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Beyond the Pulse: Multimodality Imaging of a Partially Thrombosed Distal Radial Artery Pseudoaneurysm in a Young Adult — A Case Report

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ABSTRACT
Background: *Aneurysms and pseudoaneurysms of the distal radial artery are uncommon vascular lesions that may mimic benign soft-tissue swellings of the wrist. Their accurate characterisation is critical because untreated lesions risk thrombosis, distal embolisation, ischaemia, and rupture. Multimodality imaging — high-resolution ultrasound with colour Doppler complemented by magnetic resonance imaging (MRI) — provides both haemodynamic information and superior soft-tissue delineation to guide surgical planning.*
Case Presentation: *A 35-year-old patient presented with a gradually enlarging, mildly pulsatile swelling over the volar aspect of the distal left forearm, proximal to the wrist crease. Plain radiography showed only a localised soft-tissue density. High-resolution greyscale ultrasonography (Samsung HS70A) revealed a well-defined saccular outpouching arising from the distal radial artery with a thick peripheral echogenic rim of mural thrombus. Colour Doppler demonstrated the characteristic "yin-yang" sign within the residual lumen. Contrast-free MRI (Siemens MAGNETOM Essenza 1.5 T) confirmed a partially thrombosed saccular pseudoaneurysm with a heterogeneously hyperintense peripheral rim of laminated thrombus, and time-of-flight MR angiography demonstrated the patent residual lumen and an intact palmar arch. The patient underwent surgical excision with ligation of the distal radial artery and remained asymptomatic with preserved hand perfusion at follow-up.*
Conclusion: *This case underscores the complementary role of ultrasound and MRI in the workup of distal radial artery pseudoaneurysms. Ultrasound with colour Doppler provides a rapid, non-invasive bedside diagnosis through the yin-yang sign, while MRI accurately delineates the extent of the lesion, the burden of mural thrombus, and its relationship to adjacent neurovascular and tendinous structures, enabling confident pre-operative planning.*
KEYWORDS
Pseudoaneurysm; Radial Artery; Ultrasonography, Doppler, Color; Magnetic Resonance Imaging; Multimodality Imaging.

I. INTRODUCTION

Pseudoaneurysms — also termed false aneurysms — represent a contained disruption of the arterial wall, in which the extravasated blood is confined by the surrounding adventitia or peri-arterial soft tissues rather than by all three layers of the vessel wall.[1] Unlike true aneurysms, which involve an intact but dilated vessel wall, a pseudoaneurysm communicates with the parent artery through a defect and maintains a swirling, to-and-fro pattern of flow that is the cornerstone of its imaging diagnosis.[2]

Peripheral arterial pseudoaneurysms most commonly affect the femoral, brachial, and popliteal arteries, with iatrogenic puncture and penetrating trauma accounting for the majority of cases.[3] Involvement of the distal radial artery is comparatively rare, with most reported cases occurring after transradial cardiac catheterisation, repeated arterial blood gas sampling, or sharp/blunt trauma to the wrist.[4,5] Spontaneous or post-traumatic pseudoaneurysms of the distal radial artery in young, otherwise healthy adults are distinctly uncommon and may be mistaken for ganglion cysts, soft-tissue tumours, or simple haematomas on clinical examination alone.[6]

Accurate and early imaging diagnosis is therefore essential. Colour Doppler ultrasonography, with the pathognomonic "yin-yang" sign of bidirectional flow within the sac and the corresponding to-and-fro spectral waveform across the neck, has become the first-line modality.[2,7] Magnetic resonance imaging and MR angiography contribute superior soft-tissue contrast, accurate sizing of the thrombus burden, and a clear map of the lesion's relationship to adjacent flexor tendons, the median and superficial radial nerves, and the wrist joint

capsule — information that materially influences operative planning.[1,3] We present a case of a young adult with a partially thrombosed pseudoaneurysm of the distal radial artery, in whom an integrated ultrasound–MRI workup permitted confident diagnosis, characterisation, and surgical management.

II. CASE PRESENTATION

A 35-year-old patient presented to the outpatient department with a gradually progressive swelling over the volar aspect of the distal left forearm, noted for several weeks before consultation. The swelling was associated with mild local discomfort but no constitutional symptoms, no distal pallor, and no paraesthesia of the radial three-and-a-half digits. There was no history of intravenous drug use, prior arterial puncture, or known coagulopathy. A history of remote blunt or penetrating trauma to the wrist was reported [to be confirmed and elaborated by the treating team].

On examination, a soft to firm, non-tender, mildly pulsatile swelling measuring approximately [insert dimensions in cm] was palpable over the volar aspect of the distal left forearm, just proximal to the wrist crease. The overlying skin was unremarkable, with no signs of erythema, induration, or sinus formation. Distal capillary refill was brisk; the ulnar pulse was well felt; and a modified Allen test demonstrated an intact and dominant ulnar contribution to the palmar arch. Sensory and motor function of the hand were preserved. Routine haematological and biochemical investigations were within normal limits, and the coagulation profile was unremarkable.

Plain radiography of the left wrist and forearm (anteroposterior and lateral projections) demonstrated a localised soft-tissue swelling along the volar aspect of the distal forearm, immediately proximal to the wrist crease, without bony erosion, periosteal reaction, or radio-opaque foreign body (Figure 1).

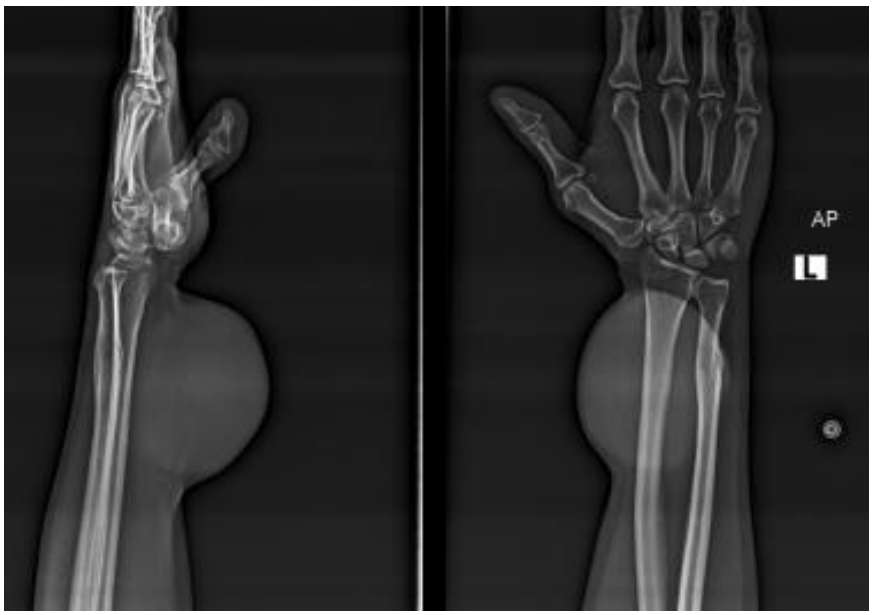

Figure 1: Plain radiographs of the left wrist and distal forearm (lateral and anteroposterior views) demonstrating a localised soft-tissue swelling along the volar aspect of the distal forearm, proximal to the wrist crease, without bony erosion or periosteal reaction.

High-resolution greyscale ultrasonography performed using a linear high-frequency probe on a Samsung HS70A platform demonstrated a well-defined, predominantly anechoic saccular outpouching arising from the distal radial artery, with a thick peripheral hyperechoic rim consistent with laminated mural thrombus (Figure 2). The lesion measured approximately [insert greatest dimension] in maximum diameter and communicated with the parent artery through a narrow neck of approximately [insert neck width].

Figure 2: Greyscale ultrasonography demonstrates a well-defined, predominantly anechoic saccular outpouching arising from the distal radial artery (left side of image), with a thick peripheral hyperechoic rim consistent with laminated mural thrombus.

Colour Doppler interrogation showed the classical "yin-yang" sign within the residual patent lumen, with alternating red and blue colour signals representing bidirectional swirling flow (Figure 3). Spectral Doppler at the neck confirmed a characteristic "to-and-fro" arterial waveform, consistent with a pseudoaneurysm. Flow distal to the lesion in the radial artery and through the superficial palmar arch was preserved.

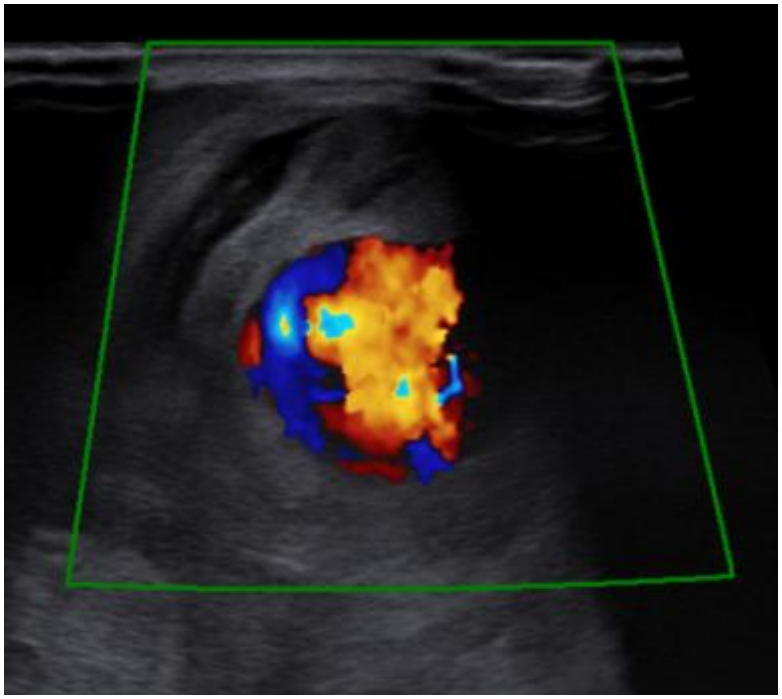

Figure 3: Colour Doppler ultrasonography shows the classical “yin-yang” sign within the residual patent lumen of the lesion, with alternating red and blue colour signals representing bidirectional swirling flow — the imaging hallmark of a pseudoaneurysm.

Magnetic resonance imaging of the left forearm and wrist was performed on a Siemens MAGNETOM Essenza 1.5 T scanner with a dedicated extremity coil. Sagittal and axial proton density and T2-weighted fat-saturated sequences demonstrated a well-circumscribed saccular lesion arising from the volar aspect of the distal radial artery (Figure 4). The lesion showed a heterogeneously hyperintense peripheral rim of laminated thrombus with an inner crescentic flow-void corresponding to the residual patent lumen, confirming a partially thrombosed pseudoaneurysm. Adjacent flexor tendons, the median and superficial radial nerves, and the wrist joint capsule were intact and clearly delineated. Time-of-flight MR angiography of the forearm demonstrated a focal saccular outpouching arising from the distal radial artery with preserved flow in the proximal radial artery, distal radial artery, and ulnar artery, and a complete palmar arch (Figure 5).

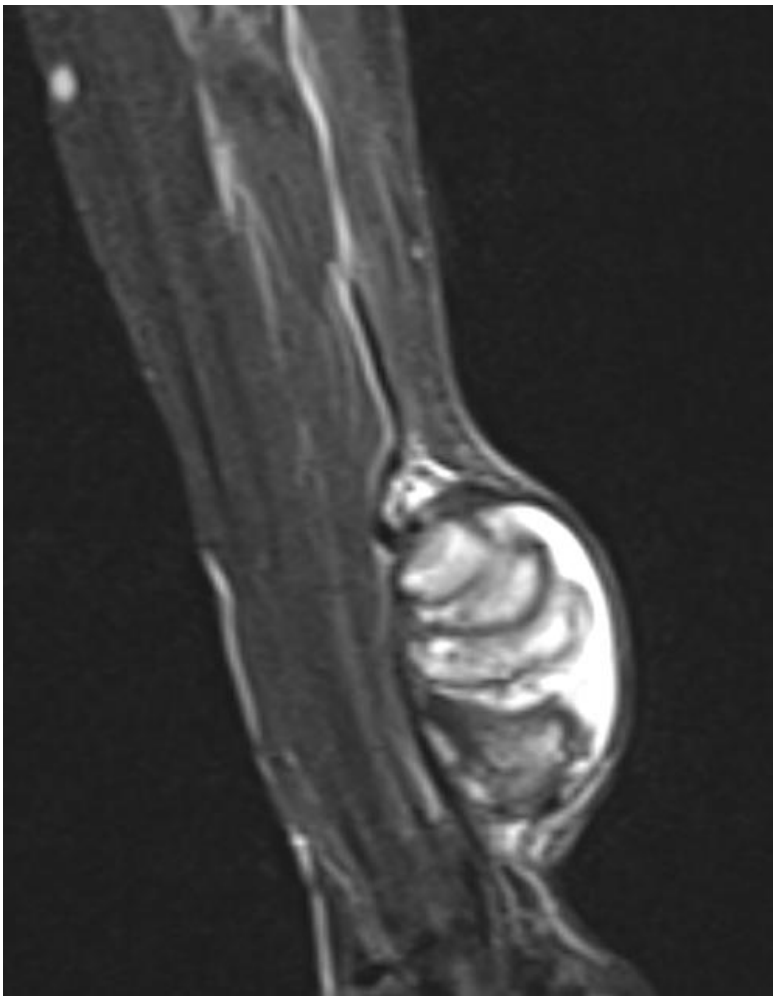

Figure 4: Sagittal T2-weighted fat-saturated MR image of the distal left forearm shows a well-circumscribed saccular lesion arising from the volar aspect of the distal radial artery, with a heterogeneously hyperintense peripheral rim of laminated thrombus and an inner crescentic flow-void corresponding to the residual patent lumen — consistent with a partially thrombosed pseudoaneurysm.

Figure 5: Coronal maximum-intensity projection time-of-flight MR angiography image demonstrates a focal saccular outpouching arising from the distal radial artery, with preserved flow in the proximal and distal radial artery and an intact palmar arch.

Based on the integrated imaging findings, a confident diagnosis of a partially thrombosed pseudoaneurysm of the distal radial artery was established. Following a multidisciplinary discussion with the vascular and plastic surgery teams, the patient underwent surgical exploration. A longitudinal volar incision was made directly over the lesion. The pseudoaneurysm sac was identified, carefully dissected free of adjacent neurovascular structures, and excised in toto after proximal and distal control of the radial artery (Figure 6). Given the demonstrably intact ulnar–palmar arch circulation on pre-operative Doppler and Allen testing, the distal radial artery was ligated. The post-operative course was uneventful, and the patient was discharged with preserved sensory and motor function of the hand. At follow-up [insert duration, e.g., six weeks / three months], the surgical site had healed well; capillary refill and digital perfusion remained intact; and there was no clinical or sonographic evidence of recurrence.

Figure 6: Intra-operative photograph showing the pseudoaneurysm sac exposed through a longitudinal volar incision over the distal forearm. Proximal and distal control of the radial artery was obtained before en-bloc excision of the sac.

III. DISCUSSION

A pseudoaneurysm is defined as a pulsatile, encapsulated haematoma in continuity with the lumen of a ruptured artery, in which the wall of the sac is composed of compressed peri-arterial tissue rather than the three layers of a normal vessel.[1,3] This anatomical distinction from true aneurysms is clinically important: pseudoaneurysms tend to enlarge progressively because the surrounding tissue cannot reliably contain arterial pressure, and they carry a meaningful risk of rupture, distal embolisation, local mass effect on adjacent nerves, and secondary skin breakdown.[1,3,6]

Radial artery pseudoaneurysms are uncommon overall, with most contemporary case series describing them as a complication of the transradial approach for coronary angiography, occurring in approximately 0.05% of procedures.[4,5] Other reported aetiologies include arterial cannulation in the intensive care setting, repeated arterial blood gas sampling, penetrating trauma (including unusual mechanisms such as animal bites), and — much less commonly — both-bone forearm fractures or sharp injuries in young adults.[6] The clinical presentation of a slowly enlarging, mildly pulsatile volar wrist swelling, as seen in our patient, is non-specific, and the differential diagnosis is broad — including ganglion cyst, lipoma, schwannoma of the median or superficial radial nerve, giant cell tumour of the tendon sheath, organised haematoma, and an arteriovenous malformation. The risk of an unsuspected radial pseudoaneurysm being inadvertently incised at the time of "ganglion cyst" excision is well documented and underscores the value of imaging confirmation before any operative intervention.[6]

Colour Doppler ultrasonography is now widely accepted as the first-line investigation for any suspected peripheral pseudoaneurysm.[2,7] The "yin-yang" sign — bidirectional, swirling colour-flow within the residual lumen of the sac — and the corresponding spectral "to-and-fro" waveform across the neck are highly specific imaging signs.[2] Both features were elegantly demonstrated in our patient and, in conjunction with the saccular morphology and peripheral mural thrombus, allowed an immediate bedside diagnosis. Ultrasound also accurately delineated the neck of the pseudoaneurysm, which is critical for selecting between conservative, image-guided, and surgical strategies; a narrow, well-defined neck is a prerequisite for ultrasound-guided compression or thrombin injection.[2,7]

Magnetic resonance imaging plays a complementary and increasingly important role, particularly in cases where the lesion is large, partially thrombosed, or anatomically complex. The advantage of MRI in our case was three-fold. First, the heterogeneous laminated peripheral signal characteristic of organising mural thrombus was clearly resolved, supporting an in vivo estimate of chronicity. Second, MR angiography confirmed the presence of an intact and dominant ulnar–palmar arch circulation, which was a deciding factor in the safety of distal radial artery ligation at surgery.[3] Third, multiplanar MRI definitively excluded other soft-tissue masses entering the differential diagnosis and clarified the spatial relationship of the lesion to the median and superficial radial nerves and the flexor carpi radialis tendon — information that directly informed the surgical approach. Conventional digital subtraction angiography, although historically considered the diagnostic gold standard, is now infrequently used purely for diagnostic purposes when high-quality ultrasound and

MRI/MR angiography are available, and is largely reserved for cases in which an endovascular intervention is planned.[1,3]

The management of distal radial artery pseudoaneurysms is individualised and depends on lesion size, neck morphology, thrombus burden, the integrity of the contralateral palmar arch supply, and patient comorbidity.[3,4,5] Small (<2 cm), recently formed pseudoaneurysms with a long narrow neck may respond to ultrasound-guided compression or percutaneous thrombin injection.[2,3] Larger, partially thrombosed lesions; those with rapid enlargement; those exerting local mass effect; and those at risk of distal embolisation are best managed surgically, with excision of the sac and either primary repair, vein-graft interposition, or simple ligation when the dual arterial supply to the hand is intact, as confirmed by Allen testing and Doppler interrogation of the palmar arch.[4,5,6] In the present case, the relatively large size, the substantial mural thrombus burden, and the absence of a favourable narrow neck for percutaneous treatment favoured an open surgical approach, while the angiographically and sonographically confirmed dominant ulnar contribution to the palmar arch permitted safe ligation of the distal radial artery without compromising hand perfusion.

Two features make this case particularly instructive. First, the patient was young and otherwise healthy, in contrast to the typical post-catheterisation cohort reported in the contemporary literature, in which mean age is in the eighth decade.[4,5] Second, the case illustrates the value of pairing a rapid, dynamic, and inexpensive ultrasound examination with a problem-directed MRI study — neither modality alone provides the full anatomical and haemodynamic picture, but together they yield a confident pre-operative diagnosis that is durable, reproducible, and easily communicated to the operating surgeon.

IV. CONCLUSION

Pseudoaneurysms of the distal radial artery are uncommon vascular lesions that can mimic benign soft-tissue swellings of the wrist and may have serious consequences if missed. An integrated multimodality imaging approach — colour Doppler ultrasonography for rapid haemodynamic confirmation through the "yin-yang" and "to-and-fro" signs, complemented by MRI and MR angiography for accurate soft-tissue characterisation and pre-operative mapping — establishes the diagnosis with confidence and directly informs the choice between conservative, image-guided, and surgical management.

Clinicians and radiologists should maintain a high index of suspicion for a vascular aetiology in any pulsatile distal forearm or wrist swelling, even in young patients without an obvious history of arterial intervention. Pre-operative imaging confirmation prior to any open biopsy or excision is essential to avoid catastrophic haemorrhage and to ensure that hand perfusion is preserved through pre-operative assessment of the palmar arch.

DECLARATIONS

Patient Consent: Written informed consent was obtained from the patient for the use of clinical history, investigation findings, and anonymised images for academic publication.

Conflict of Interest: None declared.

Ethical Approval: Not applicable for a single-patient case report; institutional policy was followed regarding patient confidentiality and anonymisation of identifying information.

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Author Contributions: KS and P were responsible for imaging acquisition, radiological interpretation, and image curation. S undertook the initial clinical assessment, evaluation of the patient, and clinico-radiological correlation. All three authors contributed equally to the literature review, drafting of the manuscript, and critical revision of intellectual content. All authors read and approved the final version submitted for publication.

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