



Technical Note

# Transradial approach for endovascular diagnosis and treatment of ruptured cerebral aneurysms: A descriptive study

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## ABSTRACT

**Background:** For cardiovascular procedures, the transradial approach has been documented to yield fewer complications than the femoral approach. It has become the approach of choice for diagnostic and therapeutic interventions involving the coronary arteries. However, few published data exist on using this approach for neuroendovascular procedures and we describe a series of ruptured cerebral aneurysms diagnosed and treated using the transradial approach.

**Methods:** All patients scheduled for cerebral angiography to diagnose and treat subarachnoid hemorrhages at our hospital from June 2016 to May 2018, by right radial artery access, were recruited and followed prospectively. The main outcomes of interest were the length of the procedure (in minutes), the success of treatment, and the incidence of postprocedural complications.

**Results:** Over the observation period, 59 patients (66% women, mean age = 48 years) with a combined 61 aneurysms treated were identified who met inclusion criteria. Of the 61 aneurysms treated, eight (13%) were within the posterior circulation (13%) and 53 (87%) the anterior circulation. Average procedural duration was 64.9 min. No occlusion or spasm of the radial artery was observed during any procedure. All patients had immediate pre- and post-embolization angiography, which revealed the guide catheter coming from the right subclavian artery. A radial pulse was evident after all interventions. All procedures were considered successful at treating the ruptured aneurysm, and no patient experienced a clinically significant complication related to the approach.

**Conclusions:** The transradial approach is a viable option for the diagnosis and endovascular treatment of acute cerebral aneurysms in different locations.

**Keywords:** Aneurysms, endovascular, subarachnoid hemorrhage, transradial approach

## BACKGROUND

Endovascular coiling is considered a Class 1 Level B recommendation for ruptured cerebral aneurysms when the procedure is performed at experienced health centers.<sup>[6]</sup> The vascular access approach used

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at most institutions, for both diagnostic and therapeutic neuroendovascular procedures, involves puncturing the femoral artery, probably due to familiarity with this pathway. When the femoral approach is adopted, however, manual compression of the groin is required for 10–20 min once the procedure is completed, followed by application of a compression bandage and absolute rest for 4 h, then relative rest for 24 h, maintaining the bandage in position throughout this period.

Complications associated with the femoral approach, whether used diagnostically or therapeutically and despite taking all the above-mentioned precautions, include hematomas at the puncture site (1.3%), retroperitoneal hematomas (0.4%), pseudoaneurysms (0.1%), and arterial dissections (0.3%), with higher incidences of these in anticoagulated and anti-aggregated patients. Low back pain, arteriovenous fistulae at the puncture site, femoral nerve injury, chronic ischemia of the lower limb, and thromboemboli are other complications that have been described.<sup>[2,8,21,28]</sup> The presence of stenosis, whether due to atherosclerosis or aneurysms at the level of either the iliac arteries or abdominal aorta, often renders catheterization difficult through this approach.<sup>[8,21,28]</sup>

The radial approach for coronary angiography was initially described in 1989.<sup>[5]</sup> Since then, multiple advantages of this approach have been documented, relative to the femoral approach, which has led to the former's habitual use at most of the centers specializing in cardiovascular hemodynamics worldwide.<sup>[11,14,17,23,24]</sup> In one prospective study comparing coronary catheterization procedures using the femoral versus radial approach for diagnosis and treatment, a higher incidence of vascular complications was identified with the former.<sup>[1]</sup> In another cardiac catheterization study comparing femoral and radial access, the incidence of pseudoaneurysms was 1.4% with the former and just 0.08% with the latter ( $P < 0.0001$ ), and this difference persisted whether the procedure was diagnostic or therapeutic.<sup>[9]</sup>

In addition to its use for coronary procedures, there have been published series describing diagnostic transradial cerebral angiographies,<sup>[3,12,15,18,20,22,26,27]</sup> as well as isolated cases of aneurysms treated by radial embolization when femoral access was deemed impossible.<sup>[19,29]</sup> The current authors have already published a report describing a series of embolization procedures for different cerebral aneurysms employing coils and flow diverter devices, starting with transradial access.<sup>[13]</sup> Over the past 2 years, the right transradial approach has been our first option for the diagnosis and treatment of cerebral aneurysms in patients with a subarachnoid hemorrhage. In the present paper, we describe a group of patients with nontraumatic subarachnoid hemorrhages, and all were diagnosed and treated by radial access, detailing the technique used and complications observed in each case.

## METHODS

At our institution, between June 1, 2016, and May 31, 2018, a radial access was employed for 61 aneurysms that were evaluated

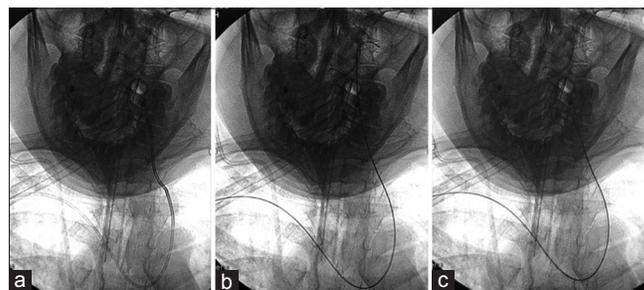
and treated in 59 patients with subarachnoid hemorrhage. All patients with incidental aneurysms, aneurysms already diagnosed by previous studies, and fusiform aneurysms ineligible for endovascular coiling were excluded from this series. Patient information was extracted from the hospital's medical record database. All the procedures were performed by either one or both of the current authors, jointly, at Hospital El Cruce in Buenos Aires, Argentina.

All patients with right radial pulse palpable underwent right radial arteriopuncture.<sup>[4,13,25,30,31]</sup> The technique we used is described in a previous publication, consisting of puncture of the right radial artery between 2 cm and 4 cm proximal to the wrist. A radial approach set (Merit Medical Systems, Utah, USA) was used, and a 6-French sheath was placed using a modified Seldinger technique. Once the sheath was in position, 5cc of nitroglycerin (200 µg/mL) was administered, followed by 70 IU/kg of heparin.

All diagnostic studies to assess the supra-aortic vessels were performed with a Simmons Type II catheter (Merit Medical Systems, Utah, USA) on a 0.035-inch-thick hydrophilic guidewire.

After the diagnostic study, a 260 cm-long hydrophilic guidewire was passed either through the external carotid artery on the side corresponding to the aneurysm or through the left vertebral artery [Figure 1]. For aneurysms that had to be accessed through the right vertebral artery, the vessel was entered directly with the guide catheter. The guide catheters used were the Fargo Max 6Fr (Balt Extrusion, Montmorency, France) and Guider Softip XF 6F (Stryker, Neurovascular Fremont, CA, USA). As the main vessel was approached by the guide catheter, a microcatheter was introduced under a 0.014-inch microguide, up to the aneurysm fundus, where coiling was performed, using either Headway 17 catheter (MicroVention, Inc., Tustin, CA, USA), Excelsior SL-10 catheter (Stryker, Neurovascular Fremont, CA, USA), or Vasco 10 catheter (Balt Extrusion, Montmorency, France). The coils we used were GDC or Target (Stryker, Neurovascular Fremont, CA, USA).

Once coiling was completed, the microcatheter was removed and angiographic acquisition was performed to demonstrate



**Figure 1:** Converting from the diagnostic to the guide catheter. (a) Simmons catheter inside the left vertebral artery. (b) A 260-cm-long hydrophilic guide wire inside the left vertebral artery. (c) Guide catheter located inside the left vertebral artery.

**Table 1:** SAH patients treated with endovascular coiling through radial access.

Case#	Gender	Age (years)	Topography (arterial location of aneurism)	Study duration (min)
1	Male	56	Right posterior communicating	60
2	Female	60	Right posterior communicating	60
3	Male	40	Left anterior communicating	45
4	Female	68	Right medial cerebral	60
5	Male	37	Left anterior communicating	60
6	Female	55	Right medial cerebral	70
7	Male	32	Right posterior communicating	80
8	Male	57	Left posterior inferior cerebellar	66
9	Female	27	Left posterior communicating	90
10	Female	54	Right anterior communicating	60
11	Male	59	Right posterior communicating	60
12	Male	53	Left anterior communicating	30
13	Female	24	Basilar	65
14	Female	71	Left pica – left posterior communicating	45
15	Female	52	Left medial cerebral	50
16	Female	61	Right superior hypophyseal	70
17	Female	43	Left anterior communicating	60
18	Female	49	Right medial cerebral	60
19	Male	42	Right medial cerebral	70
20	Female	46	Right anterior communicating	60
21	Female	26	Left posterior cerebral	75
22	Female	52	Left superior cerebellar	90
23	Male	67	Right anterior communicating	60
24	Female	47	Right posterior communicating	120
25	Female	50	Right posterior communicating	60
26	Female	57	Right pericallosal	60
27	Male	61	Left anterior communicating	60
28	Female	42	Right posterior communicating	55
29	Male	43	Basilar	120
30	Male	38	Right carotid bifurcation	45
31	Female	38	Left carotid bifurcation	40
32	Female	58	Left ophthalmic	60
33	Female	42	Left pericallosal	60
34	Male	46	Right medial cerebral	60
35	Female	56	Right anterior communicating	110
36	Female	52	Right posterior communicating	90
37	Male	52	Right posterior inferior cerebellar	90
38	Male	41	Right anterior communicating	60
39	Female	67	Right medial cerebral	40
40	Female	63	Left posterior cerebral	45
41	Female	55	Right carotid bifurcation	50
42	Female	31	left anterior communicating	90
43	Male	25	Right anterior communicating	60
44	Male	30	Right carotid bifurcation	60
45	Male	58	Right medial cerebral	50
46	Female	47	Right medial cerebral	60
47	Female	44	Right anterior communicating	90
48	Male	41	Left anterior communicating	60
49	Female	57	Right medial cerebral and post communicating	60
50	Female	53	Left medial cerebral	40
51	Female	44	Right medial cerebral	45
52	Male	53	Right posterior communicating	120
53	Male	63	Left anterior communicating	45
54	Female	55	Left anterior communicating	60
55	Female	47	Right posterior communicating	60
56	Female	47	Left anterior communicating	65
57	Female	42	Left posterior communicating	70
58	Female	58	Right posterior communicating	30
59	Female	48	Right anterior communicating	90

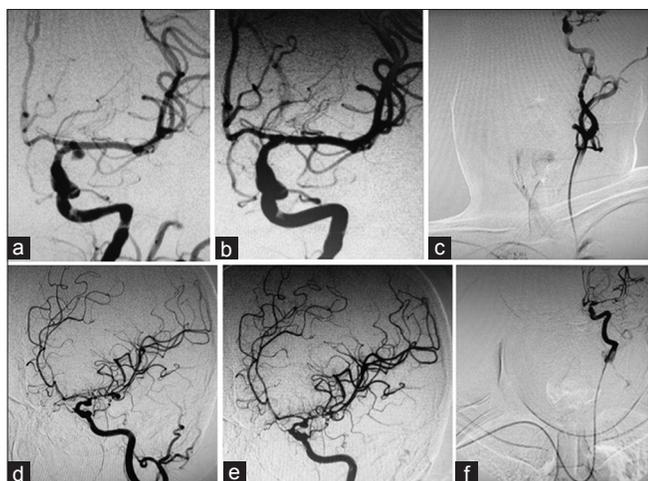
SAH: Subarachnoid hemorrhage

the guide catheter's trajectory from the right subclavian artery to the cervical vessel. Next, the guide catheter and sheath were removed, following irrigation, through the lateral route, with 5 cc of nitroglycerin (200 µg/mL). Heparin was not reversed, and a direct compression was left over the puncture site after study completion for 1 h.<sup>[11,31]</sup>

Table 1 lists the 59 patients treated, providing each patient's gender and age, the general location of the aneurysm, and the duration of the procedure, in min. Note that signed, informed consent was obtained before enrolling each patient in the study, provided either by the patient or by a legally-responsible family member or guardian when a patient was unable to do so.

## RESULTS

Over a 2-year span, between June 2016 and May 2018, 59 patients with cerebral aneurysms at different locations were treated by endovascular coiling through transradial access. In two of these 59 patients, two separate aneurysms were treated, since it was impossible to determine which one had caused the patient's subarachnoid hemorrhage, resulting in a total of 61 aneurysms treated. Of the 59 patients, 39 (66%) were women, and the average age was 48 years. Of the 61 aneurysms treated, eight (13%) were within the posterior circulation (13%), while the remaining 53 (87%) arose within the anterior circulation. The average duration of the procedure was 64.9 min. No occlusion or spasm of the radial artery was observed during any procedure. All patients had immediate postembolization angiography, which revealed the aneurysms occluded with coils and the guide catheter within the right subclavian artery [Figure 2]. A radial pulse was palpable after all 59 interventions.



**Figure 2:** Diagnostic and post therapeutic control angiographic images. (a) Aneurysm located at the left carotid artery bifurcation, (b) Final post therapeutic control, (c) Final control image showing guide catheter within the subclavian artery, (d) Aneurysm located at the left cerebral media artery bifurcation, (e) Final post therapeutic control, (f) Final control image showing guide catheter within the subclavian artery.

## DISCUSSION

In this paper, we describe 61 endovascular coiling procedures performed in 59 subarachnoid hemorrhage patients to treat cerebral aneurysms at a variety of different locations. All 61 aneurysms were accessed by introducing the catheter through the radial artery, an approach that was highly efficient and performed without complications. To date, ours is the largest published series of ruptured cerebral aneurysms embolized by endovascular coiling through the radial artery. We resolved all the cases of this series with coiling technique, but it could have been possible to perform double catheter or remodeling balloon techniques if it would have been necessary.

Radial access is used for angiography and coronary angioplasty procedures worldwide. Some series have been reported on cerebral angiographies performed by transradial access, but the use of this approach to evaluate supra-aortic vessels and to provide endovascular treatment of cerebral aneurysms has, thus far, failed to achieve the same level of acceptance afforded coronary interventions.

Two empirically supported reasons for adopting the radial approach are patient preference and the lower number of complications that occur at the puncture site, relative to the femoral approach.<sup>[7,10,16]</sup> From an anatomical perspective, there are several further advantages of transradial over transfemoral access. First, the radial artery is more superficial and easier to access. Second, again relative to the femoral artery, the radial artery lacks adjacent structures that are susceptible to injury. Third, largely since it is superficial, the radial artery is much more easily compressed, reducing the risk of postprocedural bleeding that might require anticoagulation to be reversed. Overall, transradial artery access is associated with fewer complications.<sup>[1,7,10,20]</sup> Moreover, in one survey, patients who underwent radial access coronary catheterization procedures reported a higher quality of life scores than those whose procedure was performed through femoral access.<sup>[7]</sup>

## CONCLUSIONS

The right transradial approach is an option for the endovascular diagnosis and treatment of cerebral aneurysms of different locations that require a 6Fr or smaller catheter's size. We observed no topographic limitations or arterial injuries treating aneurysms by this route. This is the largest series of ruptured cerebral aneurysms diagnosed and treated endovascularly through the right radial artery up to date.

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## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Agostoni P, Biondi-Zoccai GG, de Benedictis ML, Rigattieri S, Turri M, Anselmi M, *et al.* Radial versus femoral approach for percutaneous coronary diagnostic and interventional procedures; systematic overview and meta-analysis of randomized trials. *J Am Coll Cardiol* 2004;44:349-56.
- Bakhshi F, Namjou Z, Andishmand A, Panabadi A, Bagherinasab M, Sarebanhassanabadi M, *et al.* Effect of positioning on patient outcomes after coronary angiography: A single-blind randomized controlled trial. *J Nurs Res* 2014;22:45-50.
- Bendok BR, Przybylo JH, Parkinson R, Hu Y, Awad IA, Batjer HH, *et al.* Neuroendovascular interventions for intracranial posterior circulation disease via the transradial approach: Technical case report. *Neurosurgery* 2005;56:E626.
- Benit E, Vranckx J, Jaspers L, Jackmaert R, Poelmans C, Coninx R, *et al.* Frequency of a positive modified Allen's test in 1,000 consecutive patients undergoing cardiac catheterization. *Cathet Cardiovasc Diagn* 1996;38:352-4.
- Campeau L. Percutaneous radial artery approach for coronary angiography. *Cathet Cardiovasc Diagn* 1989;16:3-7.
- Connolly ES Jr., Rabinstein AA, Carhuapoma JR, Derdeyn CP, Dion J, Higashida RT, *et al.* Guidelines for the management of aneurysmal subarachnoid hemorrhage: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 2012;43:1711-37.
- Cooper CJ, El-Shiekh RA, Cohen DJ, Blaesing L, Burket MW, Basu A, *et al.* Effect of transradial access on quality of life and cost of cardiac catheterization: A randomized comparison. *Am Heart J* 1999;138:430-6.
- Cox N. Managing the femoral artery in coronary angiography. *Heart Lung Circ* 2008;17 Suppl 4:S65-9.
- Din JN, Murphy A, Chu K, Forman P, Mildenerger RD, Fretz EB, *et al.* Radial artery pseudoaneurysms after transradial cardiac catheterisation. *Vasa* 2016;45:229-32.
- Eichhöfer J, Horlick E, Ivanov J, Seidelin PH, Ross JR, Ing D, *et al.* Decreased complication rates using the transradial approach compared to the transfemoral approach in percutaneous coronary intervention in the era of routine stenting and glycoprotein platelet IIb/IIIa inhibitor use: A large single-center experience. *Am Heart J* 2008;156:864-70.
- Esente P, Giambartolomei A, Simons AJ, Levy C, Caputo RP. Overcoming vascular anatomic challenges to cardiac catheterization by the radial artery approach: Specific techniques to improve success. *Catheter Cardiovasc Interv* 2002;56:207-11.
- Fessler RD, Wakhloo AK, Lanzino G, Guterman LR, Hopkins LN. Transradial approach for vertebral artery stenting: Technical case report. *Neurosurgery* 2000;46:1524-7.
- Goland J, Doroszuk GF, Garbugino SL, Ypa MP. Transradial approach to treating endovascular cerebral aneurysms: Case series and technical note. *Surg Neurol Int* 2017;8:73.
- Hildick-Smith DJ, Lowe MD, Walsh JT, Ludman PF, Stephens NG, Schofield PM, *et al.* Coronary angiography from the radial artery experience, complications and limitations. *Int J Cardiol* 1998;64:231-9.
- Jo KW, Park SM, Kim SD, Kim SR, Baik MW, Kim YW, *et al.* Is transradial cerebral angiography feasible and safe? A single center's experience. *J Korean Neurosurg Soc* 2010;47:332-7.
- Jolly SS, Yusuf S, Cairns J, Niemelä K, Xavier D, Widimsky P, *et al.* Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): A randomised, parallel group, multicentre trial. *Lancet* 2011;377:1409-20.
- Kiemeneij F, Laarman GJ, de Melker E. Transradial artery coronary angioplasty. *Am Heart J* 1995;129:1-7.
- Kim JH, Park YS, Chung CG, Park KS, Chung DJ, Kim HJ, *et al.* Feasibility and utility of transradial cerebral angiography: Experience during the learning period. *Korean J Radiol* 2006;7:7-13.
- Lawson MF, Velat GJ, Fargen KM, Hoh BL, Mocco J. Direct radial artery access with the 070 neuron guide catheter for aneurysm coiling: A novel application of the neuron catheter for cerebral interventions. *Neurosurgery* 2012;71:onsE329-34.
- Lee DH, Ahn JH, Jeong SS, Eo KS, Park MS. Routine transradial access for conventional cerebral angiography: A single operator's experience of its feasibility and safety. *Br J Radiol* 2004;77:831-8.
- Lee MS, Applegate B, Rao SV, Kirtane AJ, Seto A, Stone GW, *et al.* Minimizing femoral artery access complications during percutaneous coronary intervention: A comprehensive review. *Catheter Cardiovasc Interv* 2014;84:62-9.
- Levy EI, Boulos AS, Fessler RD, Bendok BR, Ringer AJ, Kim SH, *et al.* Transradial cerebral angiography: An alternative route. *Neurosurgery* 2002;51:335-40.
- Louvard Y, Krol M, Pezzano M, Sheers L, Piechaud JF, Marien C, *et al.* Feasibility of routine transradial coronary angiography: A single operator's experience. *J Invasive Cardiol* 1999;11:543-8.
- Ludman PF, Stephens NG, Harcombe A, Lowe MD, Shapiro LM, Schofield PM, *et al.* Radial versus femoral approach for diagnostic coronary angiography in stable angina pectoris. *Am J Cardiol* 1997;79:1239-41.
- Maniotis C, Koutouzis M, Andreou C, Lazaris E, Tsiafoutis I, Zografos T, *et al.* Transradial approach for cardiac catheterization in patients with negative Allen's test. *J Invasive Cardiol* 2015;27:416-20.
- Matsumoto Y, Hongo K, Toriyama T, Nagashima H, Kobayashi S. Transradial approach for diagnostic selective cerebral angiography: Results of a consecutive series of 166 cases. *AJNR Am J Neuroradiol* 2001;22:704-8.
- Nohara AM, Kallmes DF. Transradial cerebral angiography: Technique and outcomes. *AJNR Am J Neuroradiol* 2003;24:1247-50.
- Ricci MA, Trevisani GT, Pilcher DB. Vascular complications of cardiac catheterization. *Am J Surg* 1994;167:375-8.
- Schönholz C, Nanda A, Rodríguez J, Shaya M, D'Agostino H. Transradial approach to coil embolization of an intracranial aneurysm. *J Endovasc Ther* 2004;11:411-3.
- Valgimigli M, Campo G, Penzo C, Tebaldi M, Biscaglia S, Ferrari R, *et al.* Transradial coronary catheterization and intervention across the whole spectrum of Allen test results. *J Am Coll Cardiol* 2014;63:1833-41.
- Wu CJ, Hung WC, Chen SM, Yang CH, Chen CJ, Cheng CI, *et al.* Feasibility and safety of transradial artery approach for selective cerebral angiography. *Catheter Cardiovasc Interv* 2005;66:21-6.

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