VIA MEDICA

ORIGINAL ARTICLE

Vol. 60, No. 3, pp. 217–224

ISSN 0015–5659
www.fm.viamedica.pl

A study on the morphology of the coracobrachialis muscle and its relationship with the musculocutaneous nerve

Mostafa M El-Naggar

Department of Anatomy, Faculty of Medicine and Allied Sciences, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia

[Received 1 June 2001; Accepted 10 July 2001]

Thirty-six arms from embalmed adult cadavers were utilised for this investigation. Coracobrachialis muscle was carefully examined to record variations in its attachments, morphology and its relationship with the musculocutaneous nerve. The results of the present work identified the presence of two heads of origin for the coracobrachialis muscle, which are situated superficial (anterior) and deep (posterior) to the musculocutaneous nerve. The superficial head arises mainly from most of the medial border of the tendon of the short head of the biceps brachii muscle. The deep head arises from the apex of the coracoid process of the scapula and the adjoining lateral border of the tendon of the short head of the biceps brachii muscle. The musculocutaneous nerve provides a separate branch for each head. In cases where the coracobrachialis muscle was not pierced by the musculocutaneous nerve, the muscle was formed of one head that has an origin analogous to that of the superficial head. One case showed a splitting of the deep head into two bellies shortly after its origin, where the muscle appeared as being formed of three heads. Variations in the insertion were present as an additional aponeurotic insertion above the usual insertion and an aponeurotic extension to the deep fascia on the medial aspect of the arm. Variations in the musculocutaneous nerve were in the form of lower origin from the lateral root of median nerve and a nerve with a short course after which it united with the median nerve. This investigation supplied evidence of the double heads of origin for the coracobrachialis muscle. The detected variability in insertion and association of the muscle with the musculocutaneous nerve further supports the idea that the coracobrachialis muscle is a complex muscle.

key words: anomaly, muscles of arm, two heads, variation

INTRODUCTION

Coracobrachialis muscle is classically described as taking its origin from the apex of the coracoid process of the scapula, where it is blended with the medial side of the short head of biceps brachii. The tendon is continued into a muscular belly, which is inserted into the medial border of the shaft of the humerus between the attachment of triceps and brachialis muscles. The musculocutaneous nerve usually pierces the coracobrachialis muscle in man [14, 25]. The muscle was described as being functionally unimportant [14]. However, the muscle has recently attracted interest with its potential use for contouring the infraclavicular area [18] or covering the ex-

Address for correspondence: Dr Mostafa M El-Naggar, Department of Anatomy, Faculty of Medicine and Allied Sciences, King Abdulaziz University, P.O. Box 9029, Jeddah 21413, Kingdom of Saudi Arabia, tel: 966 2 640 3443 ext. 20123, fax: 966 2 632 0477, e-mail: mmnaggar@hotmail.com

posed axillary vessels specifically in postmastectomy reconstructive operations [7].

Few morphological variations of coracobrachialis muscle and its associated musculocutaneous nerve have been described in the literature. Williams et al. [25] described accessory slips of the coracobrachialis, which may be attached to the lesser tubercle, medial intermuscular septum or the medial epicondyle of the humerus. Böhnel [2] described a case with a supernumerary head of the coracobrachialis muscle, found over the shoulder joint. A few reports described rare cases, where the musculocutaneous nerve does not pierce coracobrachialis muscle but runs downward, medial to it [6, 12, 16]. However, there has been no satisfactory explanation given for the change in the course of musculocutaneous nerve.

Some cases of examined human cadavers in our lab showed variations in the morphology, attachment and innervation of the coracobrachialis muscle. These variations might give an indication of the complex origin of the muscle. Moreover, it is also expected to have functional and surgical implications, especially on the musculocutaneous nerve, as it passes through the muscle. Therefore, it was decided to extend our work to a detailed examination of the coracobrachialis muscle and record its relationship with the musculocutaneous nerve.

MATERIAL AND METHODS

The embalmed adult cadavers used in our laboratory for gross anatomy dissection courses were utilised for this investigation. Thirty-six arms were used to determine the morphological criteria of the coracobrachialis muscle, as follows:

1. Careful dissection of the sites of origin and insertion of the muscle.
2. Any variability in innervation of the muscle and its relationship with the musculocutaneous nerve.

RESULTS

Two interesting findings were noticed in this investigation:

1. Almost all cases in which the musculocutaneous nerve passes through the muscle, which is the usual course of the nerve, the muscle was formed of two heads. Their sites of attachment were as follows:

   a) The superficial (anterior) head: This head lies superficial to the musculocutaneous nerve and was attached to most of the medial border of the tendon of the short head of the biceps brachii muscle (Figs. 1–4);

Figure 1. A photograph of the right arm of an adult cadaver, showing the two heads of the coracobrachialis muscle embracing the tendon of short head of biceps brachii muscle. Notice the following:
1. The musculocutaneous nerve (arrows) passes between the two heads of the coracobrachialis muscle.
2. The superficial head (S) is attached to most of the medial border of the tendon of the short head of the biceps brachii muscle (T).
3. The deep head (D) is attached to the upper part of the lateral border of the tendon of the short head of the biceps brachii muscle and then passes deep to it to unite with the superficial head.

   b) The deep (posterior) head: This head lies deep to both the musculocutaneous nerve and short head of biceps brachii and is attached to the coracoid process of the scapula and adjoining part of the lateral border of the tendon of short head of biceps (Figs. 1–3).

The two heads fuse with each other after a varying distance to form a common part which is inserted into the middle of the medial border of the humerus, between the origins of brachialis muscle and the medial head of triceps brachii muscle.

One case showed a splitting of the deep head into 2 bellies shortly after its origin, where the muscle appeared as being formed of three heads (Fig. 4).

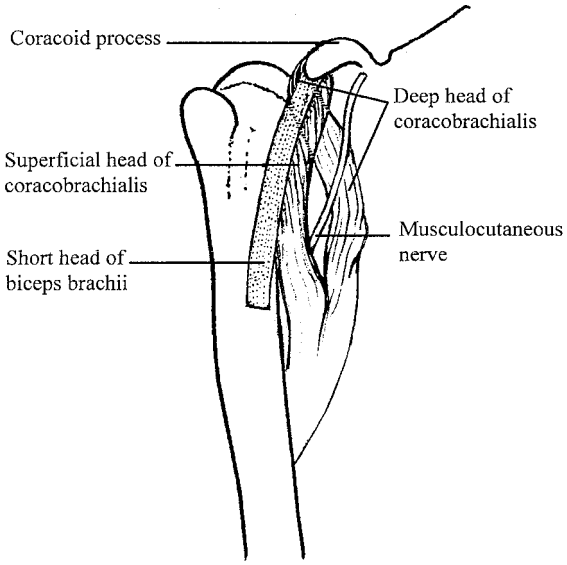

Figure 2. A figure showing the origin of the superficial and deep heads of the coracobrachialis muscle. Notice that the superficial head arises mainly from the medial side of the tendon of the short head of biceps brachii. The deep head arises from the coracoid process of the scapula and the adjoining part of the lateral side of the tendon of the short head of biceps brachii.

Figure 3. A photograph of the left arm of an adult cadaver showing the superficial (S) and deep (D) heads of the coracobrachialis muscle. The superficial head receives a separate branch from musculocutaneous nerve before its passage between the two heads (arrows).

Figure 4. A photograph of the left arm of an adult cadaver, showing coracobrachialis muscle with splitting of its deep head (D) into two parts (P), which make the muscle as being formed of three heads. Notice the following:
1. The tendinous origin of the deep head (D) from the coracoid process of the scapula (arrowhead) and the lateral side of the tendon of short head of biceps brachii (t).
2. The wide fleshy origin of the superficial head (S) from the tendon of the short head of biceps brachii.
3. The common part of insertion (C) of the coracobrachialis muscle.
4. The musculocutaneous nerve (arrows) as it passes between the superficial and deep heads of the muscle.

2. The two heads of the muscle receive separate branches from the musculocutaneous nerve. The branch for the superficial head usually arises before the nerve passes between the two heads (Figs. 3, 5).

Variations in origin

In cases where the muscle is not pierced by the musculocutaneous nerve, the muscle was formed of one head. It arises almost wholly from most of the medial border of the tendon of the short head of the biceps brachii muscle (Figs. 6, 8, 9). The origin of the muscle is analogous to that of the superficial head.

Variations in insertion

The following cases were reported in relation with insertion of the muscle:

Figure 5. A photograph of the right arm of an adult human cadaver showing superficial head (S) and deep head (D). Each head receives separate branch from the musculocutaneous nerve (arrows).

Figure 6. A photograph of the left arm of an adult cadaver, showing coracobrachialis muscle which widely arises by a single head (A) from the medial side of the tendon of the short head of the biceps brachii muscle (T). Notice the musculocutaneous nerve (arrows) which lies on the medial side of the muscle without piercing it.

a) Beside the usual insertion of a coracobrachialis muscle into the medial border of the humerus, an additional aponeurotic extension was detected. It extended from the superficial head downward and medially in front of the median nerve and brachial artery to blend with the deep fascia on the medial aspect of the arm (Fig. 7);
b) In another case, an additional aponeurotic insertion of the muscle was noticed a short distance above the usual insertion of the muscle. The muscle appeared as being inserted by two aponeurotic parts with a gap between them. This case was found in both limbs.

Variations in musculocutaneous nerve

a) In one case, the musculocutaneous nerve arose lower down from the lateral root of median nerve (Fig. 8). The musculocutaneous nerve did not pierce the muscle and passed medial to it;
b) In another case, the musculocutaneous nerve had only a short course after which it united with the median nerve. In such condition, the nerve did not pass through the coracobrachialis muscle, and the muscle had only one head. The muscular branches of the musculocutaneous nerve arose before it united with the median nerve (Fig. 9).

DISCUSSION

The most interesting finding of the present work was the identification of two heads for the coracobrachialis muscle, which are situated superficial (anterior) and deep (posterior) to the musculocutaneous nerve. The superficial head arises mainly from most of the medial border of the tendon of the short head of the biceps brachii muscle. The deep head arises from the apex of the coracoid process of the scapula and the adjoining lateral border of the tendon of the short head of the biceps. This is slightly different from the classic description of the origin of the muscle from the apex of the coracoid process of the scapula, to-

Figure 7. A photograph of the left arm of an adult cadaver showing additional insertion of the coracobrachialis muscle in the form of aponeurotic extension from the muscle (arrows) which passes downward and medially in front of the brachial artery and median nerve to blend with the deep fascia on the medial aspect of the arm.

Figure 8. A photograph of the left arm of an adult cadaver, showing a single head for coracobrachialis muscle (A) which arises from the medial side of the tendon of the short head of the biceps brachii muscle (T). Notice the low origin of the musculocutaneous nerve (solid arrows) from the lateral root of median nerve (open arrow). The musculocutaneous nerve is not piercing the coracobrachialis muscle.

gether with the short head of biceps brachii [14, 25]. The mode of their innervation, as the muscle received a separate branch for each head, provides additional support to confirm the new presentation of coracobrachialis as being formed of two heads.

The reported origin of the coracobrachialis muscle, as shown in the present work, from both sides of the tendon of the short head of the biceps brachii muscle, provides a strong suggestion that it is an enhancing muscle for this tendon. It may play an important role in putting the tendon of the short head of biceps brachii into the best axis of pull for proper action of the muscle upon the shoulder joint. This may be similar to what is seen in the lower limb; the flexor digitorum accessorius acts as an enhancing muscle for the tendon of flexor digitorum longus. It may also be comparable to the two gemilli muscles, where they act as enhancing muscles for the tendon of obturator internus muscle. The importance of coracobrachialis muscle in relation with flexion of the shoulder joint was proved by Bassett et al. [1], who found that the muscle is one of the most effective flexors of the shoulder. Moreover, it could be suggested that tonic contraction of the two heads of the coracobrachialis muscle may have an important role in fixing the tendon of the short head of biceps brachii during the movement of supination of the forearm and flexion of the elbow.

The results of the present work showed variability in the morphology of the coracobrachialis muscle and its relationship with the musculocutaneous nerve. Three cases were identified, where the musculocutaneous nerve did not pass through the coracobrachialis muscle, but medial to it. Similar cases of abnormal course of the musculocutaneous nerve were reported in the literature [6, 11, 16]. This unusual course of the musculocutaneous nerve was also documented in animals. Koizumi & Sakai [12] found that musculocutaneous nerve pierces coracobrachialis muscle in Chimpanzee, but not in Gorilla or Gib-

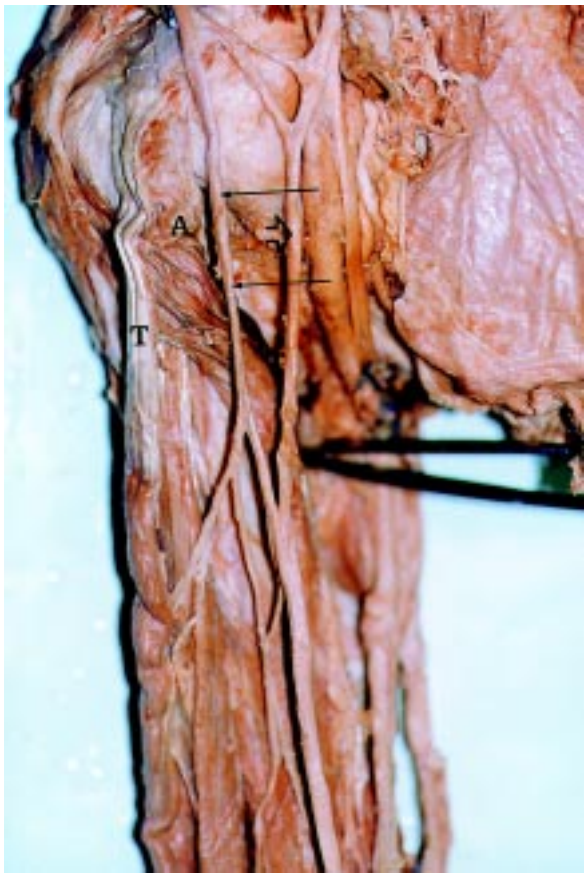

Figure 9. A photograph of the right arm of an adult male cadaver, showing a short course for the musculocutaneous nerve (solid arrows) after which it unites with the median nerve (open arrow). The branches of the musculocutaneous nerve arise before it unites with the median nerve. Notice that the coracobrachialis muscle is formed of a single large head (A), which is widely attached to the medial side of the tendon of the short head of the biceps brachii (T). The musculocutaneous nerve does not pass through the muscle.

bon. It was noticed that the course of musculocutaneous nerve has greatly affected the morphology of the muscle. In cases where the nerve was not piercing the muscle, it was formed of a single head. On the basis of the attachment of the retained part of the muscle, it corresponds to the superficial head of the coracobrachialis muscle. This could be an indication that this part of the muscle is the main part from the functional aspect. The possible effect of this unusual course of the musculocutaneous nerve on the morphology of the coracobrachialis muscle could not be denied.

Other morphological variations, including splitting of the deep head of origin and additional insertions of the muscle, were also reported in the present work. These variations could be explained in terms of comparative anatomy. During the changes in locomotion pattern from reptiles to mammals, the adductor shoulder muscles became greatly reduced into the coracobrachialis muscle [19, 23]. Sonntag [21, 22] and Howell & Straus [8] found that the coracobrachialis muscle in some animals has three heads; brevis (profundus), medius and longus (superficialis). Some mammals, such as apes [10, 20] and prosimians [11], were reported to have coracobrachialis muscles composed of two muscular heads. In man two heads have fused, trapping the musculocutaneous nerve between them, while the third head has become suppressed [14]. The identification of two heads of coracobrachialis in the present study, with variable degree of development, could be attributed to the variable degrees of fusion of its ancestral two heads.

The results of the present report showed a case with variable insertion of fibres from the superficial head of the muscle. The fibres formed an aponeurosis, which passed in front of the median nerve and brachial artery to be attached to the deep fascia of the arm. This is reminiscent of the bicipital aponeurosis, although at a higher level, giving the possibility that it is a detached part of the biceps brachii muscle. The most probable explanation is that this additional extension might represent a variable remnant of the long head of the ancestral coracobrachialis, in support of the suggestion proposed by Sonntag [21, 22]. The clinical implication of this anomaly is that it has the potential to cause median nerve entrapment and brachial artery compression. Although we could not detect similar cases described in the available literature, other muscular abnormalities were described, which may lead to a comparable arrangement and injury. Dharap [3] found an anomalous muscle that passed from the middle of the humerus obliquely across the front of the brachial artery and median nerve to blend with the common origin of the forearm flexor muscles, giving symptoms of high median nerve palsy together with symptoms of brachial artery compression. Nakatani et al. [17] described a rare anomaly, where the median nerve and the brachial artery passed through a tunnel formed by a third head of biceps brachii, where the nerve and artery seemed to be compressed. The existence of abnormal insertion of the coracobrachialis muscle should be kept in mind in a patient presenting with high median nerve palsy together with symptoms of brachial artery compression.

We reported a case with a very short course of musculocutaneous nerve after which it was connected with the median nerve. The nerve in this case was not piercing the coracobrachialis muscle. Nakatani et al. [15] and Gümüsalan et al. [6] reported cases, where the musculocutaneous nerve, the lateral cord of the brachial plexus, and the median nerve were contained in a common sheath of connective tissue. After they removed the common sheath, the musculocutaneous and median nerves were found completely separate. In the reported case, however, the musculocutaneous nerve was separable from the median nerve along a very short distance. An interesting finding is that all the branches of distribution of the musculocutaneous nerve arise from this part. Various authors reported communicating branches between the musculocutaneous and median nerves at different levels. Venieratos & Anagnostopoulou [24] found that communications between the musculocutaneous and median nerves could be proximal or distal to the entrance of the musculocutaneous nerve into coracobrachialis. Kosugi et al. [13] found that the presence of a supernumerary head of biceps brachii was associated with the presence of communicating branch between the musculocutaneous nerve and the median nerve in 57.3% of cases. Iwamoto et al. [9] found that the communicating branch between the median and the musculocutaneous nerve, consisted of fibres arising from C5 and C6. In an attempt to explain these variations, Kosugi et al. [13] supposed that if anything went wrong in one of the stages of differentiation of the muscles of the arm, the branching pattern and the course of the musculocutaneous nerve would be affected by anomalous differentiation.

It is concluded that this investigation supplies evidence of the double heads of origin for the coracobrachialis muscle. The two origins form two separable bellies, which fuse variably with each other. The presence of additional slips of insertion further supports the idea that the coracobrachialis muscle is a complex muscle. The complex formation of the muscle probably reflects the variability of the development of the musculocutaneous nerve and its inducing effect for the development of the coracobrachialis muscle.

ACKNOWLEDGEMENT

The author is grateful to Professor Mohamed S. Hamed for his critical review of the manuscript and to Dr Humayun Alvi for his excellent photographic effort.

REFERENCES

1. Bassett RW, Browne AO, Morrey BF, An KN (1990) Glenohumeral muscle force and moment mechanics in a position of shoulder instability. J Biomech, 23: 405–415.
2. Böhnel P (1979) Variant of the coracobrachialis muscle. Handchirurgie, 11: 119–120.
3. Dharap AS (1994) An anomalous muscle in the distal half of the arm. Surg Radiol Anat, 16: 97–99.
4. Eglseder WA Jr, Goldman M (1997) Anatomic variations of the musculocutaneous nerve in the arm. Am J Orthop, 26: 777–780.
5. Flatow EL, Bigliani LU, April EW (1989) An anatomic study of the musculocutaneous nerve and its relationship to the coracoid process. Clin Orthop, 244: 166–171.
6. Gümüsalan Y, Yazar F, Ozan H (1998) Variant innervation of the coracobrachialis muscle and unusual course of the musculocutaneous nerve in man. Acta Anat Nippon, 73: 269–272.
7. Hobar PC, Rohrich RJ, Mickel TJ (1990) The coracobrachialis muscle flap for coverage of exposed axillary vessels: a salvage procedure. Plast Reconstr Surg, 85: 801–804.
8. Howell AB, Straus Jr WL (1932) The brachial flexor muscles in primates. Proc US Nat Museum, 80: 1–30.
9. Iwamoto S, Kimura K, Takahashi Y, Konishi M (1990) Some aspects of the communicating branch between the musculocutaneous and median nerves in man. Okajimas Folia Anat Jpn, 67: 47–52.
10. Kohlbrügge JHF (1897) Muskeln und Periphere Nerven der Primaten. Verhandelingen der Koninklijke Akademie van Wetenschappen to Amsterdam, section 2, 6: 1–246.
11. Koizumi M (1989) A morphological study on the coracobrachialis muscle. Acta Anat Nippon, 64: 18–35.
12. Koizumi M, Sakai T (1995) The nerve supply to coracobrachialis in apes. J Anat, 186: 395–403.
13. Kosugi K, Shibata S, Yamashita H (1992) Supernumerary head of biceps brachii and branching pattern of the musculocutaneus nerve in Japanese. Surg Radiol Anat, 14: 175–185.
14. McMinn RMH (1990) Last's Anatomy, Regional and Applied. 8th ed., Edinburgh: Churchill Livingstone, pp. 79.
15. Nakatani T, Mizukami S, Tanaka S (1997a) Three cases of the musculocutaneous nerve not perforating the coracobrachialis muscle. Acta Anat Nippon, 72: 191–194.
16. Nakatani T, Tanaka S, Mizukami S (1997b) Absence of the musculocutaneous nerve with innervation of coracobrachialis, biceps brachii, brachialis and the lateral border of the forearm by branches from the lateral cord of the brachial plexus. J Anat, 191: 459–460.
17. Nakatani T, Tanaka S, Mizukami S (1998) 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, 11: 209–212.
18. Parry SW, Ward JW, Mathes SJ (1988) Vascular anatomy of the upper extremity muscles. Plast Reconstr Surg 81: 358–365.

19. Romer AS, Parsons TS (1977) The Vertebrate Body, 5th ed. Philadelphia: W.B. Saunders.
20. Sommer A (1907) Das Muskelsystem des Gorilla. Jenaische Zeitschrift fur Naturwissenschaft, 42: 181–308.
21. Sonntag CF (1923) On the anatomy, physiology and pathology of the chimpanzee. Proc Zool Soc, 23: 323–429.
22. Sonntag CF (1924) On the anatomy, physiology and pathology of the orangoutang. Proc Zool Soc, 24: 349–449.
23. Strack D (1979) Vergleichende Anatomie der Wirbeltiere, Bd 2. Berlin: Springer.
24. Venieratos D, Anagnostopoulou S (1998) Classification of communications between the musculocutaneous and median nerves. Clin Anat, 11: 327–331.
25. Williams PL, Warwick R, Dyson M, Bannister LH (1989) Gray's Anatomy, 37th ed., Edinburgh: Churchill Livingstone, pp. 614–615.