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Feasibility and safety of using the radial artery approach for the Wada test. A case report

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ABSTRACT

The Wada test is used to lateralize the dominant hemisphere in epilepsy patients prior to surgery. Either amobarbital, methohexital, or propofol is injected via a transfemoral catheter into a unilateral carotid artery, briefly suppressing the ipsilateral cerebral hemisphere to allow functional evaluation of the opposite side. Here, we highlight and propose a radial artery approach for the Wada test, allowing easier arterial access, better patient comfort, and ample procedural efficacy.

INTRODUCTION

The Wada test is conducted by a neurologist, neurointerventionalist, and neuropsychologist. Electroencephalogram (EEG) leads are placed on the patient for monitoring during the test. Preliminary cerebral angiogram is performed through transfemoral catheterization of the internal carotid artery (ICA), confirming adequate perfusion of a unilateral hemisphere. Afterwards, either amobarbital, methohexital or propofol is dispensed to suppress activity of the ipsilateral hemisphere [5]. Contralateral hemiparesis will then be observed, indicating that the medication has taken effect. Next, the neuropsychologist administers a series of speech, memory, and motor assessments to evaluate functionality of the contralateral hemisphere, which remains “awake”. After allowing the patient to recover, the entire procedure is repeated to evaluate the hemisphere not yet anesthetized. As language and memory are controlled by the dominant hemisphere, relative aphasia experienced during the test allows lateralization. Typically, the Wada test is conducted using a transfemoral artery approach (TFA). Here, we describe a case of the Wada test performed using a radial artery approach. The value of this approach in neurointervention will also be discussed.

Keywords

Endovascular,
neurointervention,
transradial catheterization,
transradial neurointervention,
transradial Wada test



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CASE REPORT

A 63-year-old woman with intractable temporal lobe seizures was evaluated by the epileptologist and worked up for surgical treatment. The patient was admitted to the epilepsy monitoring unit to lateralize seizure location. Clinical semiology and electrographic findings suggested temporal lobe epilepsy.

Wada testing was requested as part of the pre-operative evaluation by the epileptologist. The patient was kept NPO for 12 hours. With the patient supine on the angiography table, the right wrist and hand were prepped and draped in the usual sterile fashion. 10 ml of 2% lidocaine was administered subcutaneously at the puncture site. 100 µg of nitroglycerin and 5 mg of verapamil were also provided. Under sonographic guidance, vascular access was obtained via a single-wall puncture of the right radial artery and a 5 F Pinnacle sheath (Terumo, Tokyo, JA) was introduced. 3,000 units of heparin were administered intravenously following sheath placement. A right radial artery angiogram was performed. The 0.038" guidewire and Simmons II diagnostic catheter were then advanced into the right ICA (RICA) using a Simmons curve in the aorta, and digital angiograms were obtained. Initially, 3 mg of methohexital were injected intra-arterially, followed by another 2 mg after a few minutes. Neuropsychological testing was performed before and after the second 2 mg injection.

After 10 minutes, the catheter was placed into the left ICA (LICA) via the Simmons curve and additional cerebral angiograms were taken (Figure 1). Neuropsychological testing was performed. 3 mg methohexital were then injected intra-arterially and more neuropsychological testing was performed. The patient remained under EEG surveillance throughout the entire procedure.

Each instance of neuropsychological testing involved assessment of the upper extremity motor function to confirm laterality. For the left side, laterality was evaluated by asking the patient to squeeze the epileptologist's hand and raise their own arm. For the right side, the neurointerventionalist checked the patient's force by asking her to squeeze his hand, which maintained hemostasis and kept the catheter insertion site safe. On the right side, the patient was not asked to raise her arm given the risk of catheter displacement.

Following completion of the entire procedure, heparin was not reversed with protamine. The sheath was removed, and hemostasis was obtained by application of a TR band (Terumo, Tokyo, JA), followed by manual compression. Total fluoroscopy time was 7.5 minutes, and total procedure time was around 90 minutes. The patient was found to have a right dominant hemisphere, determined to be the side of the epileptogenic zone.

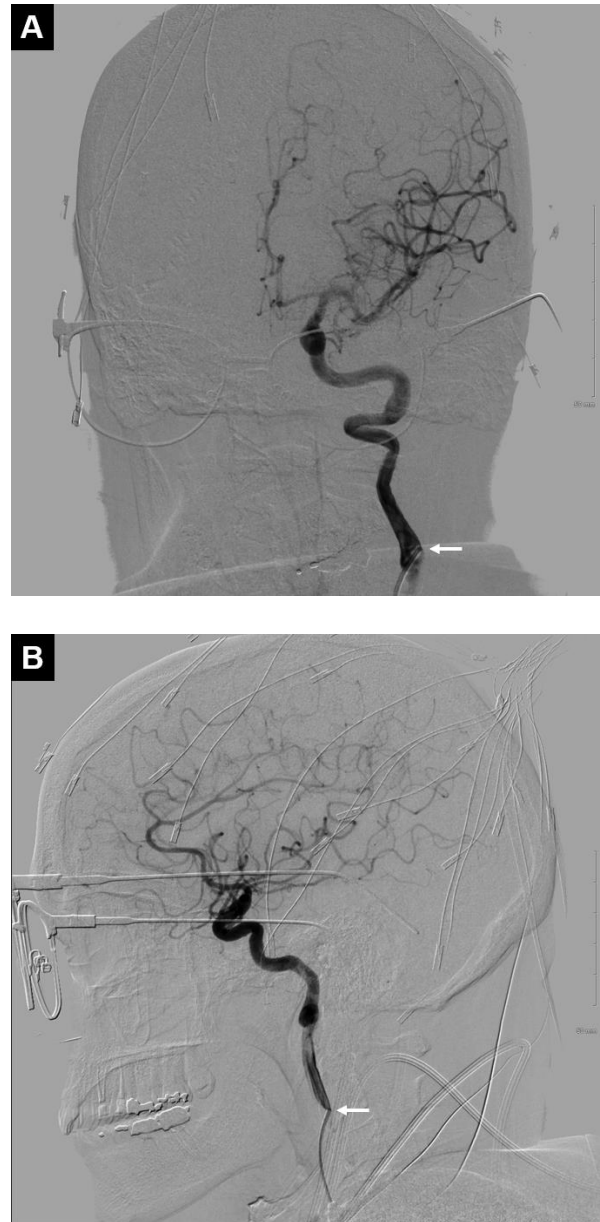


Figure 1. Frontal (A) and lateral (B) angiograms taken prior to methohexital administration, demonstrating patency of cranial vessels. The catheter tip (white arrows) is seen in the left internal carotid artery. Cranial EEG leads are best seen on lateral view. During the angiogram, the patient was wearing

glasses because she was asked to recognize objects held in front of her, in order to examine her speech and memory.

DISCUSSION

In current practice, transfemoral catheterization of the ICA is the mainstay for most neurointerventional procedures, including the Wada test. TFA is preferred due to familiarity of the anatomy among neurointerventionalists and the large vessel diameter, allowing deployment of wider catheters [9]. However, TFA has several limitations, and a new approach has been described.

As an alternative to TFA, radial artery catheterization is viable for the Wada test. Among the cardiology literature, the transradial artery approach (TRA) has been used in coronary angiography and intervention for many years. Multicenter studies led by interventional cardiologists have shown that TRA can reduce vascular complications by at least 60% compared to TFA [1]. There are several factors that make TRA feasible. Firstly, the radial artery is situated away from crucial nerves, veins, and organs, which decreases the risk of access-site complications. Also, the superficial location of the radial artery permits better compression of bleeding for establishment of hemostasis. With TFA, patients may need to tolerate bed rest with uncomfortable groin compression for several hours if percutaneous closure devices are not used [8,9]. Hemostasis in TRA is more easily attainable, using manual compression or basic compression devices [4,6,8]. In our case, combined use of a TR Band and manual compression was sufficient for establishing hemostasis. By reaching rapid hemostasis, patients experience greater comfort and satisfaction due to the ability to ambulate more quickly [6]. Moreover, collateral circulation between the palmar branches of the radial and ulnar arteries lessens the risk of ischemic complications. A pre-procedural Allen's test can confirm the presence of collateral circulation [9]. By utilizing an end artery, TFA may increase the risk of ischemia.

Access-site hematomas are the most common minor complications of TRA, but they are typically inconsequential and easily treated [9]. Rather, the most salient complications of TRA are radial artery spasm (RAS) and radial artery occlusion (RAO). RAS occurs at rates anywhere between 14-30% [1,9] and is attributed to the high density of adrenoceptors

in the tunica media. Lidocaine and prophylactic antispasmodics (i.e., verapamil and/or nitroglycerin) can mitigate RAS upon catheter introduction [1,9]. If RAS occurs, antispasmodics can be administered until resolution is seen clinically and angiographically [7]. RAO is a post-procedural complication of TRA occurring at rates up to 33% [1,4,7,9]. RAO involves excess hemostatic compression and/or blood flow stagnation promoting transmural thrombus formation [4]. Although RAO is often asymptomatic due to the collateral blood supply, the radial artery could become precluded from future interventional use [1,4,9]. Radial patency can be improved periprocedurally through best practices like ulnar artery compression and prophylactic heparin [4,9]. For both RAS and RAO, ultrasound guidance can decrease the number of TRA puncture attempts, preventing arterial spasm and stenosis [1,6,9]. The wide variation in the incidence of RAS and RAO may be due to differences in study methodology, use of prophylaxis, diagnostic definition, and access-site techniques. With proper technique and prophylaxis, the risk of RAS and RAO can be tempered. With RAO specifically, the prevalence may be reduced to less than 1% of patients by using patent hemostatic techniques [7].

Apart from our case, TRA for the Wada test has not been described in the literature. With the use of appropriate medical prophylaxis and sonographic guidance, right radial access was achieved in our experience without complication of RAS or RAO. Additionally, our fluoroscopy time of 7.5 minutes is comparable to the range of 5.46±4.21 minutes found in other studies deploying TRA in cerebral angiography [8]. Fluoroscopy times can differ depending on the number and type of vessels catheterized using a right TRA, especially when targeting left-sided supra-aortic vessels. In using a right radial approach, the formation of a Simmons curve in the aorta is crucial for selective catheterization of the left subclavian artery, left vertebral artery, and LICA [7,9]. In our case, a Simmons curve was employed to catheterize the LICA during the Wada test. We acknowledge the inherent difficulty of selective LICA catheterization. In a series of 1,240 patients, one center reported a failure rate of 17.6% in attempted LICA catheterization using a right TRA. Tortuous angulation encountered during the catheterization attempt and the lack of dedicated catheter designs

were cited as reasons for failure [3]. Tortuous angulation is seen in some patients with aberrant aortic arch anatomy and exacerbates the learning curve of TRA [7]. The formation of a Simmons curve in the aorta is often necessary for selective vessel catheterization and further increases the learning curve for inexperienced operators [7,9]. Indeed, the steep learning curve of TRA and lack of specialized catheter equipment are primary reasons for non-adoption of TRA among many neurointerventionalists [2]. However, the learning curve can be overcome as expertise is developed through procedural volume [2,7,9], resulting in decreased crossover rates to TFA and fluoroscopy times during angiography [7]. Currently, the success rate of TRA for cerebral angiography is around 92.7-99% [7,8].

CONCLUSION

We propose increased adoption of TRA for the Wada test. In recent times, TRA has been successfully used for cerebral angiography. Angiography is a primary segment of the Wada test, along with amobarbital/methohexital administration. At present, a 5 F Simmons II is a satisfactory choice for both segments of the test. As more specialized transradial kits and catheter designs are developed, TRA will only become more practical to perform. Given the straightforward nature of the Wada test, TRA is a feasible approach as it provides greater patient comfort and reduces access-site complications. Both novel and seasoned neurointerventionalists should make efforts to adopt TRA, especially for procedures like the Wada test.

Abbreviations

Electroencephalogram = EEG
 Internal carotid artery = ICA
 Left internal carotid artery = LICA
 Nothing per os = NPO
 Transfemoral artery approach = TFA
 Transradial artery approach = TRA
 Radial artery spasm = RAS
 Radial artery occlusion = RAO

REFERENCES

1. Brunet MC, Chen SH, Peterson EC. Transradial access for neurointerventions: management of access challenges and complications. *J Neurointerv Surg.* 2020;12(1):82-86.
2. Das S, Ramesh S, Velagapudi L, et al. Adoption of the Transradial Approach for Neurointerventions: A National Survey of Current Practitioners. *J Stroke Cerebrovasc Dis.* 2021;30(3):105589.
3. Jo KW, Park SM, Kim SD, Kim SR, Baik MW, Kim YW. Is Transradial Cerebral Angiography Feasible and Safe? A Single Center's Experience. *J Korean Neurosurg Soc.* 2010;47(5):332-337.
4. Panchoy SB, Shah S, Patel TM. Radial Artery Access, Hemostasis, and Radial Artery Occlusion. *Interv Cardiol Clin.* 2015;4(2):121-125.
5. Patel A, Wordell C, Szarlej D. Alternatives to sodium amobarbital in the Wada test. *Ann Pharmacother.* 2011;45(3):395-401.
6. Satti SR, Vance AZ. Radial Access for Neurovascular Procedures. *Semin Intervent Radiol.* 2020;37(2):182-191.
7. Snelling BM, Sur S, Shah SS, et al. Transradial cerebral angiography: techniques and outcomes. *J Neurointerv Surg.* 2018;10(9):874-881.
8. Wang Z, Xia J, Wang W, et al. Transradial versus transfemoral approach for cerebral angiography: A prospective comparison. *J Interv Med.* 2019;2(1):31-34.
9. Zalocar LAD, Doroszuk G, Golland J. Transradial approach and its variations for neurointerventional procedures: Literature review. *Surg Neurol Int.* 2020; 11:248..