Efficacy, Safety, and Satisfaction of Distal Transradial Artery Access in Cerebral Angiography: A Post-Print Study

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Abstract

Background Cerebral angiography plays an important role in the diagnosis of cerebrovascular diseases. In recent years, distal transradial artery access (dTRA) has been gradually applied in cerebral angiography, but currently there are few research reports on its efficacy and safety.

Objective To compare the efficacy, safety, and satisfaction of cerebral angiography performed via transradial artery access (TRA) versus dTRA.

Methods A total of 135 patients who were hospitalized in the Department of Neurosurgery at Wujin Hospital Affiliated with Jiangsu University and underwent cerebral angiography from January 2020 to June 2022 were selected. According to the access route for cerebral angiography, they were divided into a TRA group (n=72) and a dTRA group (n=63), and cerebral angiography was completed using TRA and dTRA respectively. The puncture time, cerebral angiography time, puncture success rate, X-ray exposure time, puncture site complications within 3 days after cerebral angiography, occurrence of serious cardiovascular and cerebrovascular events, pain degree at 24 hours after cerebral angiography, and satisfaction were compared between the two groups.

Results The puncture time and cerebral angiography time in the dTRA group were longer than those in the TRA group, and the puncture success rate was lower than that in the TRA group ($P<0.05$). There was no statistically significant difference in X-ray exposure time and the incidence of puncture site complications within 3 days after cerebral angiography between the two groups ($P>0.05$). No serious cardiovascular or cerebrovascular events occurred within 3 days after cerebral angiography in either group. The pain degree at 24 hours after cerebral angiography in the dTRA group was milder than that in the TRA group, and the satisfaction was higher than that in the TRA group ($P<0.05$).

Conclusion Compared with cerebral angiography via TRA, cerebral angiography via dTRA is also safe and effective, which is beneficial for reducing patient pain and improving patient satisfaction, and can be used as an alternative access for cerebral angiography. However, it has a higher puncture difficulty, longer puncture time, and a certain “learning curve”.

Full Text

Effectiveness, Safety and Satisfaction of Distal Transradial Artery Approach in Cerebral Angiography

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Abstract

Background: Cerebral angiography plays a crucial role in diagnosing cerebrovascular diseases. In recent years, the distal transradial artery approach (dTRA) has been gradually applied in cerebral angiography, though research reports on its effectiveness and safety remain scarce. **Objective:** To compare the effectiveness, safety, and patient satisfaction between the transradial artery approach (TRA) and dTRA in cerebral angiography. **Methods:** A total of 135 patients who underwent cerebral angiography in the Department of Neurosurgery at Wujin Hospital Affiliated with Jiangsu University between January 2020 and June 2022 were selected. Based on the angiographic access route, patients were divided into a TRA group (n=72) and a dTRA group (n=63). Cerebral angiography was performed using TRA and dTRA respectively. The two groups were compared in terms of puncture time, angiography duration, puncture success rate, X-ray exposure time, incidence of puncture site complications and serious cardiovascular/cerebrovascular events within 3 days post-procedure, as well as pain level and satisfaction at 24 hours post-angiography. **Results:** The dTRA group exhibited longer puncture time and angiography duration, with a lower puncture success rate compared to the TRA group ($P<0.05$). No statistically significant differences were observed between groups in X-ray exposure time or incidence of puncture site complications within 3 days post-procedure ($P>0.05$). Neither group experienced serious cardiovascular or cerebrovascular events within 3 days post-angiography. The dTRA group reported lower pain levels and greater satisfaction at 24 hours post-procedure (P<0.05). **Conclusion:** Compared with TRA, dTRA is also safe and effective for cerebral angiography, offering advantages in pain reduction and improved patient satisfaction. It can serve as an alternative access route for cerebral angiography, though it presents higher puncture difficulty and longer procedure time, indicating a notable learning curve.

Keywords: Cerebrovascular diseases; Cerebral angiography; Radial artery; Distal radial artery; Treatment outcome; Safety

Introduction

With the rapid increase in aging population, the incidence of cerebrovascular diseases in China has shown a rising trend in recent years. Data indicate that the standardized prevalence of cerebrovascular diseases among Chinese individuals over 40 years old has increased from 1.89% in 2012 to 2.58% in 2019 [1]. Cerebrovascular diseases pose significant health risks, threatening patients' physical and mental well-being and even their lives if not diagnosed and treated promptly. Cerebral angiography represents the "gold standard" for diagnosing cerebrovascular diseases. Due to its larger caliber and higher puncture success rate, the transfemoral approach (TFA) has traditionally been the classic access route for cerebral angiography. However, TFA is associated with numerous complications (including thrombosis, arteriovenous fistula, and pseudoaneurysm) with a relatively high incidence rate (1.5%~3.0%) [2-3]. Consequently, our department began gradually adopting the transradial artery approach (TRA) for cerebral angiography starting in 2020.

Although TRA for cerebral angiography offers advantages such as fewer complications [4] and no restriction on postoperative ambulation, it has certain limitations. Patients may experience intraoperative and postoperative vasospasm, radial artery occlusion, or hematoma due to improper compression hemostasis. Through technical modifications to radial artery puncture, our department began selectively using the distal transradial artery approach (dTRA) for cerebral angiography starting in July 2021. This study compares the effectiveness, safety, and satisfaction between TRA and dTRA in cerebral angiography to explore the clinical value of dTRA.

Methods

1.1 General Data We selected 135 patients who were hospitalized in the Department of Neurosurgery at Wujin Hospital Affiliated with Jiangsu University and underwent cerebral angiography between January 2020 and June 2022. Patients were divided into a TRA group (n=72) and a dTRA group (n=63) based on the angiographic access route. The two groups showed no statistically significant differences in gender, age, or underlying diseases (P>0.05), ensuring comparability . This study was approved by the Ethics Committee of Wujin Hospital Affiliated with Jiangsu University (Approval No.: Wuyi Ethics Committee [2019] No. 82), and all patients or their families provided informed consent.

1.2 Inclusion and Exclusion Criteria **Inclusion criteria:** (1) Patients with indications for cerebral angiography and without contraindications, where indications included intracranial vascular diseases, post-treatment follow-up for craniofacial diseases, preoperative evaluation of hypervascular craniofacial tumors, etiological examination for subarachnoid hemorrhage, suspected cerebrovascular lesions, clarification of blood supply to intracranial space-occupying lesions and their relationship with surrounding vessels, and arterial thrombolysis for acute cerebrovascular diseases. Contraindications included local infection at puncture site, concurrent cerebral herniation, allergy to interventional equipment, and allergy or intolerance to iodinated contrast agents [5]; (2) Intact puncture site skin without damage or infection; (3) Negative Allen test; (4) Good distal radial artery pulsation.

Exclusion criteria: (1) Poor general condition with intolerance to cerebral angiography; (2) Severe neurological/psychiatric disorders preventing cooperation; (3) Severe organ dysfunction; (4) Radial artery terminal occlusive lesions [6].

1.3 Cerebral Angiography Procedure For the TRA group, the puncture site was selected at the location of strongest radial artery pulsation in the wrist region. Post-procedure hemostasis was achieved using an inflatable compression band (TERUMO TR Band): after withdrawing the sheath approximately 2 cm, the green marker of the band was aligned with the radial artery puncture site at the wrist joint. After adjusting the hook-and-loop fastener tightness, 13-15 ml of air was injected into the balloon using the provided syringe, with deflation performed once every 2 hours (2 ml each time) for 5 cycles, followed by continued compression. The compression band was typically removed approximately 18 hours post-procedure. Notably, if patients complained of finger numbness, wrist pain, or obvious hand swelling during compression, it indicated excessive pressure requiring immediate adjustment of fastener tightness.

For the dTRA group, the puncture site was selected at the distal radial artery in the anatomical snuffbox between the extensor pollicis longus and extensor pollicis brevis tendons [Figure 1: see original paper]A. Post-procedure hemostasis involved placing a 3 cm × 3 cm sterile gauze folded into a square at the puncture site, followed by compression bandaging with elastic bandage [Figure 1: see original paper]B. Partial pressure was typically released 1-2 hours post-procedure, with complete pressure removal after 8-10 hours.

Standard anteroposterior and lateral views were obtained using the Zeego angiography system (Siemens, Germany), a high-pressure injector (MEDRAD Mark7 Arterion, Germany), and 5F Simmons-2 catheters (Cordis) guided by 0.035 soft guidewires (260 cm length). Both groups' procedures were performed by the same experienced neurointerventional physician. The contrast agent used was iodixanol injection, with flow rates controlled at 5-6 ml/s (volume 8-10 ml) for common carotid artery, 5-7 ml/s (volume 8-10 ml) for subclavian artery, and 3-4 ml/s (volume 5-6 ml) for vertebral artery. Image acquisition covered the complete circulatory period from arterial to venous phase.

1.4 Outcome Measures **1.4.1 Effectiveness indicators:** Puncture time (from skin puncture to successful arterial sheath placement), cerebral angiography time (from skin puncture to procedure completion and puncture site compression bandaging), and puncture success rate (successful arterial sheath placement enabling cerebral angiography) were compared.

1.4.2 Safety indicators: X-ray exposure time (duration of X-ray irradiation during digital subtraction angiography) and incidence of puncture site complications (including pseudoaneurysm, punctured artery occlusion, and subcutaneous hematoma) and serious cardiovascular/cerebrovascular events (including acute cerebral infarction, transient ischemic attack, and acute myocardial infarction) within 3 days post-procedure were compared.

1.4.3 Pain assessment: Pain level at 24 hours post-angiography was evaluated using the Numerical Rating Scale (NRS), with a scoring range of 0-10 (0 = no pain, 1-3 = mild pain, 4-7 = moderate pain, 8-10 = severe pain).

1.4.4 Satisfaction assessment: Patient satisfaction at 24 hours post-angiography was evaluated using a satisfaction questionnaire from reference [7], which had a Cronbach's α coefficient of 0.812. The questionnaire included 10 items: attending physician service, attending physician technical skill, treatment plan explanation, treatment cost, treatment outcome, nurse technical skill, nurse service, hospital medical facilities, ward environment, and hospital food. Each item was scored as satisfied (10 points), basically satisfied (8 points), or dissatisfied (6 points), with a total possible score of 100 points. Scores of 90-100 indicated very satisfied, 80-89 indicated basically satisfied, and $<$80 indicated dissatisfied.

1.5 Statistical Analysis SPSS 25.0 statistical software was used for data analysis. Measurement data (including age, puncture time, angiography time, and X-ray exposure time) were normally distributed and expressed as ($\bar{x}\pm s$), analyzed using independent samples t-test. Categorical data (including gender, underlying diseases, puncture success rate, and complication rates) were expressed as percentages and analyzed using ^{2} test. Ranked data (including pain level and satisfaction) were analyzed using independent samples Wilcoxon rank-sum test. The significance level was set at α=0.05 (two-tailed).

Results

2.1 Effectiveness Indicators The dTRA group demonstrated significantly longer puncture time and cerebral angiography duration compared to the TRA group, with a lower puncture success rate (P<0.05) .

2.2 Safety Indicators X-ray exposure times were (6.2$±1.2)minand(6.3±1.4)minintheTRAanddTRAgrou
0.430, P = 0.670).TheTRAgroupexperienced3casesofsubcutaneoushematomaand2casesofradialarteryocclu
P=0.132).

2.3 Pain Level and Satisfaction The dTRA group reported significantly lower pain levels and greater satisfaction at 24 hours post-angiography compared to the TRA group (P<0.05) .

Discussion

Cerebral angiography offers high diagnostic accuracy for cerebrovascular diseases and serves as an important clinical diagnostic tool [8]. Due to its larger caliber, easy localization, high puncture success rate, and wide applicability, the transfemoral approach has been widely used in cerebral angiography and was the preferred access route in earlier years with mature relevant experience and techniques [9-10]. However, the deep location of the femoral artery and thick adipose tissue in some patients often leads to serious complications such as pseudoaneurysm and arteriovenous fistula after compression hemostasis [11-12], while required immobilization and bed rest can cause urinary difficulties and deep vein thrombosis [13-14]. In recent years, with rapid development in interventional techniques, transradial cerebral angiography has also advanced rapidly. Studies have shown that TRA offers advantages including less bleeding, no requirement for bed rest, and fewer local puncture site complications [15-16], though repeated punctures may cause radial artery spasm or even occlusion (incidence 1%~10%) [17], vasovagal reflex, and radial artery pseudoaneurysm [18].

PYLES et al. first performed distal radial artery catheterization via the anatomical snuffbox in 1982. Subsequently, KIEMENEIJ et al. [19] confirmed that coronary intervention via the distal radial artery in the snuffbox was safe and effective. This study compared the effectiveness, safety, and satisfaction between TRA and dTRA for cerebral angiography. We found that the dTRA group had longer puncture and angiography times and lower puncture success rate compared to the TRA group. These differences primarily relate to the finer caliber of the distal radial artery, greater puncture difficulty, and a learning curve for operators. No statistically significant differences were observed in X-ray exposure time or puncture site complication rates within 3 days post-procedure, and no serious cardiovascular/cerebrovascular events occurred in either group, indicating comparable safety between TRA and dTRA. The dTRA group reported lower pain levels and greater satisfaction at 24 hours post-procedure, likely due to minimal impact on patient activity, greater comfort, simpler nursing care, and higher acceptance.

It should be noted that this was a single-center retrospective study with potential selection and information bias. Multi-center, large-sample studies are needed to further confirm the effectiveness and safety of dTRA. Additionally, lack of pre-procedure ultrasound examination prevented adequate assessment of radial and distal radial artery diameters, which may affect puncture success rates and complication prevention.

In recent years, the "distal-first" concept has gained traction, introducing dTRA via the snuffbox or Hegu point for interventional cardiologists and neurointerventionalists. dTRA advantages include: (1) selecting the snuffbox or Hegu point ensures stable hemodynamics in the forearm radial artery during compression hemostasis or if punctured artery occlusion occurs; (2) the distal radial artery is more superficial, requires shorter compression time, and minimally affects wrist mobility after compression bandaging, reducing hand swelling and pain from traditional compression and venous congestion, thereby improving patient comfort and satisfaction [20].

Compared with TRA, dTRA for cerebral angiography offers several benefits: (1) shorter compression hemostasis time without immobilization, typically allowing elastic bandage removal 4 hours post-procedure; (2) fewer bleeding complications with extremely low severe complication rates; (3) lower radial artery occlusion rates; (4) reduced pain and higher satisfaction; (5) better post-procedural positional comfort and compression tolerance. However, dTRA also presents disadvantages: (1) longer puncture time and higher failure rate; (2) finer distal radial artery with greater puncture difficulty; (3) unsuitability for some patients [21].

This study compared the effectiveness, safety, and satisfaction between TRA and dTRA for cerebral angiography. While dTRA demonstrated longer puncture times and higher difficulty with a learning curve, it showed comparable safety to TRA and superior performance in pain reduction and satisfaction improvement. Future studies should incorporate pre-procedure ultrasound assessment to optimize puncture success rates.

Conclusion

Compared with TRA, dTRA is also safe and effective for cerebral angiography, offering advantages in pain reduction and improved patient satisfaction. It can serve as an alternative access route for cerebral angiography. As interventional techniques continue to advance and equipment evolves, dTRA for cerebral angiography and intervention will become more mature with broader application prospects.

Data Availability Statement: The data supporting this study have been publicly released in the Science Data Bank (ScienceDB) of the Chinese Academy of Sciences, with DOI: 10.57760/sciencedb.j00150.00014, CSTR: 31253.11.sciencedb.j00150.00014, accessible at https://doi.org/10.57760/sciencedb.j00150.00014.

Author Contributions: LU Bin conceived and designed the study, conducted feasibility analysis, collected and organized literature/data, and drafted the

manuscript. LU Bin and XIANG Chong revised the manuscript and English translation. YUAN Xuesong, CAI Gaojun, and WEI Wenfeng were responsible for quality control and final approval, providing overall supervision.

Conflict of Interest: The authors declare no conflict of interest.

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Note: Figure translations are in progress. See original paper for figures.