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Review Article

Transradial approach in neurointervention: Part-II: Diagnostic and therapeutic intervention

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ABSTRACT

Recent studies and meta-analysis have shown the safety, feasibility, and success of the transradial approach in diagnostic and therapeutic neurointervention. This second part of the review focuses on the technical aspects of diagnostic and therapeutic neurointervention after the radial sheath has been placed.

Keywords: Aneurysm, Coiling, Neurointervention, Transradial

INTRODUCTION

Recent literature has already established the role of the transradial approach (TRA) in diagnostic and therapeutic neurointerventions regarding safety, feasibility, shorter hospital stays, and improved patient satisfaction.[1-3] In this second part of the review article, we will be discussing specific features for successful diagnostic or therapeutic neurointervention once the radial access has been established.

DIAGNOSTIC CEREBRAL ANGIOGRAPHY

After the radial sheath is placed, as discussed in the first part of the review. Our standard practice is to take a roadmap of the radial artery, which demonstrates any anatomic variation or presence of any loop. It also helps in the smooth transit of the wire, avoiding inadvertent trauma to side branches.

Standard hardware used by us for TRA cerebral angiography includes:

i. 5f Radial Sheath preferably coated sheath such as Terumo Glidesheath Slender 5F (Terumo, Tokyo, Japan).
ii. J tipped 150 cm 035 wire (Terumo, Tokyo, Japan).
iii. 5f Simmons 2 coated catheter, preferably Glidecath (Terumo, Tokyo, Japan).

We prefer coated Glidesheath catheters to non-coated catheters as they are less rigid, offer less friction, and are less traumatic during Sim formation[4] Simmons 2 is advantageous in assessing the contralateral subclavian artery.[4]

Technique: After the roadmap is obtained, the guidewire and diagnostic catheter are advanced gently up to the aorta using a standard coaxial technique. It is beneficial if a loop can be formed at the distal part of the wire, which helps in avoiding any side branch cannulation.

SIMMONS CURVE FORMATION

Once the guidewire and Simmons 2 catheter reach the aorta, the next step is to reconstitute the curve of the catheter. Multiple techniques for Sim curve formation are described in the literature, such as at ascending aorta, aortic arch, aortic valve, descending aorta, or using the left carotid artery or right vertebral artery directly.[5] Our preferred choice is descending aorta, arch, and ascending aorta in that order.

The right vertebral artery can be directly assessed by hooking through the wire without the need for Sim formation.

To cannulate the left common carotid artery (CCA), it is more advantageous to form the Sim in ascending aorta.[4] At the same time, for the left subclavian, it is better to form the Simmons curve in the descending aorta in our experience.

In cases of difficulty in cannulating the left vertebral artery or left internal carotid artery, a coaxial system using a 2.7 Fr catheter is suggested.[4] Alternatively, if only left VA is required, left radial access can be planned.

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Once the Sim has cannulated the target vessel at the arch, the catheter can be taken for selective runs over the hydrophilic 035 wire.

After the procedure, a standard radial band can be used for closure, as described in the first part of the review.

THERAPEUTIC NEUROINTERVENTIONS

Recent literature and meta-analysis are available showing the feasibility and technical success of therapeutic neurointerventions using a TRA.[6]

General considerations for planning therapeutic neurointervention through TRA:

1. A careful ultrasound assessment of the radial artery should be done to look for diameter, which can help us select the appropriate sheath size.[7]
2. For most cases, a 6F radial short or long sheath can be used safely.
3. It is essential to use a radial cocktail to prevent spasm. Heparin dose is 80–100 IU/kg bolus and titrated depending on the duration of the procedure.[8] To counter the effect of patient anxiety, in therapeutic cases, we take the radial puncture after the patient is intubated, except in stroke cases where conscious sedation is our preferred method.
4. Continuous nimodipine/heparin saline flush through the sheath and guiding catheter should be maintained throughout the procedure.
5. We preferably use a 6F 088 inner diameters 80/90 cm sheath (ballast, Balt India) for most cases. It provides a greater inner diameter for other hardware and more significant support for the guiding catheter. It is instrumental in pathologies involving the bilateral ICA. Initial puncture is made with a 5F radial sheath, and then over an 035 hydrophilic wire, an exchange with the long sheath is made. Once the sheath is inserted, we use a coaxial system with 5F Simmons 2 diagnostic catheter to assist the sheath placement into the vessel of interest. After that, the guiding catheter is advanced, and the rest of the steps are similar to the therapeutic interventions as done by the TFA route.
6. It is advisable to use a longer length of 110–125 cm guiding catheters, especially in cases of the left anterior circulation pathologies, as the catheter may fall short in tall patients.[4]
7. The bovine arch is favorable anatomy for TRA, and a short sheath and a 6f guiding catheter can be directly used without a supportive long sheath.
8. In cases of vertebral artery pathology, a direct right or left access is taken with a 6F sheath. Then, a 6F guiding catheter is directly taken over the wire into the vessel of interest.
9. If the diameter of the radial artery is small, options are to use a brachial route, ulnar route, contralateral radial artery, or shift to transfemoral access.[4] A direct access through guiding catheter in case of the small radial artery after initial puncture with 4f sheath is also suggested; however, in our experience, it can result in significant spasm and injury to the radial artery due to repeated catheter movements and should be avoided. Furthermore, there is a risk of shelving at the puncture site when the large-bore catheter is directly passed, causing difficulty in access.

Examples of disease-specific intervention:

PATHOLOGIES INVOLVING RICA/LICA

Multiple studies have shown successful procedural outcomes when TRA is used for aneurysm coiling, Flow diversion, AVMs, tumor embolization, or carotid stenting.[6] We prefer right radial access for most of our cases:

Typical hardware preferred by us in pathologies involving RICA/LICA when using TRA includes any of the following depending on the imaging finding and patient profile:

Ballast sheath 6F, ID 088 (Balt USA, LLC) + 6F Guiding Catheter (e.g., Neuron, Penumbra Inc., USA) ± Distal access catheter (DAC) + microcatheter (027/021/017 depending on intervention planned) or 6F short radial sheath (11/25 cm) + Neuron 6F guiding catheter ± Distal access catheter + Microcatheter (027/021/017 depending on intervention planned) (Penumbra Inc., USA).

Case scenario 1 [Figure 1]: A 37-year-old female presented with Grade III Subarachnoid hemorrhage (SAH) and CT angiography revealing a ruptured Pcom aneurysm of size 7.4 × 3.4 mm. The patient was taken for endovascular management. Right radial access was taken and a 5F glide short sheath was placed. Radial runs after putting short sheath. It was then exchanged with Ballast long sheath. Right ICA was catheterized with 5F Simmons 2 Glide catheter to guide the Ballast sheath to the Right CCA. A 6F neuron guiding catheter was advanced through the Ballast sheath and tip was placed in petrous ICA. A total of four coils were used with complete occlusion of the aneurysm. Post procedure hemostasis was achieved with a radial band. No access site complication was seen.

Case scenario 2 [Figure 2]: A 70-year-old female with poor grade SAH and a ruptured Acom aneurysm (8 × 6.3 mm) with a large teat on CT angiography. Right radial access was taken with ultrasound guided puncture using a 5F short glide sheath which was subsequently exchanged with Ballast long sheath. A Coaxial technique was used with assembly of Ballast sheath in CCA and Neuron 6F placed in the petrous ICA. A double lumen balloon (Scepter-XC; Microvention, USA) was placed at the neck of the aneurysm and coiling of the aneurysm was done using a 017 microcatheter (Echelon-10; Medtronic, USA). Five coils were used and

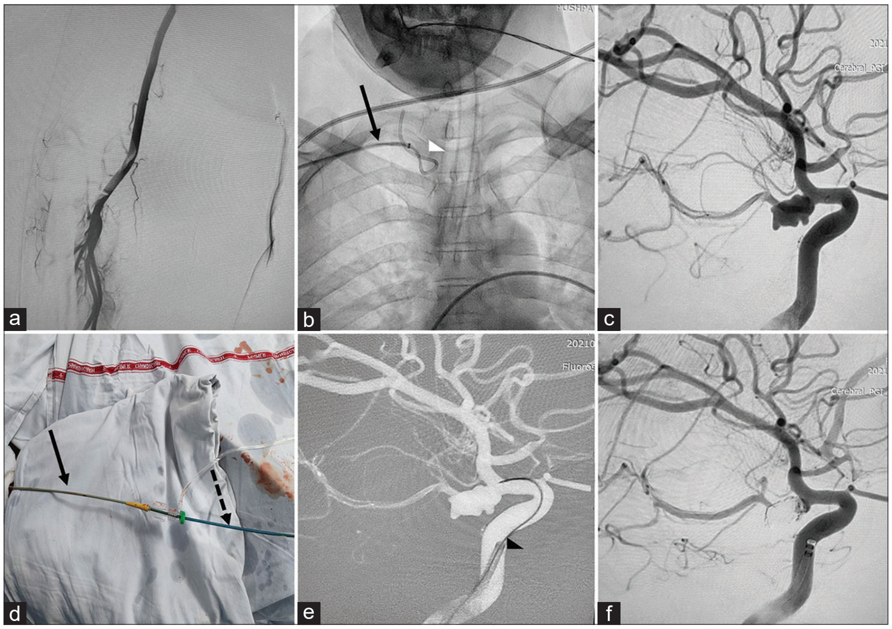

Figure 1: (a) A 37-year-old female presented with SAH due to ruptured Right Pcom aneurysm. Radial runs after putting short 5F sheath (a). It was then exchanged with Ballast long sheath. Right ICA was catheterized with 5F Simmons 2 Glide catheter (white arrow head) to guide the Ballast sheath (Black arrow) to the Right CCA. (b) RICA angiographic run shows the lobulated Pcom aneurysm. (c) A 6F neuron guiding catheter (interrupted black arrow) was passed through the Ballast Sheath (solid black arrow) and (d) tip of the Neuron was placed at the petrous ICA (black arrow head), (e) Post coiling, and (f) angiographic runs showing almost complete occlusion of the aneurysm with four coils.

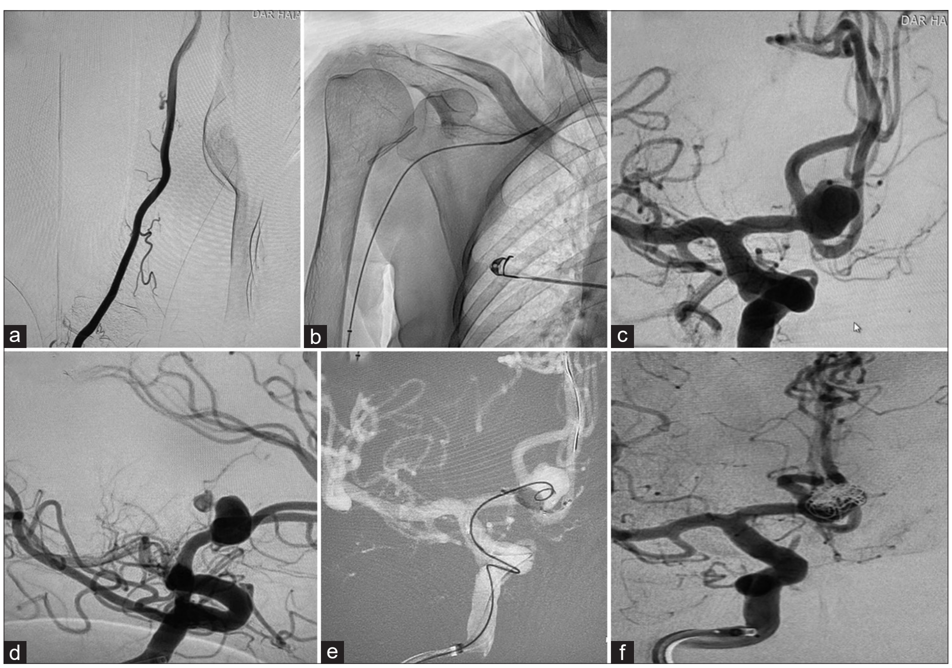

Figure 2: Rupture ACOM aneurysm (a) right radial run shows brachioradialis variant, (b) Coaxial technique showing an assembly of Ballast sheath and Neuron 6F advanced over a hydrophilic wire, and (c and d) oblique AP and lateral working position runs show wide-necked Acom aneurysm with a teat. (e) Balloon-assisted coiling was performed and (f) RICA run shows partial coiling of the aneurysm with the disappearance of the teat.

partial coiling was achieved with obliteration of the teat. No procedure or access related complications were seen.

PATHOLOGIES INVOLVING RVA/LVA/BASILAR

For pathologies involving RVA/LVA, we prefer an ipsilateral radial artery access as it is easier for the guiding catheter to pass over the wire into the vessel of interest. The most commonly used hardware is 6F short radial sheath (11/25 cm) + Neuron (Penumbra Inc., USA) 6F guiding catheter ± Distal access catheter + Microcatheter (027/021/017 depending on intervention planned).

Case scenario 3 [Figure 3]: A 46-year-old male presented with Grade III SAH and demonstration of a ruptured left PICA aneurysm of size 3.8 × 1.8 mm. Left radial access was taken with a 6F radial sheath. Angiographic run was taken to demonstrate the anatomy of the radial artery and exclude any loops or variants. Neuron 6F guiding catheter was passed through the radial sheath over a hydrophilic wire and direct access to left vertebral artery could be taken. The neuron was placed in the V2 segment of the vertebral artery and angiographic runs were taken. Unassisted coiling using three coils was done and complete obliteration of the aneurysm was seen. No procedural or access site complications were seen. Hemostasis was achieved with a radial band kept for 3 h.

STROKE

The goal of intervention in stroke is to obtain revascularization without causing any delay. It is essential that careful patient selection is made and the operator has considerable experience in TRA access to avoid any delay in access and ultimately revascularization.

Recent studies have shown certain factors which may be unfavorable for TRA in stroke, such as LICA type I arch, LICA with type II/III arch, subclavian artery tortuosity, small female patients, and arch variations.

With the availability of dedicated radial specific hardware shortly, these factors may be mitigated.

It is essential to review the CT angiographic findings for appropriate patient selection.

Typical hardware preferred by us in stroke when using TRA includes any of the following depending on the imaging finding and patient profile:

Ballast sheath 6F, ID 088 (Balt USA, LLC) + 6F Guiding Catheter (e.g., Neuron, penumbra Inc.,USA) + microcatheter (021/027) + stentreiver.

Ballast sheath 6F, ID 088 (Balt USA, LLC) + Aspiration catheter (068-071) + microcatheter (021/027) + stentreiver.

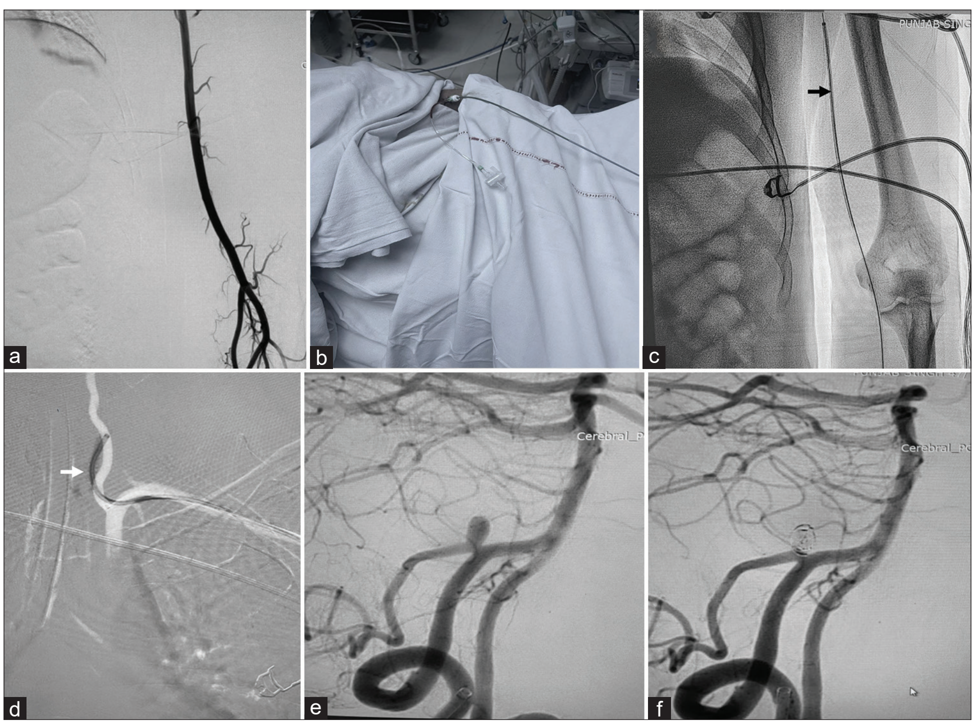

Figure 3: (a) A 46-year-old male with ruptured left PICA aneurysm (a) left radial access was taken with a 6F sheath, and angiographic run was taken, (b) Neuron 6F guider was passed through the 6F sheath, (c) fluoroscopy image shows neuron guiding catheter passing through the left radial artery over the hydrophilic guidewire (black arrow), (d) roadmap image shows catheterization of the left VA by neuron (white arrow), (e) left VA run shows a small left PICA aneurysm, and (d) simple coiling was performed with complete obliteration of the aneurysmal sac.

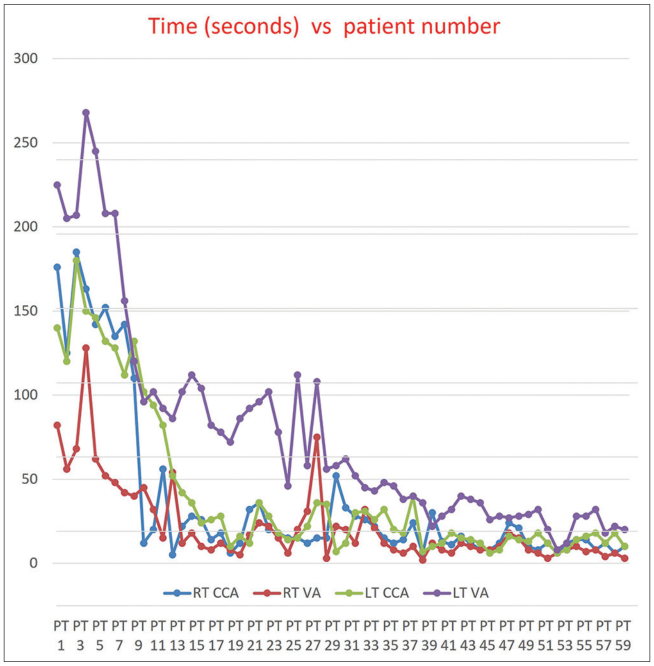

Figure 4: Learning curve through TRA as observed for a single operator at our institute showing time taken versus number of patients for various vessels. Note that the time to plateau for the left VA is prolonged as compared to the rest of the vessels.

6F short radial sheath (11/25 cm) + 6F benchmark (Penumbra Inc. USA) ± Distal access catheter + Microcatheter + stentriever.

6F short radial sheath (11/25 cm) + 6F Guiding Catheter (e.g., Neuron, penumbra Inc.,USA) ± Distal access catheter + Microcatheter + stentriever.

Closure: After the procedure, patent hemostasis should be obtained with a radial band such as TR Band (Terumo) and PreludeSync (Merit, Malvern, PA).[9] We prefer to keep the band up to 3–4 h or depending on the amount of heparin received and antiplatelet status of the patient. A constant vigil for hematoma formation should be done.

Again, it is to be reemphasized that the operator should overcome the initial learning curve for the transradial technique for smooth adaptation in future interventions [Figure 4]. We have recently shown that aortic factors and angles of origin of the left CCA and VA can influence cannulation time in transradial cerebral angiography.[10]

CONCLUSION

TRA will become a favorable or preferred route for neuroendovascular interventions shortly. The interventionists should become familiar with the technique and practice to overcome the learning curve for TRA. Benefits including less risk of access site complications, shorter hospital stay, cost-related benefits, and patient satisfaction are potent motivators to learn and adapt to TRA in routine practice.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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