CASE REPORT

Crucial neurovascular structures entrapped in a brachial intramuscular tunnel

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Abstract

We report a case where the median nerve accompanied by brachial vessels were found to traverse an intra-muscular tunnel within the brachialis muscle, in the floor of the cubital fossa. The muscular tunnel commenced 5 cm proximal to the neck of radius, measured 4.4 cm in length, and was present unilaterally. This unusual tunnel was distally found to blend with the brachial fascia. The present study was planned with an endeavor to elucidate in an improved way the clinical implications of compressed median nerve and brachial vessels. There are several sites where median nerve maybe compressed along its course in the arm and forearm. The relevance of the present documentation lies in the fact that these vital neurovascular structures may be compressed leading to neuropathies and vascular changes.

***Keywords*:** muscular, tunnel, median nerve, compression.

Introduction

Median nerve compression is a well-known and established clinical entity. The various causes ascribed to its compression in the forearm are lacertus fibrosis and forearm muscles such as pronator teres and flexor digitorum superficialis [1]. Less frequently seen in the compression of median nerve beneath ligament of struthers from supracondylar region of the humerus. The median nerve passes through various musculo-aponeurotic structures during its course in the arm and forearm. These areas acquire importance, as they comprise potential sites of neurovascular entrapment [2]. The neurovascular bundle of the arm comprising of median nerve (MN) and brachial artery (BA) is seen to pass within a fascial sheath along the medial border of brachialis muscle towards the cubital fossa. Anatomical studies continue to describe varied sites of median nerve compression ranging from deep fascia to aponeurotic bands [2, 3]. These may cause perplexing situations while interpreting CT-scans and while performing explorative procedures in patients with neurological symptoms pertaining to median nerve.

In the current case report, we document an unusual intramuscular tunnel entrapping the median nerve and brachial vessels proximal to the supracondylar region of the elbow. The brachialis muscle a prime flexor of the arm is closely related to both median nerve and brachial vessels, which run along its medial border to reach the cubital fossa. There have been reports where the brachialis muscle has accessory bellies, but an intra-muscular tunnel entrapping the neurovascular bundle of the arm has been cited infrequently in literature.

Material, Methods, and Results

An attempt to explain the relationship of median nerve and the brachial vessels to the brachialis muscle in the arm during a regular instructive dissection session revealed that these structures traversed a tunnel within the brachialis muscle on the right side (Figure 1).

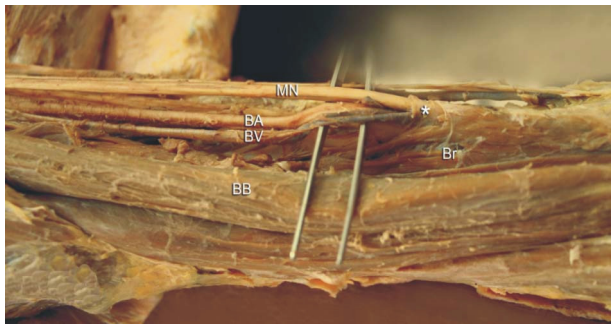

Figure 1 – ***Dissection of the distal third of the right arm showing: * – intramuscular tunnel; Br – brachialis muscle; BB – biceps brachii muscle; Mn – median nerve; BA – brachial artery; BV – brachial vein.***

A careful inspection of the tunnel revealed the median nerve and brachial vessels entrapped within its walls. The tunnel was located in the distal third of the arm and measured 4.4 cm in length. It extended distally and was found to blend with fascia over the brachialis in the floor of the cubital fossa. There were no variant branches given by the neurovascular bundle. The musculature and their innervation in the arm displayed normal anatomy. The course of the median nerve and brachial vessels on the other side were as usual.

Discussion

There are several instances in literature where carpal tunnel surgery failed to cure the patient of nerve compression symptoms, often due to erroneous diagnosis. Thus, the surgeons should execute caution and should consider the option of proximal median nerve compression [1]. A similar survey was documented earlier, in which a fibro muscular band entrapped the median nerve and brachial artery [3]. However, the passage ensheathing the neurovascular bundle was an intramuscular tunnel in our case. Since brachialis is a key flexor of the arm, contraction of this muscle could compress these crucial neurovascular structures, causing compression symptoms and jeopardizing the circulation. Median nerve compression proximal to its entrance into forearm is bound to have widespread neurological deficits. An additional slender tendon probably a remnant a coracobrachialis longus was found to cross anterior to median nerve and brachial artery in another case study [4]. Similarly, several other muscular etiologies such as anomalous muscles, hypertrophic brachialis have been incriminated in the causation of neurovasculopathy of the brachium [3]. However, an intra-muscular tunnel such as the one observed in the present study is not only unusual but also suggestive of posing diagnostic challenges for the neurologist and vascular surgeon.

The ligament of Struthers, which has been commonly incriminated by various scientists in the etiology of MN compression, is found in less than 2% of humans. Rarely the supracondylar process forms an arch that is comparable to a bony arch found in the lower part of humerus of cats and monkeys [4]. Two cases of muscular variations constituting a similar tunnel have been reported earlier. In one report, the extra muscle was originating from the humeral shaft to merge with the common flexors of the forearm while the second case reported a four-headed biceps [5, 6].

We construe that such an intramuscular tunnel has been rarely reported in literature. It could certainly cause compression of these critical neurovascular structures. An important observation in the present case was that the normal anatomical relationship of the structures at the cubital fossa was undisturbed. Since blood pressure recording is universally performed in this region, it is further speculated that owing to BA compression physicians may find the task burdensome. Moreover, the strategic location of these crucial neurovascular structures within the brachialis muscle would possibly render them more vulnerable to trauma in the event of fracture of distal humeral shaft.

The formation of this intramuscular tunnel could possibly be attributed to embryogenesis where the muscle primordia within different layers of the arm fuse to form a single muscle mass [7]. The topographical anatomy of MN with respect to fibrous arches and bands was studied in an earlier study [2] where they reported multiple sites where MN could be compressed. These sites included lacertus fibrosis, which is deep fascia of the forearm and various fibrous arches beneath flexor digitorum superficialis and deep head of pronator teres. The multiplicity of sites leading to MN compression and the inability to localize these sites on electrodiagnostic tests could lead the surgeon to explore and consequently release the structures causing the compression [2]. We strive to highlight by this study that this exploration should begin from the level of distal arm instead of proximal forearm as recommended by earlier workers in cases where lacertus fibrosis was responsible for MN compression. Since numerous tunnels in the distal arm have been described earlier, each having different constitutions, the surgeons need to explore this region as well. Despite the rarity of variation found in the brachialis muscle a frequent observation is the division of this muscle into two or three parts [8]. Therefore, we deduce from the above statements that probably somatic alterations during embryogenesis or modifications in cell adhesion molecules on the precursor cells may be responsible for the division of the brachialis muscle into two or more parts. This division of the muscle may lead to the formation of the tunnel in which these vital neurovascular structures are trapped. An understanding of the gross and morphological details of the nerves innervating the brachial muscles is greatly facilitated by MRI studies of these nerves. Henceforth, the signal intensity, course and diameter of the nerves of the brachium were meticulously studied in a previous study by performing MRI scans in asymptomatic patients [9]. An atypical intermuscular course of the median nerve in between the brachialis and the pronator teres muscles in 17% of the cases. A retrospective MRI scan study was performed in fifteen elbows with substantiation of radiologically confirmed nerve disorders [10]. Three patients were found to have median nerve diseases and it was deduced that MRI studies could reliably aid the detection of nerve disorders and aid as a guide for treatment. Similarly, another study confirmed the fundamental role of MRI in assessment of nerve disorders [11].

We further opine that the contraction of brachialis muscle during flexion of arm could result in irritation of the MN lying within this tunnel. Prolonged muscular contraction could lead to symptoms such as parathesias and numbness. The plethora of muscular variants is ever increasing, nonetheless, as anatomists, it is our responsibility to report the same due to the surgical and clinical relevance of such anomalies. It is an endeavor to help physicians and surgeons to be able to actually diagnose the neurological ailment, so that the patient is relieved from the distressing symptoms at the earliest.

Conclusions

The extraordinary intramuscular tunnel found in the current case report deserves special mention in anatomical literature owing to the clinical consequences caused by the entrapped neurovascular bundle. It is further suggested by this study that the surgeons begin exploration from the distal forearm rather than the proximal forearm, as is the usual practice. This unusual intramuscular tunnel within the brachialis muscle could possibly be cited as another cause of compression of the neurovascular bundle of the arm.

References

[1] OLEHNIK WK, MANSKE PR, SZERZINSKI J, *Median nerve compression in the proximal forearm*, J Hand Surg, 1994, 19A(1):121–126.

[2] DELLON AL, MACKINNON SE, *Musculoaponeurotic variations along the course of the medial nerve in the proximal forearm*, J Hand Surg, 1987, 12B(3):359–363.

[3] WADHWA S, MEHRA S, KHAN RQ, KAPUR V, *Abnormal musculo-aponeurotic tunnel in the arm: possible entrapment of the median nerve and brachial artery with high origin of nerve to pronator teres within the tunnel*, Clin Anat, 2004, 17(4):360–363.

[4] EL-NAGGAR MM, ZAHIR FI, *Two bellies of the coraco-brachialis muscle associated with a third head of the biceps brachii muscle*, Clin Anat, 2001, 14(5):379–382.

[5] DHARAP AS, *An anomalous muscle in the distal half of the arm*, Surg Radiol Anat, 1994, 16(1):97–99.

[6] NAKATANI T, TANAKA S, MIZUKAMI S, *Bilateral four-headed biceps brachii muscles: the median nerve and brachial artery passing through a tunnel formed by a muscle slip from the accessory head*, Clin Anat, 1998, 11(3):209–212.

[7] CHIAK R., *Ontogenesis of the skeleton and intrinsic muscles of the human hand and foot*, Adv Anat Embryol Cell Biol, 1972, 46:1–194.

[8] LOUKAS M, LOUIS RG JR, SOUTH G, ALSHEIK E, CHRISTOPHERSON C, *A case of an accessory brachialis muscle*, Clin Anat, 2006, 19(6):550–553.

[9] HUSARIK DB, SAUPE N, PFIRRMAN CWA, JOST B, HODLER J, ZANETTI M, *Elbow nerves: MR findings in 60 asymptomatic subjects – normal anatomy, variants, and pitfalls*, Radiology, 2009, 252(1):148–156.

[10] ROSENBERG ZS, BELTRAN J, CHEUNG YY, RO SY, GREEN SM, LENZO SR, *The elbow: MR features of nerve disorders*, Radiology, 1993, 188(1):235–240.

[11] KIM YS, YEH LR, TRUDELL D, RESNICK D, *MR imaging of major nerves about the elbow: cadaveric study examining the effect of flexion and extension of the elbow nad pronation and supination of the forearm*, Skeletal Radiol, 1998, 27(8):419–426.

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