Case Report

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

Ageridis Savvas,[1] Karampini S. Sofia,[1] Koutsakis Christos,[1] Psyllia Dimitra,[1] Drakonaki Elena[1]

[1]*Anatomy Department, Medical School, University of Crete*

Correspondence Address: Savvas Ageridis, savvas.ageridis@yahoo.com

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 the most common focal peripheral neuropathy [1]. Typical symptoms include numbness, tingling, nocturnal paraesthesia or "pins-and-needles" pain in the radial 3.5 digits and the respective thenar area of the palm [1]. In more advanced cases, motor symptoms are displayed as difficulties in the performance of precise activities, grasp weakness or thenar muscle atrophy [1]. Idiopathic CTS is typically caused by pressure on the median nerve inside the carpal tunnel related to repetitive exposure to vibrations or forceful angular motions, associated with genetic predisposition, chronic injury, diabetes, pregnancy and morbid obesity [1]. Other risk factors of CTS include female sex, hypothyroidism, arthritis, hemodialysis and acromegaly [1].

Thrombosis of the persistent median artery (PMA) is a rare and very unexpected cause of CTS. It is associated to the presence of anatomical variation in the hand vascularization, commonly coexisting with a bifid median nerve [2-5]. We report such as case PMA thrombosis to raise awareness for this anatomical variation and its clinical significance.

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 palm and was accompanied by paresthesia in the 3.5 radial fingers, suggesting a median nerve distribution. The patient reported no history of injury or systemic disease. After the examination by an orthopedic surgeon she was directly referred for high-resolution ultrasonography (US) instead of Electromyography (EMG), as US was easily accessible for immediate appointment and would provide anatomical information as well as allow assessment of the cause of disease.

US 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 also identified focal dilatation of the artery which contained inhomogeneous slightly echogenic material accompanied with loss of Doppler signal suggesting absence of flow. The findings were suggestive of acute arterial thrombosis, leading to symptoms similar to those of 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.

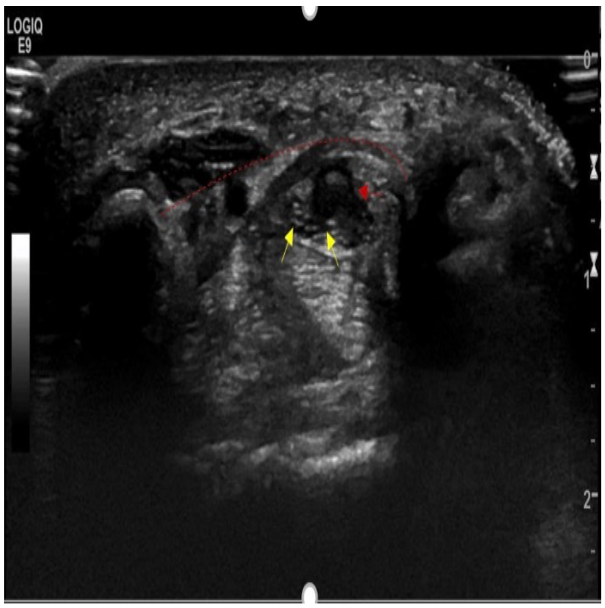

Figure 1. Transverse ligament (red dashed line), the PMA (red arrow) and the bifid median nerve (yellow arrows)

Discussion

The median nerve branches into two or three branches after entering the carpal tunnel [2]. A bifid median nerve results if the nerve bifurcates at the distal forearm proximal to the entrance of the carpal tunnel, found with a frequency of 9-19% [2-5]. The bifid median nerve is occasionally accompanied by a PMA, an embryologic remnant which is located between the two nerve bundles and may be enclosed by a common epineurium [4-7]. During early embryonic development the middle artery is a major route of blood supply to the forearm and hand and degenerates around the 8th week of development, following the development of the ulnar and radial artery. [5-7]. Failure of this vessel to regress results into the middle artery remaining open as a large vessel until adulthood. Two arterial patterns of the middle artery have been described [5-7]: a forearm type, which is a short vessel that ends in the forearm and a palmar type, which is a large and long vessel that accompanies the median nerve into the carpal tunnel and is referred to as the PMA, ending as the 1st, 2nd or 1st and 2nd common digital arteries (65%) or joining the superficial palmar arch (35%) [6]. The palmar type PMA has a reported incidence of ~8-20% in cadaver studies, being more frequent in females than in males (1.3:1), occurring unilaterally more often than bilaterally (4:1) and slightly more frequently on the right than on the left (1.1:1). [5, 6] On hand and wrist MRI, the prevalence of PMA is reported as 11%, coexisting with a bifid nerve in 19%, whereas on US, the incidence is 7.5% and 6.3% respectively [7, 8]. The typical position of the PMA is dorsal to the flexor retinaculum however, a variant of the artery lying between the palmar aponeurosis and the flexor retinaculum has been reported [9].

Although the association of bifid median nerve with increased possibility of CTS Is debated in the literature, the coincidence of PMA does not act as an independent predisposing factor for CTS [3,4,9,10], with only very rare association of a non-thrombosed PMA with CTS reported in the literature [11]. The clinical importance of this arterial anatomical variation is rather associated to the risk of injury during CTS surgery as well as the possibility of arterial thrombosis, as in our case. In case of PMA thrombosis, due to its proximity with the median nerve especially in cases when

covered by a common epineurium, the occurrence of symptoms resembling CTS is very likely. In case symptoms present acutely, the clinical differential diagnosis includes acute tenosynovitis or acute hemorrhage into the carpal tunnel (usually secondary to warfarin use).

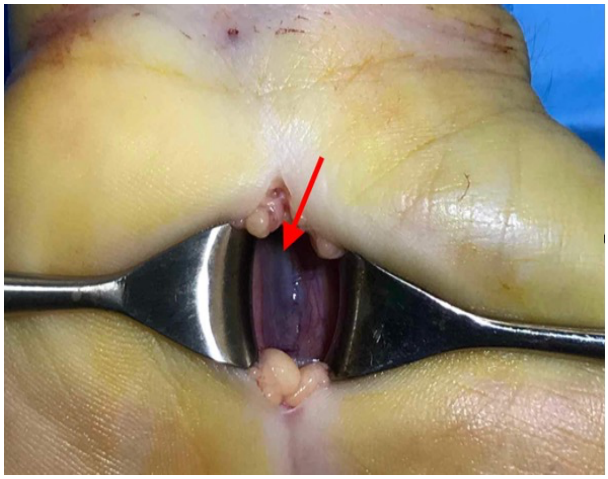

Figure 2. Intraoperative image showing the PMA (red arrow) containing the thrombus

Cases of PMA thrombosis causing CTS-like symptoms have been reported in the literature [12-20]. Similar to our case, in most such cases, patients usually presented with symptoms that resemble CTS such as acute pain and paresthesia, yet often lacked motor deficits and thenar muscles atrophy [12-20]. In many of those case, US has been used to diagnose the presence of both the PMA and the presence of thrombus inside it [13, 14, 18-20]. The use of US is an established means for the diagnosis of CTS also in patients with a bifid median nerve in addition to electrophysiology [8, 10], 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. A careful examination and an experienced user are the main factors of an accurate US evaluation. The use of Doppler US can reveal the intraarterial thrombus and the absence of blood flow in the PMA [13, 14, 18-20].

There is no consensus regarding the treatment plan in CTS caused by thrombosis of PMA. 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 [12-20]. In most cases in the literature, anticoagulants were chosen as the proper treatment [17-20]. In other cases, surgical therapy was chosen either as PMA resection [14] or as decompression without PMA resection [12, 13, 16]. 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 [13]. In our case, in agreement with previous reports, the patient was treated initially with anticoagulants but due to recurrence of the symptoms, surgery with simple release of the transverse carpal ligament was performed which led to their full remission [20], without the need for further anticoagulant therapy.

Conclusion

Thrombosis of the PMA can present as acute CTS. Preoperative US imaging is crucial for identifying both the PMA with the associated median nerve variations and the presence of thrombosis as the cause of symptoms, so that appropriate treatment can be selected.

References

1. Osiak K, Elnazir P, Walocha JA, Pasternak A. Carpal tunnel syndrome:

state-of-the-art review. Folia Morphol (Warsz). 2022;81(4):851-862.

2. Beris AE, Lykissas MG, Kontogeorgakos VA, Vekris MD, Korompilias AV. Anatomic variations of the median nerve in carpal tunnel release. Clin Anat. 2008 Sep;21(6):514-8.

3. Asghar A, Patra A, Satish Ravi K, Tubbs RS, Kumar A, Naaz S. Bifid median nerve as an anatomical risk factor for carpal tunnel syndrome: A meta-analysis. Clin Anat. 2022 Oct;35(7):946-952.

4. Gruber M, Wawrik A, Gasser F, Ebner B, Reitbauer P, Uzel R, Poupardin R, Mahrhofer M, Weitgasser L, Schwaiger K, Schaffler G, Wechselberger G, Russe E. Anatomical variations and their association with carpal tunnel syndrome: a comparison with healthy controls. Int Orthop. 2025 Apr;49(4):911-917.

5. Ellis C, Thibault D, Lencke J, Hemric LD. Prevalence and anatomical significance of the persistent median artery: A cadaveric study. PLoS One. 2025 Mar 31;20(3):e0320288.

6. Rodríguez-Niedenfuhr M, Sanudo JR, Vãzquez T, Nearn L, Logan B, Parkin I. Median artery revisited. J Anat. 1999; 195:57–63.

7. Pierre-Jerome C, Smitson RD, Jr, Shah RK, Moncayo V, Abdelnoor M, Terk MR. MRI of the median nerve and median artery in the carpal tunnel: prevalence of their anatomical variations and clinical significance. Surg Radiol Anat. 2010; 32:315– 322

8. Chen L, Chen J, Hu B, Jiang LX. Sonographic Findings of the Bifid Median Nerve and Persistent Median Artery in Carpal Tunnel: A Preliminary Study in Chinese Individuals. Clinics (Sao Paulo). 2017 Jun;72(6):358-362.

9. Feintisch AM, Ayyala HS, Datiashvili R. An Anatomic Variant of Persistent Median Artery in Association with Carpal Tunnel Syndrome: Case Report and Review of the Literature. J Hand Surg Asian Pac Vol. 2017 Dec;22(4):523-525.

10. Klauser AS, Halpern EJ, Faschingbauer R, Guerra F, Martinoli C, Gabl MF, Arora R, Bauer T, Sojer M, Löscher WN, Jaschke WR. Bifid median nerve in carpal tunnel syndrome: assessment with US cross-sectional area measurement. Radiology. 2011 Jun;259(3):808-15.

11. Bilgin SS, Olcay SE, Derincek A, Adiyaman S, Demirtas AM. Can simple release relieve symptoms of carpal tunnel syndrome caused by a persistent median artery? Clinical experience. Arch Orthop Trauma Surg. 2004 Apr;124(3):154-6.

12. Nather A, Chacha PB, Lim P. Acute carpal tunnel syndrome secondary to thrombosis of a persistent median artery (with high division of the median nerve). A case report. Ann Acad Med Singap. 1980 Jan;9(1):118-21.

13. Srivastava A, Sharma P, Pillay S. Persistent median artery thrombosis: A rare cause of carpal tunnel syndrome. Australas J Ultrasound Med. 2015 May;18(2):82-85.

14. Bartels DW, Shin AY. Surgical Excision of a Thrombosed Persistent Median Artery Causing Carpal Tunnel-Like Symptoms: A Case Report. JBJS Case Connect. 2020 Jul-Sep;10(3):e20.00139.

15. Khashaba A. Carpal tunnel syndrome from thrombosed persistent median artery. J Emerg Med. 2002 Jan;22(1):55-7.

16. Abdouni YA, Brunelli JPF, Munia MAS. Acute Carpal Tunnel Syndrome due to Persistent Median Artery thrombosis: Case report. Rev Bras Ortop (Sao Paulo). 2020 Sep 25;58(2):347-350.

17. Shyu, S. G., Chang, M. C., & Boudier-Revéret, M. (2020). Thrombosed Persistent Median Artery Diagnosed By Ultrasonography and Treated With Oral Anticoagulant. Pain practice : the official journal of World Institute of Pain, 20(2), 228–229.

18. Salter M, Sinha NR, Szmigielski W. Thrombosed persistent median artery causing carpal tunnel syndrome associated with bifurcated median nerve: A case report. Pol J Radiol. 2011 Apr;76(2):46-8..

19. Jain RD, Bathala L, Anuradha HK, Kale SK, Pujar GS, Mehndiratta MM, Visser LH. A rare cause of median neuropathy at the carpal tunnel: Thrombosis of the persistent median artery. Indian J Radiol Imaging. 2020 Apr-Jun;30(2):229-232.

20. Rzepecka-Wejs L, Multan A, Konarzewska A. Thrombosis of the persistent median artery as a cause of carpal tunnel syndrome - case study. J Ultrason. 2012 Dec;12(51):487-92.