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Transaneurysmal Suturing of Pseudoaneurysm Neck: Novel and Not a Pseudo-Technique for Treatment of Complicated Femoral Pseudoaneurysm

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Abstract

Introduction Femoral pseudoaneurysm is one of the common complications following femoral artery catheterization. It poses a significant morbidity and a nonsurgical technique with the utmost low complication risk is warranted. Various methods have been used to treat these pseudoaneurysms including manual compression, ultrasound-guided compression, and percutaneous injection of thrombin or glue. Various novel methods are also being used to treat the pseudoaneurysms, including angioseal closure device, vascular plugs, etc. Cirrhosis poses a separate challenge with deranged coagulation and hyperfibrinolysis, making traditional methods, which are dependent on patients' coagulation cascade, less effective.

Materials and Methods We used a novel technique to treat the complicated femoral pseudoaneurysm using a suture-mediated closure device, Perclose ProGlide system (Abbott Vascular, California, United States). The transaneurysmal approach was used in seven patients. All the patients had acute or chronic liver disease with deranged coagulation. Six patients had femoral arterial access for angiographic procedure while one had a femoral line for intensive care unit monitoring. Compression was done in all the patients, but failed. Percutaneous injection of thrombin was done in two patients.

Results Technical success was achieved in 7/7 (100%) patients. There was instantaneous thrombosis of the pseudoaneurysm, which was confirmed the next day by ultrasound. There were no procedure-related complications.

Conclusion Transaneurysmal closure of the femoral pseudoaneurysm using suture-mediated closure device is a novel and effective, minimally invasive bedside technique that can be used in patients with deranged coagulation.

Keywords
- femoral pseudoaneurysm
- transaneurysmal
- vascular closure device
- ProGlide

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Introduction

Femoral pseudoaneurysm (PSA) is one of the common complications following femoral artery catheterization, either for arterial procedures or arterial line placement for monitoring.[1] The incidence of PSAs has been reported between 0.2 and 8%; however, considering the number of patients undergoing arterial procedures, the burden is significant.[2–4]

Various methods have been used to treat the PSAs including ultrasound or stethoscope-guided compression, percutaneous injection of thrombin, coils, n-butyl cyanoacrylate glue, and placement of stent graft.[5–9] Direct thrombin injection is the most widely accepted and used treatment for the PSA, however, failures do occur and some require surgery. Various innovative techniques have also been used to treat these PSAs, like the use of vascular plugs and vascular closure devices, as these are quick and effective ways to tackle the PSAs.[10–12]

Presence of chronic liver disease (CLD) poses a separate set of challenges with deranged coagulation and hyperfibrinolysis resulting in increased incidence of PSAs and also making their treatment challenging.[13] The traditional methods of treatment of PSA that depend on the patient's coagulation cascade are less effective in patients with CLD.

Perclose ProGlide system (Abbott Vascular Devices, Redwood City, California, United States) is a suture-mediated closure device (SMCD) used for closure of femoral arterial access sites and leads to healing with primary intention. Transaneurysmal use of SMCD for the treatment of PSA has been described; however, published data are limited.[12,14] This article aims to describe the method of percutaneous suturing of femoral PSA in patients with deranged coagulation using SMCD.

Materials and Methods

Patient Population

Between January 2023 and December 2023, seven consecutive patients were included who developed femoral artery PSA postcatheterization. All the patients had some form of coagulation abnormality in the form of CLD or thrombocytopenia. Pressure banding was employed in all the cases. Two patients had significant groin hematoma reaching up to the upper thigh. Two patients were initially managed with percutaneous thrombin injection (►**Fig. 1**), which resulted in complete thrombosis. However, there was recanalization and subsequently ProGlide was used to successfully obliterate the PSA.

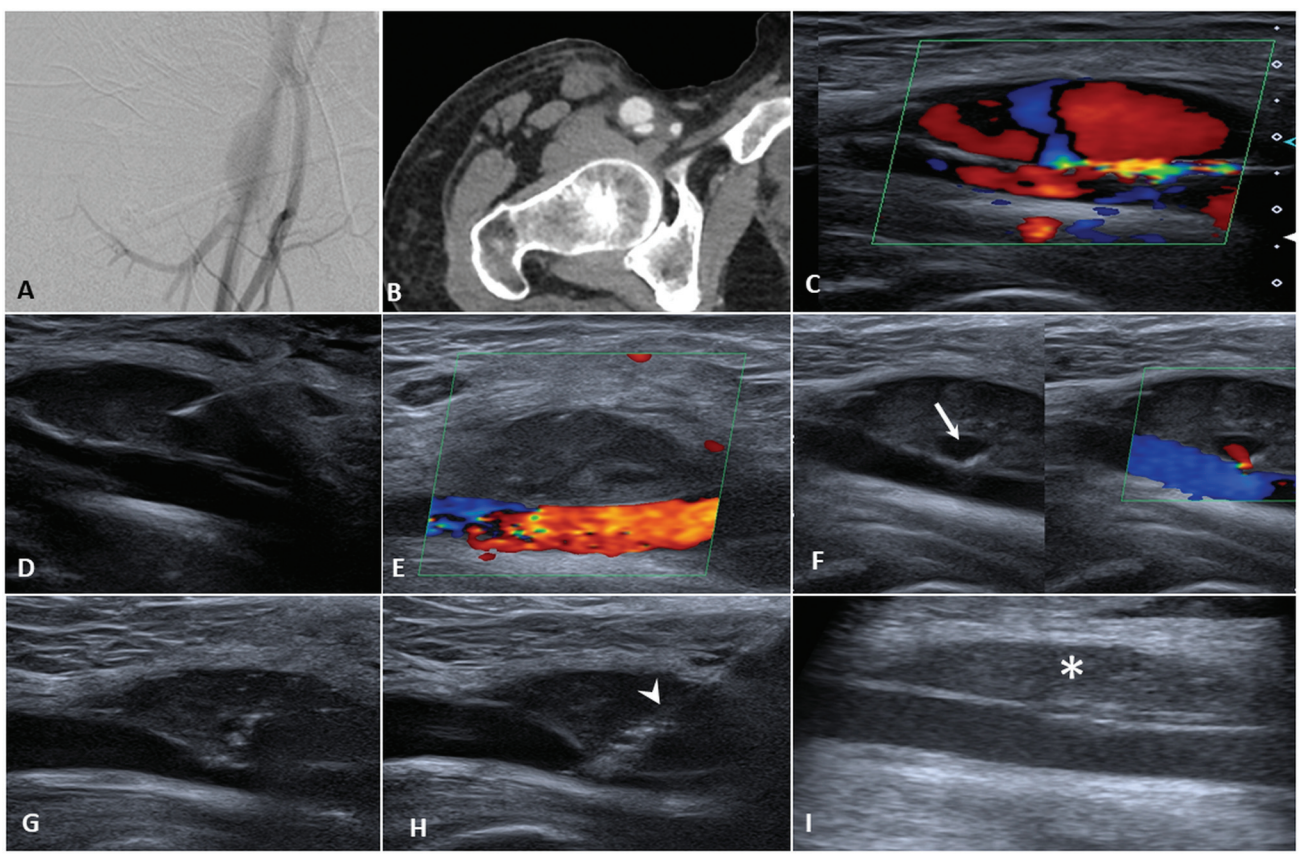

Fig. 1 Digital subtraction angiography (**A**), computed tomography (CT) angiography (**B**), and color Doppler (**C**) image shows a dissecting pseudoaneurysm (PSA) arising from the superficial femoral artery (SFA). Thrombin injection done after balloon occlusion of the SFA (**D**), which shows complete thrombosis of the PSA (**E**). However, ultrasound and color Doppler done on the next day shows recanalization of the PSA with a small sac (white arrow in **F**). Transaneurysmal suturing of the neck done (**G** and **H**). Micropuncture needle (arrowhead in **G**) and closure device (arrowhead in **H**) is seen through the PSA into the SFA. Complete thrombosis of the PSA seen subsequent to the suturing (asterisk in **I**).

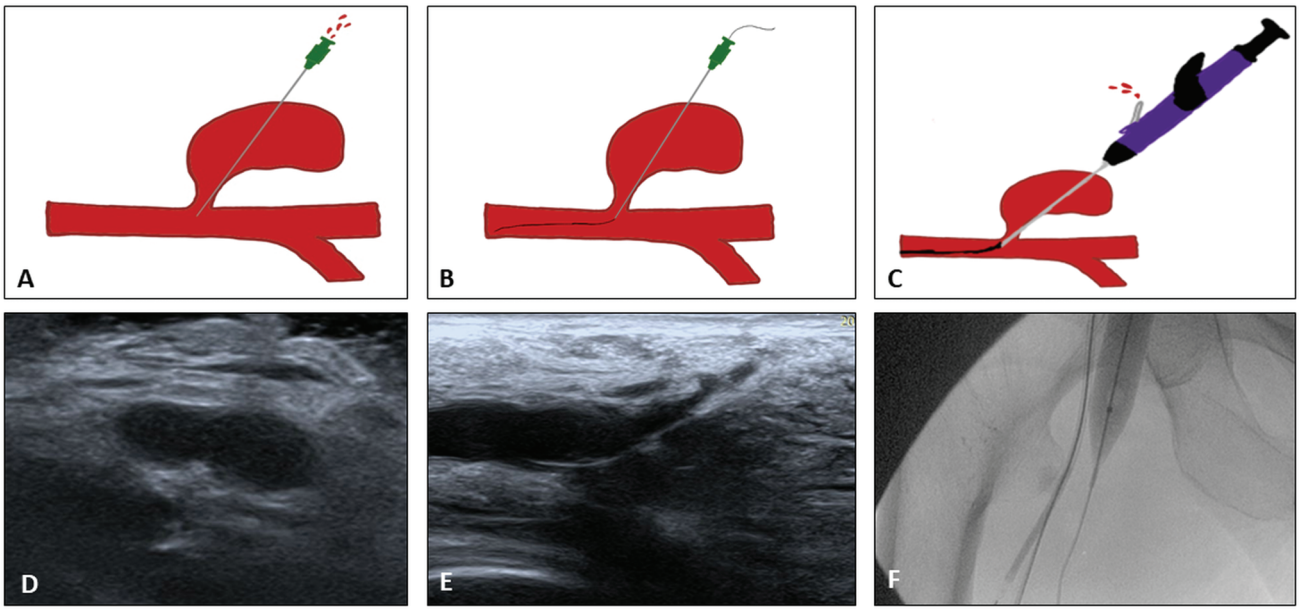

Fig. 2 Technique of transaneurysmal suturing of the pseudoaneurysm (PSA). Schematic diagram (**A**–**C**) and corresponding ultrasound and fluoroscopy image (**D**–**F**). Neck of the PSA is accessed using 21G micropuncture needle through the PSA sac (**A** and **D**). Guidewire is passed through the needle (**B** and **E**). The microguidewire is then exchanged for 0.035" guidewire and suture-mediated closure device is placed over the guidewire (**C** and **F**).

Procedure

All the procedures were done in a digital subtraction angiography suite; however, fluoroscopy was employed as per needed in two cases. Sterile draping was done and local anesthesia was administered. The neck of the PSA was punctured using a 21G, 7 cm micropuncture needle (►**Fig. 2A, D**) under ultrasound guidance and the needle was advanced within the femoral artery lumen through the neck or just adjacent to it. In cases of groin hematoma, the puncture was made through the hematoma keeping

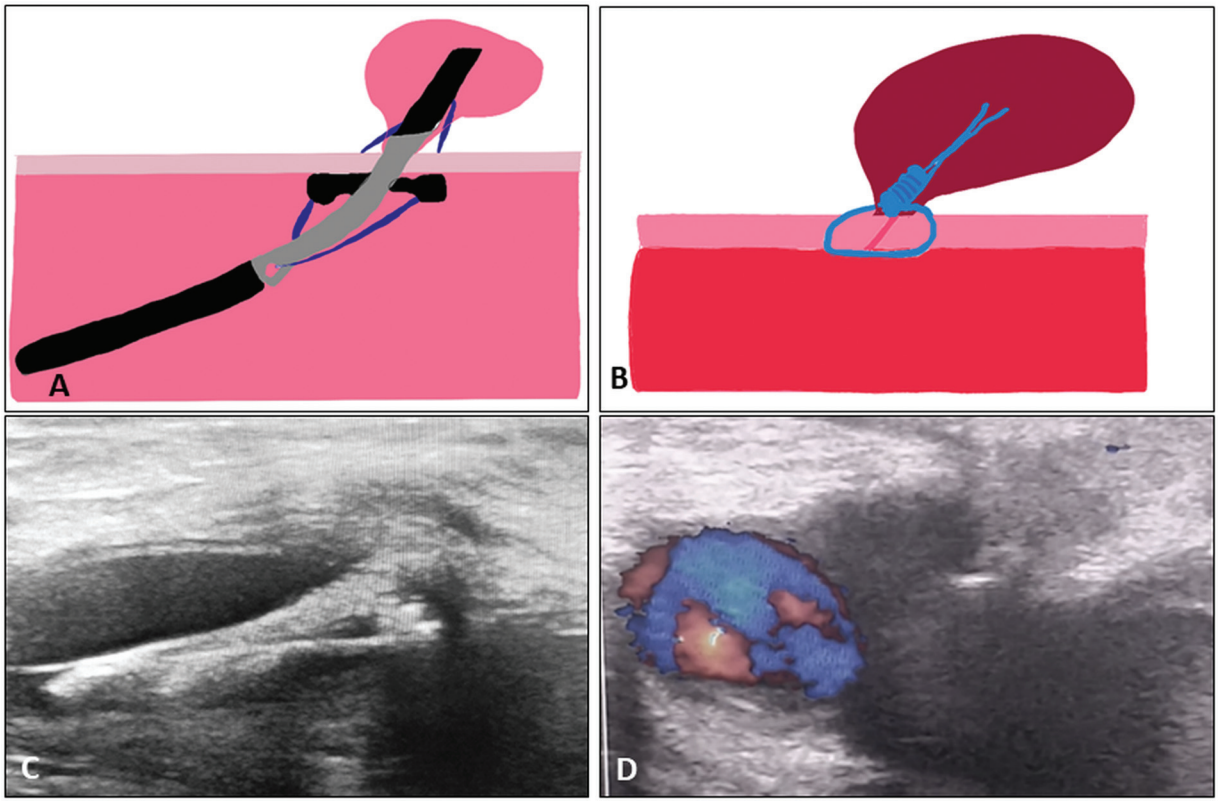

Fig. 3 Technique of transaneurysmal suturing of pseudoaneurysm (continued from Fig. 1). The footplate of the device is opened and engaged at the neck of the pseudoaneurysm (**A** and **C**). The knot is then tightened and cut with complete obliteration of the pseudoaneurysm (**B** and **D**).

the needle tract straight. A microguidewire (0.018") was introduced through the needle into the femoral artery (►**Fig. 2B, E**) and the position was confirmed on ultrasound or fluoroscopy. The 5F introduced sheath was then inserted over the guidewire and a 0.018" guidewire was exchanged for 0.035" J-tip stiff access guidewire. Over the guidewire, a 6F SMCD was introduced into the common femoral artery (CFA) till there was arterial spurt from the side port, which confirmed the location of the SMCD into the artery, which was also confirmed on ultrasound (►**Fig. 2C, F**). Since the SMCD has a hydrophilic coating, it easily tracks over the guidewire and no resistance was encountered. Care was taken to keep the SMCD at a 45-degree angle to the horizontal for smooth entry into the artery. The footplate was then opened and the device withdrawn till the spurt stopped (►**Fig. 3A, C**), confirming the engagement of the footplate at the neck. The suture was then deployed and the device removed. The suture was tightened and cut close to the arterial wall using the knot pusher available with the device (►**Fig. 3B**). Ultrasound was done immediately to confirm cessation of flow within the PSA (►**Fig. 3D**), as well as to confirm flow in the CFA and superficial femoral artery (SFA). Ultrasound was also done on the next day to confirm the thrombosis of the PSA.

Results

Technical success was attained in 100% of the patients. There were no procedure-related complications. No patient required surgery for the PSA. Ultrasound done on the next day confirmed complete thrombosis of the PSA and normal flow in the CFA and SFA distal to the PSA. All the patients had some coagulation abnormality either associated with CLD (6/7) or thrombocytopenia associated with dengue hemorrhagic fever. Five patients had 6F sheath for arterial procedure, one had 5F monitoring catheter, and one had 7F venous sheath for hepatic pressure measurement with inadvertent puncture of the CFA. The patient developed PSA from the CFA and an arteriovenous fistula communicating CFA and common femoral vein (►**Fig. 4A–D**). The femoral PSA was occluded using the SMCD

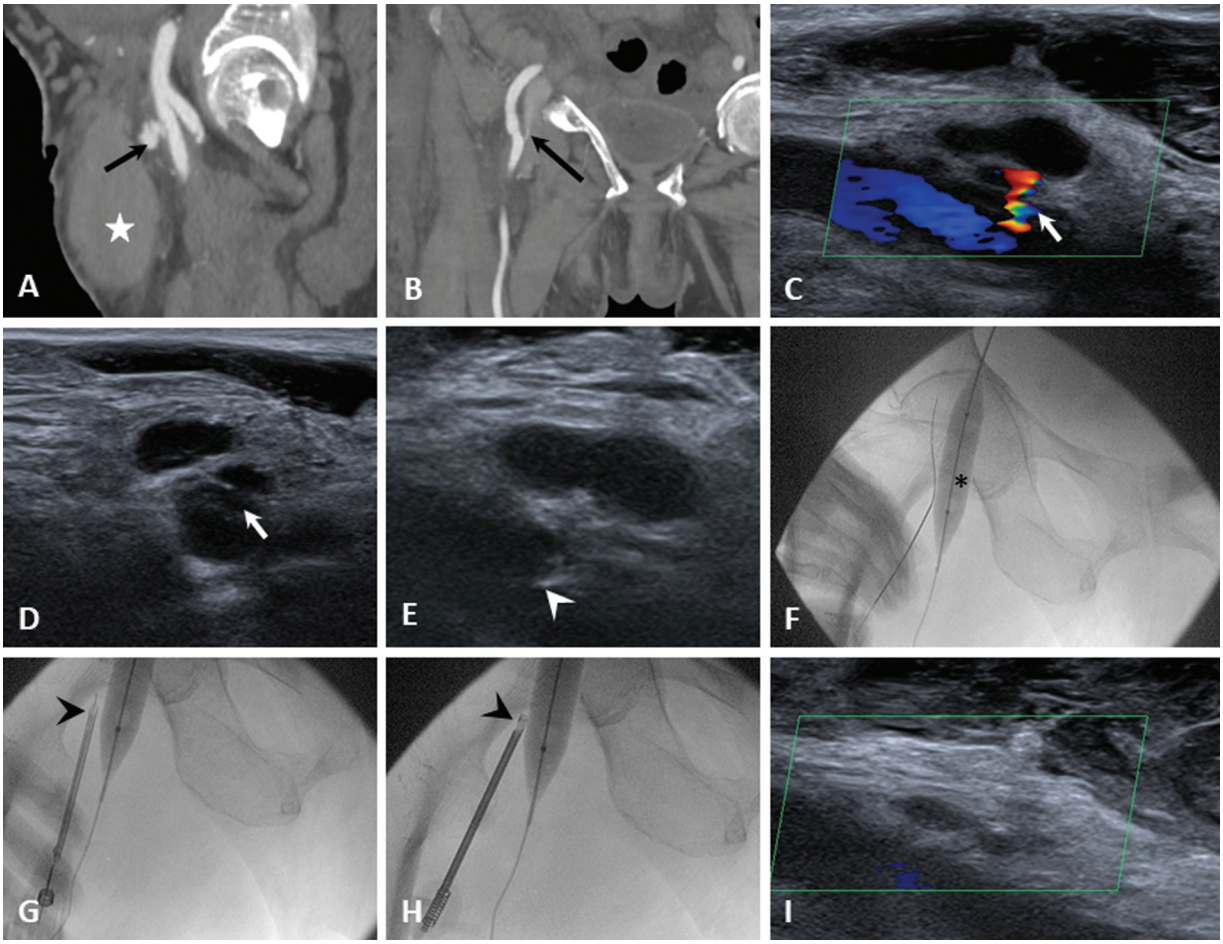

Fig. 4 Case of femoral pseudoaneurysm (PSA) and arteriovenous fistula (AVF) secondary to femoral vein sheath placement. Sagittal computed tomography (CT) angiography (**A**) shows a lobulated PSA arising from the common femoral artery (CFA) (black arrow) with a large groin hematoma (star in **A**). Coronal image (**B**) shows fistulous communication between the CFA and common femoral vein (long black arrow). Ultrasound image with color Doppler (**C**) and gray scale (**D**) shows lobulated PSA arising from the CFA with narrow neck (white arrow). Using ultrasound guidance, the neck of the PSA was targeted using 21G micropuncture needle (arrowhead in **E**). Fluoroscopic spot image (**F**) shows the micropuncture needle and guidewire in the CFA. Balloon (asterisk) is seen in the common femoral vein to obliterate the fistula. Fluoroscopic spot images (**G** and **H**) shows the closure device in **G** and knot pusher in **H** (black arrowheads). Post-device closure, there is complete thrombosis of the PSA (**I**). The AVF was kept on follow-up and showed spontaneous resolution after a few weeks.

Table 1 Patient characteristics

No.	Age/ Sex	Disease	Procedure	PSA size (mm)	Prior treatment	Sheath size	CTP	MELD Na	INR	Platelets (× 1,000)	Outcome
Case 1	43/M	ACLF (ethanol)	Circumflex iliac embolization	25 × 32	Compression	6F	11	23	1.88	51	Success
Case 2	48/M	CLD (cryptogenic)	TACE	24 × 38	Compression	6F	7	16	0.92	158	Success
Case 3	36/F	DHF	Arterial line	10 × 15	Compression	5F	9	18	1.32	38	Success
Case 4	36/M	ACLF (ethanol)	SMA PSA Embolization	37 × 12	Compression thrombin	6F	9	20	1.74	33	Success
Case 5	69/F	CLD NASH	Femoral line for HVPG	20 × 15	Compression	7F	8	18	1.6	87	Success
Case 6	26/M	DILI	Hepatic Art. embolization	4 × 6	Compression	6F	9	22	1.05	77	Success
Case 7	72/M	NASH CLD	TACE	12 × 7	Compression thrombin	6F	9	22	1.51	64	Success

Abbreviations: ACLF, acute on chronic liver failure; CLD, chronic liver disease; CTP, Child-Turcotte-Pugh; DHF, dengue hemorrhagic fever; DILI, drug-induced liver injury; F, female; HVPG, hepatic venous pressure gradient; INR, international normalized ratio; M, male; MELD Na, Model for End-stage Liver Disease-Sodium; NASH, nonalcoholic steatohepatitis; PSA, pseudoaneurysm; SMA, superior mesenteric artery; TACE, transarterial chemoembolization.

using the standard technique (►**Fig. 4E–I**). Since the sheath size was small (5–7F), all the PSAs had narrow necks measuring 2 to 3 mm. Patient characteristics and treatment-related data are summarized in ►**Table 1**.

Discussion

PSA postfemoral artery catheterization is an infrequent complication; however, considering the number of arterial catheterizations done worldwide, the absolute number is substantial, thus warranting safe and effective treatment.[4] Percutaneous thrombin injection was first proposed by Cope and Zeit in 1986 and since then has been the mainstay of treatment.[15] However, the presence of CLD with deranged coagulation and hyperfibrinolysis poses a separate set of challenges as the techniques dependent on patient's coagulation is less effective. Therefore, mechanical obliteration of the PSA neck with a SMCD is a promising technique especially with comorbidities and deranged coagulation.

In the current study, there was 100% success with immediate obliteration of the PSA without any complications. Two patients underwent percutaneous thrombin injection (patient 4) prior to the use of SMCD. The PSA was thrombosed on the day of the procedure; however, recanalization of the PSA was seen subsequently. Another patient (patient 6) did not have any PSA or hematoma after transarterial embolization of active hepatic extravasation and came with PSA after 1 month. These suggest hyperfibrinolysis in patients with CLD and the PSAs were effectively obliterated using the SMCD.

Auer et al used transaneurysmal maneuver using a collagen-based closure device (Angio-Seal-System, Terumo, Tokyo, Japan) and achieved 100% success, similar to the current study.[11] Ibrahim et al did a similar procedure using the ProGlide suture-based closure device with 100% success.[14] There is slight technical difference in this study compared with the above two. While both the above studies punctured the PSA and negotiated guidewire through the neck, in the current study the neck was directly punctured with the 21G needle and the needle was advanced into the CFA lumen, thus avoiding the need for fluoroscopy and making it a bedside procedure. Since the footplate of the device is larger than the defect itself, therefore, even if the puncture is slightly away from the neck, the PSA gets obliterated. Attempts, however, must be made to puncture the neck of the PSA.

Although this series has 100% success without any complications, the device must be used with caution especially in patients with extensive atherocalcific changes. Vessel wall injury is a risk associated with the use of SMCD and the technique requires a level of expertise with accurate needle guidance and use of the device. Limitations of the study include its small sample size and that the procedure has been done by a single operator. The technique needs to be validated in a larger cohort.

Conclusion

In conclusion, treatment of postcatheterization PSA of the femoral artery is a promising technique with a high success rate and may be used as first-line treatment specially in patients with deranged coagulation. The procedure has low complications with thorough familiarity and use of the device.

Note
This study was previously presented at ISVIR annual conference, January 13, 2024, Jaipur, Rajasthan, India.

Authors' Contributions
N.K.: concepts, design, data acquisition, data analysis, literature search, and manuscript preparation.
C.K.P.: concepts, data analysis, literature search, and manuscript editing.
S.S.B.: data acquisition and manuscript review.

A.M.: concepts, design, data acquisition, data analysis, and manuscript review.
Guarantor: A.M.

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Conflict of Interest
None declared.

References

1 Webber GW, Jang J, Gustavson S, Olin JW. Contemporary management of postcatheterization pseudoaneurysms. Circulation 2007;115(20):2666–2674
2 Ahmad F, Turner SA, Torrie P, Gibson M. Iatrogenic femoral artery pseudoaneurysms–a review of current methods of diagnosis and treatment. Clin Radiol 2008;63(12):1310–1316
3 Messina LM, Brothers TE, Wakefield TW, et al. Clinical characteristics and surgical management of vascular complications in patients undergoing cardiac catheterization: interventional versus diagnostic procedures. J Vasc Surg 1991;13(05):593–600
4 Katzenschlager R, Ugurluoglu A, Ahmadi A, et al. Incidence of pseudoaneurysm after diagnostic and therapeutic angiography. Radiology 1995;195(02):463–466
5 Morgan R, Belli AM. Current treatment methods for postcatheterization pseudoaneurysms. J Vasc Interv Radiol 2003;14(06):697–710
6 Korkmaz A, Duyuler S, Kalayci S, et al. An alternative noninvasive technique for the treatment of iatrogenic femoral pseudoaneurysms: stethoscope-guided compression. Acta Cardiol 2013;68(03):279–283
7 Huang TL, Liang HL, Huang JS, et al. Ultrasound-guided compression repair of peripheral artery pseudoaneurysm: 8 years' experience of a single institute. J Chin Med Assoc 2012;75(09):468–473
8 Nakai M, Sato M, Sanda H, et al. Percutaneous fluoroscopically guided n-butyl cyanoacrylate (NBCA) injection for iatrogenic femoral arterial pseudoaneurysm under temporary balloon occlusion of arterial blood flow. Jpn J Radiol 2012;30(04):365–369
9 Orimoto Y, van Keulen JW, Waasdorp EJ, Moll FL, van Herwaarden JA. Treatment of a recurrent false aneurysm of the femoral artery by stent–graft placement from the brachial artery. Ann Vasc Surg 2011;25(06):841.e1–841.e4
10 Loh EJ, Allen R. Endovascular treatment of refractory iatrogenic femoral artery pseudoaneurysm using Amplatzer vascular plugs following unsuccessful retrograde Angio-Seal deployment. Indian J Radiol Imaging 2019;29(02):211–214
11 Auer TA, Fehrenbach U, Torsello GF, et al. Transaneurysmal occlusion of complicated common femoral artery pseudoaneurysms using the Angio-Seal closure device-a promising technique. Cardiovasc Intervent Radiol 2023;46(02):268–273
12 Inagaki Y, Nakao M, Arashi H, Yamaguchi J. Novel interventional technique for the treatment of an iatrogenic pseudoaneurysm of the brachial artery. J Cardiol Cases 2021;25(04):250–253
13 Ferro D, Celestini A, Violi F. Hyperfibrinolysis in liver disease. Clin Liver Dis 2009;13(01):21–31
14 Ibrahim K, Christoph M, Wunderlich C, et al. A novel interventional method for treating femoral pseudoaneurysms. EIJ-D-16-00865; 2012 Dec
15 Cope C, Zeit R. Coagulation of aneurysms by direct percutaneous thrombin injection. AJR Am J Roentgenol 1986;147(02):383–387

