Scholars Journal of Medical Case Reports
Abbreviated Key Title: Sch J Med Case Rep
ISSN 2347-9507 (Print) | ISSN 2347-6559 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Vascular Surgery

A Case Report of a Spontaneous Non-Anastomotic False Aneurysm as A Late Complication of in-Situ LSV Femoropopliteal Bypass

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DOI: https://doi.org/10.36347/sjmcr.2025.v13i10.114 | **Received:** 11.09.2025 | **Accepted:** 27.10.2025 | **Published:** 31.10.2025

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Abstract **Case Report**

Background: An in-situ saphenous vein bypass graft pseudoaneurysm represents a highly infrequent late complication. A 56-year-old male who had undergone femoropopliteal bypass surgery using an in-situ great saphenous vein nine years prior developed an unnoticeable false aneurysm located in the middle portion of the graft. We examine vein graft aneurysms, including their frequency of occurrence, pathogenesis, diagnostic methods, and treatment options. ***Case Summary:*** The patient exhibited an unnoticeable bulge in the middle of his thigh where the graft ran. The duplex ultrasound and CT angiography revealed a 22×34 mm pseudoaneurysm within the vein graft body, located away from the anastomoses while maintaining distal blood flow. Peripheral pulses showed a triphasic pattern, while the patient displayed no signs of infection or trauma. Open surgery involved excising the aneurysmal section containing organized thrombus and calcification, followed by end-to-end anastomoses of the graft ends. The patient experienced an uneventful recovery process with preserved limb blood flow. ***Discussion:*** Non-anastomotic vein graft pseudoaneurysms occur less than 0.1% of the time in grafts and manifest several years following surgery due to degenerative changes. True vein graft aneurysms affecting all vessel layers are sporadic and frequently associated with systemic aneurysmal conditions and atherosclerotic changes. The development of vein graft pseudoaneurysms results from prolonged arterial pressure contact, altered vein wall structures, and blood flow stress. Establishing a proper diagnosis through duplex and imaging tests enables healthcare professionals to choose the most appropriate management approach. Surgical excision of the graft and graft reconstruction is the definitive therapeutic approach for preventing rupture, although high-risk patients may receive endovascular stent graft exclusion. Autologous vein grafts require continuous lifetime monitoring because they can develop late complications.

Keywords: Pseudoaneurysm; Saphenous vein graft; Femoropopliteal bypass; In-situ bypass; Aneurysm; Vascular surgery.

INTRODUCTION

Autologous great saphenous vein (GSV) bypass is the primary choice for femoropopliteal arterial reconstruction, as it demonstrates better long-term patency compared to prosthetic grafts. The in-situ technique maintains the vein in its original position, avoiding valve destruction and tributary ligation, which results in a strong outflow and minimizes graft manipulation. Vein grafts risk developing late complications, although their incidence remains low. The medical community widely documents saphenous vein graft aneurysms in coronary bypass procedures, yet these occurrences remain uncommon in peripheral arterial grafts. The classification of vein graft aneurysms includes true aneurysms, which affect all wall layers, and false aneurysms, also known as pseudoaneurysms, which form when the vessel wall experiences a breach leading to contained hematoma. Most pseudoaneurysms that develop in vein bypasses tend to appear at points of graft connection (anastomotic sites) due to suture line stress, infection, or technical errors. According to certain studies, false aneurysms at graft–artery anastomoses appear as a more frequent complication in femoral anastomotic sites, with incidence rates reaching up to 7%. Non-anastomotic pseudoaneurysms occurring within autologous vein graft bodies represent a sporadic occurrence.

The pathogenesis of true venous graft aneurysms occurs through vein wall remodeling processes and time-dependent atherosclerotic

deterioration. Vein grafts exposed to arterial pressure develop adaptive responses, including media thickening alongside intimal hyperplasia and a potential loss of elasticity in the vessel wall. The atherosclerotic plaque development and calcification process resemble native arterial processes within vein grafts after several years of exposure to arterial pressure. The weakened vessel walls become prone to aneurysm development due to these modifications. The development of vein graft aneurysms occurs much more frequently in patients who had bypass surgery for arterial aneurysms instead of occlusive disease. The development of aneurysms in vein grafts depends on the type of bypass surgery performed, specifically whether it involves popliteal artery aneurysms or occlusive disease, according to Loftus *et al.,* [1]. The observed differences in graft dilation suggest that patients with aneurysms experience increased systemic connective tissue factors and hemodynamic conditions that lead to graft dilation. The persistent nature of arteriovenous fistulae within in-situ grafts that remain unligated creates high-flow channels, which might lead to localized aneurysmal growth.

The susceptibility of vein grafts to aneurysms exists, but significant vein graft aneurysms remain rare. The incidence of saphenous vein graft aneurysms (SVGAs) in coronary bypass surgery reaches 0.07% when studying 5,579 grafts. The majority of reported SVGAs develop after a minimum period of 5–10 years following CABG surgery because degenerative processes need time to develop; peripheral vein graft aneurysms emerge multiple years after graft placement. The delayed diagnosis of these aneurysms suggests that wall remodeling processes and pathological changes play a more significant role than pressure alone. Vein graft pseudoaneurysms typically do not exhibit symptoms until they have grown significantly in size or caused related problems. These aneurysms face an elevated risk of rupture because their walls primarily consist of fibrous scar tissue and adventitial tissue, which are less resilient than normal arterial tissue. Identifying such conditions should be done promptly while also receiving appropriate treatment. The following study introduces a seldom-seen case of false aneurysm development in the mid-section of an in-situ femoropopliteal vein graft nine years after surgical bypass. This paper evaluates the clinical findings that led to the identification of a vein graft pseudoaneurysm, along with an analysis of documented information regarding their occurrence rates, causes, diagnostic techniques, treatment protocols, and postoperative results. The case highlights the importance of surgeons remaining vigilant for vein graft complications that can occur after a prolonged bypass period, as well as the necessity of performing prompt surgical intervention to prevent fatal graft ruptures.

Clinical Scenario

A 56-year-old male patient with peripheral arterial disease presented to our vascular clinic, reporting a new swelling on the left medial thigh (Figure 1). The patient underwent a left femoropopliteal bypass procedure with an in-situ great saphenous vein graft nine years prior because of chronic superficial femoral artery occlusion. The patient experienced left leg angioplasty in the distant past, but there were no records of this procedure available to us. The patient had no history of trauma or infections in this area. The patient reported a 5-day history of painless swelling in his thigh, accompanied by no numbness, changes in foot sensation, or changes in foot color. He mentioned no fever or systemic symptoms.

Figure 1: Swelling on the left medial thigh

Examination revealed a pulsatile mass measuring 3 cm in diameter, located on the anteromedial aspect of the thigh (figure 1), where the bypass graft passed through. The top layer of skin remained unbroken and showed no signs of inflammation. The graft area displayed no tenderness during palpation, while no bruit was detectable. The dorsalis pedis and posterior tibial arterial signals displayed triphasic waveform patterns when using a handheld Doppler to check distal perfusion. The vein graft demonstrated both patency and proper function. No signs of graft infection appeared during clinical assessment, as the skin showed no signs of inflammation, drainage, or warmth.

Imaging studies were promptly obtained. Ultrasound duplex imaging showed that the vein graft developed a saccular aneurysmal bulge at the mid-thigh point (figure 2). A color Doppler scan revealed the signature yin-yang blood flow pattern in the sac, while also showing a narrow neck linking the sac to the graft, through which blood moved in a to-and-fro pattern. The pseudoaneurysm measured between 2.5 and 3 cm, as determined by ultrasound measurements. The duplex ultrasonography examination revealed no problems with blood flow at either the graft's proximal or distal connections. An imaging examination of the lower extremity, performed through CT angiography (CTA), provided detailed information about the anatomy of the affected blood vessels. The CTA results showed a 22.7 × 33.7 mm false aneurysm located at the midpoint of the vein graft that exhibited contrast leakage from the vein graft while maintaining proper contrast flow to the popliteal artery (figure 3). A CT angiography scan revealed that the proximal anastomosis (common femoral to GSV) and distal anastomosis (GSV to popliteal artery) demonstrated typical structures without any signs of dilation or leak. The examination revealed no fluid collections or gas in the surrounding area, and the femur and its soft tissues were unaltered.

Figure 2: Saccular aneurysmal bulge at the mid-thigh points by ultrasound

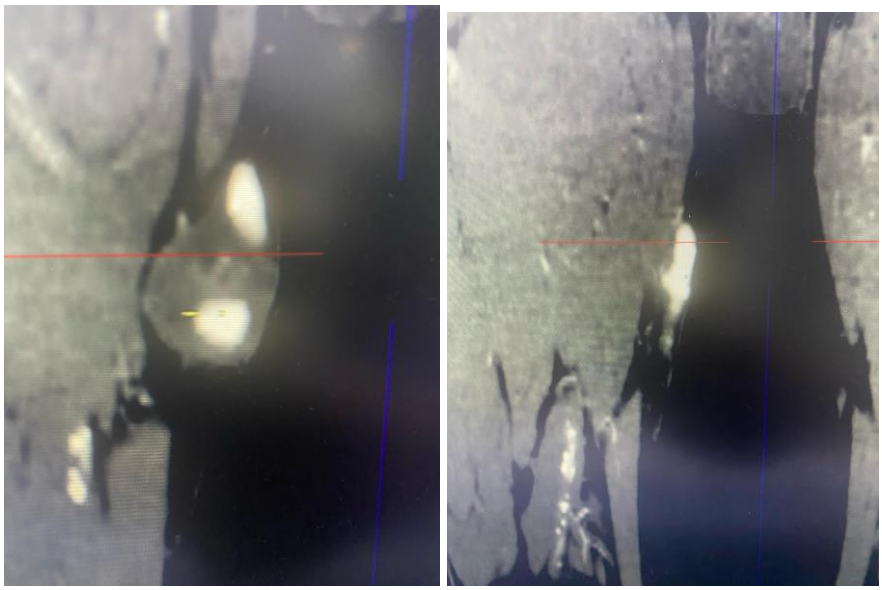

Figure 3: CTA showing a contrast leakage from the vein graft while maintaining proper flow to the popliteal artery

Surgical treatment was recommended for the pseudoaneurysm because of its potential to rupture, even though the patient showed no symptoms. The patient received information about the upcoming procedure and then provided his consent to undergo open surgical repair. General anesthesia was used to perform an incision that followed the course of the previous graft on the medial thigh. Surgical exploration revealed a vein graft that had developed an aneurysmal protrusion at its central point, consistent with the imaging findings.

Vessel loops were used to achieve control at both ends of the graft. Following heparinization throughout the body, the graft was clamped while the aneurysmal portion was exposed. The pseudoaneurysm cavity contained old, organized thrombus alongside thin and calcified areas of the vein wall. The false Aneurysm formed from a complete graft wall defect located around calcific degeneration. There was no gross pus or infection. The surgical team excised the diseased segment, which measured about three centimeters in length (figure 4). After trimming the vein graft's healthy parts, the surgical team performed end-to-end anastomosis of the remaining sections. The procedure removed the pseudoaneurysm while creating a seamless connection between graft segments. The surgical team completed the anastomosis using 6-0 polypropylene sutures (figure 5), resulting in excellent forward blood flow upon removal of the clamps and good Doppler signals in both the graft and the distal areas. The leg experienced continuous warmth, accompanied by excellent blood flow. The surgical site received irrigation before being closed with multiple layers.

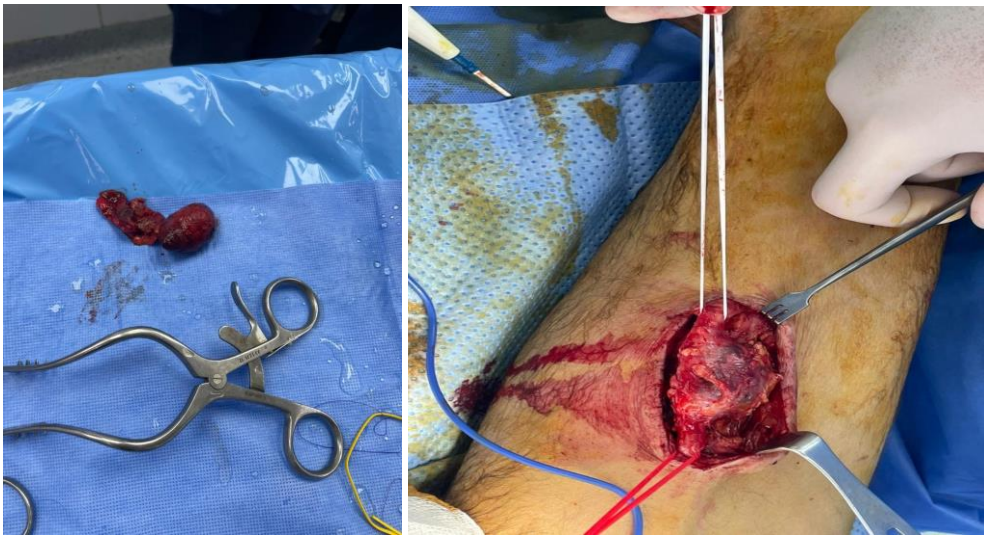

Figure 4: Excised pseudoaneurysm

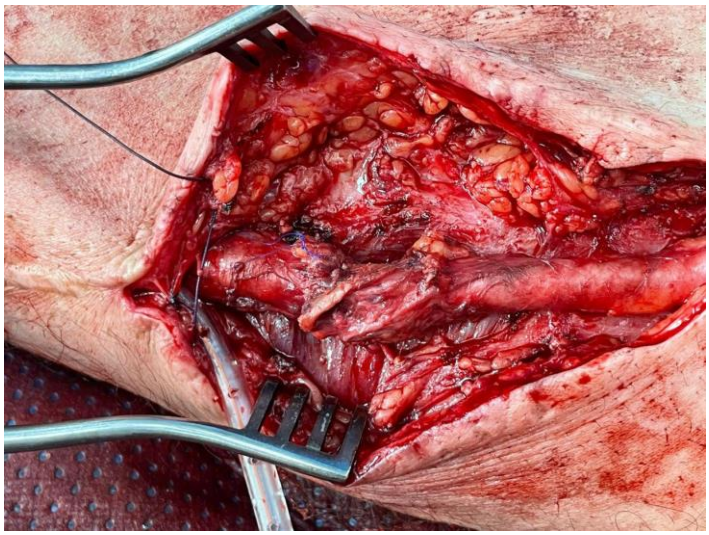

Figure 5: Anastomosis using 6-0 polypropylene sutures

The patient showed good recovery after the operation. The graft salvage procedure succeeded because the patient maintained robust peripheral pulses with triphasic Doppler signals. He received aspirin and statin medication after discharge on postoperative day four. Microbiological cultures of the resected graft segment showed no growth, confirming a non-infectious etiology. At the 1-month follow-up, the patient was doing well with an intact graft and no recurrence of swelling. The patient needed periodic duplex ultrasound surveillance of the bypass graft as part of his future treatment plan.

DISCUSSION

The patient presented an unusual late complication of autologous vein bypass grafting through the formation of a non-anastomotic pseudoaneurysm that appeared ten years after the initial surgical procedure.

Pseudoaneurysms that occur at distances from the anastomotic sites in saphenous vein grafts remain very infrequently documented in the medical literature. Most vein graft aneurysms develop at the anastomotic sites due to suture line degeneration, technical failure, or infection. The pseudoaneurysm located in the vein graft's middle segment indicates that the degeneration process occurred within the vein conduit itself. The intraoperative examination of focal calcification and organized thrombus in the aneurysmal sac suggests a chronic, non-infectious process resulting from progressive weakening of the atherosclerotic vein wall. The absence of clinical or microbiological evidence of infection, together with no history of trauma, indicates that a degenerative mechanism stands as the most probable cause.

The physiological environment of vein grafts changes after arterialization because they are subjected to conditions for which they were not naturally designed. The structural and histological changes that occur in arterialized veins after exposure to arterial pressure and plasticity result in intimal hyperplasia, medial fibrosis, lipid accumulation, and progressive loss of smooth muscle cells and elastic fibers. The degenerative processes cause either true aneurysms, resulting from wall dilation, or pseudoaneurysms, which form through wall breaches and develop fibrous capsules. True aneurysms may develop into pseudoaneurysms when the intima and media of the wall deteriorate, creating a contained leak. The rupture site contains a calcified plaque, demonstrating that atherosclerosis caused localized wall failure. The patient's peripheral arterial disease history makes it probable that he had systemic atherogenic factors, even though smoking and dyslipidemia details were not documented in his medical records.

Combining mechanical stress and previous endovascular interventions might cause delayed graft deterioration. The medical records indicated that the patient underwent angioplasty on the affected limb; however, it was unclear whether the procedure involved the bypass graft. Using endovascular instruments in conjunction with balloon angioplasty can cause intimal damage while drug-eluting technology prolongs the healing and remodeling process. The authors of Bergenfield *et al.,* demonstrated that drug-coated balloon angioplasty led to the development of pseudoaneurysms in vein grafts due to paclitaxel-induced impairment of vascular healing processes [2]. The thrombus exhibited chronic characteristics, indicating a gradual degenerative process rather than immediate post-intervention damage despite having formed over several years. The potential exists for late complications from minimal iatrogenic damage to the vessel wall despite the absence of immediate symptoms.

The patient's medical history aligns with various published reports. Mokhtari *et al.,* presented a case of a non-anastomotic pseudoaneurysm in a distal femoropopliteal vein graft that was successfully treated with a self-expanding covered stent [3]. Mäkelä *et al.,* published a study on a giant aneurysm that occurred in an in situ femoropopliteal vein graft and required open surgical intervention [4]. Daly *et al.,* described how aneurysmal rupture happens due to unsealed arteriovenous fistulas in vain grafts undergoing in situ procedures when venous side branches are not properly tied off [5]. These cases demonstrate that proper surgical techniques and thorough postoperative monitoring are essential for successful in situ graft outcomes. The paper by Erkut *et al.,* described how a pseudoaneurysm developed from anastomotic trauma that occurred during femoral artery catheterization many years after bypass surgery [6].

Proper diagnosis of vein graft aneurysms and pseudoaneurysms requires both clinical attention and the use of appropriate imaging modalities. The clinical presentation can manifest as a painless, pulsatile mass, as in our case, or as compression symptoms, distal embolization, or rupture. The combination of duplex ultrasound is the optimal first diagnostic tool because it reveals the shape of aneurysms, graft functionality, and blood flow patterns. The combination of color Doppler's "yin-yang" sign and the to-and-fro waveform at the neck strongly indicates the presence of pseudoaneurysm. CT angiography enhances ultrasound results by providing detailed anatomical data necessary for surgical planning. CTA in this patient's case showed the full dimensions of the Aneurysm while ruling out any involvement of adjacent blood vessels. Endovascular therapy might require conventional angiography even though this procedure is not always essential for diagnosis.

Prompt intervention is needed for vein graft pseudoaneurysms since rupture poses a significant risk of resulting in limb-threatening hemorrhage or compartment syndrome. The medical team should avoid monitoring pseudoaneurysms through conservative means since confirmed lesions that show growth or produce symptoms require intervention. Surgical repair stands as the established treatment approach. The approach for graft repair depends on graft location and available redundancy between options, which include primary resection followed by end-to-end anastomosis, interposition grafting, or patch angioplasty. Our patient underwent successful removal of the aneurysm segment, followed by direct re-anastomosis of the remaining healthy graft section, which preserved graft continuity and achieved an excellent outcome. The treatment of suspected infection requires complete graft removal and extra-anatomic bypass procedures. Mokhtari *et al.,* show how endovascular exclusion using covered stents can be an effective treatment method for specific cases when anatomical conditions are suitable and surgical risks are elevated. Researchers have not adequately investigated the long-term patency rates of stent grafts used in vein bypass circuits.

Endovascular procedures, including ultrasound-guided thrombin injection or coil embolization, primarily treat native artery pseudoaneurysms but should not be applied to bypass graft pseudoaneurysms because they risk damaging the bypass conduit. Medical staff should evaluate pseudoaneurysms through embolization or surgical ligation only when the graft is non-functional, and collateral circulation provides adequate blood flow.

Open repair delivered a definitive treatment in this situation. The formation of a pseudoaneurysm raises potential concerns about the development of new aneurysms in other parts of the graft. Vein grafts function as dynamic conduits that undergo long-term remodeling processes, and multiple sequential aneurysms have been documented. The patient requires periodic duplex ultrasonography tests to monitor the development of new aneurysms or the recurrence of existing ones. The study by Daly *et al.,* emphasizes that routine graft surveillance following in-situ bypass procedures enables the detection of late complications at an early stage [5].

This case report contributes to the existing knowledge about vein graft complications in the late period while establishing fundamental principles for patient care. A new limb mass in bypass surgery patients should undergo immediate vascular imaging, as pseudoaneurysm formation can occur after many years. A degenerative cause should be investigated after medical professionals rule out both infection and trauma—the treatment of choice, whether surgical or endovascular, should be performed immediately to prevent rupture from occurring. The need for ongoing monitoring persists even after years of successful graft operations.

The occurrence of pseudoaneurysms in in-situ saphenous vein bypasses constitutes an unusual yet potentially dangerous complication that develops over a prolonged period. The prevention of severe complications depends on immediate identification, proper diagnosis, and treatment of this condition. This case highlights the importance of meticulous long-term monitoring for patients undergoing autologous vein bypass grafts. It demonstrates that each patient requires a personalized treatment plan tailored to their specific conditions and the level of expertise at the treatment facility.

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