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Case Report

Traumatic radial artery pseudoaneurysm with cephalic venous graft repair

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ABSTRACT

A pseudoaneurysm of the radial artery is a rare vascular abnormality most frequently resulting from penetrating injuries or iatrogenic etiologies. The lack of structural integrity predisposes it to complications, including, but not limited to, rupture. In the given case, a middle-aged man presented with a pulsating mass over the flexor aspect of the right forearm secondary to a traumatic injury previously managed with debridement and suturing. Physical examination demonstrated a cystic swelling with a positive Nicoladoni-Branham sign. Doppler ultrasound findings were suggestive of an arteriovenous malformation. The lesion however was found to be a pseudoaneurysm intraoperatively. The patient underwent an exploratory surgery, including ligation and pseudoaneurysm excision, followed by reconstruction of the radial artery using a cephalic venous graft. Post operatively, the patient exhibited satisfactory healing with a healthy, patent graft. The increasing utilisation of the radial artery in procedures such as catheterisation owing to its accessibility, lower complication rates and faster recovery, establishes it as a key site for pseudoaneurysm formation. The absence of standardized diagnostic criteria complicates timely diagnosis and management of pseudoaneurysms, thereby increasing the risk of complications.

Keywords: Arteriovenous malformation, Pseudoaneurysm, Radial artery, Cephalic vein graft, Diagnostic guidelines

INTRODUCTION

A pseudoaneurysm, also referred to as a false aneurysm, is a complex vascular lesion that develops at the site of arterial injury. It is characterized by a pulsatile hematoma contained within a fibrous capsule, which communicates with the arterial lumen through a distinct opening.[1] Unlike true aneurysms, pseudoaneurysms do not involve all three layers of the arterial wall (intima, media, and adventitia). Their lack of structural integrity predisposes them to rupture and other complications. Pseudoaneurysms may result from trauma, surgical interventions, infections, or invasive procedures such as catheterization, and are most frequently associated with arterial punctures and vascular surgeries. The most commonly reported sites include the cardiac, femoral, visceral, and aortic arteries. Clinical presentation varies with location, but typical manifestations include a pulsatile mass, localized pain, or swelling.

Radial artery pseudoaneurysms represent a rare clinical entity, most often arising from penetrating trauma or iatrogenic injury. At present, no universally accepted guidelines exist for the diagnosis of pseudoaneurysms.

Diagnostic evaluation is based on a combination of clinical assessment, imaging, and laboratory investigations. Commonly utilized imaging modalities include ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI).

CASE REPORT

Patient information

A male in his early 40s, with no significant medical history, presented with a pulsatile mass on the flexor aspect of his right forearm. One month prior, he had sustained a traumatic injury from the penetration of a glass shard into his forearm. Subsequent debridement and suturing were done for wound closure.

Clinical findings

Following the surgery, the patient noticed a gradually increasing swelling at the site of the original injury. The swelling, initially 1×1 cm in size, had progressively enlarged to approximately 2×2 cm (Figure 1a). The patient reported no pain, functional impairment, or changes in the overlying skin.

Physical examination

Swelling

A cystic swelling with positive fluctuation was noted over the flexor aspect of the right forearm.

Skin

No changes in skin color or texture over the swelling. The overlying skin was non-adherent- a finding that is inconsistent with malignancy (Figure 1b).

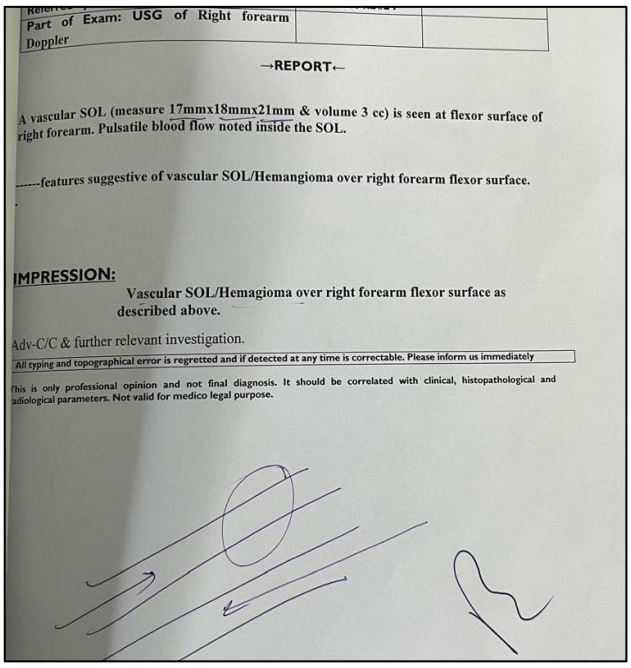
Vascular signs

Following the temporary occlusion of the suspected arterio-venus fistula, a significant reduction in the pulse rate (from 84 bpm to 77 bpm) and a slight increase in blood pressure (from 124/78 mmHg to 130/82 mmHg). This is consistent with a positive Nicoladoni-Branham sign, indicative of vascular involvement and suggestive for an arteriovenous fistula. No evidence of additional abnormalities was identified elsewhere in the body.

Investigation

A doppler ultrasound study conducted was suggestive of an arteriovenous malformation described as a vascular space occupying lesion or hemangioma measuring 17×18×21 mm and 3cc in volume (Figure 2,3). The characteristic 'yin-yang' sign and 'to and fro' signs were not observed on duplex ultrasound imaging. Radiographic imaging of the right forearm demonstrated no observable bone or joint space abnormalities. Routine laboratory and diagnostic investigations conducted confirmed all the results falling within normal limits (Table 1). No identifiable risk factors predisposing the patient to a pseudoaneurysm formation were noted. There were no clinical or laboratory findings corresponding with any underlying infections

Figure 1: (a) Superior view of the vascular lesion. (b) Lateral view of the vascular lesion.


Part of Exam: USG of Right forearm Doppler

→REPORT←

A vascular SOL (measure 17mmx18mmx21mm & volume 3 cc) is seen at flexor surface of right forearm. Pulsatile blood flow noted inside the SOL.

-----features suggestive of vascular SOL/Hemangioma over right forearm flexor surface.

IMPRESSION:

Vascular SOL/Hemagioma over right forearm flexor surface as described above.

Adv-C/C & further relevant investigation.

All typing and topographical error is regretted and if detected at any time is correctable. Please inform us immediately

This is only professional opinion and not final diagnosis. It should be correlated with clinical, histopathological and radiological parameters. Not valid for medico legal purpose.

Figure 2: Ultrasonography report.

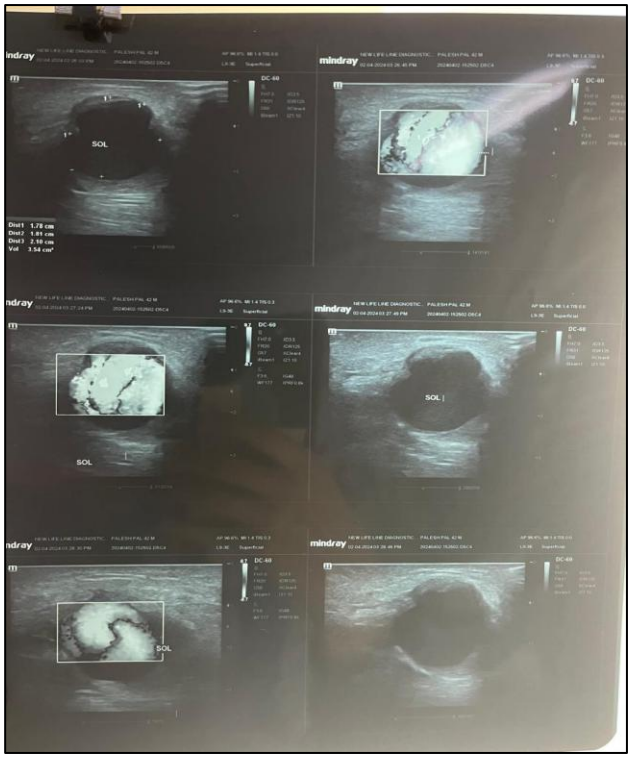


Figure 3: Ultrasonography imaging.

Figure 4: Ultrasound guided regional block-axillary block.

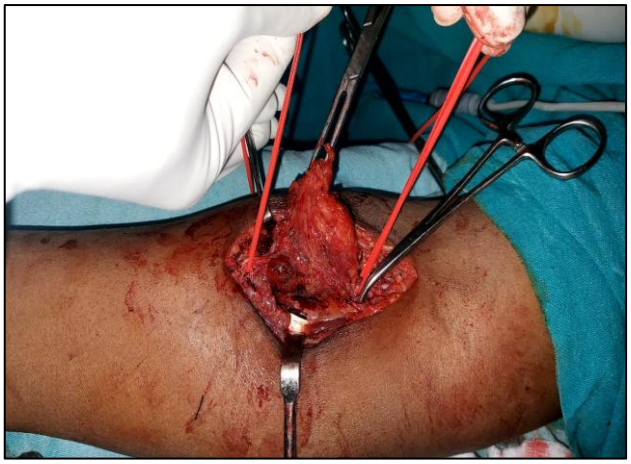


Figure 5: Silicone looping.

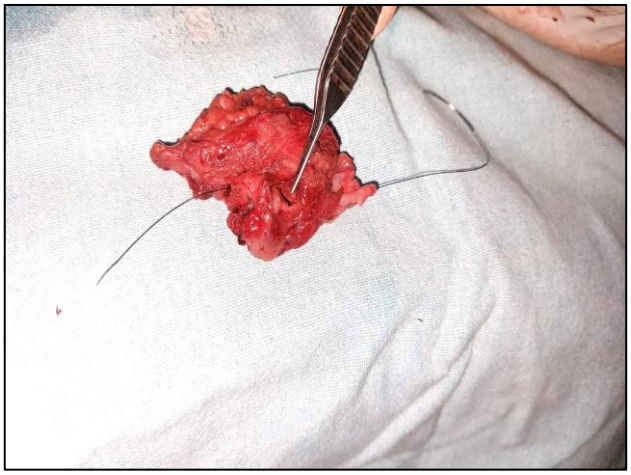


Figure 6: Excised pseudoaneurysm.

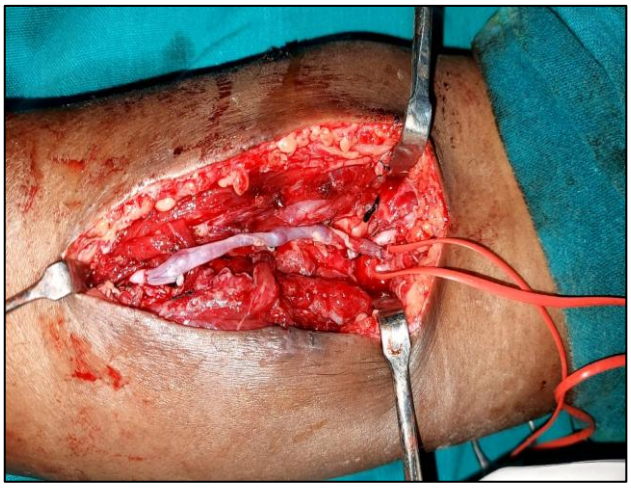


Figure 7: Reconstruction of radial artery using cephalic venous graft.

Advanced imaging modalities, including computed tomography, angiography, and magnetic resonance angiography, were not performed due to financial limitations.

Surgical procedure

The patient was taken up for an elective procedure-ligation and removal of arteriovenous malformation under regional anaesthesia.

Pre operative

Informed consent for anesthesia classified as American society of anesthesiologists (ASA) physical status II and surgical procedure were obtained from the patient in the presence of a reliable witness. Pre-anesthetic evaluation yielded a Wilson's score of 0 and a Mallampatti grade 1 indicating no anticipated difficulty with intubation. On examination, the patient was conscious, oriented and stable with no observable abnormalities. Patient was instructed to remain nil per os for 8 hours and 2 hours for solids and clear liquids respectively. A 20-gauge intravenous cannula was placed in his left hand. Pre-operative vitals are as follows (Table 2).

Intra operative

Under strict asepsis, an ultrasonography-guided regional block (axillary block) was administered (Figure 4). Intraoperative monitoring of various parameters including electrocardiogram, non-invasive blood pressure, pulse oximetry was performed. A total of 2000 ml of crystalloid solution (Ringer's lactate) was infused during the duration of the surgery. With the patient in supine position, the right arm was placed on arm rest. Arm was cleaned, painted and draped as per protocol.

Under asepsis, an exploratory incision was made. Skin and superficial tissues were dissected and retracted. The lesion was then dissected all around. Under visualisation, the radial artery was proximally and distally looped with a silicone loop (Figure 5).

Contrary to the initial clinical diagnosis based on imaging findings, no evidence of an arteriovenous fistula was identified intraoperatively. Instead, a lesion arising directly from the radial artery was observed- indicative of a pseudoaneurysm of the radial artery. The lesion was excised along with an approximately 10 cm segment of the radial artery (Figure 6).

Radial artery was reconstructed in the right forearm using a cephalic vein graft harvested from the ipsilateral arm. An end-to-end anastomosis was done using ethilon 8-0 (Figure 7). A surgical drain was then secured at the surgical site with 2-0 ethilon.

The incision was closed in layers. Post operatively, vitals were stable (Table 3). Post operatively satisfactory healing with minimal scarring was observed. Ultrasonography guided doppler imaging demonstrated a healthy and patent vascular graft. No postoperative complications observed during the three-month follow-up period.

Table 1: Routine investigations.

Parameter	Value	Biological reference interval
Hemoglobin	13.3 g/dl	13.5-17.5 g/dl
Total leukocyte count	10400 cells/cumm	4500-11,000 cells/cumm
Platelet	1.15 lakh cells/cumm	1.5-4.0 lakh cells/cumm
Prothrombin time	16.3 seconds	11-13.5 seconds
Activated partial thromboplastin time	34.4 seconds	21- 35 seconds
International standardised ratio	0.9 seconds	0.8- 1.1 seconds
HIV, HbsAg, HCV	negative	
Urine routine and microscopy	within normal limits	

Table 2: Pre-operative vitals.

Pre-operative vitals	Value
Heart rate	74 bpm
Blood pressure	131/88 mmHg
Respiratory rate	14
Peripheral oxygen saturation	100

Table 3: Post-operative vitals.

Post-operative vitals	Value
Heart rate	75bpm
Blood pressure	127/72 mmHg
Respiratory rate	14
Peripheral oxygen saturation	100

DISCUSSION

A pseudoaneurysm- false aneurysms occurring at the site of arterial injury, is a complex vascular lesion characterized by a pulsatile hematoma, enclosed by a fibrous capsule, with an opening connecting it to the arterial lumen. Unlike true aneurysms, which involve the ballooning of blood vessels, a pseudoaneurysm does not involve the vascular wall. Instead, blood leaks from the injury site and is contained by a wall developed with the products of the clotting cascade. This distinction is crucial as the pseudoaneurysms' lack of structural integrity render them more prone to rupture and complications.

Subsequently, pseudoaneurysms do not involve all three layers of the arterial wall (intima, media, and adventitia). Pseudoaneurysms can arise from trauma, surgery, infection, or as a complication of invasive procedures such as catheterizations. They are commonly associated with arterial punctures and vascular surgeries.[1] Despite these common associations and history of trauma pseudoaneurysms may, as demonstrated in this case, develop in the absence of any other identifiable risk factors, complicating both the diagnosis and management. Pseudoaneurysms occur in approximately 1-2% of patients following traumatic injuries involving major arteries.

This rate can be higher in specific types of trauma or injury settings.[2] This case involves a male in his early 40's who is observed to have developed a pseudoaneurysm one month after he was treated for a penetrating injury to his right forearm. This rare complication is further compounded by the lack of traditional risk factors like hypertension, female sex, anticoagulant use, placement of access to the left femoral artery, puncture of calcified blood vessels, larger sheath size-greater than 6 French, obesity, lack of ultrasound utilization during an access procedure and multiple puncture attempts.[3] The atypical presentation highlights the need for vigilance, even in patients outside the high-risk categories, as pseudoaneurysms may develop unpredictably.

The most commonly encountered pseudoaneurysms include cardiac, femoral, visceral, and aortic pseudoaneurysms. Symptoms of pseudoaneurysms can vary depending on location. Common signs include a pulsatile mass, pain, or swelling.[4] In some cases, pseudoaneurysms may be asymptomatic and discovered incidentally during imaging for unrelated issues.

In addition to local symptoms, more severe complications, such as rupture or thromboembolic events, may present as sudden pain, ischemia, or even hemorrhagic shock. Early detection and appropriate management are crucial to preventing these potentially fatal outcomes.[5] The absence of obvious symptoms, or the presence of vague complaints such as mild discomfort or swelling, often leads to delayed diagnosis. In this case, the patient presents with a pulsatile mass and discomfort over the right forearm, a typical clinical presentation. Pseudoaneurysms of the radial artery is a rare clinical entity, usually occurring due to penetrating trauma and iatrogenic injury.[6] The incidence of pseudoaneurysm of the radial artery are reported to be between 1% and 5% following traumatic vascular trauma but can vary based on the severity of the injury. The specifics of the trauma related data are less comprehensive than for post-procedural pseudoaneurysms.[7]

The radial artery is less frequently involved in pseudoaneurysm formation compared to larger arteries like the femoral or brachial arteries, which are more susceptible due to their size and common involvement in procedures such as catheterization. However, the radial artery's anatomical location and its involvement in routine procedures such as catheterizations or arterial punctures make it a notable site for pseudoaneurysm development. In this case, it is unclear whether the pseudoaneurysm resulted directly from the initial penetrating trauma or from complications during the suturing process. This highlights the influence of trauma management, surgical technique, and post-procedural care in mitigating pseudoaneurysm formation risks.

Currently, no universally applicable guidelines exist for the diagnosis of pseudoaneurysms. The diagnosis of a pseudoaneurysm relies on a combination of clinical findings, imaging and laboratory findings. Diagnostic modalities include ultrasound, computed tomography (Computed tomography) scans, and magnetic resonance imaging (Magnetic resonance imaging). Ultrasound is often the first-line investigation due to its accessibility and effectiveness in assessing the pulsatile nature of the mass. Doppler ultrasound can further evaluate the blood flow dynamics, providing insight into the arterial connection and confirming the diagnosis.[8] Computed tomography and Magnetic resonance imaging are useful for more detailed imaging, especially in complex cases or when there are concerns about associated injuries to other structures. Despite the availability of advanced imaging modalities, pseudoaneurysms can go undetected for extended periods, particularly when symptoms are vague.

In this case, an initial misdiagnosis of arterio-venous malformation was made despite the use of both ultrasonography and Doppler imaging as diagnostic modalities. This is not uncommon and may be attributed to the lack of specific diagnostic techniques or the absence of arterial contrast in initial computed tomography imaging, emphasizing the importance of a thorough clinical evaluation and appropriate imaging for accurate diagnosis.

Misdiagnoses frequently lead to the formulation of an inaccurate and unapplicable treatment plan. Patient outcomes drastically improve when the delay in diagnosis is reduced. Presence of a pseudoaneurysm can complicate

future radial artery access for catheterizations or other procedures. Proper management and resolution of the pseudoaneurysm are crucial to avoid complications in subsequent interventions.[9] Management typically includes observation, ultrasound-guided compression, percutaneous thrombin injection, or surgical intervention. The choice of treatment depends on the size, symptoms, and risk of complications.[10]

Surgical intervention, including excision and arterial reconstruction, is required for larger or symptomatic pseudoaneurysms or when less invasive measures fail. In this case, the larger size necessitated a surgical excision of the pseudoaneurysm with radial artery reconstruction using a cephalic vein graft harvested from the same hand. This approach restored arterial continuity and alleviated symptoms. Furthermore, the choice of reconstruction technique whether using autologous grafts or synthetic materials-depends on factors such as graft availability, vascular anatomy, and the patient's overall health.[11] Individualized treatment based on the patient's presentation and the pseudoaneurysm's characteristics is of utmost importance as demonstrated by this case.

Radial artery reconstruction becomes necessary in case of significant pseudoaneurysm formation with a large or symptomatic pseudoaneurysm affecting the patient's quality of life, failure of conservative management such as compression or thrombin injection, and persistent or recurrent pseudoaneurysm. Other indications include pain, discomfort, functional impairment and risk of rupture.[12]

The choice of technique for radial artery reconstruction depends on the pseudoaneurysm's characteristics and location. The pseudoaneurysm and surrounding damaged tissue are excised, followed by reconstruction of the artery using an autologous vein graft or synthetic material.[11] Successful reconstruction can alleviate symptoms, restore normal arterial function, and reduce the risk of complications.[13] In this case, a cephalic vein graft was successfully used to reconstruct the radial artery, resolving the patient's symptoms and preventing future complications.

However, it is crucial to note that even with proper surgical management, there is a risk of recurrence or complications, which necessitates follow-up and monitoring.[14] This is particularly observed in patients with underlying vascular fragility or those who experience future trauma or procedures involving the affected artery. Comprehensive postoperative care and long-term follow-up are essential for monitoring complications and ensuring optimal healing.

CONCLUSION

The long-term prognosis for patients with radial artery pseudoaneurysms is generally favorable when timely diagnosis and appropriate management are provided. However, their clinical significance lies in the potential for serious complications, the challenges in diagnosis and management, their impact on patient function, and implications for future vascular interventions. With successful treatment, most patients regain normal function and experience a reduced risk of recurrence. Post-treatment follow-up remains essential to monitor healing, detect any complications early, and ensure that the affected artery maintains its functional integrity for future procedures or vascular access needs.

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