Section: Anatomy

Original Research Article

A STUDY ON THE ANATOMICAL VARIATIONS OF THE MEDIAN NERVE

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ABSTRACT

Background: Median nerve arises from the brachial plexus, courses through the arm and forearm to divide into its terminal branches at the distal carpal tunnel. Due to significant differences in the prevalence of median nerve variations, extensive knowledge on the anatomy of the median nerve is essential to avoid iatrogenic nerve injury. The aim of this study was to identify any variations present in the course and division of the median nerve.

Materials and Methods: 50 adult upper limb specimens from 25 cadavers were obtained from the Department of Anatomy, Government medical college, Kallakurichi. The arm and forearm were dissected and median nerve was exposed completely and its branches in the palm were noted. Variations, if present were identified and photographed.

Results: Normal course and branching pattern of median nerve were noted in 44 cases (88%), bifid median nerve was observed in 6 cases (12%). The recurrent branch to thenar muscles (thenar motor branch) had a normal origin in 47 cases (94%). It arose deep to the flexor retinaculum (transverse carpal ligament) in 3 cases (6%). Communicating branch between lateral and medial branches of median nerve was present in 4 cases (8%). An accessory branch was noted in 2 cases (4%) with bifid median nerve.

Conclusion: Anatomical variations in the course of median nerve and its branches are common in the population. Preoperative ultrasound can be done to identify any median nerve variations. In order to avoid iatrogenic injury, an ulnar side approach to carpal tunnel release surgeries is recommended.

Keywords: Median nerve, Bifid median nerve, Thenar motor branch, Carpal tunnel release surgeries, Transverse carpal ligament.

INTRODUCTION

Median nerve arises from the brachial plexus, runs down the arm without any branches. It enters the forearm between the two heads of pronator teres and in the forearm it travels between flexor digitorum superficialis and flexor digitorum profundus. The median nerve enters the hand deep to the flexor retinaculum and then gives out its terminal branches, including the recurrent motor branch to thenar muscles on the radial side and palmar digital branches medially.[1]

Numerous variations in the course of the median nerve in the carpal tunnel as well as variations in the branches in the wrist have been reported.[2] Knowledge of median nerve anatomy and its variations are of importance in the diagnosis and treatment of entrapment neuropathies at the wrist. During carpal tunnel release surgeries and repair of traumatic injuries to the wrist, careful attention must be paid to the course of the median nerve.[3]

Bifid median nerve may be an independent risk factor for development of carpal tunnel syndrome, as they have a higher cross sectional area than non-bifid median nerves and occupy more room in the carpal tunnel.[4]Bifid median nerve may be associated with persistent median artery in some cases.

MATERIALS AND METHODS

50 adult upper limb specimens were obtained from the embalmed cadavers used for routine dissection of first MBBS students at the Department of Anatomy, Government Medical College, Kallakurichi.

The anterior surface of the arm, forearm and wrist were dissected and the median nerve exposed completely. The flexor retinaculum was cut open to expose the terminal branches of the median nerve at the distal carpal tunnel. The normal course and branching pattern of the median nerve in the arm, forearm and hand were dissected and variations if any were identified and photographed.

RESULTS

The median nerve had a normal course and divided into its terminal branches at the distal carpal tunnel in 44 cases (88%). In 6 cases (12%), bifid median nerve was observed. Out of this, in 4 cases (8%) the median nerve divided in the middle of the forearm and in 2 cases (4%) it divided into two at the distal arm but reunited after encircling the brachial artery. Persistent median artery was not noted in any of the cases.

The recurrent branch to the thenar muscles (thenar motor branch) was given off normally from the lateral branch of the median nerve after it exited the flexor retinaculum in 47 cases (94%). In 3 cases (6%) the thenar motor branch arose from the median nerve deep to the flexor retinaculum (subligamentous origin).

A communicating branch between the lateral and medial branches of the median nerve was noted in 4 cases (8%). In 2 cases with bifid median nerve, an accessory nerve was given off from the radial side of the median nerve in mid forearm and it descended down to supply the thenar muscles. No hypertrophy of thenar muscles was noted in any of the cases.

Figure 1: High division of median nerve in mid-forearm

Figure 2: High division of median nerve in distal arm

Figure 3: Median nerve seen encircling the brachial artery at the distal arm

Figure 4: Accessory branch from median nerve

Figure 5: Thenar motor branch arising below the flexor retinaculum (cut and reflected)

Figure 6: Communicating branch between lateral and medial branches of median nerve

DISCUSSION

Many authors have described the variations in the median nerve at the carpal tunnel. In our present study, high division of median nerve was noted in 6 cases (12%). Prevalence of bifid median nerve in literature ranges from 2 – 26 % per wrist. Satoshi Shinagawa et al,[5] described bifid median nerve at the level of wrist crease to be present in 16.9% of patients. Majority of them 74.6% had a unilateral bifid median nerve.

In a MRI study by Pierre-Jerome et al,[6] the prevalence was 19% regardless of gender or age. In a ultrasound study by Giuseppe Granata et al,[7] bifid median nerve was observed in 15.4%. They showed that bifid median nerve is not always bilateral and is often incomplete. In a study by Francis O Walker et al[8], bifid median nerve was reported in 8.6% of cases and 3.7% of cases in this study had a persistent median artery.

In a study by George P.Georgiev et al,[9] bifid median nerve was reported in 1.02% of cadaveric dissection and 3.08% during surgical procedures. Bayrak et al,[10] noted that bifid median nerve, due to their large cross sectional area could get compressed and cause carpal tunnel syndrome.

In a study by George K Paraskevas et al,[11]a case was reported in which a 78 year old male cadaver had a median nerve loop associated with a superficial brachial artery.[11] Kumar MR Bhat et al,[12] reported a 58 year old male cadaver with median nerve loops around the axillary artery.

In a study by Snehlata P. Samberkar et al,[13] reported a 58 year old male cadaver where a muscular branch of brachial artery was seen winding around the median nerve.

In a case report by Hyung – Sun Won et al,[14]median nerve is divided into two in the proximal forearm and joined into a single cord in the distal forearm before entering the carpal tunnel. In a study by Roy TS,[15] a case was reported where there was median nerve penetration by a muscular branch of the brachial artery.

In our present study, the origin of the recurrent branch to thenar muscles (thenar motor branch) of the median nerve was extraligamentous after the median nerve exited from the flexor retinaculum in 47 cases (94%). In 3 cases (6%), the thenar motor branch had a subligamentous origin. Brandon Michael et al,[16] described the extraligamentous origin to be 13.5%.

Henry et al,[17] described extraligamentous origin of thenar motor branch to be 75.2%, subligamentous origin to be 13.5% and transligamentous origin to be 11.3%. In our present study, a communicating branch between medial and lateral branches of median nerve was noted in 4 cases (8%). In a study by Luis Ernesto et al,[18] incidence of communicating nerve between musculocutaneous and median nerve was reported to be 19.8% bilaterally. Communication between median nerve and ulnar nerve have also been reported in literature.

In our present study, an accessory branch was seen arising from the lateral side of the median nerve in 2 cases (4%). In a study by N.Z.Winkelman,[19] bifid median nerve was associated with an aberrant nerve branch. In another study by George Paraskevas et al,[20] a rare case of an accessory branch of median nerve taking origin in the right arm to supply the inferomedial portion of brachialis muscle in a male cadaver was noted.

CONCLUSION

Bifid median nerve by itself or associated with a persistent median artery might predispose to carpal tunnel syndrome, due to their large cross sectional area. Course of the thenar motor branch is highly variable and such variants are at high risk of iatrogenic damage during carpal tunnel surgeries. Hence an ulnar side approach for carpal tunnel release surgery is recommended. Preoperative use of ultrasound can help to identify patients with bifid median nerve who are more likely to have median nerve variations.

It is important for clinicians to recognize the frequency of variations of the median nerve and its branches to minimize further injury during surgeries.

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