

Distal solution for an (un)conventional radial artery complication: a case report

Giuseppe Colletti ^{1,2*}, Gregory Angelo Sgueglia³, Olivier Gach⁴, Alexandre Natalis¹, and Claudiu Ungureanu ²

¹Cardiovascular Department, Clinique Saint Joseph, Vivalia, Rue des Déportés 137, 6700 Arlon, Belgium; ²Cardiovascular Department, Jolimont Hospital, Rue Ferrer 159, 7100 La Louvière, Belgium; ³Cardiology Department, Sant'Eugenio Hospital, Piazzale dell'Umanesimo 10, 00144 Rome, Italy; and ⁴Cardiology Department, CHC MontLégia, Boulevard Patience et Beaujonc 2, 4000 Liège, Belgium

Received 10 March 2024; revised 28 May 2024; accepted 14 October 2024; online publish-ahead-of-print 23 October 2024

Background

The European Society of Cardiology guidelines recommend transradial access (TRA) for coronary angiography due to its advantages, including lower mortality and bleeding complications. Arterial pseudoaneurysms are rare but challenging complications of TRA, occurring in 0.009%–0.05% of procedures. Non-surgical management, especially in cases with large (>1 mm) necks or late discovery, can be difficult due to the limited effectiveness of echo-guided compression and risks of echo-guided thrombin injection, like thrombin embolization leading to necrosis.

Case summary

An 82-year-old underwent successful non-surgical management of a large-neck pseudoaneurysm following TRA for a primary percutaneous coronary intervention of the left anterior descending artery. Clinical examination revealed a pulsatile mass at the puncture site, diagnosed via ultrasound as a pseudoaneurysm with a >1 mm neck. Through distal radial access, an initial 5 Fr sheath was upsized to 8 Fr based on ultrasound findings, achieving complete pseudoaneurysm exclusion. Follow-ups confirmed pseudoaneurysm sealing and radial artery patency.

Discussion

This case illustrates an effective non-surgical approach to managing large-neck pseudoaneurysms post-TRA, utilizing an upsized sheath technique. It underscores the importance of innovative non-surgical strategies in complex cases, providing a safe and effective alternative to traditional management methods.

Keywords

Distal radial artery • Transradial access • Radial artery • Pseudoaneurysm • Case report

ESC curriculum

3.4 Coronary angiography • 3.1 Coronary artery disease • 3.3 Chronic coronary syndrome • 3.2 Acute coronary syndrome • 7.4 Percutaneous cardiovascular post-procedure

Learning points

- Radial artery pseudoaneurysm is a rare complication following transradial access.
- Depending on the dimension of the neck feeding the pseudoaneurysm, different treatment options, both surgical and non-surgical, have been described, each with different risks and limitations.
- A pure haemostatic technique for large-neck pseudoaneurysms based on both intra-arterial exclusion of the pseudoaneurysm using large sheaths and external compression could be an effective and safe alternative.

* Corresponding author. Tel: +39 3803605123, Email: giucol85@gmail.com

Handling Editor: F. Aaysha Cader

Peer-reviewers: Josip Andelo Borovac; Milenko Zoran Cankovic; Dzan Horozic; Alessia Azzano; Mohamed El-Tahlawi

Compliance Editor: Marta Peverelli

© The Author(s) 2024. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact reprints@oup.com for reprints and translation rights for reprints. All other permissions can be obtained through our RightsLink service via the Permissions link on the article page on our site—for further information please contact journals.permissions@oup.com.

Introduction

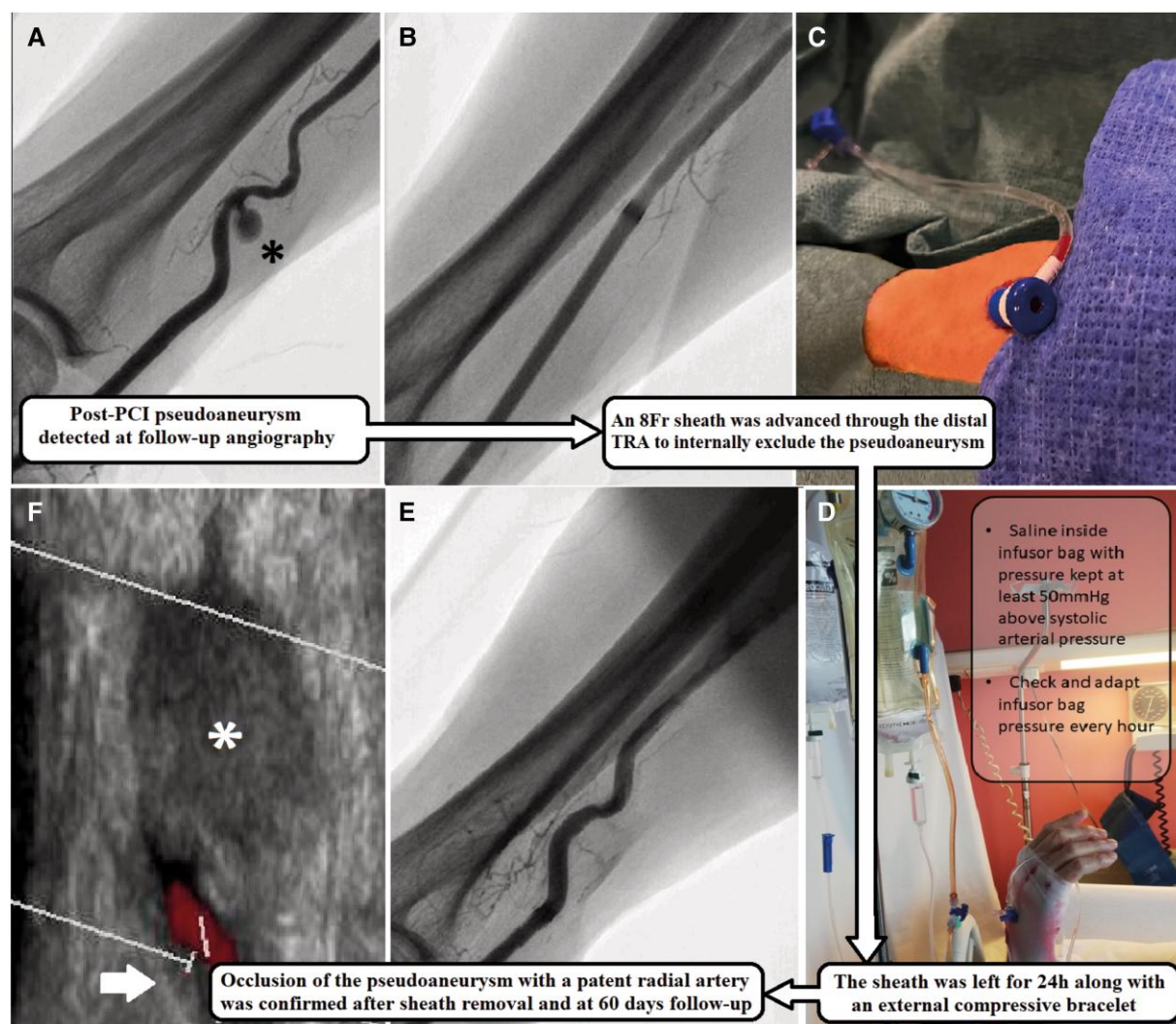
Transradial access (TRA) is recommended by the European Society of Cardiology guidelines as the standard access for coronary angiography in both acute and elective settings due to well-known advantages including reduced mortality and severe bleeding complications.^{1,2}

Arterial pseudoaneurysm is a rare complication of TRA occurring roughly in 0.009%–0.05% of the cases compared with 0.2%–3% with femoral access.³ Historically, surgical repair used to be the gold standard for management of large-neck (>1 mm) pseudoaneurysm, especially in the case of late discovery where non-surgical closure technique was less efficient.⁴ Contemporary non-surgical techniques include covered stent implantation, echo-guided compression, and thrombin injection but all present different limitations and risks.⁵ We therefore present the case of a patient managed successfully with a different yet simple and safe haemostatic technique.

Summary figure

Case presentation

An 82-year-old patient on oral anticoagulant therapy for paroxysmal atrial fibrillation was admitted for an ST-segment elevation myocardial infarction. Intense chest pain still persisted upon arrival along with diffuse anterior ST-segment elevation. Transthoracic echocardiogram showed a consistent antero-apical wall akinesia and a moderate left ventricular systolic dysfunction. Arterial pressure was normal, and no abnormalities were detected during lung auscultation. Other than being treated for dyslipidaemia and arterial hypertension, he had no other known major comorbidities. Coronary angiography was performed via the right TRA using a 7 Fr Glidesheath Slender[®] introducer and revealed a culprit lesion in the left anterior descending artery (LAD) (*Figure 1A*), which was treated with drug-eluting stent implantation from the proximal LAD to the severely diseased left main (*Figure 1B*). An external pneumatic compression device (TR Band, Terumo) was used to achieve patent haemostasis, and the right coronary artery (RCA) revascularization was staged (*Figure 1C*). The pressure in the external compression device was reduced after 2 h as per local protocol, and the patient was



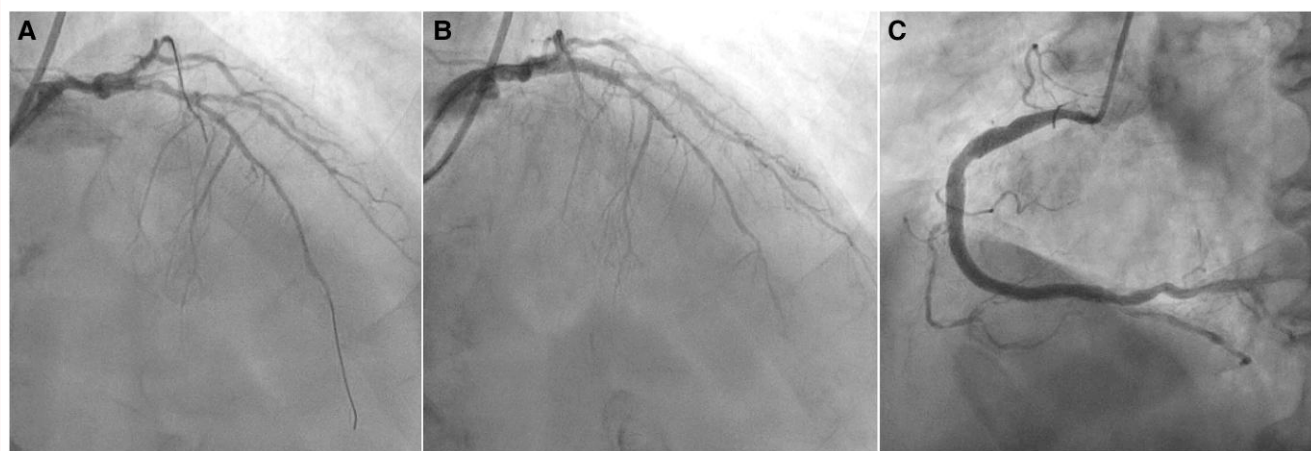


Figure 1 Coronary angiography. Unstable plaque with apposed thrombus in the proximal left anterior descending artery with a severely diseased left main (A). Final result after the primary percutaneous coronary intervention (B). Intermediate to severe lesion at the origin of the right coronary artery (C).

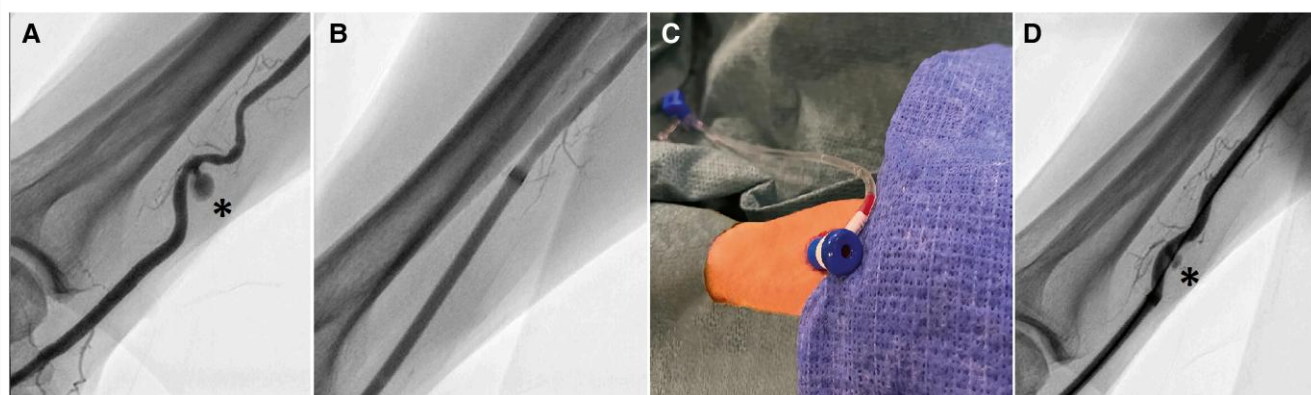


Figure 2 Right radial artery angiography through distal transradial approach. Radial artery injection showing a large-neck pseudoaneurysm at the level of the recently punctured conventional transradial site (A) completely excluded (B) after advancement of an 8Fr femoral introducer sheath (C) and reduced but still present after partial retrieval of the introducer sheath at the end of coronary angiography procedure (D). Asterisks indicate the pseudoaneurysm.

finally discharged a few days later on triple antithrombotic therapy with aspirin, clopidogrel, and apixaban for 1 month.

Upon arrival to complete the revascularization of his RCA, 40 days later, the patient presented with a pulsatile mass that had developed over time since the index procedure at the original TRA site and bedside ultrasound confirmed the presence of a large-neck (>1 mm) pseudoaneurysm. Patency of the ulnar artery was also checked and confirmed. The patient was carefully evaluated, with the follow-up transthoracic echocardiogram showing a complete normalization of the acute wall motion abnormalities and no other complication was found.

A distal radial access (DRA) was obtained using a 6 Fr Glidesheath Slender® introducer, and an angiography was performed showing the pseudoaneurysm fed by the radial artery (Figure 2A and Supplementary material online, Video S1). The treatment of the proximo-ostial residual lesion of the RCA was ultimately deferred, as a physiological evaluation using a wire pressure revealed it to be functionally non-significant. Knowing that the radial artery diameter was measured by ultrasound

to be 3.3 mm, the 5 Fr sheath was then upgraded over a 0.035 inch guidewire to an 8 Fr transfemoral (outer diameter of 3.37 mm) to ensure complete exclusion of the pseudoaneurysm (Figure 2B and C and Supplementary material online, Video S2) and a significant reduction in pulsatility.

After slight retrieval of the sheath at the end of the procedure, a final radial artery angiography showed reduced but persistent flow feeding the pseudoaneurysm (Figure 2D and Supplementary material online, Video S3).

Therefore, the 8 Fr sheath was again advanced and left in place for 24 h, and an external compression device (TR Band, Terumo) was applied and inflated with 12 mL of air to achieve complete sealing of the neck and thrombosis of the pseudoaneurysm. To maintain radial artery patency, saline was continuously flushed through the sheath using a pressure infusor bag (Figure 3). The pressure of the infusor bag was checked hourly and corrected to be at least 50 mmHg above the patient's systolic arterial pressure. The procedure was well tolerated by the patient without any discomfort reported.

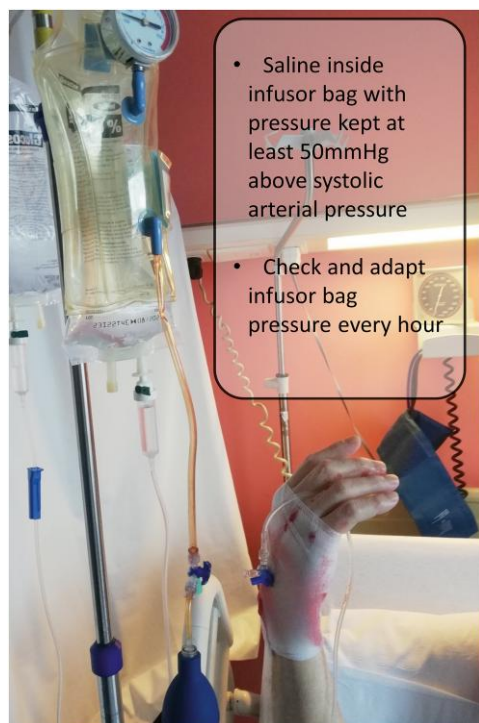


Figure 3 Pressurized saline to ensure continuous flush. A saline is continuously flushed through the introducer sheath to reduce the risk of both sheath and arterial thrombosis.

A small contrast injection was performed prior to complete sheath removal, demonstrating complete occlusion of the pseudoaneurysm (Figure 4A and [Supplementary material online, Video S4](#)). The final ultrasound evaluation, performed 6 h after complete sheath removal, confirmed a partially thrombosed mass with no further feeding from a patent radial artery (Figure 4B and C and [Supplementary material online, Videos S5 and S6](#)) and the patient was ultimately discharged on double therapy with apixaban and clopidogrel. The artery remained patent with a completely thrombosed and excluded pseudoaneurysm at discharge and 60 days follow-up (Figure 5A–C).

Discussion

Arterial pseudoaneurysm is a rare complication of radial artery access occurring roughly in 0.009%–0.05% of the procedure compared with 0.2%–3% with femoral access.³

The use of large introducer sheaths and anticoagulation therapy, as in our case, are two predisposing risk factors for its formation.

While for most elective cases the smallest reasonable sheath should always be preferred, it is our practice to use 7 Fr Slender sheaths in the setting of acute ST-segment elevation myocardial infarction because, despite their smaller outer diameter corresponding to the outer diameter of a 6 Fr radial sheath, they can still accommodate a 7 Fr guiding catheter if needed.

Anticoagulation is another important point to consider, as anticoagulated patients may require more time to achieve proper haemostasis, and therefore, prolonged compression of the arterial puncture site should be considered after checking for ulnar artery patency.

The different existing approaches to effectively treat those fed by a large neck (>1 mm), other than surgical repair, include the implantation of covered stent, echo-guided compression, and echo-guided thrombin injection.

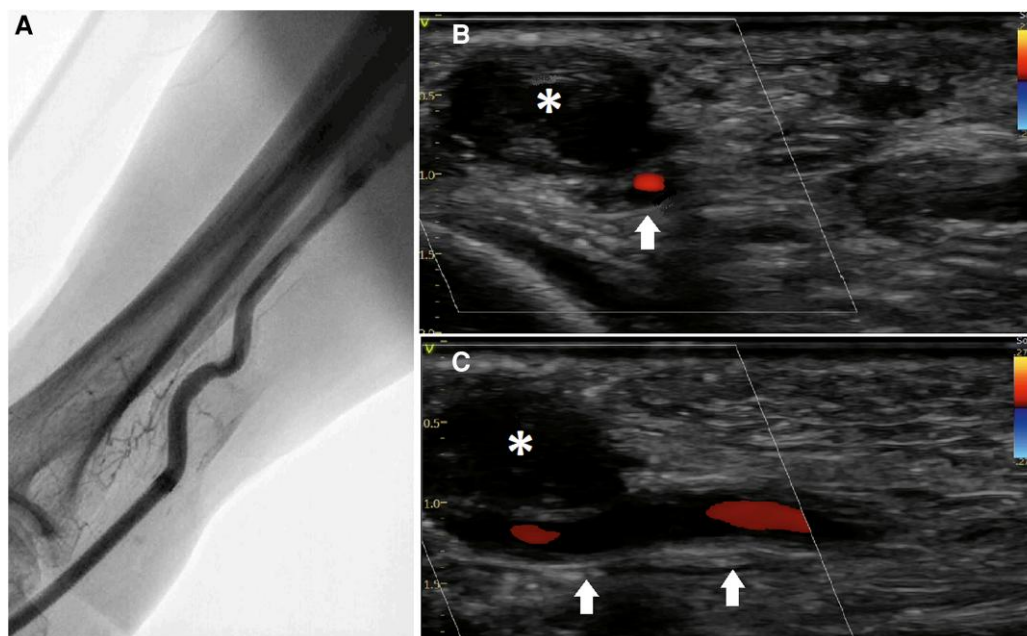


Figure 4 Angiographic and echographic visualization of the radial artery and the occluded pseudoaneurysm. A final angiography of the radial artery 24 h after compression confirmed completely occlusion of the neck feeding the pseudoaneurysm with a patent radial artery (A) while the echo colour Doppler evaluation had confirmed the same findings showing the partially thrombosed pseudoaneurysm (B and C). Asterisks indicate the pseudoaneurysm. Arrows point to the patent radial artery.

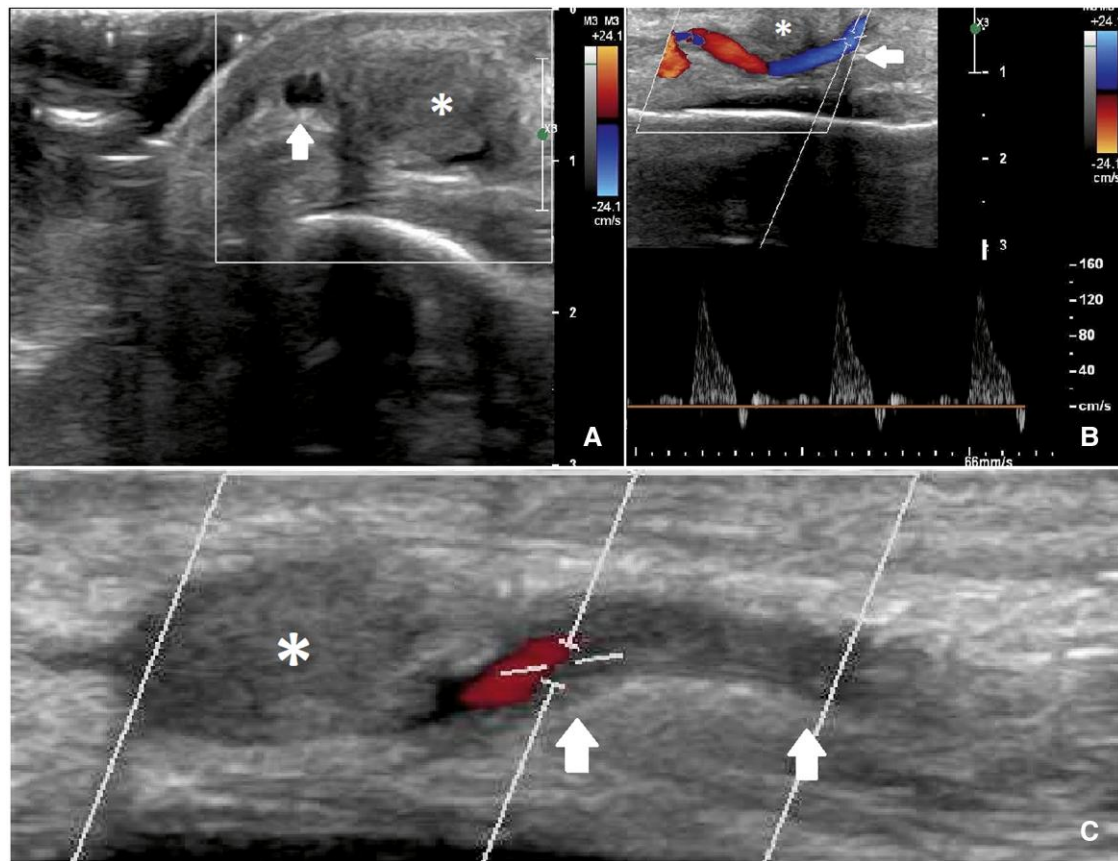


Figure 5 Sixty-day follow-up echo colour Doppler of the radial artery and the occluded pseudoaneurysm. Echo colour Doppler at 60 days showing both a short- (A) and long-axis views of the patent radial artery (B and C) with the pseudoaneurysm completely thrombosed. Asterisks indicate the pseudoaneurysm. Arrows point to the patent radial artery.

Covered stent implantation has been described through distal radial artery access but is associated with a high risk of radial thrombosis and implies a dual antiplatelet therapy treatment.⁴ Also, it carries a certain risk of external mechanical deformation related to the superficial course of the radial artery.

Echography-guided compression doesn't usually work in cases of large-neck (>1 mm) pseudoaneurysms, especially in patient under chronic anticoagulation, and can result in significant patient discomfort due to prolonged compression,⁶ and was therefore excluded in our case due to the low likelihood of success.

Percutaneous echo-guided thrombin injection is one of the most frequent and efficient techniques used, but it is associated with risks such as unwanted thrombin embolization resulting in distal necrosis or anaphylaxis.⁷ Leaving potential surgical treatment as a last resort due to its invasiveness, we had considered this option, in case our intended approach failed, while eventually completely sealing the neck of the pseudoaneurysm with an appropriately sized balloon inflated within the radial artery to reduce the risk of thrombin embolization.

Babunashvili *et al.*⁸ described a pure compressive technique conceptually similar to ours, namely based on lumen flow interruption through the use of a sheath, with the notable difference that the radial artery was punctured only few millimetres distal to a pseudoaneurysm that presented with a small neck. In the case of a more proximal location of the pseudoaneurysm, puncturing a few millimetres distally to the pseudoaneurysm is a possibility, but it would be even better to simply puncture at the conventional TRA site to ensure proper compression afterwards.

More recently, Lombardi *et al.*⁹ demonstrated the relative efficiency and safety of this technique to manage an ulnar artery pseudoaneurysm by puncturing the ulnar artery distal to the location of the pseudoaneurysm through echo-guided puncture.

To the best of our knowledge, these two cases are the only ones reported in the literature using a similar concept.

Still our case and experience bring added value to the existing reports having many peculiarities and addressing the specific scenario of very distally located radial artery pseudoaneurysms.

In such cases, a puncture more distal to the neck of the pseudoaneurysm on the palmar side of the forearm may not be technically feasible, and a distal transradial puncture through the anatomical snuffbox may be the only option.

Good patency of the ulnar radial artery is another critical factor when considering prolonged compression or occlusion, because if confirmed, it suggests an extremely low, virtually non-existent risk of hand ischaemia. Indeed, hand perfusion could be supplemented by the ulnar artery via the palmar arches, while the segment above the compressed or occluded segment of the radial artery is filled retrogradely.

Compared with other recently described pure compression techniques, our approach represents a safe and effective alternative with some advantages and limitations.

Maintaining a continuous flow into the sheath and the proximal radial artery through the administration of saline using a pressure infusion bag was important to reduce the risk of thrombosis of the sheath or of the more proximal segment of the artery, as otherwise the blood could have remained stagnant for too long.

The use of a distal TRA should further improve the likelihood of maintaining a patent radial artery. In fact, the puncture site to access the artery and to treat the pseudoaneurysm will subsequently need itself to be compressed as well to obtain haemostasis, and a recent meta-analysis have confirmed lower radial artery occlusion rates for the distal TRA.¹⁰

Furthermore, the likelihood of sealing the pseudoaneurysm even when a large neck is present might be enhanced by the presence of an external TR band compressing focally on the pseudoaneurysm's neck that will be, in this way, squeezed between the introducer sheath wall internally and the external compressive bracelet.

A limitation of this technique could be the potential discomfort the patient might experience related mainly to a prolonged external compression. Acute pain related to sheath insertion might be another issue, but we believe that appropriate sheath size selection based on echo findings might prevent this.

Despite emergent independent reports showing the potential of a purely haemostatic technique based on internal exclusion of the pseudoaneurysm, more data are still needed to investigate further its safety and efficacy.

Conclusion

Radial artery pseudoaneurysm formation, a rare complication of TRA, can be potentially dangerous if untreated. Among the different existing approaches for its treatment, ours represents a safe and effective alternative with some advantages and limitations compared with other purely haemostatic techniques based on internal exclusion of the pseudoaneurysm.

Lead author biography



Dr Giuseppe Colletti is an interventional cardiologist at Clinique Saint-Joseph in Arlon (Belgium), where he leads the complex PCI and CHIP programme. Specializing in the treatment of complex coronary lesions, especially calcified ones, he trained at Hôpital Jolimont in La Louvière and CHU de Liège – Sart Tilman after graduating from the University of Palermo (2010) and specializing at the University of Sassari (2016). An expert in complex PCI, ultra-low contrast PCI, and distal transradial access, Dr Colletti contributes as a co-investigator to several international trials.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Consent: The authors confirm that written consent for submission and publication of this case report, including the images and associated text, was obtained from the patient in line with COPE guidelines.

Conflict of interest: None declared.

Funding: None declared.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. Byrne RA, Rossello X, Coughlan JJ, Barbato E, Berry C, Chieffo A, et al. 2023 ESC guidelines for the management of acute coronary syndromes. *Eur Heart J* 2023;**44**: 3720–3826.
2. Karrowni W, Vyas A, Giacomino B, Schweizer M, Blevins A, Girotra S, et al. Radial versus femoral access for primary percutaneous interventions in ST-segment elevation myocardial infarction patients: a meta-analysis of randomized controlled trials. *JACC Cardiovasc Interv* 2013;**6**:814–823.
3. Tatli E, Buturak A, Cakar A, Vatan BM, Degirmencioglu A, Agac TM, et al. Unusual vascular complications associated with transradial coronary procedures among 10,324 patients: case based experience and treatment options. *J Interv Cardiol* 2015; **28**:305–312.
4. Sinha SK, Aggarwal P, Razi M, Sharma AK, Pandey U, Krishna V. Percutaneous endovascular exclusion of radial artery pseudoaneurysm. *ARYA Atheroscler* 2021;**17**:1–4.
5. Collins N, Wainstein R, Ward M, Bhagwande R, Dzavik V. Pseudoaneurysm after transradial cardiac catheterization: case series and review of the literature. *Catheter Cardiovasc Interv* 2012;**80**:283–287.
6. Dean SM, Olin JW, Piedmonte M, Grubb M, Young JR. Ultrasound-guided compression closure of postcatheterization pseudoaneurysms during concurrent anticoagulation: a review of seventy-seven patients. *J Vasc Surg* 1996;**23**:28–34. Discussion 34–35.
7. Khoury M, Rebecca A, Greene K, Rama K, Colaiuta E, Flynn L, et al. Duplex scanning-guided thrombin injection for the treatment of iatrogenic pseudoaneurysms. *J Vasc Surg* 2002;**35**:517–521.
8. Babunashvili AM, Pancholy SB, Kartashov DS. New technique for treatment of post-catheterization radial artery pseudoaneurysm. *Catheter Cardiovasc Interv* 2017;**89**: 393–398.
9. Lombardi M, Bianchini F, Romagnoli E, Paraggio L, Aurigemma C, Burzotta F, et al. Postcatheterization forearm artery pseudoaneurysm resolution in the context of subsequent PCI. *JACC Cardiovasc Interv* 2023;**16**:2178–2180.
10. Ferrante G, Condello F, Rao SV, Maurina M, Jolly S, Stefanini GG, et al. Distal vs conventional radial access for coronary angiography and/or intervention: a meta-analysis of randomized trials. *JACC Cardiovasc Interv* 2022;**15**:2297–2311.