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Injecting Point of care Ultrasound into your practice: A case of a femoral artery pseudoaneurysm in the Emergency department

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Case Report

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Abstract

Background

Patients with a history of intravenous drug use (IVDU) frequently present to the emergency department (ED) with extremity pain and swelling. While soft tissue infections are the most common injection-related complications, pseudoaneurysms are a serious vascular complication that can mimic soft tissue infections on physical examination. Misdiagnosis of a pseudoaneurysm as an abscess may lead to inappropriate incision and drainage, resulting in life-threatening hemorrhage. Point-of-care ultrasound (POCUS) is a rapid bedside tool that can reliably differentiate these entities.

Case Presentation:

A 36-year-old male with a history of antiphospholipid syndrome and pulmonary embolism, on warfarin, presented with two weeks of progressive right thigh pain and swelling. He endorsed injecting intravenous drugs into the affected area. Examination revealed erythema, induration, and a palpable mass. Laboratory studies were notable for a supratherapeutic international normalized ratio (INR) of 8.9. POCUS was performed as the initial imaging study, demonstrating a large hypoechoic structure with bidirectional "to-and-fro" flow on color Doppler—the "yin-yang sign"—consistent with a femoral artery pseudoaneurysm. Computed tomography angiography (CTA) confirmed an 8.6 × 6.6 × 12.1 cm pseudoaneurysm with active hemorrhage at the common femoral artery bifurcation. The patient received empiric broad-spectrum antibiotics and underwent right external iliac to superficial femoral artery bypass with bovine carotid graft. He was discharged home on hospital day eight.

Conclusions

This case demonstrates the value of bedside POCUS as a first-line imaging tool for differentiating pseudoaneurysms from soft tissue infections in patients with IVDU. Emergency physicians should maintain a low threshold for performing POCUS with color Doppler in this population, particularly in the setting of concomitant anticoagulation.

Background

Extremity pain and swelling are common presenting complaints among patients with a history of intravenous drug use (IVDU), with a broad differential diagnosis that includes cellulitis, abscess, deep vein thrombosis, pyomyositis, and vascular injury [1–3]. While skin and soft tissue infections are the most frequently encountered injection-related complications, pseudoaneurysms represent a serious and potentially life-threatening vascular complication that can be clinically indistinguishable from soft tissue infections on physical examination alone [1, 4].

A pseudoaneurysm develops when disruption of one or more layers of the arterial wall allows blood to collect in a contained periarterial hematoma that maintains communication with the arterial lumen through a neck or stalk [4, 5]. Unlike a true aneurysm, which involves dilation of all three layers of the vessel wall, a pseudoaneurysm involves outpouching of only one to two layers [6]. In patients with IVDU, pseudoaneurysms most commonly arise from inadvertent arterial puncture during injection, with the femoral artery being the most frequently affected site [4, 10]. Risk factors include recent vascular procedures, trauma, anticoagulation, and IVDU [6]. If untreated, pseudoaneurysms in patients with IVDU carry high rates of secondary infection and spontaneous rupture, making early identification critical to reducing morbidity and mortality [5, 10].

One of the greatest challenges for emergency physicians is differentiating a pseudoaneurysm from a soft tissue infection, as the physical examination findings including a tender, erythematous, fluctuant mass can be nearly identical for both entities [1]. This distinction is of paramount importance, as the management strategies are fundamentally different. The misdiagnosis of a pseudoaneurysm as an abscess could lead to inappropriate incision and drainage, resulting in catastrophic hemorrhage [7–9]. Point-of-care ultrasound (POCUS) is a rapid, noninvasive bedside tool that can reliably distinguish vascular pathology from soft tissue infections and facilitate early vascular surgery consultation [11, 13].

We present the case of a patient with IVDU and supratherapeutic anticoagulation who presented with right thigh pain and swelling and was diagnosed with a large femoral artery pseudoaneurysm using bedside POCUS as the initial diagnostic imaging modality.

Case Presentation

A 36-year-old male with a past medical history of antiphospholipid syndrome and prior pulmonary embolism, on warfarin therapy, presented to the emergency department (ED) with a two-week history of progressive pain and swelling of the right upper thigh. The patient denied any falls, injuries, or trauma to the extremity but endorsed injecting intravenous drugs into the affected area. He denied weakness, numbness, or paresthesia in the affected extremity.

On examination, the patient was hemodynamically stable with a heart rate of 82 beats per minute, blood pressure of 128/76 mmHg, respiratory rate of 16 breaths per minute, oxygen saturation of 99% on room air, and temperature of 36.8°C. Examination of the right thigh revealed a firm, tender, erythematous mass with surrounding induration. There was no crepitus, fluctuance was equivocal, and no pulsatility was appreciated on palpation. Bilateral dorsalis pedis pulses were palpable, and right lower extremity compartments were soft and compressible. The remainder of the physical examination was unremarkable.

Laboratory evaluation revealed a white blood cell (WBC) count of 7.79 × 10^3/μL, hemoglobin of 11.1 g/dL, and platelet count of 374 × 10^3/μL. The comprehensive metabolic panel was unremarkable, and the serum lactate was 1.0 mmol/L. Notably, the patient's international normalized ratio (INR) was

significantly supratherapeutic at 8.9, with a prothrombin time (PT) of 100.9 seconds and activated partial thromboplastin time (aPTT) of 82.1 seconds.

Given the patient's history of IVDU, the clinical finding of a palpable thigh mass, and the significantly supratherapeutic INR, a POCUS examination was performed at the bedside as the initial imaging study to further characterize the mass and evaluate for vascular pathology before any procedural intervention. Using a curvilinear (5–1 MHz) probe placed at the right inguinal crease in the transverse plane, B-mode imaging revealed a large, well-circumscribed hypoechoic structure with mixed internal echogenicity, smooth borders, and turbulent internal flow (Fig. 1). Application of color Doppler demonstrated characteristic bidirectional "to-and-fro" blood flow within the structure the "yin-yang sign", findings diagnostic of a pseudoaneurysm (Fig. 2).

Based on the POCUS findings, a computed tomography (CT) scan of the abdomen and pelvis was obtained, which confirmed a large heterogeneous structure involving the right iliopsoas muscle. Vascular surgery was consulted emergently and recommended CT angiography (CTA) for further characterization and operative planning. CTA revealed a large fusiform pseudoaneurysm measuring 8.6 × 6.6 × 12.1 cm extending into the right iliopsoas muscle, arising from the region of the common femoral artery bifurcation, with evidence of active contrast extravasation indicating hemorrhage.

The patient was started on empiric broad-spectrum antibiotics, including piperacillin-tazobactam 4.5 g intravenously and vancomycin 1.5 g intravenously, given concern for possible secondary infection of the pseudoaneurysm in the setting of IVDU. He was admitted to the vascular surgery service and underwent definitive surgical repair on hospital day two, consisting of right external iliac to superficial femoral artery bypass with bovine carotid interposition graft and rectus femoris flap closure. The patient's postoperative course was uncomplicated, and he was discharged home on hospital day eight with outpatient vascular surgery follow-up.

Discussion

This case illustrates the diagnostic utility of bedside POCUS as a first-line imaging modality in identifying a femoral artery pseudoaneurysm in a patient with IVDU whose physical examination findings were concerning for either a soft tissue infection or a vascular complication. The case also highlights the compounding effect of supratherapeutic anticoagulation on pseudoaneurysm expansion and hemorrhage risk.

Color Doppler ultrasound is the first-line diagnostic imaging modality for pseudoaneurysm, with reported sensitivity of 94% and specificity of 97% [7]. Alternative imaging modalities include CT angiography and magnetic resonance angiography [7]. The sonographic hallmark of a pseudoaneurysm is a hypoechoic or anechoic cystic structure communicating with an adjacent artery via a neck or stalk, with characteristic bidirectional "to-and-fro" blood flow on color Doppler—the "yin-yang sign" [7–9]. On B-mode imaging, the pseudoaneurysm appears as a well-circumscribed cystic structure with mixed internal echogenicity

representing turbulent flow and partial thrombus. The key sonographic features that differentiate a pseudoaneurysm from an abscess are summarized in Table 1.

Table 1
Sonographic features differentiating pseudoaneurysm from soft tissue abscess on point-of-care-ultrasound

Sonographic Feature	**Pseudoaneurysm**	**Soft Tissue Abscess**
B-Mode Appearance	Well-circumscribed, hypoechoic structure with smooth borders containing mixed echogenicities	Hypoechoic or anechoic fluid collection with irregular or indistinct borders
Posterior Acoustic enhancement	Minimal or abscent	Present
Internal Echoes	Swirling echoes representing turbulent flow; layering thrombus may be present	Septations, or homogeneous fluid
Color Doppler-internal flow	Bidirectional "to-and-fro" flow (yin-yang sign)	No internal vascularity present
Color Doppler-surrounding tissue	Flow within parent artery adjacent to structure	Peripheral hyperemia
Arterial Communication	Present; visible neck or stalk connecting to parent artery	Absent; no communication with adjacent vasculature
Spectral doppler waveform	Bidirectional (to-and-fro) arterial waveform at the neck	None
Compressibility	Non-compressible with transducer pressure	May compress, may see pulsastasis or movement of mixed echogenicities within the structure
Pulsatility	Pulsatile	Non-pulsatile
Wall Characteristics	Smooth, well-defined walls; may have thickened capsule	Irregular walls; surrounding inflammatory changes

When evaluating for a pseudoaneurysm at the bedside, we recommend the following approach. Place a low-frequency curvilinear (5–1 MHz) or phased-array probe over the area of concern in the transverse plane. Identify the relationship of any cystic structure to adjacent vasculature on B-mode imaging. Apply color Doppler to assess for internal flow and the characteristic bidirectional "to-and-fro" waveform pattern. If a pseudoaneurysm is identified, attempt to document the communicating neck between the cystic structure and the parent artery. Spectral Doppler can be used to confirm the bidirectional waveform. Importantly, if POCUS findings are suggestive of a pseudoaneurysm, incision and drainage should not be performed, and emergent vascular surgery consultation should be obtained.

A pseudoaneurysm is the most frequently described arterial complication of IVDU and develops from either direct trauma to the artery during injection or indirectly from damage to the arterial wall due to

spreading local infection [4, 10]. The femoral artery is the most affected vessel, owing to its frequent use as an injection site; however, pseudoaneurysms can develop at any anatomical location where injection has occurred [10]. Depending on size, pseudoaneurysms can cause vascular compromise, tissue necrosis, and nerve compression [6].

POCUS is a valuable modality for differentiating abscess from cellulitis and is the diagnostic modality of choice for evaluating a suspected pseudoaneurysm [11, 13]. In patients with IVDU, it is especially useful in distinguishing a simple abscess from vascular pathology. This distinction is critical: the misdiagnosis of a pseudoaneurysm as an abscess could lead to inappropriate incision and drainage with catastrophic hemorrhage [7–9].

Several features of this case deserve emphasis. First, the patient's INR of 8.9 likely contributed to the significant size of the pseudoaneurysm and the presence of active hemorrhage on CTA. Anticoagulation is a well-established risk factor for pseudoaneurysm formation and expansion, and the combination of IVDU with supratherapeutic anticoagulation represents a particularly high-risk clinical scenario [6]. Emergency physicians should recognize that concomitant anticoagulation significantly increases both the risk and potential severity of pseudoaneurysm in patients with IVDU.

Second, the patient's two-week delay in presentation underscores the barriers to timely healthcare access that are common among individuals who use injection drugs. This delay highlights the importance of maintaining a high index of suspicion for serious vascular complications even in subacute presentations when the history is suggestive and exam findings are nondiagnostic.

Third, the patient was afebrile with a normal WBC count, demonstrating that the absence of systemic inflammatory markers does not exclude the possibility of a pseudoaneurysm or the need for empiric antibiotic coverage in this high-risk population. Empiric broad-spectrum antibiotics were administered given the high rate of secondary infection in pseudoaneurysms associated with IVDU [1, 4].

Management of pseudoaneurysms is determined by sac size, neck diameter, presence of complications, and risk of infection [11, 12]. In recent years, therapeutic options have shifted toward less invasive strategies, including ultrasound-guided compression, percutaneous thrombin injection, endovascular repair, and balloon occlusion [11, 12]. However, in patients with infected arterial pseudoaneurysms secondary to IVDU, there remains no clear consensus on the optimal surgical treatment strategy, and open surgical repair with arterial bypass grafting remains common [4, 12].

Conclusions

This case highlights the importance of considering pseudoaneurysm in the differential diagnosis of extremity pain and swelling in patients with IVDU, particularly when physical examination findings overlap with those of soft tissue infection. The patient's supratherapeutic anticoagulation likely contributed to the significant size of the pseudoaneurysm and the presence of active hemorrhage, underscoring the compounding risk of concomitant anticoagulation in this population. POCUS

performed as the initial imaging study at the bedside enabled rapid identification of the pseudoaneurysm through visualization of the characteristic "yin-yang sign" on color Doppler, preventing a potentially catastrophic misdiagnosis and facilitating emergent vascular surgery consultation. Emergency physicians should maintain a low threshold for performing bedside POCUS with color Doppler in patients with a history of IVDU who present with extremity pain, swelling, or a palpable mass, as early recognition of this diagnosis can prevent life-threatening hemorrhage and significantly improve patient outcomes.

Abbreviations

Abbreviation	Definition
aPTT	Activated partial thromboplastin time
CT	Computed tomography
CTA	Computed tomography angiography
ED	Emergency department
INR	International normalized ratio
IVDU	Intravenous drug use
POCUS	Point-of-care ultrasound
PT	Prothrombin time
WBC	White blood cell

Declarations

Ethics approval and consent to participate

Not applicable. This case report was exempt from institutional review board (IRB) review per Northwell Health policy, as it involves a single patient case report with no experimental intervention.

Consent for publication

Informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

PK, AV directly participate in constructing the manuscript. NB, DT assisted in editing and reviewing the manuscript. AC supervised the construction and assisted with writing and editing the manuscript. AC, PK and DT constructed and edited the figures and table.

Availability of data and materials

Data sharing is not applicable to this article, as no datasets were generated or analyzed during the current study.

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Figures

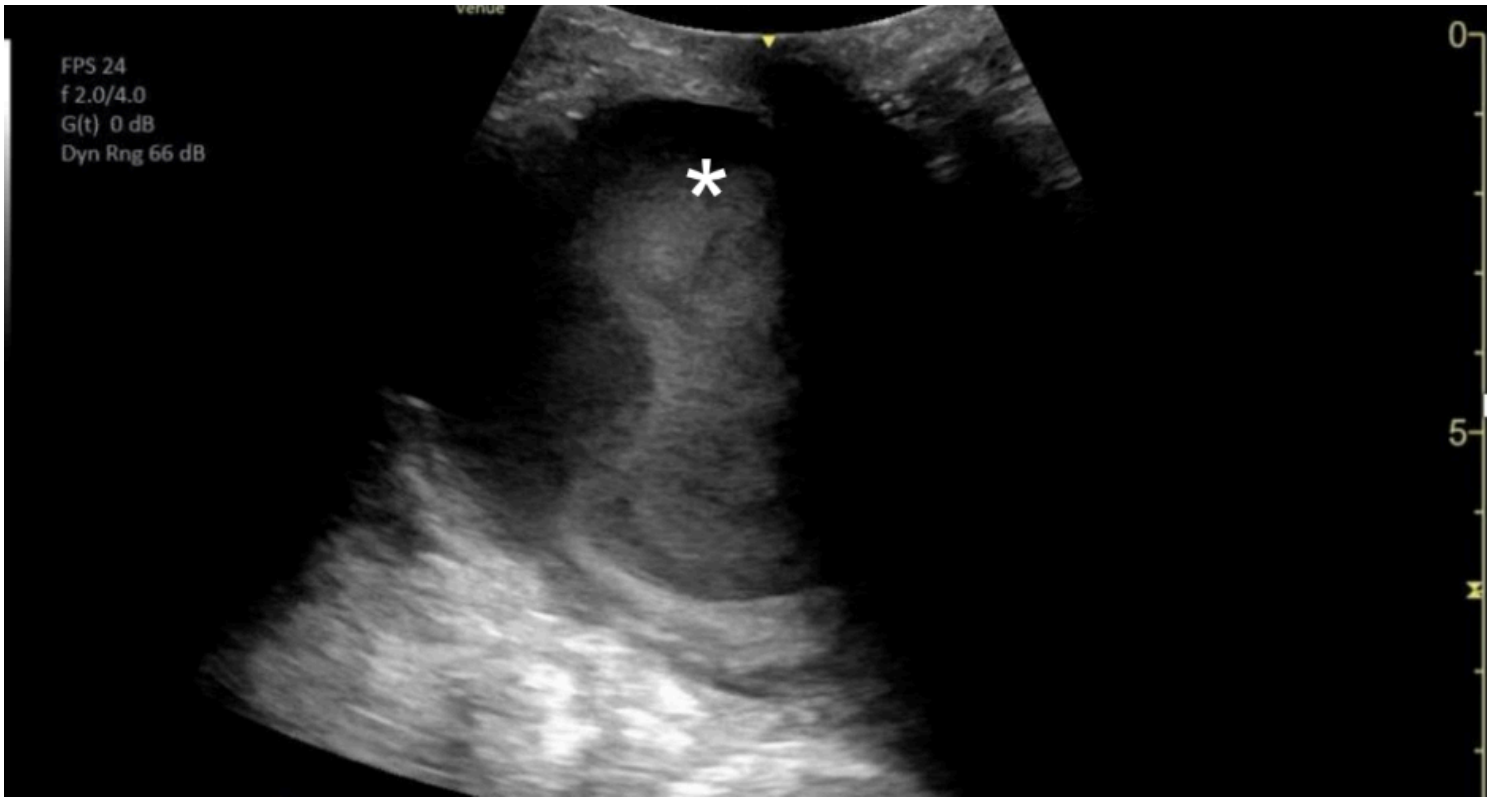


Figure 1

B-mode point-of-care ultrasound using a curvilinear (5–1 MHz) probe at the right inguinal crease in the transverse plane. A large, well-circumscribed cystic structure (*asterisk*) with mixed internal echogenicity and smooth borders is visualized adjacent to the femoral artery. Internal echoes represent turbulent flow and partial thrombus within the pseudoaneurysm sac.

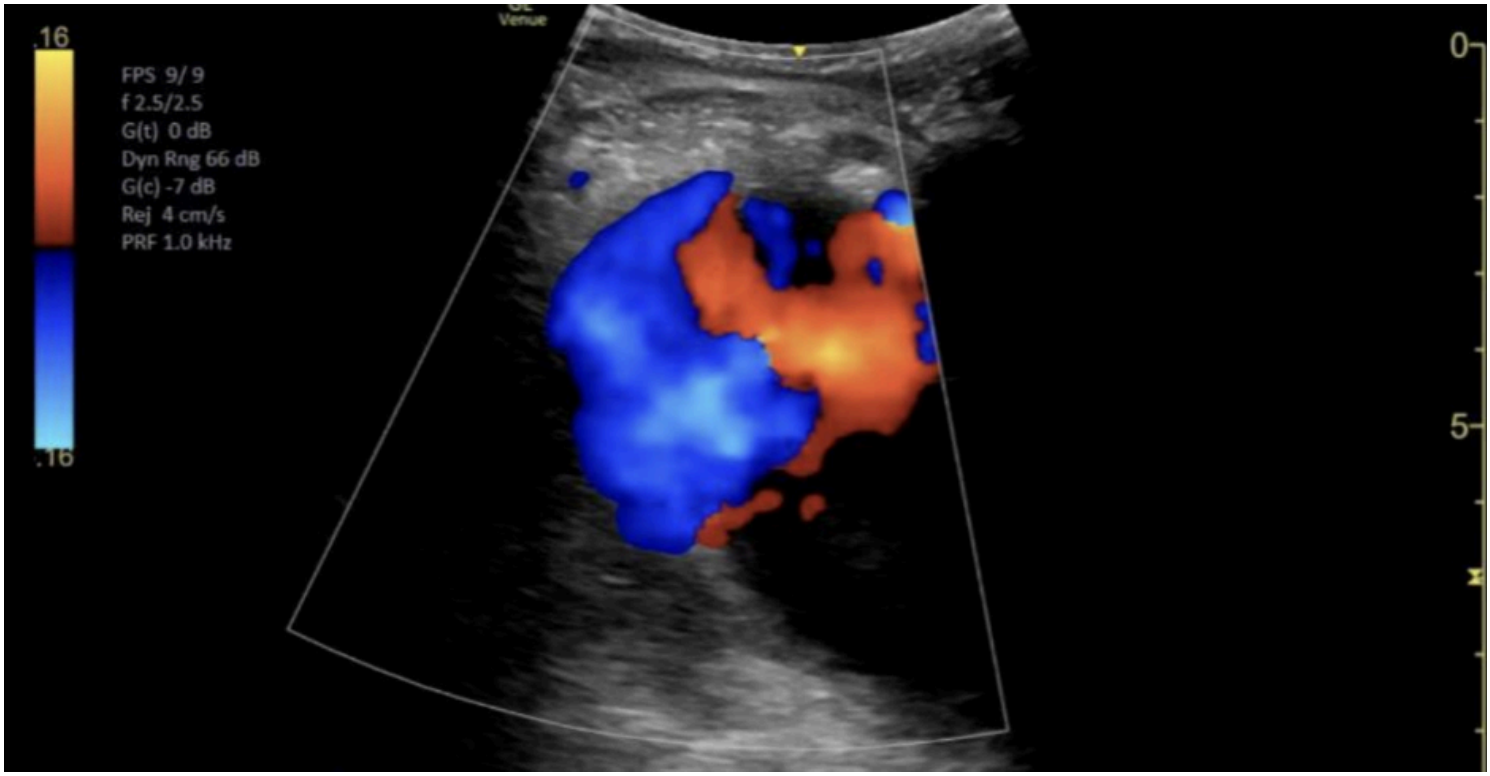


Figure 2

Color Doppler point-of-care ultrasound at the right inguinal crease in the transverse plane demonstrating the "yin-yang sign." Bidirectional blood flow is visualized within the pseudoaneurysm sac, with flow toward the transducer and flow away from the transducer creating the characteristic swirling pattern. This "to-and-fro" flow pattern is the sonographic hallmark of a pseudoaneurysm