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Case Report

Incidental bifid median nerve with a wandering ulnar division separated by the third flexor digitorum superficialis muscle: importance of ultrasound evaluation☆

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ABSTRACT

Ultrasound evaluation of the median nerve is commonly performed in patients with suspected carpal tunnel syndrome. Radiologists should be familiar with variant anatomy of the median nerve to assist clinicians in the management of these patients, particularly when surgery is being considered. A 63-year-old female was being evaluated for a ganglion cyst and was incidentally found to have a bifid median nerve with wandering ulnar division which coursed superficial to the third digit flexor digitorum superficialis (FDS) muscle belly. The patient did not have any symptoms of carpal tunnel syndrome so surgery has not been performed; however this case highlights the importance of ultrasound evaluation to avoid potential perioperative complications.

Introduction

The use of musculoskeletal ultrasound in evaluation of the median nerve has grown in the recent decade, able to document intraneural and extraneural masses, neuritis, and overall morphology which aides in diagnosis of median nerve entrapment neuropathy and patient management. Ultrasound can also evaluate for flexor tenosynovitis, ganglion cysts, or masses that may be contributing to compressive morphology. All the aforementioned are important prior to surgical intervention to avoid re-entrapment or intraoperative complications. Imaging the median nerve provides a preoperative road map for the surgeon to ensure best practice and avoid unforeseen pathology contributing to the median neuropathy. Ultimately, understanding the course of the median nerve prior to surgery is imperative to avoid complications. Our case adds to the growing literature of median nerve variations that have been reported.

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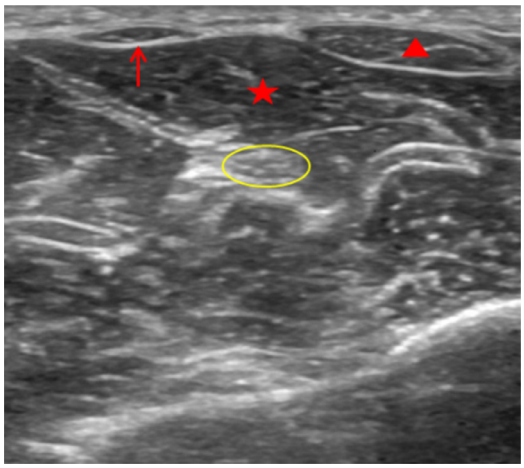

Fig. 1 – Transverse grayscale ultrasound of the volar forearm proximal to the pronator quadratus demonstrates normal appearance and position of median nerve (yellow circle) deep to the 3rd digit flexor digitorum superficialis muscle belly (star). The palmaris longus tendon (arrow) and flexor carpi radialis (triangle) are also identified for reference. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

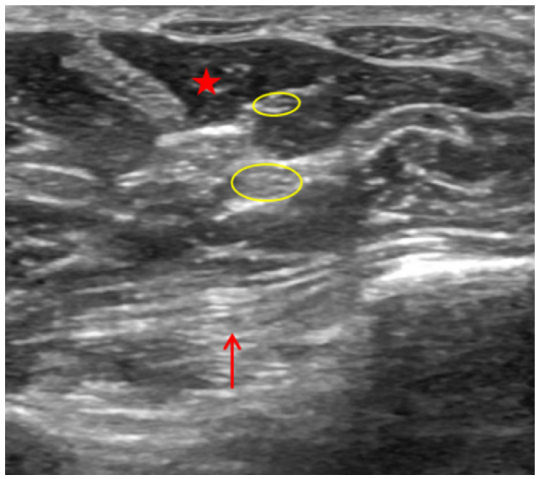

Fig. 2 – Grayscale ultrasound of the volar forearm at the proximal aspect of the pronator quadratus muscle (arrow) demonstrates early bifurcation of the radial (large circle) and ulnar (small circle) divisions of the median nerve. At this level the ulnar division is piercing the flexor digitorum superficialis muscle belly (star) and is positioned centrally within the muscle.

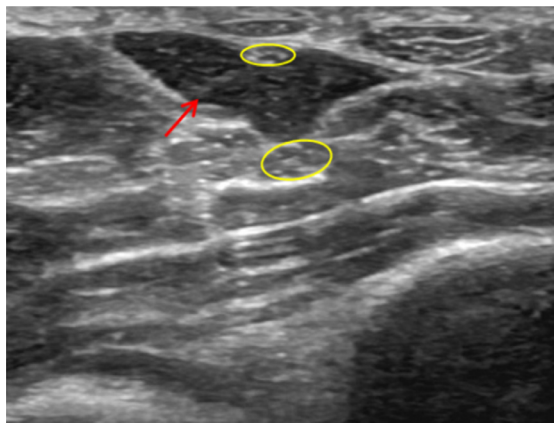

Fig. 3 – Grayscale ultrasound of the volar forearm at the mid portion of the pronator quadratus muscle demonstrates maximum separation of the radial (large circle) and ulnar (small circle) divisions of the median nerve by 4 mm with an intervening flexor digitorum superficialis muscle belly (arrow).

Case report

A 63-year-old female presented for evaluation of a presumed volar ganglion cyst along the radial aspect of the wrist. During ultrasound examination, incidentally noted was a wandering ulnar division of the median nerve at the level of the pronator quadratus muscle which pierced the distal third of the flexor digitorum superficialis (FDS) muscle belly, becoming separate from the radial division for approximately 4 cm in longitudinal dimension. Intervening was a thick muscle belly of the 3rd digit FDS measuring 13 × 4 mm (ML × AP) in maximal dimension, resulting in a separation of the 2 divisions. The 2 divisions reapproximated at the level of the proximal scaphoid with 1 mm separation. At the level of the distal scaphoid and pisiform (at the carpal tunnel inlet) the 2 divisions opposed each other, but remained bifid in morphology (Figs. 1–5). No persistent median artery was present, and there was no neural enlargement, hypervascularity or flexor tenosynovitis (Fig. 6). No accessory muscles were noted. The FDS muscle was normal in morphology. The median nerve had a cross-sectional area of 7 mm^2 at the level of the proximal third of the pronator quadratus and 9 mm^2 at the level of the carpal tunnel, which would not meet significance for median nerve entrapment neuropathy [1]. Sonographically and clinically, the patient had no evidence of carpal tunnel syndrome and therefore no operation was performed. To our knowledge, this is the first case documented by imaging where a portion of the bifid median nerve pierced the FDS muscle belly well before the myotendinous junction.

Discussion

Classification of median nerve anatomy was originally described by Lanz [2], and many anatomic variations have been described in the literature [3–8]. Bifid median nerves, originally thought to be uncommon with a prevalence reported as 2.8% by Lanz [2], are increasingly being recognized with the advent of musculoskeletal ultrasound, with a prevalence ranging from 18.5% to 19% in patients with carpal tunnel syndrome, and 9% to 15.4% in those without carpal tunnel

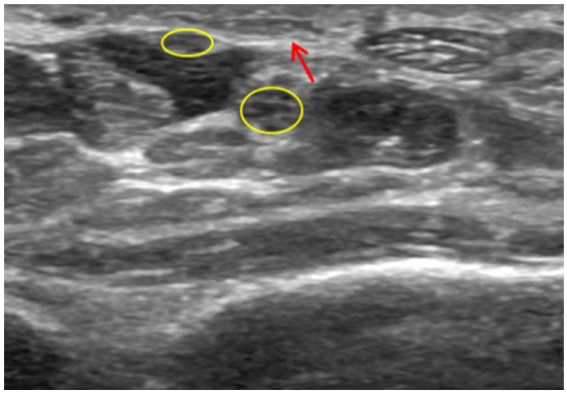

Fig. 4 – Grayscale ultrasound of the volar forearm at the distal pronator quadratus muscle demonstrates that the ulnar division (small circle) of the median nerve becomes very superficial and directly adjacent to the ulnar aspect of the palmaris longus tendon (arrow). The radial division (large circle) remains deep to the flexor digitorum superficialis muscle belly.

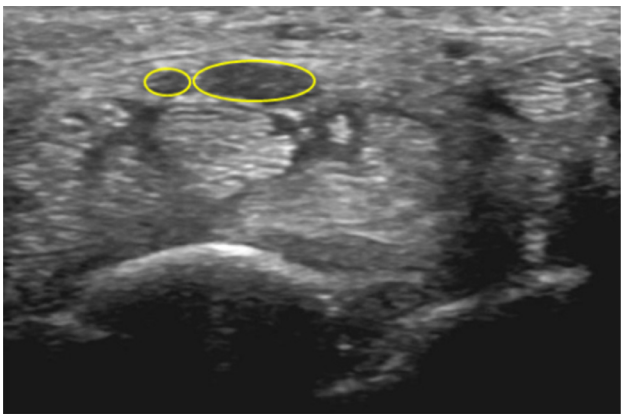

Fig. 5 – Grayscale ultrasound of the volar forearm at the carpal tunnel inlet demonstrates reapproximation of the radial (large circle) and ulnar (small circle) divisions of the median nerve. The nerve maintains a bifid morphology.

syndrome [9,10]. Bifid median nerve morphology is considered an independent risk factor for median nerve entrapment neuropathy, thought to be secondary to a larger cross-sectional area, inherently occupying more space in the carpal tunnel. Anomalous muscles including a prolonged FDS belly, accessory first lumbrical, accessory palmaris longus, and palmaris profundus have been described [11], contributing to compressive neuropathy.

In concordance with the index case, anomalous course of the bifid median nerve can be associated with the FDS, where the FDS contributes to compressive median neuropathy from adhesions, mass effect or dynamically with movement [6]. Fernandez-Garcia et al described a case of bifid median nerve anatomy where the median nerve pierced the FDS at the myotendinous junction [8], and Skie et al described the FDS muscle belly piercing the median nerve which was

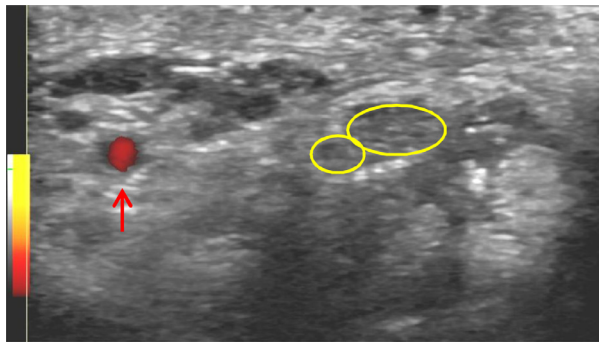

Fig. 6 – Power Doppler ultrasound at the level of the carpal tunnel where the median nerve has nearly reapproximated (circles). No persistent median artery or hypervascular neuritis of the median nerve. The ulnar artery (arrow) is identified for reference.

identified during surgery [5]. More recently, Lis et al described the median nerve piercing the FDS muscle belly which was identified during anatomical dissection [7], which may be a similar variation to the one which we have described.

Understanding the course of the median nerve prior to surgery is important for surgeons to prevent perioperative complications. For instance, each division of the nerve must be located and accounted for to avoid inadvertent injury during surgery. In addition, the median nerve may mimic a flexor tendon intraoperatively, which may result in neural laceration during the surgical dissection and neural release [12]. Moreover, in this case, the ulnar division became superficial in the deep subcutaneous tissues overlying the deep fascial plane and ulnar to the palmaris longus at the distal forearm, well before the radial division joined it at the level of the wrist. Various landmarks are used by surgeons when performing carpal tunnel release and the ulnar aspect of the palmaris longus is a known incision point to avoid transecting the recurrent motor branch of the median nerve and the palmar cutaneous branch [13]. Our patient would be at very high risk for injury to the ulnar division of the median nerve if the aforementioned incision was made. Patients with anomalous muscles in the presence of a separated bifid median nerve and carpal tunnel syndrome also usually require release of each division of the bifid median nerve in addition to excision of the intervening muscle [6], so identification preoperatively is important for a successful neural decompression [11,12] and to avoid persistent entrapment neuropathy. Interestingly, our patient did not describe any symptoms of compressive neuropathy and therefore no surgery has been performed. Regardless, this patient may be at higher risk for developing symptoms of median neuropathy in the future secondary to static or dynamic compression and possible adhesions from its intramuscular course.

Utility of imaging for median nerve entrapment neuropathy can be helpful both in diagnosis and management of carpal tunnel syndrome, and ultrasound provides a quick and inexpensive method for evaluation. By visualizing nerve morphology and contributing factors to neural compression, anatomic variations can be well seen, aiding the surgeon

in the perioperative setting avoiding intraoperative and postoperative complications.

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