

A Tiny Injection, a Big Save: Thrombin for Ruptured Femoral Pseudoaneurysm

Dr. Karnayina Pooja Harshitha¹, Dr. Harshita M. Sharda², Dr. Siddharth Shah³

¹Assistant Professor, Department of Medicine, SBKS MI & RC, Pipariya, Vadodara, harshitha.karnayina@gmail.com

²3rd Year Resident, Department of Medicine, SBKS MI & RC, Pipariya, Vadodara shardaharshita27@gmail.com

³Associate Professor, Department of Medicine, SBKS MI & RC, Pipariya, Vadodara, sks2862@yahoo.com

ABSTRACT

Background: Femoral artery pseudoaneurysm is a well-recognized complication following diagnostic and therapeutic endovascular procedures. Although most pseudoaneurysms remain clinically stable, rupture is uncommon and may result in significant hemorrhage, rapid decline in hemoglobin, and hemodynamic compromise. Surgical repair has traditionally been considered the treatment of choice in ruptured cases; however, ultrasound-guided percutaneous thrombin injection has emerged as a minimally invasive alternative in selected patients.

Case Presentation: A 73-year-old female presented with pain and bluish discoloration of the left lower limb. Computed tomography angiography demonstrated significant atherosclerotic disease with approximately 60–70% luminal narrowing of the left common iliac artery. The patient underwent successful left common iliac artery angioplasty with deployment of a 6 × 57 mm stent through left femoral arterial access. Three to four days after the procedure, she developed discoloration and swelling at the femoral access site associated with a substantial fall in hemoglobin from 11.6 g/dL to 6.4 g/dL. Ultrasonography of the left proximal thigh revealed a multilobulated pseudoaneurysm measuring approximately 1.2 × 2 cm arising from the common femoral artery with turbulent flow on color Doppler and an adjacent heterogeneous collection suggestive of a contained ruptured pseudoaneurysm. Considering the patient's advanced age and comorbidities, ultrasound-guided percutaneous thrombin injection was performed. Complete thrombosis of the pseudoaneurysm was achieved immediately, with no residual flow on follow-up ultrasonography.

Conclusion: Ruptured femoral artery pseudoaneurysm is a rare but potentially life-threatening complication following endovascular intervention. This case highlights that ultrasound-guided percutaneous thrombin injection can be a safe, effective, and minimally invasive treatment option in carefully selected patients with contained rupture, potentially avoiding the need for surgical intervention.

KEYWORDS: Femoral Pseudoaneurysm, Thrombin Injection, Angioplasty, Vascular Complications, Endovascular Intervention, Ruptured Pseudoaneurysm.

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INTRODUCTION

Femoral artery pseudoaneurysm is a well-recognized vascular complication occurring after diagnostic and therapeutic catheter-based procedures. With the increasing use of endovascular interventions for coronary, peripheral, and neurovascular diseases, the incidence of access-site complications has also risen, making femoral pseudoaneurysm an important clinical concern in contemporary practice. Although many pseudoaneurysms remain stable and asymptomatic, delayed diagnosis may result in significant morbidity and, occasionally, mortality. (1)

A pseudoaneurysm, also known as a false aneurysm, develops when disruption of the arterial wall leads to persistent extravasation of blood into the surrounding tissues while maintaining communication with the parent artery through a narrow neck. Unlike true aneurysms, pseudoaneurysms lack all three normal layers of the arterial wall and are instead contained by adjacent soft tissues, organized hematoma, or fibrous tissue. Continuous arterial flow into this cavity predisposes the lesion to progressive enlargement, thrombosis, distal embolization, compression of adjacent structures, and rupture. (2)

The incidence of femoral artery pseudoaneurysm has been reported to range from approximately 0.2% to 2% following diagnostic catheterization and may increase to as high as 8% after therapeutic interventions. Several patient-related and procedure-related factors contribute to its development, including advanced age, female sex, obesity, hypertension, peripheral arterial disease, calcified vessels, anticoagulant therapy, dual antiplatelet therapy, large sheath size, prolonged procedural duration, and inadequate post-procedural compression. Inappropriate arterial puncture site, particularly punctures below the common femoral artery, further increases the risk of pseudoaneurysm formation. (3)

Femoral artery pseudoaneurysms typically present with localized pain, swelling, ecchymosis, pulsatile mass, bruit, or tenderness at the puncture site. Larger lesions may compress adjacent nerves and veins, causing neuropathy, venous thrombosis, limb edema, or distal ischemia. In certain cases, pseudoaneurysms remain clinically silent and are detected incidentally during imaging evaluation performed for other indications. Therefore, a high index of clinical suspicion is

essential, especially in patients presenting with new groin symptoms following recent arterial catheterization. (4)

The diagnosis of pseudoaneurysm relies primarily on imaging. Duplex ultrasonography remains the investigation of choice because it is non-invasive, readily available, cost-effective, and highly sensitive. Characteristic sonographic findings include the presence of a communicating neck between the artery and pseudoaneurysm sac, the classical "yin-yang" appearance on color Doppler imaging, and the typical "to-and-fro" waveform observed at the neck. Cross-sectional imaging modalities such as computed tomography angiography and magnetic resonance angiography may provide additional anatomical information in complex cases or when associated complications are suspected. (5)

Management strategies for pseudoaneurysms have evolved considerably over the past two decades. Traditional surgical repair, once considered the gold standard, is now reserved mainly for rapidly expanding lesions, infected pseudoaneurysms, distal ischemia, skin necrosis, or failed minimally invasive procedures. The increasing availability of interventional radiological techniques has shifted treatment paradigms towards less invasive approaches associated with reduced morbidity and shorter hospital stay. (6)

Historically, ultrasound-guided compression repair represented the principal non-surgical treatment modality. However, prolonged procedure duration, significant patient discomfort, relatively high recurrence rates, and reduced efficacy in anticoagulated individuals have limited its widespread acceptance. Systematic reviews have demonstrated variable success rates with compression therapy, particularly in larger pseudoaneurysms and patients receiving antithrombotic medications. (7)

Ultrasound-guided percutaneous thrombin injection has subsequently emerged as the preferred treatment for most iatrogenic femoral artery pseudoaneurysms. The technique involves direct injection of thrombin into the pseudoaneurysm sac under real-time ultrasonographic guidance, resulting in rapid thrombosis while preserving flow within the parent artery. The procedure is technically straightforward, minimally invasive, well tolerated, and associated with excellent success rates. (8)

Multiple studies have confirmed the effectiveness of ultrasound-guided thrombin injection in achieving immediate thrombosis in the majority of patients. Reported success rates generally exceed 95%, with low recurrence rates and minimal complications. Furthermore, the technique has demonstrated favorable outcomes even in patients receiving anticoagulants or dual antiplatelet therapy, thereby broadening its applicability in contemporary vascular practice. (9)

Comparative studies evaluating thrombin injection and ultrasound-guided compression have consistently shown superior efficacy, shorter procedure times, and improved patient comfort with thrombin injection. Consequently, many centers now consider thrombin injection the first-line treatment for suitable femoral pseudoaneurysms. (10)

The safety profile of thrombin injection has also been extensively evaluated. Studies involving high-risk populations, including morbidly obese individuals, have demonstrated excellent technical success without significant procedure-related complications. Distal embolization, allergic reactions, and recurrence remain uncommon, emphasizing the overall safety of this minimally invasive technique. (11)

Several factors influence the technical success of thrombin injection, including pseudoaneurysm size, neck morphology, sac complexity, and operator experience. Careful pre-procedural ultrasonographic assessment is therefore essential for selecting appropriate candidates and minimizing complications. Recent evidence has further refined procedural techniques and optimized outcomes in complex pseudoaneurysms. (12)

Advances in endovascular and interventional radiological techniques have expanded the spectrum of minimally invasive treatment options available for pseudoaneurysm management. Contemporary approaches include covered stent placement, coil embolization, glue embolization, and image-guided thrombin injection. Meta-analytic evidence suggests that non-surgical management offers outcomes comparable to surgery while significantly reducing procedural morbidity and recovery time in selected patients. (13)

Large or anatomically complex femoral pseudoaneurysms may occasionally require advanced endovascular techniques. Case reports and small series have highlighted the successful use of covered stents and other endovascular approaches in situations where conventional thrombin injection may not be feasible. (14)

Despite improvements in preventive strategies and treatment modalities, femoral pseudoaneurysm continues to occur following contemporary catheter-based interventions. Recent studies have shown that procedural factors and patient comorbidities continue to influence its incidence even in the era of ultrasound-guided vascular access and vascular closure devices. (15)

Rupture of a femoral pseudoaneurysm is an uncommon but potentially catastrophic complication. Ruptured lesions may

present with rapidly expanding hematoma, profound anemia, hemodynamic instability, compartment syndrome, and even death if not recognized promptly. Surgical intervention has traditionally been advocated in such circumstances; however, emerging evidence suggests that carefully selected patients with contained rupture may be successfully managed using minimally invasive techniques. (16)

Recent studies have demonstrated excellent safety and effectiveness of low-dose ultrasound-guided thrombin injection protocols, further supporting their use as first-line therapy in suitable cases. In addition, isolated reports have described successful non-surgical management even in complicated pseudoaneurysms occurring in high-risk patients, emphasizing the importance of individualized treatment strategies. (17,18)

The present case describes a ruptured femoral artery pseudoaneurysm developing after left common iliac artery angioplasty and stenting that was successfully managed with ultrasound-guided percutaneous thrombin injection. This report highlights the expanding role of minimally invasive therapy in the management of complex vascular access-site complications and underscores the importance of early diagnosis, prompt intervention, and individualized patient-centered management.

CASE REPORT

A 73-year-old female presented to the Department of General Medicine with complaints of pain in the left lower limb associated with bluish discoloration of the left foot and toes. The discoloration involved the distal aspect of the foot and digits and was associated with local tenderness on palpation. The patient had a significant past history of acute ischemic infarction involving the left frontal and parietal regions one month prior to the present admission, for which she had been receiving medical treatment.

On general physical examination, the patient was conscious, oriented, and hemodynamically stable. Her resting pulse rate was 76 beats/minute and blood pressure was 130/80 mmHg. Examination of the peripheral vascular system revealed feeble peripheral pulses in the left lower limb, whereas femoral pulses were palpable bilaterally. Local examination of the left foot demonstrated bluish discoloration involving the toes suggestive of critical limb ischemia.

Baseline laboratory investigations revealed a hemoglobin level of 11.6 g/dL, total leukocyte count of 17,000/mm³, platelet count of $3.03 \times 10^5/\text{mm}^3$, prothrombin time of 15.4 seconds with an international normalized ratio (INR) of 1.1, activated partial thromboplastin time of 30 seconds, and serum creatinine of 1.4 mg/dL.

Computed tomography angiography of both lower limbs demonstrated diffuse atheromatous changes in the form of calcified and non-calcified plaques involving the left common iliac artery, causing approximately 60–70% luminal narrowing. In addition, significant attenuation of the left dorsalis pedis artery was noted. In view of symptomatic peripheral arterial disease with critical limb ischemia, the patient underwent percutaneous transluminal angioplasty with stenting of the left common iliac artery. The procedure was performed through left femoral arterial access, and a 6 × 57 mm stent was successfully deployed. Post-procedural angiography demonstrated satisfactory restoration of blood flow across the stenotic segment without any immediate complications.

However, three to four days following the intervention, the patient developed discoloration and swelling at the left femoral access site. Simultaneously, a significant decline in hemoglobin level was observed, with values decreasing from 11.6 g/dL to 6.4 g/dL, raising suspicion of ongoing bleeding. Ultrasound examination of the left groin revealed an ill-defined multilobulated cystic lesion measuring approximately 1.2 × 2 cm arising from the left common femoral artery. Color Doppler imaging demonstrated turbulent bidirectional flow within the lesion, consistent with a pseudoaneurysm. The pseudoaneurysm communicated with the parent artery through a narrow neck measuring approximately 4 mm. In addition, an adjacent heterogeneous collection was identified, suggestive of a contained rupture with surrounding hematoma formation.

Considering the patient's advanced age, multiple comorbidities, recent endovascular intervention, and the contained nature of the rupture, a decision was made to perform ultrasound-guided percutaneous thrombin injection as a minimally invasive therapeutic approach. Under real-time ultrasonographic guidance and strict aseptic precautions, thrombin was injected directly into the pseudoaneurysm sac. Immediate thrombosis of the pseudoaneurysm was achieved during the procedure.

Post-procedural Doppler ultrasonography confirmed complete thrombosis of the pseudoaneurysm sac with no residual internal flow and preserved patency of the common femoral artery. The patient remained hemodynamically stable following the procedure, with no evidence of distal embolization or recurrence. Clinical improvement was observed with gradual resolution of local symptoms. The patient was subsequently discharged in a stable condition on dual antiplatelet therapy, including aspirin and clopidogrel, with advice for regular follow-up in the interventional radiology outpatient department after 20 days.

This case illustrates the successful use of ultrasound-guided percutaneous thrombin injection for the management of

a ruptured femoral artery pseudoaneurysm following iliac artery angioplasty and stenting, thereby avoiding the need for surgical intervention in a high-risk elderly patient.

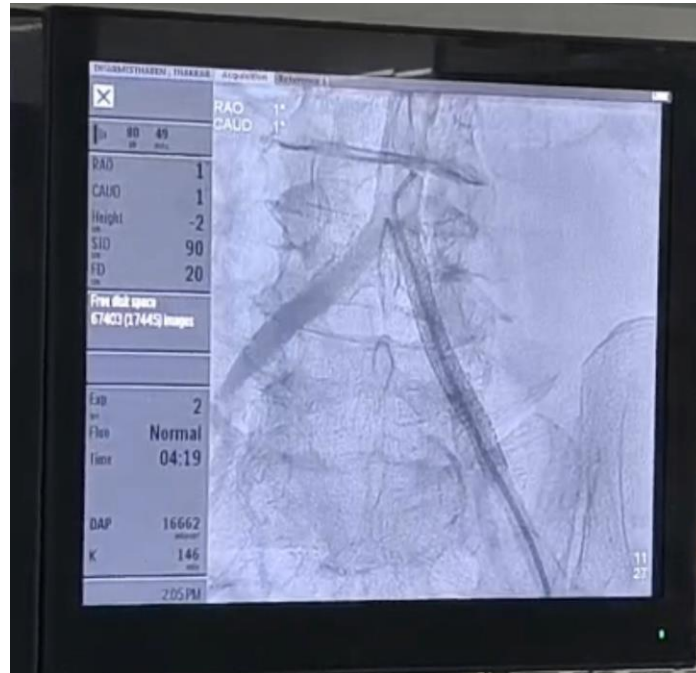


Figure 1: Angiographic image showing successful recanalization and restoration of blood flow in the left common iliac artery following angioplasty and stent deployment.



Figure 2: Digital subtraction angiography showing successful recanalization of the left common iliac artery with restoration of antegrade flow following angioplasty and stent placement.

DISCUSSION

Femoral artery pseudoaneurysm is among the most common vascular complications encountered following diagnostic and therapeutic catheter-based procedures. Despite advances in vascular access techniques and closure devices, pseudoaneurysm formation continues to be an important cause of post-procedural morbidity, particularly in elderly patients undergoing complex endovascular interventions. The widespread adoption of percutaneous interventions has further increased the clinical significance of this complication, necessitating prompt diagnosis and appropriate management to prevent adverse outcomes. (1)

Pseudoaneurysm develops as a consequence of disruption of the arterial wall at the puncture site, resulting in persistent communication between the arterial lumen and surrounding tissues. Unlike true aneurysms, pseudoaneurysms are not bounded by all three arterial wall layers and are instead confined by surrounding soft tissue and hematoma. Continued arterial flow into the sac predisposes these lesions to progressive enlargement, thrombosis, embolization, compression of adjacent structures,

and, rarely, rupture. (2)

Several risk factors have been identified for the development of femoral artery pseudoaneurysm, including advanced age, female sex, obesity, hypertension, peripheral vascular disease, anticoagulant therapy, antiplatelet use, large sheath size, prolonged procedure duration, and inadequate post-procedural compression. Our patient possessed multiple recognized risk factors, including advanced age, female sex, diffuse atherosclerotic disease, and recent endovascular intervention requiring antiplatelet therapy. These factors likely contributed to the development of the pseudoaneurysm following femoral arterial access. (3)

Clinical presentation of femoral pseudoaneurysm may vary from asymptomatic lesions detected incidentally to symptomatic cases presenting with pain, swelling, ecchymosis, bruit, pulsatile mass, neuropathy, or distal ischemia. In the present case, the patient initially developed discoloration and swelling at the femoral access site accompanied by a significant decline in hemoglobin levels, indicating ongoing hemorrhage. The marked fall in hemoglobin from 11.6 g/dl to 6.4 g/dl strongly suggested active bleeding and prompted urgent imaging evaluation. Such presentations warrant immediate investigation because delayed diagnosis may result in life-threatening complications. (4) Imaging plays a pivotal role in the diagnosis and characterization of pseudoaneurysms. Duplex ultrasonography is considered the first-line diagnostic modality owing to its non-invasive nature, wide availability, and high sensitivity. Characteristic findings include the classical "yin-yang" sign on color Doppler and the "to-and-fro" spectral waveform at the pseudoaneurysm neck. In our patient, ultrasonography demonstrated a multilobulated cystic lesion arising from the common femoral artery with turbulent flow and an adjacent heterogeneous collection suggestive of a contained rupture, thereby establishing the diagnosis and guiding subsequent management. (5)

Management of femoral pseudoaneurysm has evolved substantially over the past two decades. While surgical repair was historically considered the standard treatment, minimally invasive approaches have largely replaced surgery in uncomplicated cases. Current therapeutic options include ultrasound-guided compression, ultrasound-guided thrombin injection, endovascular stent placement, coil embolization, and surgical repair. The choice of therapy depends on lesion size, morphology, neck characteristics, presence of complications, and overall patient status. (6)

Ultrasound-guided compression repair was one of the earliest non-surgical treatment modalities employed for femoral pseudoaneurysms. However, this technique is associated with prolonged procedure duration, significant patient discomfort, operator dependency, and reduced efficacy in patients receiving anticoagulants or antiplatelet agents. Consequently, its use has gradually declined in favor of more effective minimally invasive techniques. (7)

Ultrasound-guided thrombin injection has emerged as the preferred treatment for most iatrogenic femoral pseudoaneurysms because of its simplicity, rapidity, and excellent success rates. The technique involves direct injection of thrombin into the pseudoaneurysm sac under real-time ultrasound guidance, resulting in immediate thrombosis while preserving parent vessel patency. Jargiełło et al. Reported high technical success rates with ultrasound-guided thrombin injection and emphasized its safety and effectiveness in managing post-catheterization pseudoaneurysms. (8)

Similarly, Saydam et al. Demonstrated that ultrasound-guided thrombin injection is highly effective for treating iatrogenic femoral artery pseudoaneurysms, with minimal procedure-related complications and low recurrence rates. The authors concluded that the procedure should be considered the treatment of choice in appropriately selected patients because of its minimally invasive nature and rapid clinical recovery. The successful outcome observed in our patient is consistent with these findings. (9)

Comparative studies have further strengthened the role of thrombin injection in pseudoaneurysm management. Altuwaijri et al. Compared ultrasound-guided thrombin injection with ultrasound-guided compression repair and demonstrated superior efficacy, shorter procedure times, and improved patient tolerance with thrombin injection. These advantages have contributed significantly to the widespread acceptance of thrombin injection as first-line therapy in contemporary clinical practice. (10)

The effectiveness of thrombin injection has also been established in high-risk populations. Yoo et al. Reported that ultrasound-guided thrombin injection remained safe and effective even in morbidly obese patients, a group traditionally considered technically challenging for minimally invasive

procedures. Their findings suggest that patient-related factors alone should not preclude consideration of thrombin injection when anatomical characteristics are favorable. (11)

The technical success of thrombin injection is influenced by several anatomical factors, including pseudoaneurysm size, neck width, sac morphology, and complexity. Chae et al. Demonstrated that careful pre-procedural ultrasonographic assessment significantly improves procedural success while minimizing complications such as distal embolization and recurrence. In the present case, the pseudoaneurysm measured approximately 1.2×2 cm with a relatively narrow neck, making it particularly suitable for thrombin injection. (12)

A recent systematic review and meta-analysis by Wu et al. Comparing non-surgical and surgical treatment strategies for iatrogenic femoral pseudoaneurysms concluded that minimally invasive approaches offer outcomes comparable to surgery while significantly reducing morbidity and hospital stay. These findings further support the increasing preference for image-guided interventions in appropriately selected patients. (13)

In certain situations, particularly in large, complex, multilobulated, or wide-neck pseudoaneurysms, advanced endovascular techniques such as covered stent placement or coil embolization may be required. Alexandre et al. Highlighted the successful use of endovascular approaches in managing complex femoral pseudoaneurysms, thereby expanding the therapeutic armamentarium available to clinicians. (14)

Despite improvements in access techniques and vascular closure devices, femoral pseudoaneurysm remains a clinically relevant complication of contemporary endovascular procedures. Koyama et al. Reported that patient-related factors and procedural characteristics continue to influence pseudoaneurysm incidence even in modern practice, emphasizing the need for vigilant post-procedural monitoring and early recognition of complications. (15)

Rupture of a femoral artery pseudoaneurysm is distinctly uncommon but represents a potentially catastrophic event associated with significant morbidity and mortality. Ok et al. Described a fatal case of femoral pseudoaneurysm rupture following endovascular intervention, underscoring the importance of timely diagnosis and intervention. In contrast, our patient presented with a contained rupture without hemodynamic instability, allowing successful minimally invasive treatment and avoidance of surgery. (16)

Recent studies have explored modifications in thrombin injection techniques aimed at improving safety. Shin et al. Demonstrated excellent safety and effectiveness using low-dose percutaneous thrombin injection protocols, with high technical success and minimal complications. Additionally, isolated reports have described successful non-surgical management even in complicated pseudoaneurysms occurring in high-risk patients. Ito et al. Reported successful conservative management of an infected femoral pseudoaneurysm in a hemodialysis patient, highlighting the importance of individualized treatment strategies tailored to patient characteristics and lesion anatomy. The favorable outcome observed in the present case further supports the growing role of minimally invasive image-guided therapies in managing selected complicated femoral pseudoaneurysms. (17,18)

The present case is noteworthy because it demonstrates successful management of a ruptured femoral artery pseudoaneurysm using ultrasound-guided thrombin injection in an elderly patient with multiple comorbidities. Early recognition, prompt imaging, careful patient selection, and timely intervention were crucial in achieving a successful outcome while avoiding the morbidity associated with surgical repair.

CONCLUSION

Ruptured femoral artery pseudoaneurysm is an uncommon but potentially life-threatening complication following endovascular procedures. Prompt recognition of access-site complications, particularly in patients presenting with groin swelling, discoloration, or an unexplained decline in hemoglobin levels, is essential to prevent serious hemorrhagic consequences. Duplex ultrasonography plays a crucial role in early diagnosis and therapeutic planning. The present case demonstrates that ultrasound-guided percutaneous thrombin injection can be a safe, effective, and minimally invasive treatment option for carefully selected patients with contained ruptured femoral pseudoaneurysms. Successful management in this elderly patient avoided surgical intervention and emphasizes the importance of individualized, patient-centered treatment strategies in the management of complex

vascular access-site complications.

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