 10 cases (22.2%) of carotid stenting (Figures 1 and 3), one case (2.2%) of embolisation of a meningioma, and one case (2.2%) of TCE of an arteriovenous malformation in the posterior fossa.

We performed 46 radial artery punctures in the 45 neurointerventions. There were 34 punctures (73.9%) at wrist level and 12 punctures (26.1%) at the anatomical snuffbox.

The overall rate of technical success of TRA was 93.3%, with no instances of failure in obtaining radial access. There was no case of radial artery vasospasm nor radial loop requiring crossover to TFA. There were three cases with crossover (6.7%) to TFA due to severe acute angulation between the right subclavian artery and the right common carotid artery.

For the primary safety endpoints, there was no significant access site haematoma, symptomatic radial artery occlusion, hand ischaemia, arteriovenous fistula, pseudoaneurysm, or wound infection during in-hospital stay and 30 days thereafter.

For secondary endpoints, five patients (11.1%) had procedure-related complications. There were two cases of intra-operative aneurysm rupture, two cases of thromboembolism (one case resolved with intra-arterial eptifibatide injection with no clinical sequelae; the other case suffered a middle cerebral artery territory infarct noted on postoperative day 2), and one case of intra-operative in-stent stenosis.

DISCUSSION

There is increasing utilisation of TRA in diagnostic and interventional cerebral angiography, with good clinical outcomes. It is becoming the preferred choice of access by patients.[16,17] There are published case series demonstrating feasibility and safety of TRA in a variety of neurointerventions, such as aneurysm TCE,[11] flow diverting stent placement[12] and mechanical thrombectomy,[13] which were all performed in Western countries. There is no corresponding literature in Asian populations.

Our case series is the first which consists of Asian (100%) and predominantly Chinese patients (95.6%).

It demonstrates a high success rate in performing neurointerventions with TRA, which is similar to published case series with Caucasian patients, despite the smaller radial artery diameter in Asians when compared to Caucasians.[14,15] The crossover rate in our case series was similar compared to other published case series. In a systemic review of TRA in neurointerventions which consisted of 21 studies (n = 1342 patients),[10] the crossover rate was 4.77%. Radial artery spasm is one of the potential difficulties in performing neurointervention with TRA. It was only rarely encountered in this case series. The antispasmodic cocktail was very effective in preventing and treating radial artery spasm. The fact that we performed all neurointerventions apart from carotid stenting with general anaesthesia was a protective factor. Another potential difficulty in performing neurointervention with TRA was radial loops. Radial loops were only rarely encountered in this case series. The radial loop is a rare vascular anomaly with a reported frequency of 2.3% in one large multicentre case series.[18] In the few cases with radial loop which we encountered in this case series, the loop was reduced with advancement of the catheter with the aid of a guidewire.

TRA also demonstrated safety among our patient group with no significant access site complications observed in our case series. In a systematic review,[10] the major access site complication rate was reported to be 0.15%.

The overall procedure-related complication rate in our case series was 11.1% (5 out of 45 cases). All five complicated cases were TCE of intracranial aneurysms. In subgroup analysis, the complication rate of TCE of intracranial aneurysms with TRA was 15.2%, which is within the reported range in the literature.[19-22] The overall TRA procedure–related complication rate was similar to that with TFA in our centre (10%-20%).

Limitations

Our study has a few limitations. First, it was a single-centre study which limits its generalisability. However, the neurointerventions in this series were performed by 11 operators with variable lengths of experience in neurointervention from <1 year to >20 years. This could suggest that TRA can be performed by operators with different levels of experience.

Second, this study has a small sample size. Neurointervention with TRA was increasingly performed in our centre because operators were gaining experience and confidence in TRA. According to cardiac literature and studies regarding diagnostic cerebral angiography with TRA, there is a 30- to 50-case learning curve,[23,24] and we expect our crossover and procedure-related complication rate will improve with our increasing case volume of TRA.

CONCLUSION

This case series is believed to be the first one to demonstrate that TRA is feasible and safe to perform for a variety of neurointerventions in Asian patients, who have relatively smaller radial artery calibres when compared to Caucasian patients. The crossover rate was low and there was a high success rate of 93.3% with TRA. There were no significant access site complications in this case series. There was no increase in the procedure-related complication rate with TRA when compared with TFA in our centre.

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