Case Report

Thrombosis of the Persistent Median Artery presenting as acute Carpal Tunnel Syndrome: A Case Report and Literature Review

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Abstract

We present a case of a 40-year-old female with bifid median nerve and a persistent median artery (PMA) who presented with typical symptoms of carpal tunnel syndrome (CTS). Ultrasound (US) revealed the anatomical variation and the presence of thrombosis of the PMA as the cause of symptoms. The aim of this report is to raise awareness about the clinical significance of this anatomical variation and to highlight the importance of US imaging for diagnosis and treatment planning.

Introduction

The carpal tunnel syndrome (CTS) is a common focal peripheral neuropathy caused by pressure on the median nerve in the carpal tunnel [1]. This nerve innervates the skin of the thumb, the middle finger, the outside of the little finger and is also responsible for innervation of the thenar muscles [1]. CTS is the most frequent pressure neuropathy. Typical clinical symptoms include sensory effects in the forms of pain, paresthesia or hypesthesia, limited to the wrist area innervated by the median nerve, presence of Tinel's symptoms, or a positive Phalen's test. In more advanced cases, motor symptoms are displayed as difficulties in the performance of precise activities, grasp weakness or thenar muscle atrophy [1].

The risk factors of CTS include female sex, diabetes mellitus, hypothyroidism, obesity, arthritis, hemodialysis, acromegaly and pregnancy [1].

An unexpected cause of CTS may be thrombosis of the persistent median artery (PMA), which is an anatomical variant of hand vascularization. In a big meta-analysis containing data from 8884 adults, the prevalence of a palmar-type PMA was only 7.5%. [27] Another finding coexisting in patients with such a variation is a bifid median nerve [2,3,22]. In another study containing 300 adults, the prevalence of a PMA together with a median nerve variation was 9.3% [28]. Thus, coexistence of a PMA with a bifid median nerve in the carpal tunnel, as in our case, is an unexpected finding which can lead more easily to CTS-like symptoms if that PMA is thrombosed.

Case Presentation

A 40-year-old woman presented with progressively worsening pain in her right wrist over the past week. The pain radiated to her fingers and was accompanied by paresthesia in the right distal hand, within the median nerve distribution. The patient reported no history of injury or systemic disease. After the examination by an orthopedic physician, she was directly referred for high-resolution ultrasonography instead of Electromyography (EMG), as the former was more easily accessible for immediate appointment and would provide anatomical information as well as allow assessment of the cause of disease.

Ultrasonography and Doppler imaging revealed the presence of a bifid median nerve within the carpal tunnel accompanied by a PMA in-between the two nerve bundles (Figure 1). The examination identified focal dilatation of the artery and a segment with loss of signal flow due to thrombosis, which mimicked carpal tunnel syndrome (CTS).

Based on the above findings, the patient was treated with anticoagulants which resulted in partial alleviation of her symptoms. However, recurrence of the symptoms after discontinuation of the treatment led to surgery involving the transection of the transverse ligament (Figure 2). Following the surgery, the

patient reported immediate reduction of pain. No further anticoagulant therapy was administered. She was followed up 3 weeks later when symptoms had totally resolved.

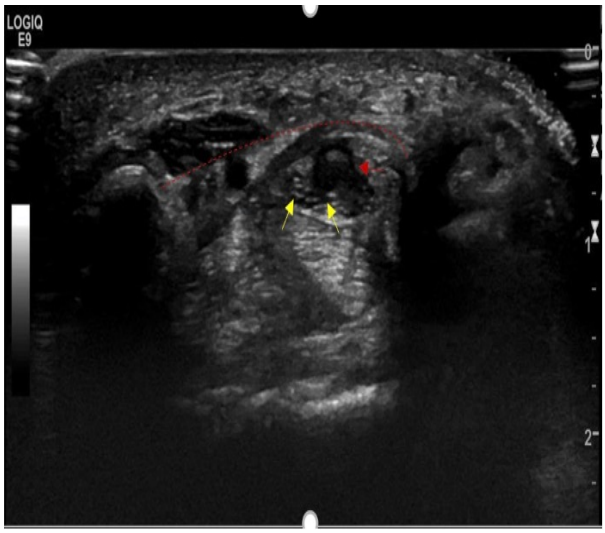

Figure 1. Transverse ligament (red dashed line), the PMA (red arrow) and the bifid median nerve (yellow arrows)

Discussion

The median nerve usually splits into two or three branches after exiting the transverse ligament covering the carpal tunnel. However, an unusual variation results in the median nerve dividing into two bundles at the distal forearm and appearing as a bifurcated median nerve in the carpal tunnel [2,3]. This is found with a frequency of 9-19% [3]. In 50% of these cases, it is accompanied by a PMA, which is located between the two nerve bundles and may be enclosed by a common epineurium [4].

During early embryonic development the middle artery is a major route of blood supply to the forearm and hand. Following the development of the ulnar and radial artery it typically regresses during intrauterine life, with its remnant being a small vessel accompanying the median nerve within the carpal tunnel [5]. Occasionally, the middle artery may remain open as a large vessel until adulthood. Two arterial patterns of the middle artery have been described in that age group [5]: 1) a forearm type, which is a small and short vessel that ends in the forearm before reaching the wrist, 2) a palmar type, which is a large and long vessel that accompanies the median nerve in the carpal tunnel and reaches the hand as a remnant of the embryonic form and is referred to as the persistent middle artery. PMA has an incidence of ~11-15% [6,7], is unilateral in ~67% of cases and is associated with a median nerve variant in ~70% (range 63-80%) of cases, most commonly with bifid median nerve [9]. In case of thrombosis of this artery and due to its close proximity with the bifid median nerve, the occurrence of symptoms resembling CTS is very likely [14,15]. It is important to note that the presence of anatomical variants of the artery and median nerve does not appear to increase the risk of CTS [12].

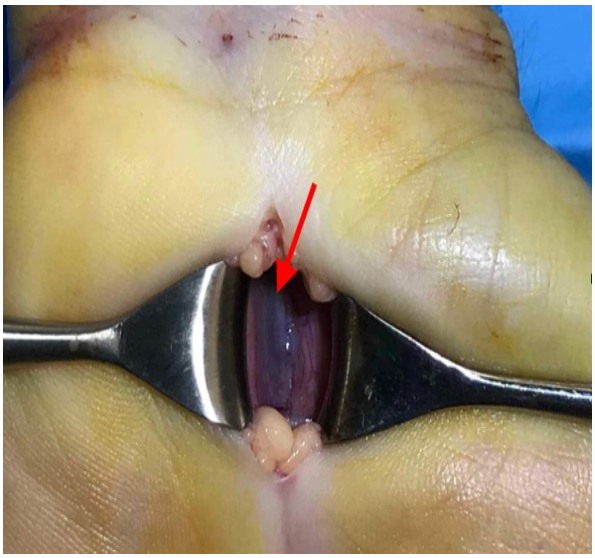

Figure 2. Intraoperative image showing the PMA (red arrow) containing the thrombus

If thrombosed it can cause pressure on the median nerve, particularly when it is covered by a common epineurium. In case symptoms present acutely, the clinical differential diagnosis includes acute tenosynovitis or acute hemorrhage into the carpal tunnel (usually secondary to warfarin use). Very few cases of PMA thrombosis causing CTS-like symptoms have been reported in the literature. In most such cases, patients usually present with acute pain and paresthesia, symptoms that resemble CTS yet often lack motor deficits and thenar muscles atrophy [7]. Khashaba

et al reported a case in which, following a working diagnosis of flexor sheath tenosynovitis, surgical exploration of the carpal tunnel revealed an occluded PMA [18]. Bartels DW et al noted motor deficits and stated that in patients presented with somewhat atypical symptoms for CTS, it is important to maintain a broad differential diagnosis [19]. Patients often present with a negative Tinnel's and Phanel's test complicating the diagnosis even more [19]. As reported by Avenel et al, in case of PMA thrombosis, the functional symptoms are secondary due to perivascular edema, rather than an ischemic mechanism [17].

EMG is most commonly used for diagnosing CTS [1]. In our case, typical clinical presentation of CTS and the acute onset of symptoms led the clinical doctor to prioritize an US over an EMG, as the former is more easily accessible for immediate appointment, better tolerated by the patient and would allow a rapid assessment of the cause of disease. Thus, the patient was directly referred to US instead of an EMG. The use of US is an established means for the diagnosis of a thrombosed PMA causing CTS-like symptoms, being an accurate diagnostic test of the syndrome also in patients with a bifid median nerve [10]. A careful examination and an experienced user are the main factors of an accurate US evaluation. In the case where the bifid median nerve coexists with PMA, their relative position in the carpal tunnel is uncertain and therefore preoperative US is necessary [11]. Finally, the use of Doppler US can reveal the intraarterial thrombus and the absence of blood flow in the PMA [12,13].

There is no consensus regarding the treatment plan in such cases. Such options include oral Anticoagulants, warfarin, LMWH analogues and surgery that may contain total excision of the thrombosed part of the PMA or simply decompression of the nerve [19,26]. In most cases in the literature, oral anticoagulants were chosen as the proper treatment [21,22,23,24]. However, Srivastava et al administered heparin intravenously followed by enoxaparin subcutaneously and warfarin orally, which also led to a full remission of the symptoms [12] There have also been cases with obvious thrombogenic backgrounds, in which the treatment plans included smoking cessation and medical treatment with aspirin and statin [17]. Though there are no specific guidelines, a confirmed thrombus in the PMA strongly suggests initiating anticoagulant medication. In our case, in agreement with a previous report, due to the persistence of symptoms surgical treatment with simple release of the transverse carpal ligament was performed which led to their full remission [20], without the need for further anticoagulant therapy. In cases of surgical treatment, it is important to note that intra-operative clamping of the PMA to assess the arterial supply to the digits is crucial [19]. Excision of the thrombosed portion of the artery should only be performed if the absence of the PMA would not affect the digits' blood flow [19]. Other authors report conservative treatment, especially in cases of relatively long course of mild symptoms [21,22,23,24,25].

Conclusion

Thrombosis of the PMA is an uncommon cause that should be considered in the differential diagnosis of acute wrist pain particularly if presenting as CTS. Preoperative US imaging is crucial for identifying such anatomical variations and diagnosing the cause of symptoms, so that appropriate treatment can be selected.

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