

EVALUATING THE EFFICACY AND SAFETY OF THE TRANS-RADIAL ARTERY APPROACH FOR CEREBRAL ANGIOGRAPHY

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Abstract

Cerebral angiography is an essential diagnostic tool for evaluating neurovascular conditions. Traditionally performed via the transfemoral approach, this technique carries notable risks such as bleeding, hematoma, and prolonged recovery.

Objective: To assess the effects and safety of the trans-radial artery approach for performing diagnostic cerebral angiography.

Methods: This prospective observational study was conducted at Services Hospital Lahore from November 2024 to April 2025. A total of 355 patients who were referred for diagnostic cerebral angiography and deemed suitable for trans-radial access were enrolled. Written informed consent was obtained from all participants. Data were collected using a structured proforma. All procedures were performed in a dedicated neuro-angiography suite by experienced interventional radiologists trained in TRA. Under sterile conditions and local anesthesia, radial artery cannulation was performed using a micro-puncture technique.

Results: Technical success was achieved in 337 out of 355 patients (94.9%). The most common indications were suspected aneurysm (38.0%) and ischemic stroke workup (29.6%). Minor complications occurred in 6.8% of cases, primarily radial artery spasms and small hematomas; no major complications were observed. The mean fluoroscopy time was 12.4 ± 4.6 minutes, and the average contrast usage was 83.1 ± 15.8 mL. Over 91% of patients were ambulatory within two hours post-procedure, and 85.9% reported minimal discomfort.

Conclusion: It is concluded that the trans-radial artery approach is a safe and effective alternative to the femoral route for cerebral angiography. TRA demonstrated high procedural success with a low complication rate and excellent patient tolerance, supporting its broader adoption in neuro-interventional practice.

INTRODUCTION

Cerebral angiography remains a cornerstone in the diagnostic evaluation of various neurovascular disorders, including aneurysms, arteriovenous malformations, vasculitis, and ischemic

cerebrovascular disease. The transfemoral artery approach (TFA) has long been considered as standard method of cerebral angiography because it was familiar and the major cerebral vessels were

easily reached [1]. Nevertheless, there are also such complications associated with the TFA as the increased risk of vascular complications, long-lasting immobilization, and the worsened pain experience in elderly or anticoagulated individuals. The trans-radial artery method (TRA) gained popularity in the framework of interventional cardiology in the last decades, and it becomes a strong contender in order to replace neuro-angiographic procedures [2]. The trend has been aided by growing body of evidence in support of TRA regarding safety profile, patient logistical benefits and technical feasibility. The advantages of TRA are related to the lower access-site bleeding rates, the decreased likelihood of hematoma and pseudoaneurysm, accelerated mobilization of patients and positive overall patient satisfaction on the procedural level [3]. Such properties are especially significant in the present healthcare context where the focus is on minimally invasive procedures, the reduction of the length of hospital survival, and improved patient-reported outcomes [4].

The superficially running radial artery can be easily compressed after the procedure, which explains why the radial artery access site is less prone to complications as compared to the femoral artery access [5]. Moreover, TRA permits immediate ambulation through the post-procedure period that may be particularly beneficial in outpatient care. In sharp contrast TFA requires the patients to be lying supine and immobilized several hours to prevent access-site bleeding resulting in the patients discomfort and use of more resources [6]. On a technical basis, a technical danger of the TRA has been the longer, more tortuous route between the wrist and the cerebral vessels, especially via the subclavian and the innominate arteries. In the latest guidewire and catheter technology, and as operator experience increases, these issues have been also largely avoided [7]. Recent innovations such as pre-shaped diagnostic catheters that are radial access competent already have enabled selective catheterization of cerebral vessels either to be more efficient and/or reproducible [8]. Numerous studies have already shown that cerebral angiography with trans-radial artery (TRA) access has success rates that are comparable to those with transfemoral artery (TFA) access. In addition, radial access virtually

eliminates serious complications like retroperitoneal hemorrhage, which is common with TFA [9]. Minor complications, such as radial artery spasm or occlusion, do occur, but they are typically self-limiting and clinically insignificant [10], particularly when the proper technique and pre-procedural radial artery assessment (such as the Allen test) are utilized. Despite the growing interest in TRA, its adoption in neuro-interventional radiology has been slower than in cardiology. This is primarily due to a lack of extensive longitudinal data, limited formal training, and anatomical variations in aortic arch branching patterns [11].

Objective

To assess the effects and safety of the trans-radial artery approach for performing diagnostic cerebral angiography.

Methodology

This prospective observational study was conducted at **Services Hospital Lahore** from November 2024 to April 2025. A total of 355 patients who were referred for diagnostic cerebral angiography and deemed suitable for transradial access were enrolled. Written informed consent was obtained from all participants.

Inclusion Criteria

- Patients aged 18 years and above
- Clinical indication for diagnostic cerebral angiography
- Adequate radial artery patency confirmed by Barbeau or Allen's test
- Informed consent provided

Exclusion Criteria

- Negative Barbeau or Allen's test indicating poor ulnar collateral circulation
- Radial artery anomaly, occlusion, or significant calcification
- Previous radial artery harvest or cannulation
- Severe subclavian or aortic arch tortuosity limiting catheter navigation
- Emergency procedures requiring rapid femoral access

Data collection

Data were collected using a structured proforma. All procedures were performed in a dedicated neuro-

angiography suite by experienced interventional radiologists trained in TRA. Under sterile conditions and local anesthesia, radial artery cannulation was performed using a micro-puncture technique. A 5 Fr or 6 Fr radial sheath was inserted, followed by the administration of a standard radial cocktail consisting of heparin, verapamil, and nitro-glycerin to prevent spasms. Diagnostic cerebral angiography was then performed using appropriate catheters navigated through the aortic arch to the target cerebral vessels. Procedural details including duration, fluoroscopy time, number of catheter exchanges, and contrast volume were recorded. The primary outcomes were technical success rate and incidence of access-site complications. Complications were categorized as minor (radial artery spasm, hematoma) or major (radial artery occlusion, pseudoaneurysm, need for surgical intervention).

Data Analysis

Data were analyzed using SPSS version 26.0 for statistical analysis. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 355 patients underwent cerebral angiography via the transradial artery approach during the study period. The mean age of the patients was 52.7 ± 13.6 years, with 218 (61.4%) males and 137 (38.6%) females. The most common indications for cerebral angiography were suspected aneurysm (38.0%), ischemic stroke workup (29.6%), arteriovenous malformation (14.6%), and vasculitis (9.0%), while 8.8% were for miscellaneous or follow-up assessments.

Table 1: Baseline Characteristics of Patients (n = 355)

Variable	Value
Total Patients	355
Mean Age (years)	52.7 ± 13.6
Male	218 (61.4%)
Female	137 (38.6%)
Indications	
Suspected Aneurysm	135 (38.0%)
Ischemic Stroke Workup	105 (29.6%)
Arteriovenous Malformation (AVM)	52 (14.6%)
Vasculitis	32 (9.0%)
Others / Follow-up	31 (8.8%)

Technical success was achieved in 337 patients (94.9%), defined as successful completion of diagnostic angiography through the radial artery without conversion to femoral access. The mean

fluoroscopy time was 12.4 ± 4.6 minutes, and the average contrast volume used was 83.1 ± 15.8 mL. The mean procedural duration from puncture to completion was 32.5 ± 8.9 minutes.

Table 2: Procedural Outcomes of Trans-radial Approach

Outcome Measure	Value
Technical Success	337 (94.9%)
Access Site Crossover	18 (5.1%)
Mean Fluoroscopy Time (min)	12.4 ± 4.6
Mean Contrast Volume (mL)	83.1 ± 15.8
Mean Procedural Duration (min)	32.5 ± 8.9

Minor complications occurred in 24 patients (6.8%), including radial artery spasm in 11 (3.1%), small hematomas in 7 (2.0%), and transient hand paresthesia in 6 (1.7%). These were managed conservatively without long-term sequelae. No major complications such as radial artery occlusion, pseudoaneurysm, or significant bleeding were

reported. There were no cases of neurological deterioration related to the angiography procedure. The majority of patients (91.5%) were able to ambulate within two hours of the procedure. Patient-reported discomfort was minimal, with 85.9% describing the experience as painless or mildly uncomfortable.

Table 3: Complications and Post-procedure Recovery

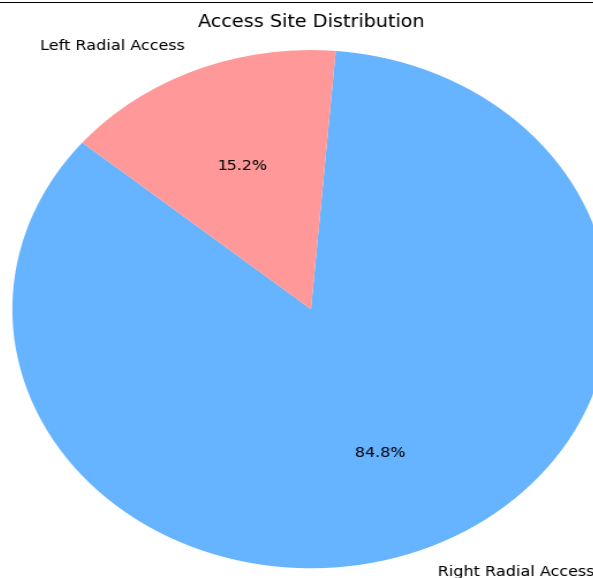
Complication/Metric	Number (%)
Radial Artery Spasm	11 (3.1%)
Small Hematoma	7 (2.0%)
Transient Paresthesia	6 (1.7%)
Major Complications	0 (0.0%)
Patients Ambulated Within 2 Hours	325 (91.5%)
Minimal/No Discomfort	305 (85.9%)

The majority of procedures were performed via the right radial artery (84.8%), while 15.2% required left-sided access. Ultrasound guidance was used in 31.5% of cases, typically in patients with weak pulses or challenging anatomy. Radial artery patency was

confirmed in all patients before cannulation, and the radial cocktail (heparin with vasodilators) was administered universally. The average number of access attempts was low, with a mean of 1.3 ± 0.6 , indicating high first-attempt success rates.

Table 4: Access Site Characteristics and Management

Parameter	Value
Right Radial Access	301 (84.8%)
Left Radial Access	54 (15.2%)
Use of Ultrasound Guidance	112 (31.5%)
Radial Artery Patency Pre-confirmed	355 (100%)
Use of Radial Cocktail (Heparin + Vasodilator)	355 (100%)
Access Attempts (mean $\pm$ SD)	1.3 ± 0.6

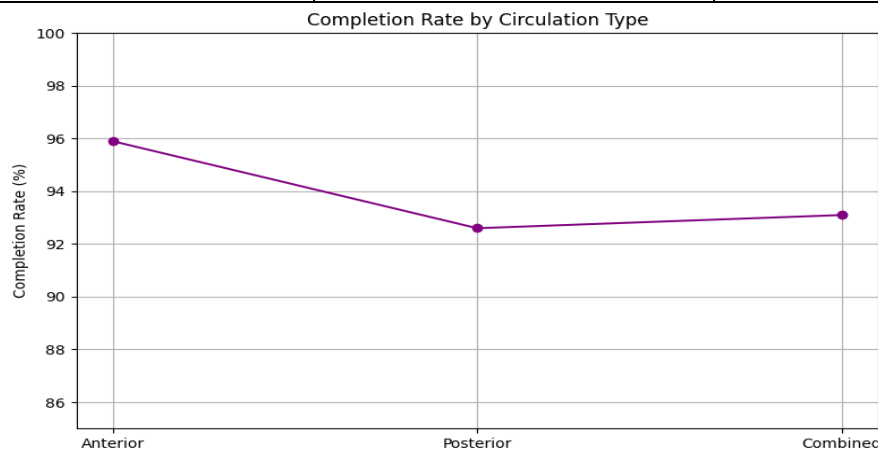


Among the 355 patients, procedures targeting the anterior circulation were most common (243 cases), with a high completion rate of 95.9%. Posterior circulation studies had a slightly lower success rate at

92.6%, while combined circulation procedures achieved a 93.1% completion rate. Overall, the transradial approach yielded a robust procedural success rate of 94.9%, underscoring its reliability across diverse neurovascular territories.

Table 5: Target Circulation and Procedure Completion

Target Circulation	Number of Cases	Completion Rate (%)
Anterior Circulation Only	243	233 (95.9%)
Posterior Circulation Only	54	50 (92.6%)
Combined Circulation	58	54 (93.1%)
Overall Completion	355	337 (94.9%)



Discussion

This observational study evaluated the effectiveness and safety of the trans-radial artery approach (TRA) for cerebral angiography in a cohort of 355 patients. The findings indicate that TRA is a very viable and safe alternative to the older form of transfemoral, with technical success of 94.9 per cent to the few complication rates as well as high comfort levels and comfort tolerance of the patient to the procedure. In this study the very high success rate can be compared with that of literature, where success rates are regarded as technical success at 90 percent (high) to 98 percent (very high) in TRA in neuro-angiography [12]. We add to the increasing literature evidence indicating that radial access, when the technique and experience of the operator are considered, is possible to selectively catheterize the anterior and posterior cerebral circulations. Limited variances between the target circulations of success in this research serve to support that TRA could be strongly applied to different diagnostic applications, such as aneurysms,

stroke assessment, and arteriovenous malformations [13].

One of the greatest benefits of TRA is in its safety. Our experience was 6.8 percent overall minor complications and no major complications as pseudoaneurysm, significant bleeding, or occlusion of the radial artery [14]. The most common of problems was radial artery spasm, followed by small hematomas and transient paresthesia, which were self-limiting. These rates are considerably smaller than those which are usually related to the transfemoral approach, the access-site complications of which have been observed in 3-10% of cases, frequently resulting in either very lengthy hospital stays or other interventions [15]. Early post-procedural ambulation and minimal discomfort on the part of majority of the patients were another interesting finding. More than 91 percent of patients who underwent the procedure managed to mobilize within two hours, and in excess of 85 percent of patients reported the procedure was painless or just a little uncomfortable. This evidence presents the

patient-related benefits of TRA especially when used in the outpatient environment and with risk groups that are more prone to complications due to prolonged immobilization, older patients or those with heart comorbidities [16]. The slightly higher failure rate in posterior and combined circulation angiograms suggests that technical difficulties may still exist due to the complex aortic arch anatomy or vertebral origin variability. However, these limitations are anticipated to diminish with increased experience, the use of pre-shaped catheters, and improved imaging guidance. In this study, the conversion rate to transfemoral access was only 5.1%, indicating that TRA can be used in everyday practice [17]. Our study's real-world design, large sample size, and lack of randomization make it more applicable to other settings. Nevertheless, it is essential to acknowledge that TRA necessitates procedural planning and a learning curve, particularly in situations involving significant aortic arch tortuosity or small-caliber radial arteries. Success depends on using the Barbeau or Allen test before the procedure, using vasodilator cocktails, and choosing the right catheter systems [18]. Limitations of the study include its single-center nature, lack of a direct comparison arm using the transfemoral route, and the short follow-up period, which precluded assessment of long-term radial artery patency or delayed complications. Nevertheless, our findings strongly reinforce the growing consensus that the trans-radial approach offers a safer, more comfortable, and technically viable route for cerebral angiography.

Conclusion

It is concluded that the transradial artery approach is a safe, effective, and patient-friendly technique for performing cerebral angiography. With a high technical success rate of 94.9%, minimal complication profile, and favorable patient tolerance, TRA proves to be a reliable alternative to the traditional transfemoral route. The majority of procedures were completed successfully, including those targeting both anterior and posterior circulations, and most patients were able to ambulate within hours of the procedure with minimal discomfort.

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