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Case Report

Accessory head of flexor carpi radialis and abnormal course of the median nerve in the forearm

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ABSTRACT

Background: The median nerve anatomy and its clinical presentation are crucial for surgeons to consider avoiding iatrogenic injury and performing effective surgical interventions.

Case Description: An atypical presentation of median nerve anatomy proximal to the carpal tunnel was found during cadaveric dissection. The median nerve was located deep to a uniquely double-headed flexor carpi radialis and curved medially around the tendons of the forearm to enter the carpal tunnel superficially.

Conclusion: The atypical presentation of median nerve anatomy can assist surgeons in adverse event reduction during surgeries such as carpal tunnel and pronator teres syndrome releases.

Keywords: Anatomy, Iatrogenic injury, Median nerve, Surgery, Variation

INTRODUCTION

Recognizing classical nerve anatomy is important for understanding surgical approaches, but many variations exist that require specialized attention to decrease the risk of injury during surgery. The median nerve is classically described as originating from the lateral and medial cords of the brachial plexus and, from there, coursing down the brachium without branching.[3] The median nerve then enters the proximal antebrachium between the humeral and ulnar heads of the pronator teres before branching to innervate its target muscle groups.[3,10] One such muscle is the flexor pollicis longus in the anterior compartment, located laterally and deep to the flexor digitorum profundus, the primary flexor of the thumb.[9] The main branch of the median nerve continues deep in the proximal forearm between the flexor digitorum superficialis and flexor digitorum profundus to then supply the anterior interosseous nerve.[3,9,10] At the wrist, the palmar cutaneous branch runs superficial to the transverse carpal ligament, while the main median nerve branch travels deep to the transverse carpal ligament.[3] The median nerve then gives off the terminal palmar digital and palmar recurrent (thenar, motor) branches.

The most common procedure involving the median nerve is carpal tunnel release. Symptoms of median nerve compression include thenar muscle atrophy and weakness with numbness and shooting pain in the first three digits. Surgery involves the release of the transverse carpal ligament

surrounding and compressing the nerve.[7] This release, when successful, improves symptoms of pain, numbness, and loss of function.

Procedures involving the median nerve can also occur near the elbow due to entrapment of the median nerve by the pronator teres or the sublime arch. Compression of the median nerve near the elbow often presents symptoms similar to those of carpal tunnel syndrome, though the origin is at the proximal median nerve.[5] Pronator teres syndrome (PTS) is one such case.

While the classical presentation of median nerve anatomy is important for understanding surgical approaches to most cases of carpal tunnel and PTSs, it is not representative of every case, as anatomical variants are often reported in the literature. Recognizing anomalies such as the one reported here is crucial, as variations may lead to complications if not well anticipated and understood. To the best of our knowledge, this variant has not been previously described in the literature.

ILLUSTRATIVE CASE

A cadaveric dissection of an elderly male's right upper limb was performed to reveal the brachial plexus and its branching patterns. There were no apparent signs of trauma or prior surgery. Typical anatomy of the median nerve was observed at the brachial plexus. On further inspection of the proximal forearm, however, it was evident that the median nerve was not visible in its typical position, superficial to the flexor digitorium superficialis. In following the nerve, it was revealed that the median nerve lay deeper than classically described in Figure 1,(A). The median nerve crossed from lateral to medial deep to the flexor tendons (B and C), then from medial to lateral superficial to the flexor tendons before entering the carpal tunnel (C and D).

In addition, abnormal muscle anatomy was found. The flexor carpi radialis (FCR) had one tendinous insertion [Figure 2],(A). But two heads and two origins from both the medial and lateral epicondyles of the humerus [Figure 2],(B). Normally, the FCR originates only from the medial epicondyle of the humerus.

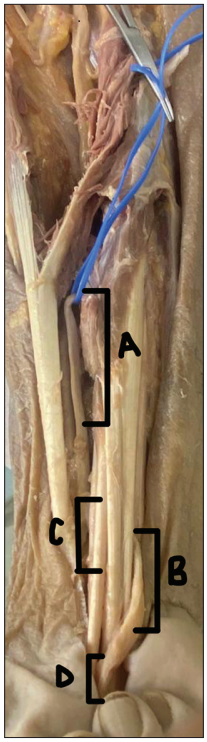

Figure 1: Median nerve (A), lateral twist underneath the flexor digitorum profundus and flexor digitorium superficialis (FDS) (B), medial twist over FDS (C), and typical superficial exit of the median nerve from the carpal tunnel (D).

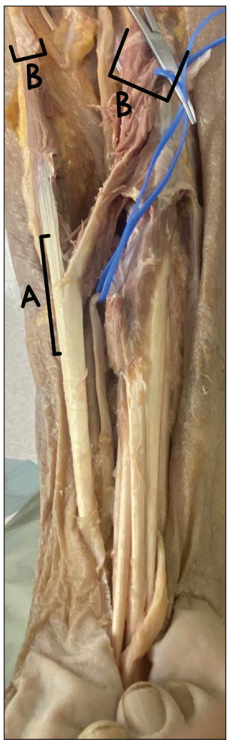

Figure 2: One tendinous insertion of flexor carpi radialis (A) from the junction of two muscle bellies (B).

DISCUSSION

Observations

Carpal tunnel syndrome is the most common form of neuropathy caused by entrapment of the median nerve.[11] Entrapment of the median nerve is often caused by rigidity of the tissue, connective tissue overgrowth, or settling of metabolic wastes in the ligament. These causes may be related to effects of trauma, hormones, metabolism, inflammation, vascularization, neuroplasticity, or aging. To relieve the

symptoms of this syndrome, carpal tunnel release surgeries are often employed, involving a release of the transverse carpal ligament.[3] This procedure has greater than a 90% success rate short-term and a 60% success rate after about five years.[11]

Neuropathy of the median nerve also occurs at the elbow. Median nerve compression in the elbow is most frequent at the pronator teres.[8] PTS can be caused by overuse of the pronator teres, especially in individuals with extra fibrous bands. PTS has been observed after local trauma, compression due to schwannoma, and in patients undergoing anticoagulation therapy or renal dialysis.[2] To relieve the symptoms, both conservative treatment and surgical treatment may be employed. The pronator teres muscle and other compressive structures are released in surgery.[2] Studies disagree on the efficacy of PTS release, with reported success ranging from 21% to 92%, according to multiple studies.[6] These unclear outcomes further emphasize the need to identify anatomic variations that may be impacting surgical treatment efficacy.

Lessons

Knowledge of the structures of anatomical variations before operation is critical for improving long-term success and avoiding iatrogenic injury. The median nerve during carpal tunnel release is one of the most commonly injured nerves during surgery. Median nerve injury was found to occur in 0.55% of carpal tunnel release surgeries, with 0.2–0.3% of those cases being irreparable. Anatomic variation of the nerve's branches, division locations, and sensory and motor branches is widely accepted to be implicated in these poor surgical outcomes.[12]

Dag *et al*. did a literature review to calculate the prevalence of median nerve anomalies.[1] Of the 300 wrists studied, a total of 72 wrists (24%) presented with variation from normative anatomy described in textbooks either before or within the carpal tunnel. This finding suggests that median nerve variation makes up a significant portion of the population and should be considered preoperatively to avoid injury during surgery.

Although iatrogenic median nerve injury in the proximal forearm is not as well studied as in the carpal tunnel, the anatomical variations presented in this case study are relevant to any procedure concerning entrapment of the median nerve. In various emergency procedures such as venous cutdown, ignorance of anatomical variations of the median nerve can lead to iatrogenic injury.[4] In addition, other medical specialists who require high-level anatomic understanding, such as radiologists, benefit from increased knowledge of possible anatomical anomalies of the median nerve. Accurate identification of structures on imaging can help confirm diagnosis of median nerve entrapment throughout the arm, further assisting in the medical and surgical management of these patients.

CONCLUSION

Knowledge of proper anatomy is crucial for accurate and effective surgical approaches, and classical anatomic descriptions only represent the majority of clinical anatomical presentations. Although less common, these anomalies are prevalent in the community and require careful attention to avoid median nerve injury during carpal tunnel and PTS releases.

Ethical approval

Not applicable

Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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