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Atypical Venous Malformation of the Volar Wrist Presenting as a Ganglion Cyst: Diagnostic Pitfalls and Surgical Insights - Case Report

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Abstract

Background: Wrist swellings are most often benign cystic lesions such as ganglion cysts; however, vascular anomalies such as venous malformations (Vms), though rare, can closely mimic these entities and pose diagnostic challenges.

Case Report: A 24-year-old male presented with a painful volar wrist swelling following trauma, radiologically suggestive of a multiloculated ganglion cyst. Conservative management failed, and surgical excision through a modified Henry approach was undertaken. Intraoperatively, an ill-defined, violaceous, non-pulsatile vascular mass was identified and completely excised with assistance from a vascular surgery team. Histopathological examination confirmed a VM.

Results: Post-operative rehabilitation led to significant improvement in pain and wrist function, with no recurrence noted at short-term follow-up.

Conclusion: VMs, though rare, should be considered in persistent wrist swellings unresponsive to conservative treatment. Complete surgical excision with multidisciplinary support and structured rehabilitation can achieve excellent functional recovery and prevent recurrence.

Keywords: Atypical venous malformation, Wrist, Ganglion cyst, Surgical excision, Vascular anomaly.

Introduction

Wrist swellings are a common clinical presentation, most frequently arising from benign cystic lesions such as ganglion cysts. However, vascular anomalies, particularly venous malformations (Vms), though uncommon in this region, can closely mimic these benign entities, leading to diagnostic uncertainty. VMs are congenital, low-flow vascular lesions that may remain asymptomatic for years and often become apparent following trauma or thrombosis within the lesion.

We describe a case of a young adult male who presented with a painful volar wrist swelling initially suspected to be a multiloculated ganglion cyst, but intraoperative and histopathological findings revealed a VM. This report underscores the importance of considering vascular anomalies in the differential diagnosis of persistent wrist swellings and highlights the role of detailed imaging, intraoperative assessment, and multidisciplinary management in achieving accurate diagnosis and optimal functional outcomes.

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Case Description

A 24-year-old right-hand-dominant male student presented to the outpatient department with complaints of pain and localized swelling over the right wrist for 1 year following a wrist injury. The pain was insidious in onset, dull aching, and localized, exacerbated by prolonged writing (beyond one page) and relieved with rest and medication. There was no history of fever, morning stiffness, or systemic symptoms.

On clinical examination, a globular swelling was noted over the radial-volar aspect of the right wrist. The lesion was fluctuant, non-pulsatile, and mobile, with mild tenderness but no signs of inflammation or deformity. Wrist movements were full, though radial deviation elicited pain. Finkelstein and Eickhoff tests were positive. There was no dorsal joint line tenderness, and neurovascular examination was normal (Fig. 1).

Plain radiographs showed reduced radio-scaphoid and radio-lunate joint spaces with marked osteopenia in the metaphyseal region of the distal radius and ulna, but no arthritic changes.

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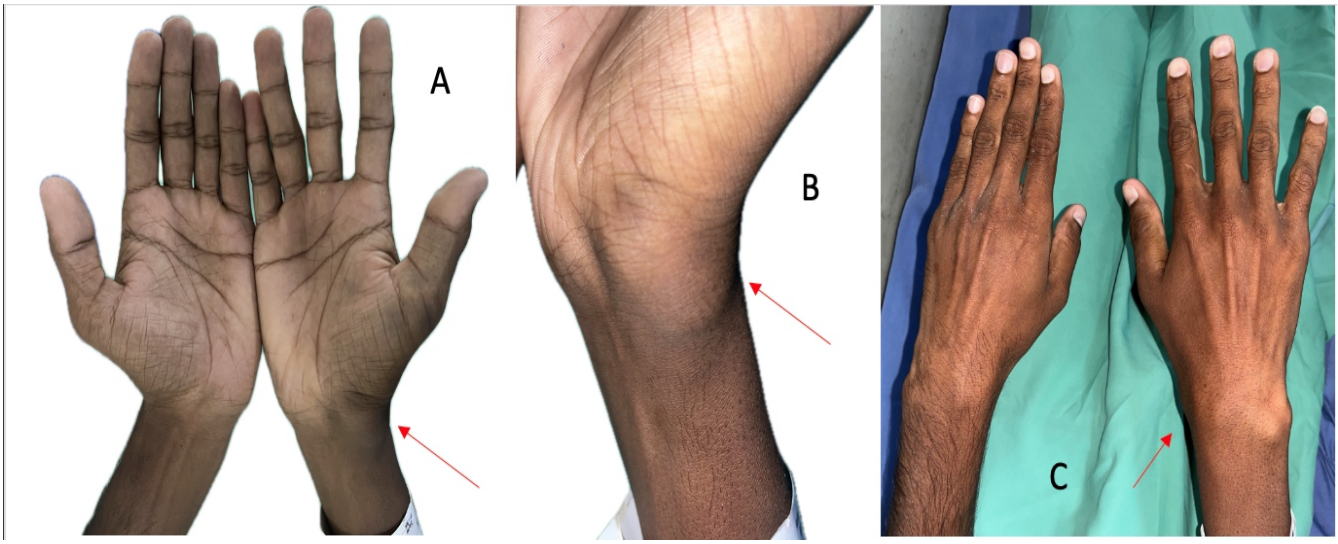

Figure 1: Clinical images of bilateral wrists depicting the gross swelling over the volar radial wrist.

Ultrasonography (USG) revealed a cystic lesion without internal vascularity on Doppler. Magnetic resonance imaging (MRI) demonstrated a multiloculated cystic lesion in the subcutaneous plane of the volar radial aspect of the wrist, measuring 4 × 2.4 × 1.9 cm, with hyperintense signals and disproportionate soft-tissue edema extending toward the radial side of the thumb. The lesion abutted the flexor pollicis longus, flexor retinaculum, and first extensor compartment but showed no intra-articular extension (Fig. 2).

A provisional diagnosis of a multiloculated ganglion cyst with intra-cystic hemorrhage was made, and the patient underwent 2 months of conservative management with splinting and medication, which failed to relieve symptoms. Surgical excision was then planned. Under regional anaesthesia and tourniquet control, a modified Henry approach was employed. Intraoperatively, an ill-defined, intertwined vascular mass was identified between the flexor carpi radialis tendon and the radial artery. The lesion appeared multi-cystic and violaceous, with abnormal collateral vessels and soft-tissue adhesions distorting local anatomy. The mass was non-pulsatile, and needle puncture elicited slow venous oozing, characteristic of a VM. A vascular surgery team assisted intraoperatively in isolating and tagging the major vessels interwoven within the lesion. Careful dissection allowed complete excision of the mass. Hot saline and papaverine were used to confirm arterial pulsations following relief of vasospasm, after which layered closure was performed, and the wrist was immobilized in a dorsal slab (Fig. 3).

Histopathological examination revealed thickened venous channels lined by atypical endothelial cells without bridging

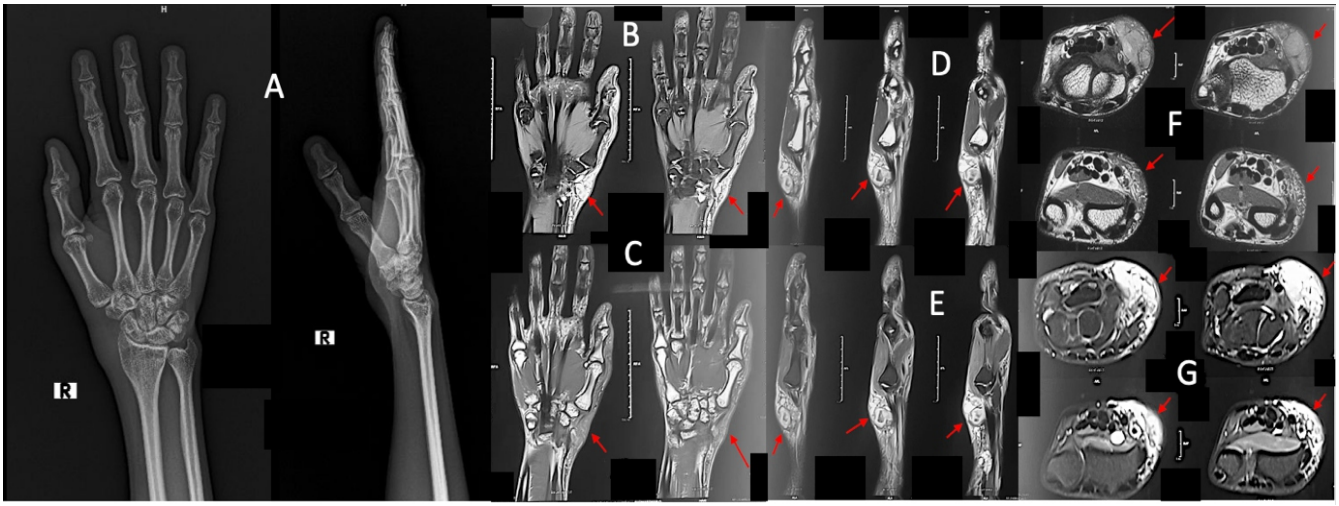

Figure 2: (a) Depicts the antero-posterior and lateral views of the right wrist with hand, showing osteopenia of the metaphyseal region of the distal radius and ulna. Magnetic resonance imaging images (b, c, d, e, f, g) show the multi-loculated cyst in the volar distal radius aspect the wrist in both T1- and T2-weighted images.

arterial or capillary components, confirming the diagnosis of a VM (Fig. 4). Post-operative rehabilitation emphasizing wrist mobilization and progressive strengthening was initiated within 4 weeks. The patient-rated wrist evaluation (PRWE) score improved from 86/100 preoperatively to 14/100 postoperatively, and the Visual Analog Scale (VAS) score improved from 8 to 1. At 4 months, the patient remained asymptomatic with no evidence of recurrence but was subsequently lost to follow-up.

Discussion

VMs are congenital vascular anomalies consisting of abnormally dilated venous channels with sluggish blood flow. They result from developmental disturbances in the venous system during embryogenesis and constitute the most frequent subtype of vascular malformation, accounting for nearly 40% of all cases [1]. Although the exact incidence varies among populations, VMs are estimated to affect approximately 1–2 individuals per 10,000, with a general population prevalence of around 1% [2]. These lesions may become evident at any age but are typically recognized during childhood or early adulthood, as they enlarge in proportion to somatic growth or secondary to trauma or hormonal influences. Anatomically, VMs most often involve the head and neck region (40%), followed by the extremities (40%) and the trunk (20%) [1,2].

Most VMs are congenital lesions present at birth but may remain clinically silent until adolescence or adulthood, often becoming evident after a triggering event such as trauma [3]. While trauma does not create a VM de novo, it can reveal or aggravate a pre-existing, asymptomatic lesion, an observation supported by numerous clinical reports. True post-traumatic (acquired) VMs are exceptionally rare; many presumed cases likely represent congenital anomalies unmasked by injury [3,4]. In the present case, the patient's VM became apparent following a wrist injury, reflecting this typical pattern where trauma serves as a precipitating rather than causative factor. Such presentations, though uncommon, are well-documented and should be distinguished from post-traumatic arteriovenous malformations, which are pathophysiologically distinct.

VMs usually appear as soft, compressible, bluish masses that enlarge with dependency or Valsalva maneuver, reflecting their low-flow venous origin [2, 5]. They are often asymptomatic but may become painful or swollen following trauma or thrombosis. The overlying skin may appear normal or have a bluish tint, and the lesion typically decompresses with pressure and refills on release. Growth is gradual, with symptoms that may fluctuate due to hormonal or inflammatory triggers. Phleboliths or calcified thrombi visible on imaging are characteristic findings [5]. In the present case, the patient exhibited a tender, fluctuant, non-pulsatile swelling with pain on movement, with no cardinal features of VM, suggestive of an atypical variant.

Evaluation of wrist swellings typically begins with a thorough clinical examination and plain radiographs, followed by high-resolution USG and MRI for precise characterization [6]. Among cystic wrist lesions, ganglion cysts are the most common and classically appear on ultrasound as well-defined, anechoic or hypoechoic cystic structures without internal vascularity [6, 7]. On MRI, they demonstrate low signal intensity on T1-weighted and high signal intensity on T2-weighted sequences, with minimal or thin rim enhancement. Synovial cysts and bursitis may present similarly but are usually linked to underlying joint pathology, often showing synovial thickening or fluid communication with adjacent joints [2,6,7,8]. Giant cell tumors of the tendon sheath appear as solid, lobulated, hypoechoic lesions with internal vascularity on Doppler studies. On MRI, they exhibit intermediate to low signal intensity on both T1- and T2-weighted images, with pronounced enhancement due to hemosiderin deposition [6,9,10]. Hemangiomas, by contrast, demonstrate high-flow vascularity on Doppler and show early, intense enhancement with flow voids on MRI, indicative of rapid blood flow [11]. Lipomas appear as homogeneous, hyperechoic soft-

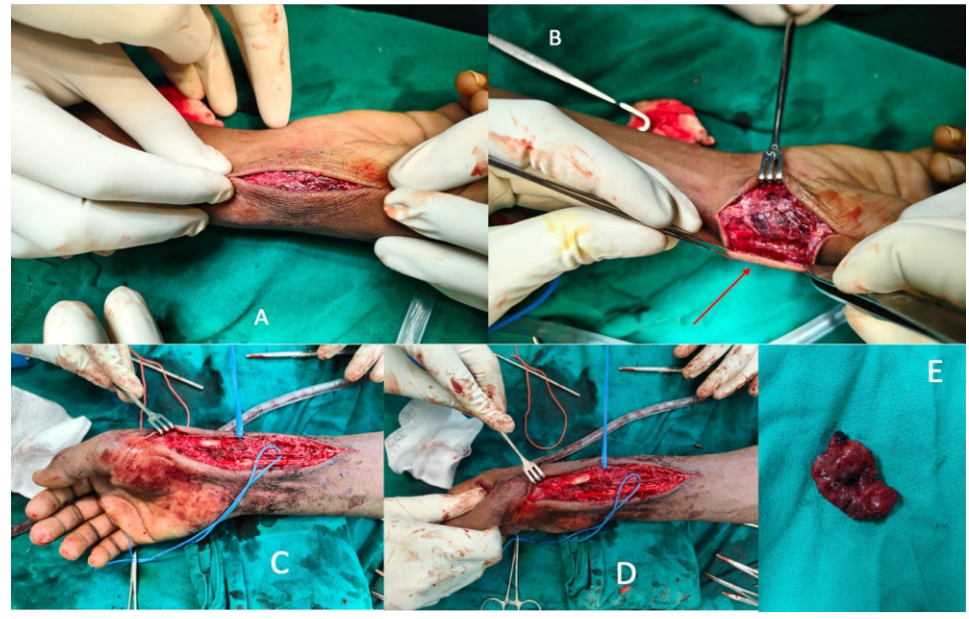

Figure 3: (a and b) show the initial incision and the venous malformation. (c and d) show the exploration of the volar wrist with isolation of the radial artery, flexor carpi radialis, and brachioradialis post-excision, and image (e) shows the excised mass of venous malformation.

tissue masses on ultrasound and show high T1 signal intensity with complete suppression on fat-saturated MRI sequences, confirming their fatty composition [12]. Tuberculous tenosynovitis, though uncommon, is an important consideration in chronic wrist swellings involving the tendon sheath. Radiographs may show soft-tissue fullness, regional osteopenia, calcifications, or bone erosions in advanced disease. Ultrasound typically demonstrates thickened tendon sheaths with minimal to moderate synovial fluid and hypertrophy. MRI remains the preferred modality, revealing synovial thickening with low to intermediate T1 and variable T2 signal intensities due to granulomatous tissue and rice bodies. Post-contrast images usually show tenosynovial enhancement, with possible associated soft-tissue edema, joint effusion, or cortical erosion. The presence of multiple small hypointense "rice bodies" within the synovial cavity is characteristic. Correlation with clinical features and laboratory evidence of tuberculosis is essential for definitive diagnosis and differentiation from other inflammatory or infective tenosynovitis [13]. VM typically presents as compressible, multiloculated, heterogeneous echogenic lesions with minimal or absent Doppler flow and occasional phleboliths. On MRI, they display multiloculated, high T2 signal lesions with gradual, progressive contrast enhancement; phleboliths appear as signal voids. MRI remains the gold standard for assessing the full extent and anatomic relationships of VMs [2, 3, 6]. Pertaining to this case, USG revealed a non-vascular, cystic lesion suggestive of a ganglion cyst, and MRI showed a multiloculated cystic mass without intra-articular extension; findings that initially supported a benign cystic diagnosis. This underscores how VMs can closely resemble ganglion cysts, especially when slow or stagnant venous flow leads to absent Doppler signals due to thrombosis or intralesional hemorrhage.

The management of VMs is individualized, guided by lesion size, anatomical location, symptom severity, and functional impairment. Asymptomatic or mildly symptomatic lesions are best managed conservatively with observation, compression therapy, and analgesics for symptom relief, an approach particularly suited to diffuse or anatomically intricate lesions [14]. For symptomatic cases, percutaneous sclerotherapy remains the cornerstone of treatment. Sclerosants such as ethanol, polidocanol, or bleomycin promote endothelial damage, thrombosis, and subsequent fibrosis, leading to lesion shrinkage and symptomatic improvement [14, 15]. Multiple treatment sessions are often necessary to achieve durable results. Adjunctive modalities, including laser ablation and selective embolization, may be employed to enhance outcomes and minimize morbidity while preserving adjacent structures [15]. Surgical excision is reserved for well-circumscribed lesions that remain symptomatic despite conservative or minimally invasive interventions. Owing to the potential for significant bleeding and involvement of neurovascular structures, operative management demands careful preoperative imaging, meticulous surgical planning, and a multidisciplinary approach to optimize both safety and functional outcomes [15]. Nowadays, hybrid treatment modalities combining sclerotherapy with surgical excision or laser ablation are increasingly utilized to optimize outcomes. These less invasive options can reduce lesion size and vascularity preoperatively, potentially facilitating safer and more effective surgical resection or avoiding surgery altogether [16]. In the present case, surgical excision was chosen due to the lesion's well-defined anatomy and the patient's failure to improve with conservative measures, highlighting the importance of a tailored, multidisciplinary approach. Intraoperative findings revealed a complex VM, emphasizing the diagnostic challenge of distinguishing atypical VMs from benign cystic lesions on imaging alone. This case highlights the continued relevance of surgical exploration as both a diagnostic and therapeutic modality when non-invasive assessments prove inconclusive and conservative measures fail. Comparable diagnostic dilemmas have been described in the literature; Mehta and Gohil reported a 65-year-old male whose presumed wrist cyst was intraoperatively identified as a haemangioma, while Corvino et al. Documented a 28-year-old male with a dorsal hand swelling, ultimately diagnosed as a superficial venous

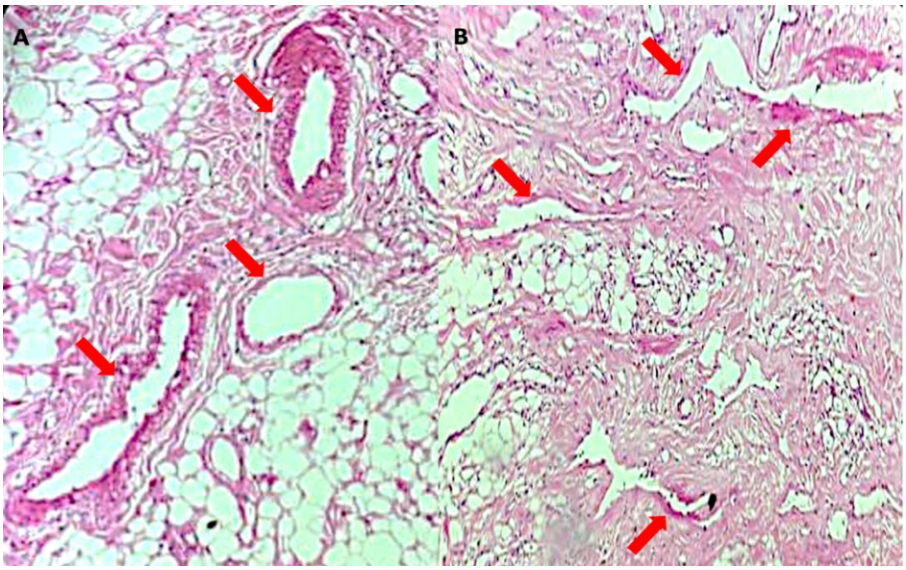

Figure 4: Histopathological images (a and b) show the abnormally dilated veins and venules lined by atypical endothelial cells, interspersed with fibro-adipose tissue and fibro-collagenous matrix.

aneurysm [17, 18]. Such cases collectively underscore the importance of considering vascular anomalies in the differential diagnosis of persistent, cyst-like wrist lesions.

Rehabilitation following treatment of VMs is crucial for restoring function, preventing stiffness, and minimizing post-operative discomfort. Early, controlled mobilization adapted to the surgical site and extent of excision helps preserve joint motion and muscle strength. A structured physiotherapy program emphasizing gradual strengthening, proprioceptive training, and edema control with compression therapy promotes optimal recovery. Management should be individualized and coordinated through a multidisciplinary team. Given the infiltrative nature of VMs and the risk of recurrence reported in up to 40% of cases after incomplete excision, long-term follow-up with periodic ultrasound or MRI is essential. Patient education on recognizing recurrent symptoms such as swelling, pain, or functional decline facilitates early intervention. In the present case, targeted post-operative rehabilitation led to significant improvements in PRWE and VAS scores, but was lost to follow-up after 4 months, limiting long-term assessment and surveillance for recurrence. This underscores the challenge faced in managing patients with VMs, where adherence to follow-up is critical for optimized outcomes and early identification of recurrence.

Despite the encouraging short-term results, several limitations merit discussion. They include its inherent nature as a single-patient observation, which restricts the generalizability of the findings to broader populations. Although the clinical and radiological features strongly suggested a VM, histopathological confirmation was not obtained preoperatively. The diagnosis was established intraoperatively and on post-operative histopathology, introducing a degree of diagnostic uncertainty. Advanced vascular imaging modalities such as magnetic resonance angiography, Doppler ultrasound with compression manoeuvres, or venography were not utilized, potentially limiting detailed pre-operative characterization of the lesion's vascular anatomy. The short follow-up duration of 4 months further limits assessment of long-term outcomes, including risks of recurrence or delayed complications, which are known considerations in VMs. The patient was subsequently lost to follow-up, precluding evaluation of durability and recurrence risk over an extended period. Additionally, although validated functional scores such as PRWE and VAS were used for outcome assessment, broader quality-of-life measures such as the DASH questionnaire or patient satisfaction scores were not included, which may have provided a more comprehensive evaluation of functional recovery. Finally, the case originates from a tertiary care setting with prior unsuccessful interventions, introducing potential selection bias and reflecting a more refractory or atypical presentation, thereby further limiting generalizability.

Conclusion

This case underscores the diagnostic complexity of atypical VMs that may closely mimic benign cystic wrist lesions. Meticulous imaging interpretation, a high index of clinical suspicion, and intraoperative vigilance are pivotal for accurate diagnosis. Complete excision with multidisciplinary support, followed by structured rehabilitation, can yield excellent functional outcomes. However, vigilant long-term follow-up remains indispensable, given the potential for recurrence. Early recognition and management of recurrent symptoms through patient education and periodic imaging are key to sustaining recovery and preventing morbidity in such rare and deceptively benign presentations.

Clinical Message

This case highlights the importance of considering VMs in the differential diagnosis of wrist swellings that mimic ganglion cysts. It emphasizes the diagnostic limitations of imaging in atypical presentations and the value of intraoperative assessment. Early multidisciplinary intervention and complete excision can ensure accurate diagnosis, functional recovery, and prevention of recurrence.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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