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Case Report

Difficult 6F Guiding Sheath Removal Using the Transradial Artery Approach: A Case Report

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Objective: Recently, the use of the radial artery approach for neuroendovascular treatment has become more frequent. The main advantage of this approach is that there is a low complication risk. However, in the aforementioned case, the 6F guiding sheath proved difficult to remove from the radial artery.

Case Presentation: A 60-year-old female patient presented with an unruptured basilar tip aneurysm, which we treated with coil embolization under general anesthesia. We performed paracentesis on the right radial artery and inserted a 6F Axcelguide. The radial artery is bifurcated at the brachial region. We guided the Axcelguide to the right subclavian artery and filled the aneurysm with a coil. After embolization, we attempted to remove the Axcelguide. However, we encountered extreme resistance, and removal proved difficult. We injected verapamil, isosorbide nitrate, nitroglycerin, and papaverine hydrochloride intra-arterially and subcutaneously into the forearm and then performed a brachial plexus block. Unfortunately, the situation remained unchanged. We attempted to slowly remove the catheter with the vascular mass remaining adhered to it. We transected the radial artery in the middle. We could not achieve hemostasis through manual compression and thus injected *n*-butyl-2-cyanoacrylate intra-arterially. Postoperatively, the patient experienced mild subcutaneous hematoma and pain.

Conclusion: We consider reporting this case valuable because no previous studies have described similar difficulties in removing a 6F guiding sheath from the radial artery.

Keywords neuroendovascular therapy, radial artery, complication

Introduction

Because of the minimal invasiveness of neuroendovascular treatments, including thrombectomy, carotid artery stenting, and coil embolization, there is an increasing demand for and frequency of such interventions. Neuroendovascular treatments are commonly performed via the femoral artery, which has been significantly replaced by the radial artery approach as a less invasive coronary artery procedure.[1,2] Recently, the number of studies reporting neuroendovascular treatments using the radial artery approach has increased.[3–6] The main advantage of this approach is the low complication risk. However, here we report a case where 6F guiding sheath removal from the radial artery proved difficult. We are convinced that reporting this case is relevant because no previous studies have described such difficulties, even in the coronary artery region, and we wish to raise awareness that care should be taken during such neuroendovascular therapies.

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Case Presentation

A 60-year-old female patient presented at our hospital with the onset of dizziness. The patient had a history of hypertension and took a daily dose of 5 mg of amlodipine. Her family history was unremarkable. Magnetic resonance angiography revealed an unruptured cerebral aneurysm

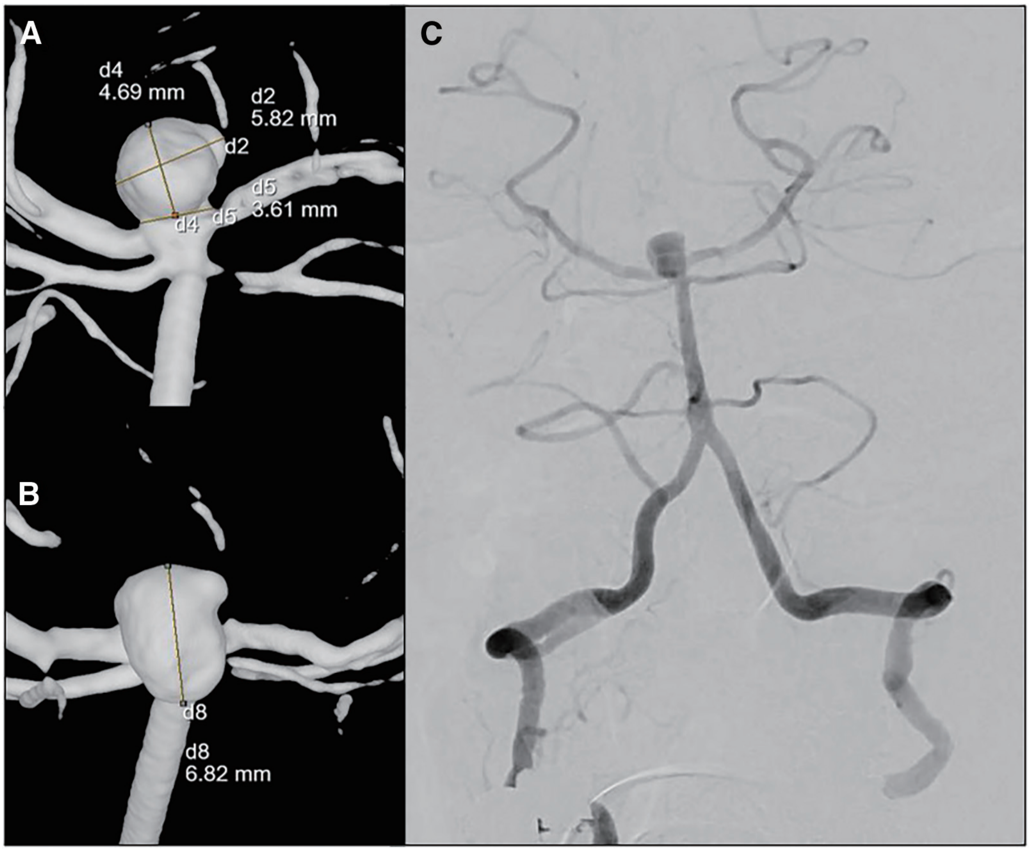

Fig. 1 Aneurysm angiography findings. (**A**, **B**, and **C**) An aneurysm was observed at the tip of the basilar artery.

with a maximum diameter of approximately 7 mm at the tip of the basilar artery (**Fig. 1**). After consultation with the patient and her family, we decided to perform coil embolization to prevent the rupture.

Treatment course

We began the oral administration of two antiplatelet agents (100 and 75 mg/day of aspirin and clopidogrel, respectively) to the patient 3 weeks prior to treatment. We performed the treatment under general anesthesia and heparinization to achieve an activated clotting time of 250–300 sec. We placed a 4F Super Sheath (Medikit, Tokyo, Japan) into the right radial artery. We performed a single paracentesis of the posterior in the blood vessel with a diameter of 1.86 mm at the paracentesis site. We confirmed sufficient return flow from the ulnar artery to the distal side. The radial artery bifurcation occurred at the brachial region rather than the elbow (**Fig. 2A** and **2B**). We performed a 6F Axcelguide (Medikit) replacement without any intra-arterial vasodilator injection. We detected no resistance at the time of insertion, only upon guidance to the vicinity of the vertebral artery origin of the right subclavian artery (**Fig. 2C**). We guided an AXS Vecta71 (Stryker, Kalamazoo, MI, USA) intermediate catheter into the right vertebral artery. We embolized the aneurysm using a double catheter technique with two SL-10 (Stryker) catheters for 10 coils at 63 cm. As we obtained satisfactory embolization, we decided to conclude the treatment. Eighty minutes have elapsed following paracentesis. Upon the removal of the SL-10 (Stryker) and Vecta71 (Stryker), we noticed strong resistance when removing the Axcelguide and detected that the tip did not move from its position into the subclavian artery. We injected verapamil, isosorbide nitrate, nitroglycerin, and papaverine hydrochloride intra-arterially and subcutaneously into the forearm and performed a brachial plexus block. However, the catheter resistance remained unchanged. We attempted to remove the catheter slowly, gradually thinning the Axcelguide, but it was still not released. Finally, we pulled out the Axcelguide with force, which came out with the vascular mass attached to it. Because the radial artery was potentially severed, we made a small incision and removed the Axcelguide while performing hemostasis (**Fig. 3**). A 4F Super Sheath (Medikit) was inserted into the right femoral artery.

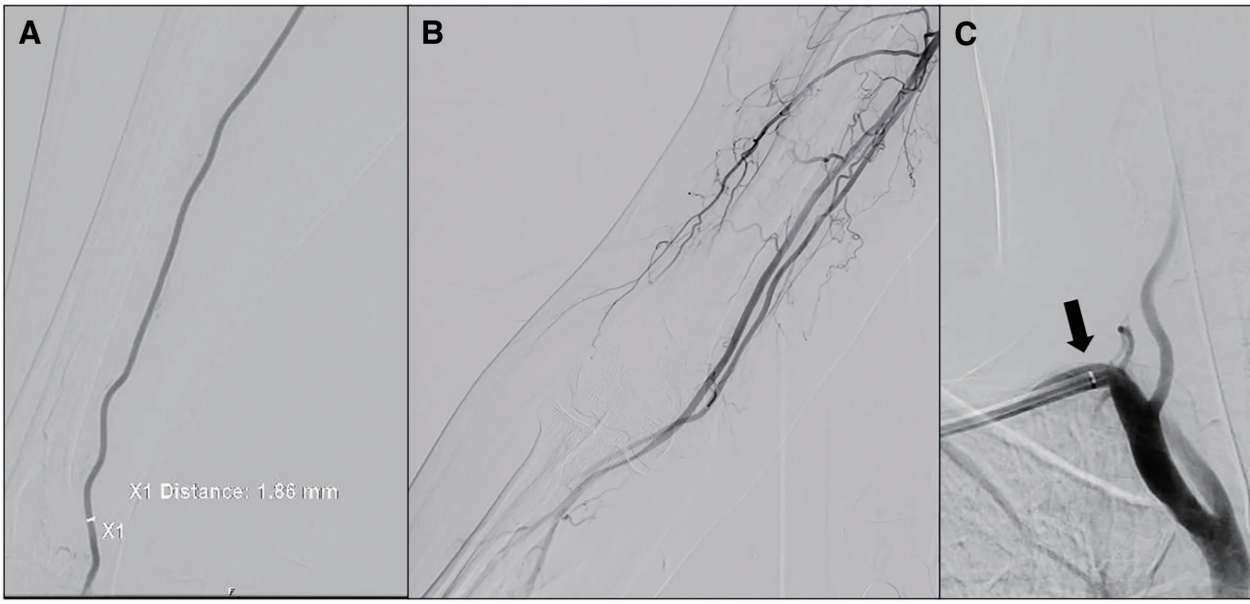

Fig. 2 Radial arteriogram (**A**, **B**) and subclavian arteriogram (**C**). (**A**) The paracentesis site vessel diameter was 1.86 mm. (**B**) The radial artery was bifurcated at the brachial region. (**C**) A 6F Axcelguide (Medikit) was guided to the vicinity of the vertebral artery origin (arrow).

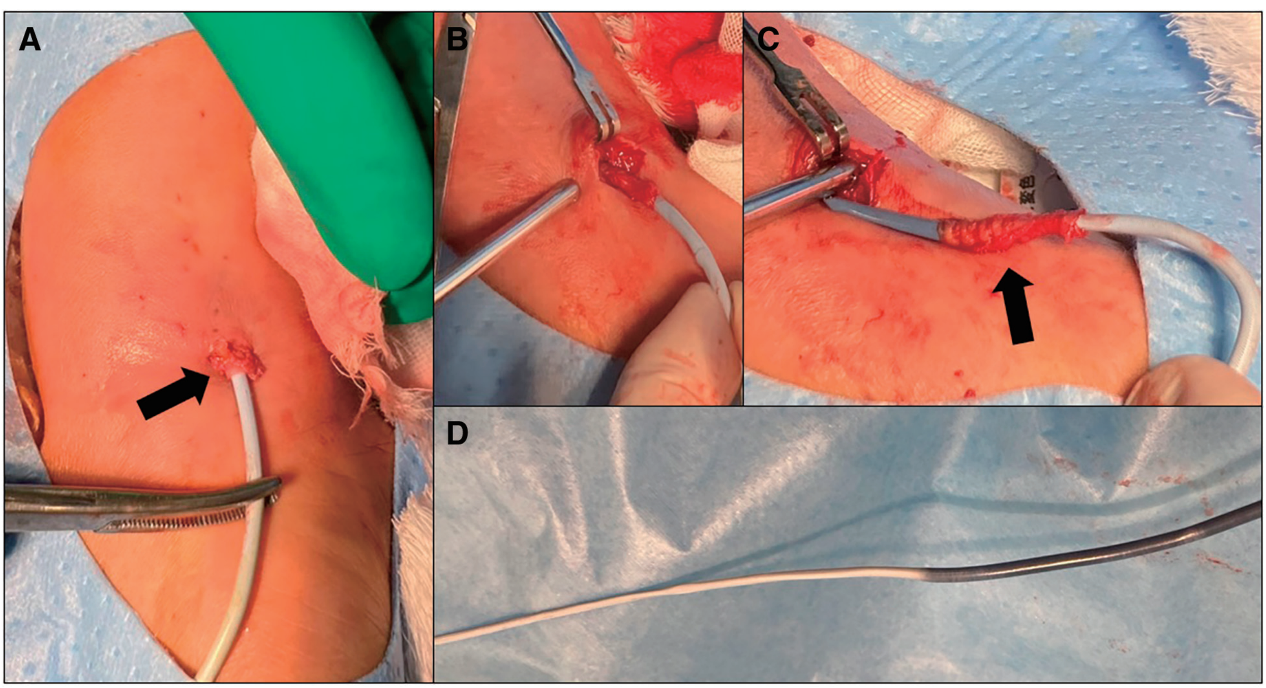

Fig. 3 Gross pathology upon catheter removal. (**A**) The catheter came out with the vascular mass (arrow) attached to the Axcelguide. (**B**) After a small incision, catheter removal was continued slowly with hemostasis. (**C**) During removal, the vascular mass was transected while it remained attached to the Axcelguide (arrow). (**D**) The Axcelguide was elongated, and its color was changed to white from the vascular mass attachment site to the insertion site.

Contrast imaging from the brachial artery revealed that the radial artery had been severed, and the contrast medium was leaking. We secured collateral circulation from the ulnar artery; however, we were unable to achieve compression hemostasis. We guided SL-10 (Stryker) into the radial artery and injected *n*-butyl-2-cyanoacrylate intra-arterially, resulting in hemostasis (**Fig. 4**). The attached vascular mass consisted of the entire arterial layer (**Fig. 5**). Although the patient postoperatively experienced subcutaneous hematoma and pain for several days, she improved

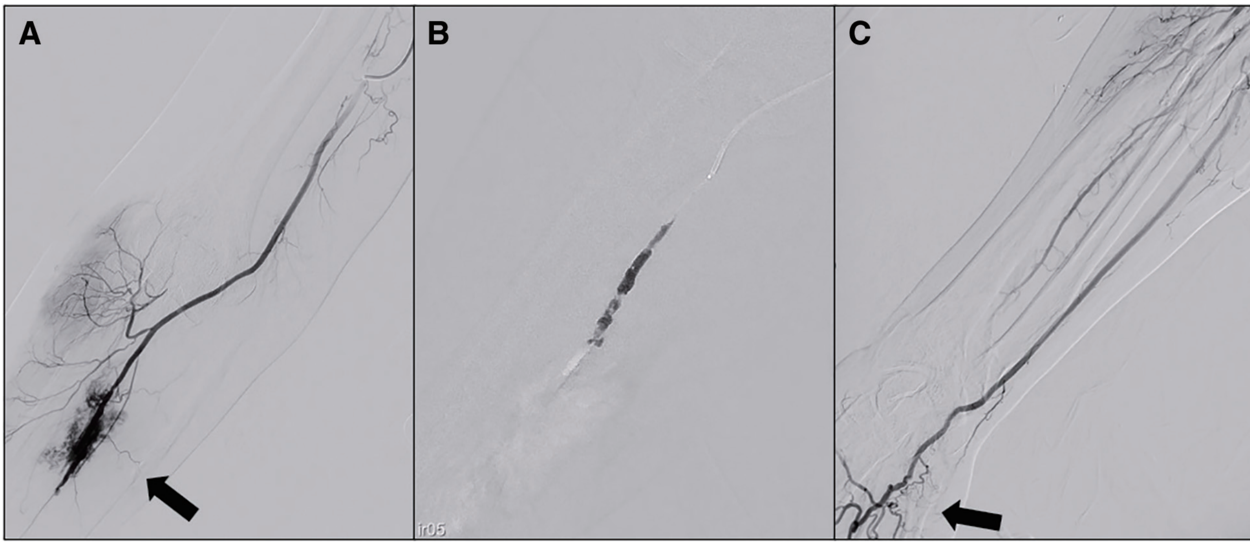

Fig. 4 Angiographic findings upon catheter removal. (**A**) Extravasation was observed from the radial artery after removal (arrow). (**B**) Intra-arterial injection of *n*-butyl-2-cyanoacrylate. (**C**) After hemostasis, extravasation disappeared. Collateral circulation from the ulnar artery was observed (arrow).

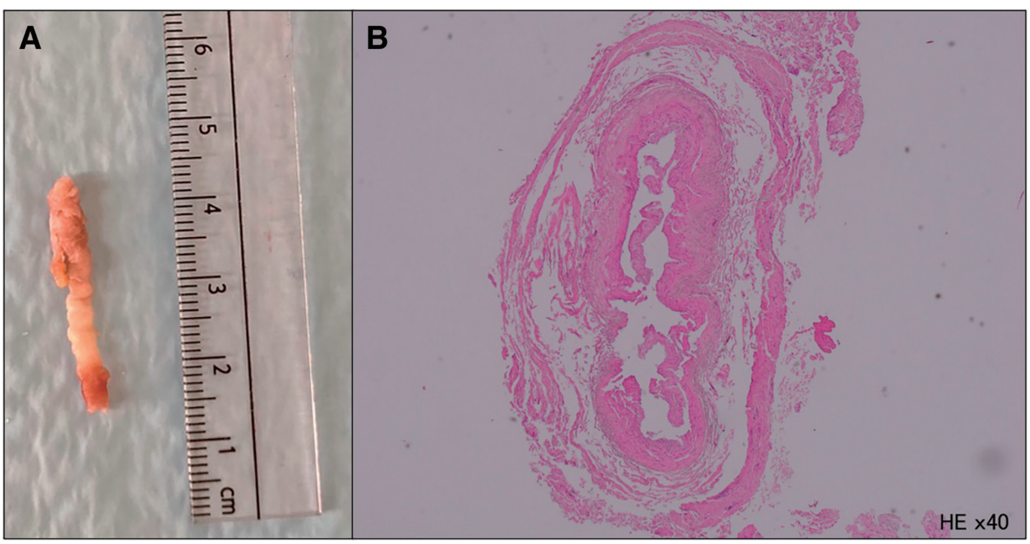

Fig. 5 Dislodged blood vessel. (**A**) Gross pathology. (**B**) Pathological findings (hematoxylin and eosin staining staining). The dislodged vessel represented the full arterial layer.

over time and was discharged home (**Fig. 6**). We observed no permanent neurological disorder or ischemia.

The patient consented to publication when this study was submitted. It received our institutional review board's approval.

Discussion

In the hereby presented case, we performed coil embolization using the transradial artery approach with subsequent 6F guiding sheath removal, which proved difficult. Although neuroendovascular treatment is often performed via the transfemoral artery approach, many studies report approaches from the upper extremities, including the radial artery, to reduce anatomical problems in the aortic arch and complications at the paracentesis site.[3–6] However, interventions have already shifted toward the transradial approach in the coronary artery region. The radial artery procedure is useful when approaching the vertebral artery, as in the present case.[7] The advantages of this approach include shorter postoperative bed rest and fewer complications (e.g., pseudoaneurysms and postoperative

Fig. 6 Postoperative forearm findings. (**A**) Immediately after surgery. (**B**) Three days after surgery. Although skin discoloration spread and the patient experienced pain, there was no neurological damage.

hemorrhage), thereby reducing patient burden.[8] Nevertheless, a disadvantage is that the paracentesis site should be changed due to paracentesis-associated angiospasm in certain cases.[8] Although postoperative obstruction has been reported, almost all described cases were asymptomatic.[9] Pseudoaneurysm, arteriovenous fistula, and guidewire-perforated radial artery are listed among the related complications that might require additional treatment.[10] We are not aware of any studies reporting damage to the radial artery due to difficulties in removing the guiding catheter, including the coronary artery region, as experienced in the aforementioned case.

The first factor that potentially contributed to the removal-related difficulties was that the diameter of the blood vessel at the paracentesis site (1.86 mm) was smaller than the outer diameter of the inserted guiding sheath (2.7 mm). The observed blood vessel diameter was below 2.7 ± 0.41 mm, that is, the mean radial artery diameter.[11] Necessary measures when the blood vessel diameter is smaller than that of the device, like in this case, include using a smaller diameter and paracentesis at a different site. Such an approach could be advisable to measure the blood vessel diameter at the paracentesis site using angiography or ultrasonography before treatment strategy formulation.

Second, we used the guiding catheter as a sheath rather than a sheath introducer. In the cardiovascular region, guiding catheters are generally manipulated after sheath introducer placement in the radial artery. By contrast, the use of multiple devices and larger-diameter catheters is often necessary in the neurovascular region. Radial artery obstruction risk reportedly increases with increasing sheath diameters.[12] Therefore, guiding catheters are often used as sheaths without sheath introducers to further reduce the paracentesis site diameter. While sheath introducers mostly have a hydrophilic coating, guiding sheaths display a hydrophilic coating only at the tip. The Axcelguide we used, in this case, exhibits no coating in a region potentially contacting the radial artery after insertion, although a 30 cm portion from the tip is coated. Non-hydrophilic coatings could cause angiospasm, as radial artery spasm incidence reportedly differs significantly depending on the presence or absence of a hydrophilic coating.[13]

Third, the radial artery is bifurcated in the upper arm above the elbow. It is possible that the longer route through the smaller diameter vertebral artery led to higher-level friction and induced angiospasm. The brachioradial type, that is, radial artery bifurcation in the upper arm, is present in 4.7%–15.6% of cases.[14,15]

In addition, the lack of preoperative intra-arterial vasodilator injection, gender, and treatment time potentially influenced the results. The above-described factors presumably contributed in combination to the guiding catheter removal-related difficulties in the present case.

Possible countermeasures to reduce the risk of difficult catheter removal include using a sheath with a more hydrophilic coating, changing the paracentesis site for the brachioradial type or when the diameter of the paracentesis site is narrow, and intra-arterial vasodilator injection before surgery.

Although the hereby presented case is rare, permanent sequelae could be reduced even if the radial artery is transected by prompt hemostasis before compartment syndrome occurs because radial artery obstruction is mostly asymptomatic. In this case, we achieved hemostasis by intra-arterial *n*-butyl-2-cyanoacrylate injection. However, care should be taken in the case of this intervention as this compound could induce subcutaneous tissue necrosis upon entering healthy blood vessels. Therefore, hemostasis should preferably be achieved via mechanical compression, direct application, or coil embolization.

Conclusion

The transradial artery approach expectably reduces patient burden because it is associated with fewer complications and shorter postoperative bed rest than the femoral artery approach. However, similar to this case, 6F guiding sheath removal from the radial artery might prove difficult; therefore, sufficient caution is required.

Disclosure Statement

There are no conflicts of interest or financial disclosure to declare.

References

1) Archbold RA, Robinson NM, Schilling RJ. Radial artery access for coronary angiography and percutaneous coronary intervention. *BMJ* 2004; 329: 443–446.
2) Hamon M, Pristipino C, Di Mario C, et al. Working group on thrombosis on the European society of cardiology. Consensus document on the radial approach in percutaneous cardiovascular interventions: position paper by the European association of percutaneous cardiovascular interventions and working groups on acute cardiac care and thrombosis of the European society of cardiology. *EuroIntervention* 2013; 8: 1242–1251.
3) Matsumoto Y, Hokama M, Nagashima H, et al. Transradial approach for selective cerebral angiography: technical note. *Neurol Res* 2000; 22: 605–608.
4) Jo KW, Park SM, Kim SD, et al. Is transradial cerebral angiography feasible and safe? A single center's experience. *J Korean Neurosurg Soc* 2010; 47: 332–337.
5) Levy EI, Boulos AS, Fessler RD, et al. Transradial cerebral angiography: an alternative route. *Neurosurgery* 2002; 51: 335–342; discussion, 340–342.
6) Snelling BM, Sur S, Shah SS, et al. Transradial cerebral angiography: techniques and outcomes. *J Neurointerv Surg* 2018; 10: 874–881.
7) Patel T, Shah S, Malhotra H, et al. Transradial approach for stenting of vertebrobasilar stenosis: a feasibility study. *Catheter Cardiovasc Interv* 2009; 74: 925–931.
8) Ghaith AK, El Naamani K, Mualem W, et al. Transradial versus transfemoral approaches in diagnostic and therapeutic neuroendovascular interventions: a meta-analysis of current literature. *World Neurosurg* 2022; 164: e694–e705.
9) Kiemeneij F, Laarman GJ, Odekerken D, et al. A randomized comparison of percutaneous transluminal coronary angioplasty by the radial, brachial and femoral approaches: the access study. *J Am Coll Cardiol* 1997; 29: 1269–1275.
10) Kanei Y, Kwan T, Nakra NC, et al. Transradial cardiac catheterization: a review of access site complications. *Catheter Cardiovasc Interv* 2011; 78: 840–846.
11) Eid-Lidt G, Rivera Rodríguez A, Jimenez Castellanos J, et al. Distal radial artery approach to prevent radial artery occlusion trial. *JACC Cardiovasc Interv* 2021; 14: 378–385.
12) Aminian A, Saito S, Takahashi A, et al. Comparison of a new slender 6 Fr sheath with a standard 5 Fr sheath for transradial coronary angiography and intervention: RAP and BEAT (radial artery patency and bleeding, efficacy, adverse event), a randomised multicentre trial. *EuroIntervention* 2017; 13: e549–e556.
13) Rathore S, Stables RH, Pauriah M, et al. Impact of length and hydrophilic coating of the introducer sheath on radial artery spasm during transradial coronary intervention: a randomized study. *JACC Cardiovasc Interv* 2010; 3: 475–483.
14) Rodríguez-Niedenführ M, Vázquez T, Nearn L, et al. Variations of the arterial pattern in the upper limb revisited: a morphological and statistical study, with a review of the literature. *J Anat* 2001; 199: 547–566.
15) Haładaj R, Wysiadecki G, Dudkiewicz Z, et al. The high origin of the radial artery (brachioradial artery): its anatomical variations, clinical significance, and contribution to the blood supply of the hand. *BioMed Res Int* 2018; 2018: 1520929.