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Variations in Coracobrachialis Muscle of Arm – A Study in Adult Human Cadavers

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KEYWORDS

Muscular anomalies, Coracobrachialis, Musculocutaneous nerve, Median nerve

ABSTRACT:

Introduction: Anomalies of muscles of arm have been frequently reported in literature. These are important with regard to surgical approaches and orthopaedic procedures. Coracobrachialis, a muscle of the anterior compartment of arm, also exhibits numerous variations that can pose challenges during radiological diagnosis and surgeries of upper arm and hence requires evaluation regarding these variations and their incidence.

Objectives: This study aims to document and evaluate the variations of coracobrachialis muscle of arm along with its nerve supply in human cadavers and discuss its clinical and phylogenetic significance.

Methods: The study was conducted on 60 upper limbs belonging to 28 male and 2 female adult human cadavers using standard dissection methods and variations of coracobrachialis muscle and its nerve supply were specifically looked for.

Results: Two limbs showed variation in origin and 20 limbs in insertion of the coracobrachialis muscle and these variations were examined and reported in detail. Nerve supply of the muscle also showed variations in eight limbs which was further evaluated in detail.

Conclusion: Variations of coracobrachialis muscle do occur, especially in its insertion, and their knowledge is essential as these can confuse surgeons/orthopaedicians during surgeries and pose challenges in evaluating CT and MRI scans of the arm.

1. Introduction

Coracobrachialis, a muscle of the anterior compartment of arm originates from the tip of coracoid process of scapula in common with the tendon of the short head of biceps brachii, and by muscular fibers from the proximal 10 cm of this tendon. It inserts on an impression, 3-5 cm in length, along the medial border of the humeral shaft midway between the attachments of the triceps and brachialis [1,2]. The insertion often extends above this also into an aponeurotic band that extends from the tendon along the medial margin of the humerus, arches over the tendons of the latissimus dorsi and teres major, and is attached to the lesser tubercle of the humerus [3]. Some fibers may continue into the medial intermuscular septum also [4]. Occasionally, a fibrous band known as the ligament of Struther's may also be present. It runs from the supratrochlear spur, which projects down from the anteromedial aspect of the lower humerus, to the medial epicondyle of the humerus. Abnormally low fibers of coracobrachialis, known as the third head may insert into this band [5].

Many variations in the form and origin of coracobrachialis have been reported [6-8]. Wood described the muscle termed as coracocapsularis arising from coracoid process and inserting into the shoulder capsule [9]. Three different types of coracobrachialis have been described in the literature – coracobrachialis brevis, coracobrachialis medius and coracobrachialis longus. Coracobrachialis brevis originates from coracoid process and inserts onto the proximal humerus at the level of surgical neck [10-12], into the crest of lesser tubercle or intertubercular groove and articular capsule

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of shoulder joint [6, 13]. Coracobrachialis medius inserts into humeral diaphysis and Coracobrachialis longus extends till the medial epicondyle of humerus [10, 11] or medial supracondylar ridge [10]. The nerve supply of coracobrachialis also exhibits numerous variations. In the present study, origin, insertion and nerve supply of coracobrachialis, and their clinical and phylogenetic significance is discussed.

2. Methods

Material for the present study comprised of 60 upper limbs belonging to 30 embalmed adult human cadavers (male:female::28:2). The cadavers were labelled from 1 to 30 with suffix R or L for Right or Left extremity and M or F for Male or Female sex respectively. These were dissected as per standard methods to expose origin, insertion and nerve supply of coracobrachialis. Any variation was specifically looked for.

3. Results

In all limbs, the origin of coracobrachialis was normal except in two (3.3%) where an additional tendinous slip of origin was seen. In one limb this tendinous slip arose from anatomical neck of humerus [Fig. 1] and in the other from the lesser tubercle [Fig. 2]. Both these limbs belonged to different cadavers. The insertion of coracobrachialis in two-thirds of the limbs was normal and in remaining one-third i.e. 20 limbs (33.3%), as the superficial part of the muscle extended distally it became tendinous and extended till the medial epicondyle. This tendinous superficial part of the muscle blended with the medial head of triceps and brachialis muscle [Fig. 3]. The deeper part of the muscle inserted normally into the middle of the medial border of humerus. This was seen bilaterally in ten male cadavers. Further, out of the 60 limbs studied, in 55 coracobrachialis was supplied by a branch from the musculocutaneous nerve with three limbs (5%) showing an additional twig from the lateral cord of brachial plexus. In remaining five limbs (8.3%) musculocutaneous nerve was absent and the muscle was supplied by the median nerve in four limbs (6.7%) and a branch from lateral cord of brachial plexus in one limb (1.7%) [Fig. 4].

4. Discussion

Wood and Kyou-Jouffroy et al. described three varieties of coracobrachialis [10,11]. Out of these the coracobrachialis longus might be attached to humerus, to a fibrous band of the medial intermuscular septum (ligament of Struther's) or to medial epicondyle or into the tendinous part of latissimus dorsii [9,10,14]. Extension of coracobrachialis till the medial epicondyle and its blending of the tendon of insertion with medial head of triceps and/or brachialis has been encountered earlier by Wood, Anson, Williams et al. and Kopuz et al. but none has made a mention of its incidence [2,3,9,15].

Further, Kopuz et al. while dissecting a neonate male cadaver found an anomalous muscle mimicking cocacobrachialis longus. It originated separately from the coracoid process and capsule of the shoulder joint, passed superficial to the normal coracobrachialis and then formed a muscle belly in the upper one third of arm. It inserted into the deep fascia of arm and medial epicondyle of humerus. Normal coracobrachialis showed no abnormality. This was named as musculus coracobrachialis accessories [15].

As far as the nerve supply is concerned, the additional twigs from lateral cord of brachial plexus supplying the coracobrachialis have been described earlier by Kerr and Flatow et al [16,17]. Also isolated cases of absence of musculocutaneous nerve with coracobrachialis being innervated by a branch from median nerve have been reported in the past by Moore, Sud and Sharma and Rao and Chaudhary [18-20]. On the other hand, Le Minor, Nakatani et al, Gumusburun and Adiguzel and Rao and Chaudhary have encountered the absence of musculocutaneous nerve with coracobrachialis supplied by a branch from lateral cord [20-23].

Cihak described four fundamental phases in the ontogenesis of muscle pattern. The anomalous head of coracobrachialis could have arisen during phase three when muscle primordia from different layers fuse to form a single muscle [24]. According to Grim some of these muscle primordia usually disappear through cell death despite the fact that cells within them have differentiated to the point of containing myofilaments. Persistence of some cells between biceps and brachialis muscles account for such anomalous heads of coracobrachialis [25].

Absence of musculocutaneous nerve with coracobrachialis being supplied by median nerve is aptly explained by Iwata according to whom brachial plexus appears as a single radicular cone in the upper limb, which divides into ventral and dorsal segments. The

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ventral segment gives roots to the median and ulnar nerves. The musculocutaneous nerve arises from the median nerve and the cases that show such variations with median nerve taking over the area of musculocutaneous nerve not only confirm the primitive common embryological origin of these two nerves, but also that a failure of origin of musculocutaneous nerve may be blamed for such a variation [26].

Piersol pointed out that in most of the species, which use the upper extremity in a prehensile capacity, the coracobrachialis has three components: the longus, the medius and the brevis [27]. Earlier, Wood had shown that while the longus or inferior component is particularly conspicuous in porcupine and squirrels; the brevis component is the only representative in cat, dog, bat and moles; and a double muscle representing short and long portions is seen in marmot, beaver and hamster [10].

As we further ascend in phylogeny, all the three components are seen in Gibbon and Gorrilla, though in the latter, longus and brevis are rudimentary. In Chimpanzee and Orang, coracobrachialis medius and longus are both present. In man, the coracobrachialis longus becomes shorter and its insertion rises higher on humerus until it fuses with medius resulting in a single muscle perforated by musculocutaneous nerve [28].

In the light of different stages of phylogeny (vide supra) the extension of coracobrachialis upto medial epicondyle of humerus seems to be a persistent longus component of the muscle normally seen in porcupine, squirrels, chimpanzee and orang.

Wood had also equated the three components of coracobrachialis to adductor group of thigh muscles; viz coracobrachialis brevis being homologous to adductor brevis, coracobrachialis medius to adductor longus and coracobrachialis longus to adductor magnus. Accordingly, the variation seen in the present study that has been concluded to be a persistent longus component can be equated with adductor magnus of thigh [29].

In lower vertebrates of Artiodactyla and Perissodactyla (amphibians, reptiles and birds) there is only one nerve i.e. median nerve supplying muscles of upper arm and independent musculocutaneous nerve is absent [30,31]. So, it may be explained as persistence of this normal condition of lower vertebrates in humans.

Wood was of the opinion that the animals which use forearm for distinct prehension, digging, swimming or climbing, have as a rule, a larger and more highly developed coracobrachialis muscular apparatus [29]. From this whether we can assume that the humans with a well-developed coracobrachialis muscular apparatus may be good at climbing or swimming is still open to question. In addition, coracobrachialis longus may enhance flexion of shoulder joint in subjects possessing it.

Coracobrachialis is used in repair of infraclavicular defects, especially in reconstructive surgery after mastectomy. Acute and chronic acromioclavicular dislocations have been treated by surgical transfer of the distal 1cm of the coracoid process with the attached conjoined tendon of coracobrachialis and short head of biceps brachii to the clavicle [32]. Additionally, Woodworth and Katz reported that coracobrachialis could be used as a guide to the axillary artery [33]. Hence it is important to recognize the variations of coracobrachialis muscle, whenever present, to avoid confusion during surgical procedures. Further, when musculocutaneous nerve is absent and median nerve supplies the muscles of anterior compartment of arm, injury to median nerve in the axilla would result in paralysis of coracobrachialis, biceps brachii and medial part of brachialis leading to weakness of flexion and supination at elbow. This may confuse the orthopaedician to locate the site of injury if he is not familiar with such variation.

Well-developed anatomic variations of the coracobrachialis muscle may also be confused with other muscles and pathologic conditions on CT and MRI scans of the arm. These variations had quite a significant incidence towards the insertion of the muscle. Hence surgeons and radiologists should be particularly aware of these anomalies while evaluating the lower arm.

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Fig. 1 Two origins of coracobrachialis (CB), one normal from short head (SH) of biceps brachii, other tendinous (T) from anatomical neck (AN) of humerus. Both joining to have a common insertion

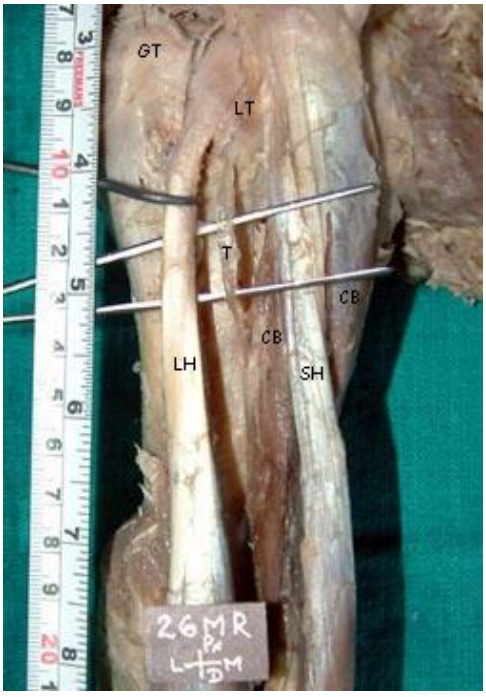

Fig.2 Additional tendinous slip (T) of origin of coracobrachialis (CB) arising from lesser tubercle (LT) of humerus [LH and SH – long and short heads of biceps brachii; GT – greater tubercle]

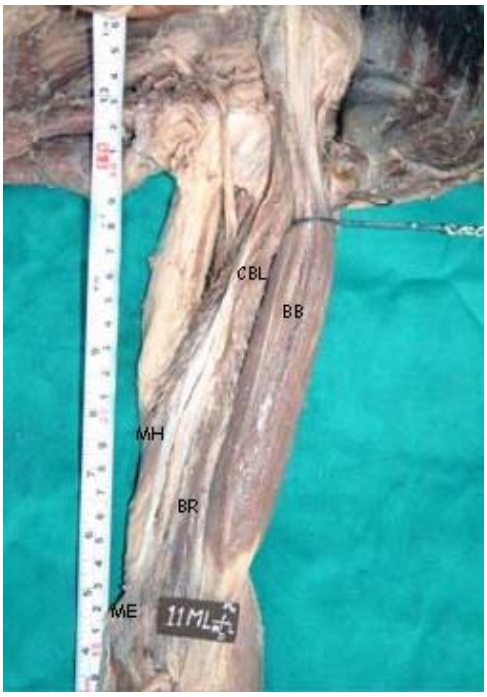

Fig. 3 Coracobrachialis longus (CBL) fused with medial head (MH) of triceps and brachialis (BR), and extending till medial epicondyle (ME) [BB – biceps brachii]

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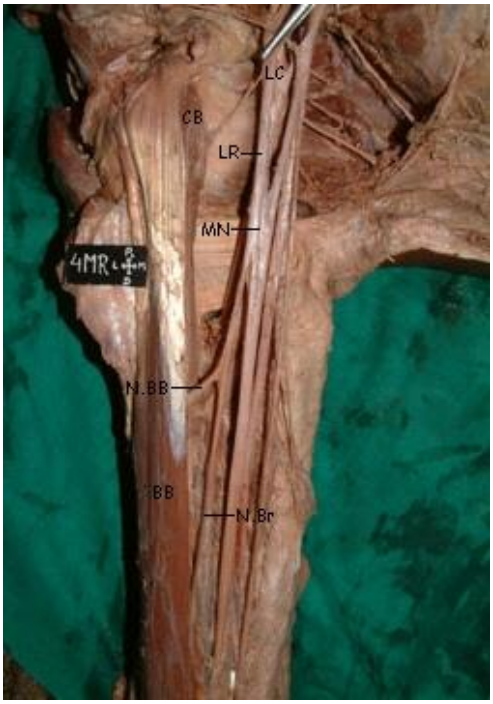

Fig. 4 Lateral cord (LC) supplying coracobrachialis (CB) and continuing as lateral root (LR) of median nerve (MN). Median nerve supplying biceps brachii (N.BB) and brachialis (N.Br.) with absent musculocutaneous nerve