Received: 25 January 2024 | Accepted: 1 March 2024

DOI: 10.1002/ccr3.8725

CASE REPORT

Clinical Case Reports Open Access WILEY

Radial artery pseudoaneurysm a rare complication after coronary angiography: A case report and systematic review of the reported cases

Nasser G. Alqahtani

Department of Internal Medicine, Cardiology Section, College of Medicine, King Khalid University, Abha, Saudi Arabia

Correspondence
Nasser G. Alqahtani, Department of Internal Medicine, Cardiology Section, College of Medicine, King Khalid University, Abha, Saudi Arabia.
Email: naser.32@hotmail.com

Key Clinical Message

This is a case of 83 years old male who had radial artery pseudoaneurysm after cardiac catheterization. The diagnosis was through Doppler ultrasound and the patient was treated with thrombin injection and reported good outcomes. The literature also included 41 cases of pseudoaneurysm after catheterization. The mean age of patients was 68.5 years with a male prevalence of 49%. Onset of pseudoaneurysm ranged from 0 days (directly after the catheterization) to 150 days with a median of 5 days. The treatment of patients was mainly surgical (19 cases) followed by compression (either manual or TR band) (12 cases), thrombin injection (four cases), compression then surgery (three cases), compression then thrombin injection (one case), percutaneous endovascular repair using a covered stent (one case) and not reported in one case. All cases recovered well.

KEYWORDS

cardiac catheterization, postcardiac intervention, radial artery pseudoaneurysm, thrombin injection

1 | INTRODUCTION

Since the discovery of cardiac catheterization, huge improvement has been noticed regarding the mortality, hospital stay, and discharge in many cardiac conditions.[1] Although many access sites can be used for the application of catheterization, access through the radial artery became the most preferred site until now. Such observation stems from the lower risk of complications such as bleeding, morbidity, mortality, and hospital length of stay.[2]

Many complications arose from the transradial (TR) access such as radial artery occlusion, spasm, perforation, arteriovenous fistula, granuloma, bleeding, pseudoaneurysm, neurological injury, and compartment syndrome.[3] The risk of pseudoaneurysm after the TR access seems to be low and estimated to be less than 1%.[4,5] The increasing number of puncture attempts, patients with high bleeding tendency, inadequate compression after catheterization, and the use of large sized sheath are reported to be risk factors for pseudoaneurysm development.[6] Pain and swelling along with the radial access site are considered the one of the manifestations of pseudoaneurysm which later confirmed by Doppler ultrasound examination.[7,8]

Herein, this report indicated our experience with one case of pseudoaneurysm development after cardiac catheterization in accordance with a literature review of the existed case reports.

2 | CASE HISTORY

An 83-years-old-male, who is known to have hypertension, hyperlipidemia, benign prostatic hypertrophy, and severe aortic stenosis awaiting trans-catheter aortic valve implantation (TAVI), came to our hospital for elective coronary angiogram as a part of pre TAVI assessment. The examination was normal regarding: temperature, heart rate, blood pressure, peripheral oxygen saturation, and neurological examination. Respiratory examination demonstrated minimal bibasilar crackles heard bilaterally. Cardiovascular examination showed normal 1st and 2nd heart sounds, S4 gallop, crescendo-decrescendo harsh systolic ejection murmur heard at the right 2nd intercostal space radiating to the carotids bilaterally, and minimal pitting lower limb edema. All the laboratory data were normal including complete blood picture, renal and liver function tests and troponin levels; except for a high Pro-BNP value (1161.0 pg/mL). The patient was also negative for human immunodefieincy virus and hepatitis C and B viruses.

After the injection lidocaine 1% local anesthesia and the intravenous injection of 5000 unit heparin, a 6Fr sheath was placed in the right radial artery using modified Salinger technique. Selective coronary arteriography was then performed using a 5Fr JR4 diagnostic catheter to engage the right coronary artery and 5Fr JL3.5 diagnostic catheter to engage the left coronary artery. Right and left coronary angiographies were performed in multiple views by hand injections of contrast. Following the procedure, the sheath was removed and hemostasis was achieved by using TR Band at 10 cc of air.

Two days post angiography the patient was presented to our hospital complaining from small bulge in the wrist associated with pain.

3 | METHODS

Local hand examination showed a right wrist swelling associated with redness and pain, intact pulses with no coldness or paresthesia. Sonography indicated an oval heterogeneous structure in the right lateral wrist measuring 3.31 × 1.58 cm, demonstrated swirling flow of PS of 83 cm/s as evident by different color signal within the lesion (yin yang sign) in Doppler US with a narrow neck measuring 0.15 cm communicates with the distal radial artery (Figure 1). The findings were consistent with partially thrombosed pseudoaneurysm arising from the distal radial artery. Using ultrasound guidance, sterile technique and local anesthetic, a 25-gauge needle was advanced into the right radial artery pseudoaneurysm, targeting the anterior portion, 0.2 mL of 1000 units of thrombin mixed with normal saline was injected.

4 | CONCLUSION AND RESULTS

Post injection imaging showed no color flow of the pseudoaneurysm. The patient was discharged and followed for 1 month with no apparent complications.

5 | DISCUSSION

A literature search was performed in five databases until 28th July 2023: Virtual Health Library (59),

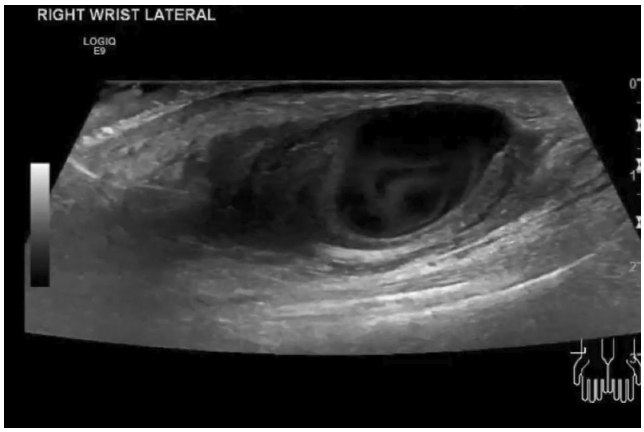

FIGURE 1 Yin-Yang sign of pseudoaneurysm.

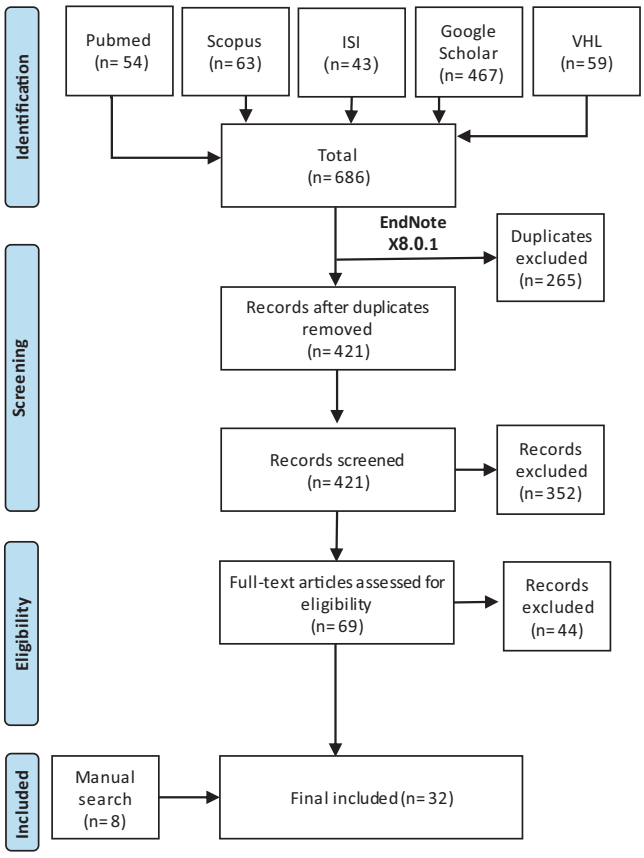

FIGURE 2 PRISMA flow diagram.

TABLE 1 Representing the reported cases in the literature.

Study ID	Country	Sex	Age	Cardiac presentation	Comorbidity	Onset of pseudoaneurysm (days)	Treatment
Prakash-2021	India	Male	82	Myocardial infarction	-	2	Compression then surgery
Gallinoro-2019	Italy	Female	84	Severe aortic stenosis	Breast cancer, chronic hepatitis- C-virus infection, hypertension and permanent atrial fibrillation	4	Compression then surgery
Inan-2011	Turkey	Male	65	Anterior ischemia in the electrocardiogram	Aortic dissection	7	Surgery
Suchoń-2013	Poland	Female	85	Left bundle branch block, atrial fibrillation and acute cardiac syndrome	Hypertension	2	Compression
Bolt-2022	USA	Male	42	Preoperative cardiac evaluation	Bicuspid aortic valve with severe aortic stenosis		Surgery
Iftikhar-2019	USA	Female	82	Acute thrombus in the distal posterior descending artery (PDA) and posterior left ventricular (PLV) branch.	Hypertension and atrial fibrillation	1	Compression
Babunashvili-2017	Russia	Male	68	Class III angina	MI, persistent atrial fibrillation, hypertension, and moderately depressed left ventricular function	2	Surgery
Alerhand-2018	USA	Female	57	Atrial fibrillation	NSTEMI	5	Surgery
Barıs-2016	Turkey	Female	73	Refractory angina pectoris	Atrial fibrillation	10	Compression then surgery
Bauer-2014	Germany	Male	65	Acute coronary syndrome	Coronary heart disease, hypertension and diabetes mellitus	3	TR compression then thrombin injection
Blasco-2005	Spain	Male	55	Myocardial infarction	Metallic mechanical mitral and tricuspid prostheses	1	TR compression band
Cauchi-2014	USA	Male	45	Myocardial infarction	–	0	TR compression band
Bhat-2013	USA	Female	80	Acute decompensation of heart failure	Hypertension and smoker	10	Surgery
Collins-2012	Australia	Female	82	–	Mechanical aortic and mitral valve replacement and previous coronary artery bypass grafting	14	Surgery
		Female	58	–	Mechanical mitral valve prosthesis	60	Surgery
		Male	44	–	–	2	Surgery
		Female	61	–	Coronary artery bypass grafting on a background of diabetes mellitus and obesity	7	Surgery
		Female	66	–	Hypertension, obesity and obstructive sleep apnea	1	Compression
Ghanavati-2016	Iran	Male	32	Anterior ST-elevation myocardial infarction	-	60	TR compression band

(Continues)

TABLE 1 (Continued)

Study ID	Country	Sex	Age	Cardiac presentation	Comorbidity	Onset of pseudoaneurysm (days)	Treatment
Hamid-2012	UK	Female	83	Acute coronary syndrome	Paroxysmal atrial fibrillation, moderate aortic valve stenosis, with preserved left ventricular function and chronic stable angina	1	Surgery
		Female	80	Acute coronary syndrome	Type 2 diabetes and hypertension	2	Surgery
Kiat-2022	Singapore	Female	76	Acute coronary syndrome	Diabetes, hypertension, and hyperlipidemia	5	Surgery
Kis-2021	Turkey	Female	78	Chronic ischemia	Hypertension and coronary artery disease	1	Compression
Korabathina-2015	USA	Male	56	Acute coronary syndrome	Diabetes mellitus and multi-vessel coronary artery disease	150	Compression
Korngold-2023	USA	Male	45	Acute coronary syndrome	Hypertension	3	Surgery
Maeba-2021	Japan	Male	71	Angina pectoris	Angina pectoris	1	Surgery
Mohamed-2015	UK	Female	85	Stable angina	Inferior myocardial infarction, hypertension and hypothyroidism	0	Thrombin injection
Pacha-2017	USA	Female	67	Preoperative cardiac evaluation	Severe mitral regurgitation	1	Thrombin injection
Molina-López-2021	USA	Male	82	Non-ST Elevation Myocardial Infarction (NSTEMI).	Atherosclerosis, coronary artery disease, atrial fibrillation treated with apixaban, diabetes mellitus type II, hyperlipidemia, chronic kidney disease stage III, and hypertension	21	TR compression band
Nykl-2022	Czech Republic	Female	60	Coronary arterial disease	Pulmonary hypertension, high blood pressure, dyslipidemia, sleep apnea syndrome, paroxysmal atrial fibrillation and thyroid goiter with normal function	72	Surgery
Papadoulas-2022	Greece	Male	83	Mild coronary disease	Smoker, arterial hypertension and hyperlipidemia	7	Surgery
Sharma-2021	USA	Female	77	Worsening angina	Atrial fibrillation on apixa-ban, systolic heart failure, and chronic stable angina	120	Surgery
ÜNAL-2015	Turkey	Male	42	Preoperative cardiac evaluation	–	60	Surgery
Tsiafoutis-2018	Greece	Male	65	Acute coronary syndrome	Hypertension and atrial fibrillation	7	Percutaneous endovascular repair using a covered stent
Wu-2019	USA	Female	75	Unstable angina	Coronary artery disease, end-stage renal disease on dialysis, paroxysmal atrial fibrillation	2	TR compression band
Williams-2009	UK	Female	79	-	–	5	Surgery
Zegrri-2015z	Spain	Male	55	–	–	15	Compression
		Male	76	–	–	5	Thrombin injection
		Male	79	–	–	4	
		Male	88	–	–	17	Thrombin injection
		Female	81	–	–	10	Compression

PubMed (54), Google Scholar (467), Web of Science (43) and Scopus (63). The following keywords were used for the search: "radial artery pseudoaneurysm," "post catheterization" "post cardiac catheter" "post percutaneous coronary intervention" "post PCI" "post coronary intervention" "catheterization" "catheter." Any case report that reported pseudoaneurysm of the radial artery following catheterization was included. Exclusion criteria: reviews, abstract only articles and nonrelevant articles were excluded. The literature included 41 patients from 32 case reports (Figure 2 and Table 1).[6,8–38] The mean age of patients was 68.5 years with a male prevalence of 49%. Onset of pseudoaneurysm ranged from 0 days (directly after the catheterization) to 150 days with a median of 5 days. The treatment of patients was mainly surgical (19 cases) followed by compression (either manual or TR band) (12 cases), thrombin injection (four cases), compression then surgery (three cases), compression then thrombin injection (one case), percutaneous endovascular repair using a covered stent (one case) and not reported in one case. All cases recovered well. This is the first reported case in the Middle East region that developed pseudoaneurysm after cardiac catheterization. Few case reports had discussed the development of radial artery pseudoaneurysm post cardiac catheterization in the current literature. Most of the reported cases came from high, upper, or lower middle income countries which indicated a high quality of care towards patients as well as performing more interventional procedure compared to resource limited settings presented in low income countries where surgery remains the main therapeutic strategy.[39] Of the reported 41 patients from the literature and by including our case report, pseudoaneurysm prevalence was equal in both males and females. Such observation is crucial for health care professional as vascular complications were reported to be higher in females rather than males.[40]

The onset of presentation of pseudoaneurysm is variable among the existed case reports with a median of 5 days from the 41 reports. In our case, the onset of development was 2 days post cardiac catheterization. The case report of Cauchi et al, demonstrated that pseudoaneurysm developed in a 45 years old male directly after finishing the procedure and presented with sharp pain.[8] However, the onset may be delayed to reach 4 months post interventional cardiac procedure that was reported by Sharma et al, in a 77 years old female.[33] Interestingly, the 56 years old male that was reported by Korabathina et al, had developed pseudoaneurysm after 5 months of performing cardiac stenting through the radial access.[25] Per se, follow up of the patient for local complications in the access site is still of paramount interest by the clinicians as the vascular complications may be presented months after the intervention. For the best of our knowledge, such delay should be under investigation in the future studies where precipitating factors may play a role in pseudoaneurysm presentation months after the procedure.[25,33] Carrying a heavy object was a triggering factor for inducing pseudoaneurysm in a 32 years old male after 2 months of the catheterization.[21] Though, detailed history taking could solve the mystery of why pseudoaneurysm may develop months after the catheterization.

Surgery was the main therapeutic strategy in treating pseudoaneurysm in almost half of the reported cases. This was followed by manual compression or TR band compression as the second most common reported therapy. However, few cases reported the use of thrombin for treating such complications.[29,30] Our patient was successfully treated with thrombin injection and favorable outcome was achieved. Additionally, thrombin injection was reported as a backup treatment after failing of compression technique in the case report of Bauer et al.[18] The choice of choosing thrombin injection in the treatment of pseudoaneurysm should be considered as an alternative approach to the surgical technique. While weighting the risks and benefits of applying this treatment strategy should be used wisely by the treating physicians especially in patients with a high risk of bleeding tendency.

In all the reported case reports, no patient had developed severe complications after pseudoaneurysm treatment by different treatment strategies. Indeed, one patient had suffered from paresthesia postsurgical treatment.[6] And another patient had asymptomatic radial occlusion after using compression technique as a treatment strategy.[38] This indicates the good outcomes of pseudoaneurysm when treated with many therapeutic techniques.

Pseudoaneurysm of the radial artery after the cardiac catheter is considered a rare event. Curious follow up of the patients especially those who reported local symptoms in the access site is recommended. Furthermore, choosing the best technique for treating such event should be wise according to the general health status of each patient.

AUTHOR CONTRIBUTIONS

Nasser G. Alqahtani: Conceptualization; data curation; investigation; methodology; project administration; resources; validation; writing – original draft.

ACKNOWLEDGMENTS

None.

FUNDING INFORMATION

None.

CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

Data regarding this submission can be requested from the corresponding author upon reasonable request.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

ORCID

Nasser G. Alqahtani https://orcid.org/0000-0003-2302-2651

REFERENCES

1. Naidu SS, Abbott JD, Bagai J, et al. SCAI expert consensus update on best practices in the cardiac catheterization laboratory: this statement was endorsed by the American College of Cardiology (ACC), the American Heart Association (AHA), and the Heart Rhythm Society (HRS) in April 2021. *Catheter Cardiovasc Interv*. 2021;98(2):255-276.
2. Valgimigli M, Gagnor A, Calabró P, et al. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomised multicentre trial. *Lancet*. 2015;385(9986):2465-2476.
3. Aoun J, Hattar L, Dgayli K, Wong G, Bhat T. Update on complications and their management during transradial cardiac catheterization. *Expert Rev Cardiovasc Ther*. 2019;17(10):741-751.
4. Sanmartín M, Cuevas D, Goicolea J, Ruiz-Salmerón R, Gómez M, Argibay V. Vascular complications associated with radial artery access for cardiac catheterization. *Revista Española de Cardiología*. 2004;57(6):581-584.
5. Tatli E, Buturak A, Cakar A, 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(3):305-312.
6. Collins NW, Rodrigo Ward, Michael Bhagwandeen, Rohan Dzavik Vladimir, Pseudoaneurysm after transradial cardiac catheterization: case series and review of the literature. *Catheter Cardiovasc Interv* 2012;80(2):283–287.
7. Liou M, Tung F, Kanei Y, Kwan T. Treatment of radial artery pseudoaneurysm using a novel compression device. *J Invasive Cardiol*. 2010;22(6):293-295.
8. Cauchi MPR, Paul M, Zemple RP, Ball TC. Radial artery pseudoaneurysm: a simplified treatment method. *J Ultrasound Med*. 2014;33(8):1505-1509.
9. Prakash B, Mukhopadyay S, Singodia P, Shah MM. Radial artery Pseudoaneurysm following cardiac catheterization: a case report. *Cureus*. 2021;13(11):e19284.
10. Gallinoro E, Natale F, D'Elia S, Golino P, Cimmino G, Radial pseudoaneurysm in elderly: a rare event with undefined therapeutical approach. A case report and literature review. *Monaldi Arch Chest Dis* 2019;89(3):3.
11. Suchoń EJ, Dykla J, Depukat D, Krochin R, Matysek M. Radial artery pseudoaneurysm as an extremely rare complication associated with transradial catheterisation. *Kardiol Pol*. 2013;71(5):542:542.
12. Bolt RJ, Ssm J, Siegel TS, Werns S. A concurrent Pseudoaneurysm and an arteriovenous fistula following percutaneous radial artery access. *Cureus*. 2022;14(11):e31207.
13. Inan MB, Acikgoz B, Yazicioglu L, Kaya B, Ozyurda U. A rare complication of radial artery catheterization. *Vascular*. 2011;19(3):167-169.
14. Iftikhar S, Jamil A, Savoj J, Hu P. Noninvasive treatment approach of radial pseudoaneurysm. *Cardiol Res*. 2019;10(2):131-134.
15. Babunashvili AMP, Samir B, Kartashov DS. New technique for treatment of postcatheterization radial artery pseudoaneurysm. *Catheter Cardiovasc Interv*. 2017;89(3):393-398.
16. Alerhand S, Apakama D, Nevel A, Nelson BP. Radial artery pseudoaneurysm diagnosed by pointof- care ultrasound fi ve days after transradial catheterization: a case report. *World J Emerg Med*. 2018;9(3):223-226.
17. Barış V. *Radial Artery Pseudoaneurysm after Transradial Coronary Angiogram: A Mostly Overlooked Complication*. Ankara Üniversitesi Tıp Fakültesi Mecmuası; 2016.
18. Bauer P, Koshty A, Hamm CW, Gündüz D. Ultrasound guided percutaneous thrombin injection in a radial artery pseudoaneurysm following percutaneous coronary intervention. *Clin Res Cardiol*. 2014;103(12):1022-1024.
19. Blasco A, Oteo JF, Fontanilla T, Salamanca J, Ocaranza R, Goicolea J. Unusual complications of cardiac catheterization via the radial artery. *Rev Esp Cardiol*. 2005;58(10):1233-1235.
20. Bhat T, Bhat H, Teli S, Rajiv B, Akhtar M, Gala B. Pseudoaneurysm a rare complication of transradial cardiac catheterization: a case report. *Vascular*. 2013;21(5):331-334.
21. Ghanavati R, Arab Ahmadi M, Behnam B. Successful nonsurgical treatment of a radial artery Pseudoaneurysm following Transradial coronary angiography. *J Tehran Heart Cent*. 2017;12(2):82-84.
22. Hamid T, Harper L, Mcdonald J. Radial artery pseudoaneurysm following coronary angiography in two octogenarians. *Exp Clin Cardiol*. 2012;17(4):260-262.
23. Kiat JTCL, Wong A, Tang S, Chee C. When one complication begets another–a case report of radial artery pseudoaneurysm following radial artery occlusion post-transradial coronary angiography. *J Cardiol Cases*. 2020;22(2):52-54.
24. Mehmet KS. Elton. Radial artery Pseudoaneurysm as a rare complication after Transradial coronary angiography. *Anatolian Clinic J Med Sci*. 2020;26(2):221-224.
25. Korabathina RE, Coppola D, John T. Delayed occurrence of radial artery pseudoaneurysm following transradial percutaneous coronary intervention. *J Cardiol Cases*. 2015;11(4):117-119.
26. Korngold ECW, Ullery DE, Brant W. Left distal radial artery access-site Pseudoaneurysm treated with open surgical repair. *J Soci Cardiovasc Angio Interv*. 2023;2:101047.
27. Maeba T, Urata H, Nagata K, et al. Pseudoaneurysm and arteriovenous fistula in the radial artery after cardiac catheterization: a case report. *Plast Reconstr Surg Glob Open*. 2022;10(1):1.

28. Molina-Lopez V, Nieves-La Cruz C, Llopart-Herrera L, Mirabal-Arroyo J. Successful treatment of radial artery Pseudoaneurysm after Transradial cardiac catheterization with continuous compression therapy by a TR band® radial compression device. *Cardiovasc Revascul Med*. 2021;28S:227-231.
29. Mohamed MO, Saif M, Townend JN, Khan SQ. Successful treatment of a radial artery pseudoaneurysm in an octogenarian. *BMJ Case Rep*. 2015;4:1.
30. Moussa Pacha HA, Soud MC, Bernardo M, Nelson L. Minimally invasive intervention of radial artery pseudoaneurysm using percutaneous thrombin injection. *Eur Heart J*. 2018;39(3):257.
31. Nykl RP, Jan Spacek, Milos Sluka, Martin Hudec, Stepan Heinc, Petr Taborsky Radial artery pseudoaneurysm as a rare very late complication of transradial cardiac catheterization. *Biomedical Papers of the Medical Faculty of the University Palacky*. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2021;165(4):452–453.
32. Papadoulas SI, Tsantrizos P, Kouri N, et al. A case report of surgical repair of a post-catheterization radial pseudoaneurysm. *Pan Afr Med J*. 2022;41(1):261.
33. Sharma RPP, Catanzaro JN. Late massive radial artery pseudoaneurysm following cardiac catheterization: a case report. *Int J Surg Case Rep*. 2021;81:105774.
34. Unal E, Turkcan A, Soran B, Anıl O, Sabit KS, Ahmet S. A Very Rare Complication of Trans-Radial Cardiac Catheterization: Radial Artery Pseudoaneurysm: Case Report.
35. Tsiafoutis IZ, Koutouzis T, Katsivas M. Apostolos Percutaneous endovascular repair of a radial artery Pseudoaneurysm using a covered stent. *JACC Cardiovasc Interv*. 2018;11(11):e91-e92.
36. Wu LH, Berookhim F, Ratcliffe J, Puma J. Development and treatment of two distinct pseudoaneurysms following transradial coronary catheterization in a patient with high bleeding risk: a case report. *J Med Case Rep*. 2019;13(1):282.
37. Williams PDE, Eccleshall S. Delayed presentation of radial artery pseudoaneurysm secondary to catheter trauma during percutaneous coronary intervention. *Heart*. 2009;95(13):1084.
38. Zegrí IG-T, Cuenca A, Oteo S, Fernández-Díaz JF, Gj JA. Radial artery pseudoaneurysm following cardiac catheterization: clinical features and nonsurgical treatment results. *Rev Esp Cardiol*. 2015;68(4):349-351.
39. Landon BE, Hatfield LA, Bakx P, et al. Differences in treatment patterns and outcomes of acute myocardial infarction for low- and high-income patients in 6 countries. *JAMA*. 2023;329(13):1088-1097.
40. Ebeed MES, Khalil NS, Ismaeel MS. Vascular complications and risk factors among patients undergoing cardiac catheterization. *Egyptian Nursing Journal*. 2017;14(3):259.

How to cite this article: Alqahtani NG. Radial artery pseudoaneurysm a rare complication after coronary angiography: A case report and systematic review of the reported cases. *Clin Case Rep*. 2024;12:e8725. doi:10.1002/ccr3.8725