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Case Report

Langer's Axillary Arch – Case Presentation and Literature Overview

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Abstract

Langer's axillary arch is an important anatomical variant of the shoulder region, connecting the latissimus dorsi and the pectoralis major muscles. Due to its frequency, clinicians should be aware of this variant as misidentifications could lead to severe complications in patient treatment.

The presented axillary arch was identified in a 67 years old specimen. Its innervation by the lateral pectoral nerve and blood supply by the subscapular artery could be preserved.

In conclusion, this case report and literature overview point out a clinical important anatomical variant, Langer's axillary arch. Its misidentification can lead to wrong diagnoses and massive surgical complications, which could easily be avoided by intimate anatomical knowledge of the axillar region and its most frequent variants.

Keywords: Langer's axillary arch; Anatomical variant; Shoulder region; Lateral pectoral nerve; Subscapular artery; Latissimus dorsi muscle; Pectoralis major muscle

Introduction

Langer's axillary arch is an important anatomical variant of the shoulder region, connecting the latissimus dorsi muscle and the pectoralis major muscle. With a frequency of 7-8 % [1-9] it is a variant seen often in this region. However, this frequency range is depending on the population. Numbers can be found in literature between 1.7% in the Turkish population [10] and 43.8% in the Chinese population [11]. Cases of this anatomical variant reported during surgery are even less frequent [12] ranging from 0.25% to 4.3% [8, 13-15].

The history of the axillary arch is already a long one. First described in 1783 by Bugnone [16] and in 1793 by Ramsay [5,17], this variant became of greater interest after the account of Langer in 1846 [18,19]. Nevertheless one should mention, that Bugnone [16] and Ramsay [5,17] both described a muscular variation, and that Langer [18,19] mentions a fibrous arch without any muscular fibres. However, nowadays "Langer's axillary arch", as mentioned first by Testut [20] and now known by this name throughout literature, is the term for any variant coursing between the latissimus dorsi muscle and the pectoralis major muscle.

Jelev [21] summarized the three main characteristics of a typical axillary arch in his literature review:

- The axillary arch has a constant origin from the latissimus dorsi muscle.
- The axillary arch inserts into structures around the anterosuperior part of the humerus.
- The axillary arch crosses the axillar neurovascular bundle from dorsomedial to ventrolateral.

The aim of this report was, to show the high variability of this anatomical variant, to emphasise the importance of its correct identification and to summarize existing literature on muscular variants in this shoulder by an example of a muscular axillary arch found during dissection.

Case Presentation

During the dissection course for our medical students at the anatomical institute of the medical university, this variant was observed in a 67 years old male specimen. The specimen was previously prepared for dissection by perfusion with a formol-phenol-solution.

The muscular slip of the axillary arch was identified in a right shoulder, running from the latissimus dorsi muscle towards the insertion of the pectoralis major muscle at the crest of the greater tubercle of the humerus. There it inserted distally to the insertion of the pectoralis major muscle directly into the humerus (Figure 1).

The axillary arch originated from the latissimus dorsi muscle via a tendinous intersection (Figure 2), no continuous muscle fibres from the latissimus dorsi muscle into the axillary arch were observed.

Innervation of this muscular slip was provided by the lateral pectoral nerve. Also the separated vascularization of the axillary arch was preserved, originating from the subscapular artery (Figure 2).

Discussion

Discussing Langer's axillary arch, one has first to recapitulate the muscular anatomy of the shoulder region and get an impression of all the possible muscular variants in this region. The muscle mass of the shoulder built of three groups, the scapulohumeral group (supraspinatus, infraspinatus, teres minor, subscapularis, deltoideus), the axiohumeral group (pectoralis major, latissimus dorsi, pectoralis minor) and the axioscapular group (serratus anterior, rhomboideus major and minor, levator scapulae, trapezius) [22]. Biceps brachii, tricpes brachii, brachialis and coracobrachialis complete this enumeration.

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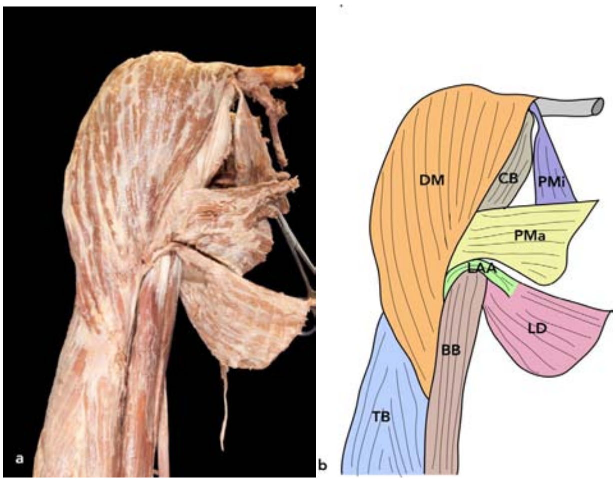

Figure 1: (a) photograph of the right shoulder of the specimen, (b) sketch of the same specimen showing the localization of Langer's axillary arch (LAA) and the surrounding muscles: pectoralis major muscle (PMa), latissimus dorsi muscle (LD), pectoralis minor muscle (PMi), coracobrachialis muscle (CB), biceps brachii muscle (BB), triceps brachii muscle (TB), deltoideus muscle (DM).

In all those muscles, anatomical variants have been described in literature and should be mentioned in short in the following paragraphs.

Variations described for the biceps brachii muscle only affect the proximal origin of the muscle. It can show different numbers of heads, those arising from different parts of the scapula, the humerus or the soft tissue of the upper arm and shoulder. There are no variations described at the insertion site at the radial tuberositas described [1,23,5,6,24].

For the brachialis muscle, there are variations mentioned concerning the complete division into two bellies by the biceps brachialis or a fibrous arcade between radius and ulna and different insertion sites at the forearm or its total absence [1,5,24].

Similar to the biceps brachii muscle, the triceps brachii muscle also shows a frequent variation of its heads - usually an additional one originating from the scapula, the coracoid process, the glenoid capsule or the humerus - or connections with muscles in the vicinity of its origin, for example the subscapularis muscle or the latissimus dorsi muscle. The most frequent variation (m. epitrochleo-olecraneum sive epitrochleoanconeus) with 25 % of dissected bodies described by Bergman and 26,5 to 34 % of dissected body's described by Le Double is a musculotendinous arch crossing from the medial epicondyle over the ulnar nerve towards the olecranon process [1,5,25-27].

The deltoid muscle is overall featured as a reliable structure with very few variations. Exceptions are the total separation of the muscular part of the deltoid muscle or their absence [24]. Only Le Double, Rauber-Kopsch and Bergman describe interconnections with the pectoralis major, the trapezius the infraspinatus, the latissimus dorsi, the brachioradialis and the brachialis muscles. The fascicle towards the brachialis muscle can present itself crossing the biceps brachii muscle to its medial side and traversing the neurovascular bundle to insert near the medial epicondyle [1,28,5].

The major variations of the coracobrachialis muscle are the

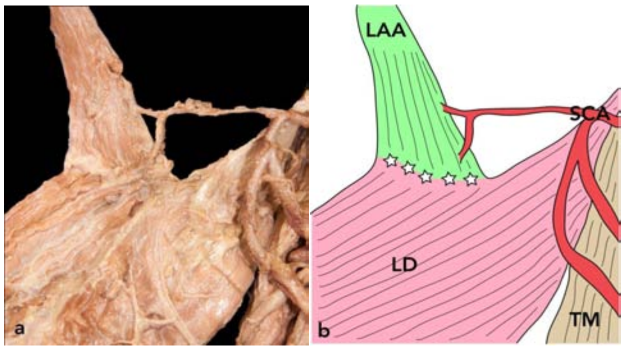

Figure 2: (a) photograph of the origin of Langer's axillary arch, (b) sketch of the same section showing the attachment of Langer's axillary arch (LAA) through the tendinous intersection (stars) at the latissimus dorsi muscle. Blood supply was derived from the subscapular artery (SCA). Teres major muscle (TM).

possible formation of a muscle with a more distal (m. coracobrachialis longus) or proximal (m. coracobrachialis brevis) insertion. The insertion of the coracobrachialis brevis muscle reaches only the humeral capsule of the shoulder or its vicinity [1,29,24,30]. The insertion of the coracobrachialis longus muscle can get as far as the medial epicondyle of the humerus [1,29,5].

The pectoralis major muscle - apart from variations of his origin - can give off a musculotendinous bundle towards the brachial fascia, the joint capsule of the shoulder, the coracobrachial muscle and the latissimus dorsi muscle (Langer's axillar arch) [23,29,6,31,24]. A strand from the insertion of the pectoralis major muscle to the medial intermuscular septum of the arm is called chondrofascial muscle of Macallister and a strand arising from one or more ribs inserting into the medial intermuscular septum or the medial epicondyle of the humerus is named costo-epitrochlearis, chondro-epitrochlearis or chondro-humeralis muscle and described by Le Double in 12 to 20 % of the dissected bodies [1,29,5,31]. This muscle fascicle, passing the inferior margin of the pectoralis major, has to cross the large nerves and vessels at the medial border of the biceps brachii to get to the medial epicondyle [32,33]. Although the high incidence stated by Le Double this should be regarded rather critically - many authors doubt this high number of cases considering the few documentations in literature [32]. Natsis et al. [34] for example didn't find this variation at all in a study of 107 anatomic specimens. The descriptions of Wood [25,26,35,36,37,38,30] are a perfect example for the high incidence described by Le Double, considering that according to him every epigastric slip running in direction of the arm equalized the chondro-epitrochlearis of apes and monkeys and was therefore added to the list [39].

Apart from variations of its origin, the latissimus dorsi frequently has an additional origin at the inferior angle of the scapula. In conjunction with the pectoralis major, it forms Langer's axillary arch. In 5 % of dissected body's an additional musculotendinous strand towards the medial epicondyle can be found - the dorsoepitrochlearis, anconeus longus or latissimus condylaris muscle [1,23,29,5,24,37].

Throughout literature, the described muscular variant running from the latissimus dorsi muscle towards the pectoralis major muscle is known by several names: arcus axillaris [40,10,41], Achselbogen [2,23,42-47], axillary arch [48-52,9], arc axillaire [5,20,53].

As described previously, the typical axillary arch shows three characteristics (constant origin from the latissimus dorsi muscle, insertion into structures around the anterosuperior part of the humerus, crossing over the axillar neurovascular bundle from dorsomedial to ventrolateral) [21].

There exists however some difference in the characterization of the axillary arch. The primary description of this variant by Bugnone [16] and Ramsay [5,17] was a muscular one. In contrast, Langer [18,19] described a fibrous or fascial variant. This Eisler [2] took into consideration and made the following differentiation: A fascial axillary arch was defined as a fascial thickening of the medial border of the axillar fascia coursing between the pectoralis major muscle and the latissimus dorsi muscle. A muscular axillary was further subdivided into a latissimus axillary arch and a pectoralis axillary arch, depending on the course of the muscular fibres and their attachments.

There are several forms of origins of the axillary arch described in literature: direct continuation of the muscular fibres of the latissimus dorsi muscle [7,12,54-60], origin at the latissimus dorsi tendon [54,61,62,56,51,7,45,59], a combination of direct muscular fibres of the latissimus dorsi muscle and small tendinous intersections of the arch [54,62,46,59]. Looking at the case presented in this study, the axillary arch showed a clear origin solely by tendinous intersection from the muscular bulk of the latissimus dorsi muscle.

The possible locations of the insertions of the axillary arch are even more numerous: attached to the deep surface of the tendon of the pectoralis major muscle [63,54,62,7,57,46,41,24], to the pectoralis major itself [60], to the fascia of the coracobrachialis muscle [1,54,10,7,52], to the fascia covering the biceps brachii muscle [41,58,27], to the long head of the biceps brachii muscle [1], to the coracoid process [1,2,57,20,64,24,26], to the pectoralis minor muscle [1,5] and to the axillary fascia [1,18,19,5]. In described case, the muscular slip inserted distally to the insertion of the pectoralis major muscle at the crest of the greater tubercle of the humerus directly to the bone (Figure 1). This was also not described up to now in existing literature.

The innervation of the axillary arch is also quite variable and mainly based on the following three nerves: the lateral pectoral nerve [65,42,14,66,67,46,68,69,47], the medial pectoral nerve [56,14,7,66,68,69,70,71], the thoracodorsal nerve [72,10,7,57,70,73,59,60]. In the presented case the innervation of the axillary arch was derived from the lateral pectoral nerve.

There is however confusion, which nerve most frequently innervates the axillary arch whether it is the lateral pectoral nerve [74,65,73,42,46], the medial pectoral nerve [55,74,71] or the thoracodorsal nerve [77].

But this innervation could give some clue as to the embryological origin of the axillary arch [42,5,31,78] whether it originates from an incomplete dorsoepitrochlearis muscle, or it is a homologue of the pectoralis quartus muscle, or a remnant of panniculus carnosus, or a remnant of the superficial common layer of the latissimus dorsi muscle and the pectoralis major muscle are the hypotheses mentioned in literature. Especially the last theory seems interesting as Hollinshead and Wilson propose to identify the embryological origin of this variant based on the respective innervation: coming from the pectoral nerves it is probably derived from the pectoralis major muscle [71], coming from the thoracodorsal nerve it is probably originating from the latissimus dorsi muscle [72]. On the other side, one has also to report on the work of Shinohara [79,80, who strictly refutes such line of hypothesis of muscle origins and rather links the development of a muscle and its nerve to differential expression of genes by their positions on the anterior-posterior axis. He also argues that the migration patterns of a muscle and its corresponding nerve are not due to their respective origin but rather are regulated by the gene encoding of the nerve cells, the myogenic cells and the surrounding tissue. Reading the mentioned hypotheses, it is clear that the last word on muscle and motoric nerve development is not yet spoken and needs further research in the future.

Concerning the blood supply, there are only two patterns described hitherto–derived from the lateral thoracic vessels [62] and, as in our case, coming from the subscapular artery [81].

Knowledge of this particular variant is especially important in clinical practice and could lead to several complications in patient treatment. Looking at lymph nodes, the muscular bulk of the axillary arch could possibly be mistaken for a tumor [50,69], or the palpation of the lymph nodes could be made more difficult [74,3,82]. Also in imaging procedures, these lymph nodes could be obscured by the muscle [74,74,82]. But also some axillar structures could be entrapped, leading to the impingement of the brachial plexus, to a hyperabduction syndrome [7,20], to a costoclavicular compression syndrome and to axillary vein entrapment [83,84,68]. But also in axillary surgery [69] or in breast reconstruction using a latissimus dorsi musculocutaneous flap this anatomical variant could lead to complications due to its close relationship to the neurovascular structures of the axilla [81,85].

Due to these possible complications, correct identification of Langer's axillary arch is very important in clinical practice. In patients with blue discolorations of the arm and complaining of swelling in the axilla starting especially when physically active (e.g. swimmers) this muscular variant should be kept in mind [77,68]. The symptoms should disappear in adduction, as the arch becomes taut in shoulder abduction and elevation with concomitant compression of the axillary neurovascular bundle [83,61,68].

Sometimes this muscle mass is more visible than palpable [68], but mostly one sees a visible axillar fullness [15] and the muscle should be always better palpable in shoulder abduction and can be absent in adduction [61,12,3,77,86,69,15,87]. Also the use of several imaging techniques like echography, mammography, computed tomography and magnetic resonance imaging have been described in literature [83,61,3,88], but here also the axillary arch seems to be almost only visible in abduction and could be easily missed nowadays by the adducted position of the patients during the respective imaging procedure.

Especially when Langer's axillary arch develops a contracture, the patients complain of severe difficulties in elevating or even moving their arms. But in all symptomatic cases, transection of this muscular slip cures the problem [48, 68,62].

Conclusion

In conclusion, this case presentation and literature overview point out a clinical important anatomical variant, Langer's axillary arch. Its misidentification can lead to wrong diagnoses and massive surgical complications, which could easily be avoided by intimate anatomical knowledge of the axillar region and its most frequent anatomical variants.

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