ANATOMICAL STUDY OF THE MUSCULOCUTANEOUS NERVE IN RELATION TO THE CORACOID PROCESS

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ABSTRACT

Objective: The authors performed an anatomical study on the path of the musculocutaneous nerve by dissecting 20 shoulders from 10 fresh adult cadavers. Method: The distance from the lower edge of the coracoid process to the point of penetration of the most proximal branch of the musculocutaneous nerve in the coracobrachialis muscle was measured and named the base. Starting from the inferomedial edge of the coracoid process, a second measurement was made to the point at which the lateral fascicle of the brachial plexus crossed the subclavius muscle, and was named the height. The third measurement was of the triangular area formed by the two first measurements, and was named the area. Results: The mean base length was 3.42 cm, ranging from 2.38 cm to 4.40 cm. The mean height measurement was 2.74 cm, ranging from 1.03 cm to 3.80 cm. The mean area was 4.92 cm², ranging from 1.22 cm² to 7.99 cm². Conclusion: These measurements are very important because of the risk of injury to the musculocutaneous nerve in surgical approaches to the shoulder.

Keywords – Musculocutaneous nerve/anatomy & histology; Musculocutaneous nerve/injuries; Shoulder/surgery

INTRODUCTION

The musculocutaneous nerve is one of the branches of the lateral fascicle of the brachial plexus. The fibers that form it come from the fifth and sixth cervical pairs, and some from the seventh. It starts its path behind the pectoralis minor muscle, above and laterally to the median nerve and axillary artery. It heads obliquely downwards and laterally, crosses above the tendon of the subscapularis muscle and then penetrates the coracobrachialis muscle. After exiting from this muscle, it runs between the biceps muscle (in front of it) and the brachialis muscle (behind it), crossing the anterior face of the upper arm diagonally to arrive at its lateral face between the brachioradialis muscle and the lower end of the biceps muscle. At the elbow, it goes through the superficial aponeurosis medially to the cephalic vein at the level of the joint interline, where it becomes subcutaneous and branches out across the lateral face of the forearm.

Along its path, the musculocutaneous nerve gives rise to two classes of branches: collateral and terminal. Collateral branches to the coracobrachialis, biceps and brachialis muscles, a branch to the diaphysis of the humerus, vascular branches and a joint branch to the anterior face of the elbow originate in the upper arm. The terminal branches appear when the musculocutaneous nerve becomes subcutaneous: one branch is posterior and the other is anterior. The posterior branch, goes more laterally and passes behind the cephalic vein to successively reach the external and posterior layers of the forearm and go down to the carpus, sending out branches to the skin. The anterior branch continues to head downwards in front of the cephalic vein, going forwards to the anterior face of the forearm and ending as small branches heading to the skin in the anterolateral region of the forearm.

Several surgical procedures on the shoulder involve mobilization or separation of the muscles that are...
inserted in the coracoid process. These operations include osteotomy and transfers of the coracoid process, subcoracoid loops and muscle transfers. Lesions of the musculocutaneous nerve as a complication of shoulder surgery were the motivation for us to carry out this anatomical study.\(^2\)\(^-\)\(^9\)

**METHOD**

Twenty shoulders from ten fresh cadavers were dissected by means of a 15-cm deltopectoral route. After dissecting the skin and the subcutaneous cellular tissue, the pectoralis major muscle was deinserted in order to achieve better exposure of the coracobrachialis and pectoralis minor muscles (Figure 1). The pectoralis minor muscle was then deinserted from the coracoid process in order to view the musculocutaneous nerve and the point at which it penetrates the coracobrachialis muscle (Figure 2).

All the cadavers were males, with ages ranging from 43 to 79 years (mean of 57 years). The height, weight, skin color and race of each cadaver were not taken into account. None of the cadavers presented physical deficiencies or scars on the shoulders studied.

Two measurements were made, taking the coracoid process as a reference point:

1) The distance from the lower edge of the coracoid process to the point of penetration of the most proximal branch of the musculocutaneous nerve in the coracobrachialis muscle (independent of whether this branch was the principal or the accessory branch). This distance was named the base.

2) The distance from the inferomedial edge of the coracoid process to the point at which the lateral fascicle crossed the lower edge of the subclavius muscle. This distance was named the height.

From these two measurements, mathematical calculations were made to determine the triangular area that was created by adding another, imaginary line to join the two points (Figure 3).

The two measurements were made in centimeters and the triangular area was calculated in square centimeters.

**RESULTS**

The results obtained and the statistical analyses are described in Tables 1 and 2.

**STATISTICAL ANALYSIS**

Firstly, all the variables were analyzed descriptively. For the quantitative variables, this analysis was performed through observations of the minimum and maximum values, and calculations of the means, standard deviations, medians and 95% confidence intervals.

To analyze the hypothesis that the measurements made on the right and left sides would be equal, the nonparametric Wilcoxon test was used.

The significance level used for the tests was 5%.

**BASE** – The distance from the lower edge of the coracoid process to the point of penetration of the most...
The anatomical relationships of the musculocutaneous nerve have been studied over recent years with the aim of avoiding injury during surgical procedures on the shoulder. Helfet, in 1958, was the first to recognize the existence of smaller branches of the musculocutaneous nerve that penetrate the coracobrachialis muscle proximally to the principal branch. This author observed that the musculocutaneous nerve was located more proximally in the coracobrachialis muscle, in relation to the coracoid process.

DISCUSSION

Table 1 – Summary of the measurements made, with the mean, standard deviation, median, minimum, maximum and confidence interval values for the base, height and area measurements on the 20 cadavers studied

|       | Base | Height | Area  |
|-------|------|--------|-------|
| Mean  | 3.42 | 2.75   | 4.92  |
| Standard deviation | 0.59 | 0.71   | 1.95  |
| Median | 3.47 | 2.85   | 5.30  |
| Minimum | 2.38 | 1.03   | 1.22  |
| Maximum | 4.30 | 3.80   | 7.99  |
| 95% confidence interval | LL 3.17 | 2.44 | 4.07 |
|         | UL 3.68 | 3.06 | 5.78 |

* 95% confidence interval for the study population; LL: lower limit of confidence interval; UL: upper limit of confidence interval.

Table 2 – Comparison between the sides measured for the base, height and area measurements

| Variable | Side | Mean  | SD   | Median | Minimum | Maximum | 95% CI* | p**  |
|----------|------|-------|------|--------|---------|---------|---------|------|
|          |      | LL    | UL   |        |         |         |         |      |
| Base     | Right| 3.25  | 0.56 | 3.12   | 2.38    | 4.30    | 2.90    | 3.59 | 0.721 |
|          | Left | 3.60  | 0.58 | 3.73   | 2.68    | 4.24    | 3.24    | 3.96 |        |
| Height   | Right| 2.58  | 0.76 | 2.54   | 1.03    | 3.53    | 2.11    | 3.05 | 0.333 |
|          | Left | 2.93  | 0.65 | 3.00   | 1.77    | 3.80    | 2.53    | 3.33 |        |
| Area     | Right| 4.35  | 1.89 | 3.97   | 1.22    | 7.52    | 3.18    | 5.53 | 0.508 |
|          | Left | 5.49  | 1.93 | 5.77   | 2.37    | 7.99    | 4.29    | 6.69 |        |

* CI: 95% confidence interval for the study population; LL: lower limit of confidence interval; UL: upper limit of confidence interval.

**: descriptive probability level of nonparametric Wilcoxon test

**Figure 3** – Triangular area. Coracoid process (small black arrow). Lateral fascicle (white arrow). Musculocutaneous nerve (narrow black arrow).
Klepps et al\(^{(10)}\) reported two cases of neuropraxia of the musculocutaneous nerve during procedures to transfer the pectoralis major muscle to the lesser tubercle, in cases of rupture of the tendon of the subscapularis muscle. There was spontaneous resolution in one of the cases, while the second case underwent exploration, which showed tensioning of the musculocutaneous nerve. This was resolved by modifying the technique for reinsertion of the pectoralis major muscle, thereby achieving relief of the nerve compression.

Flatow et al\(^{(6)}\) and Klepps et al\(^{(10)}\) studied the anatomical relationships of the musculocutaneous nerve and measured the distance from the coracoid process to the point of penetration of the musculocutaneous nerve in the coracobrachialis muscle. They highlighted the presence of small branches that penetrated the muscle more proximally than the main branch, and in some cases these were responsible for the complications encountered.

The principal branch of the musculocutaneous nerve penetrates the coracobrachialis muscle in 92% of the cases, with a mean distance from the coracoid process to the point of penetration of 5.6 cm. For the smaller branches, the mean distance has been found to be 3.1 cm\(^{(5)}\).

According to Klepps et al\(^{(10)}\), the principal branch penetrates at a distance of 6.1 cm from the coracoid process, while the smaller branches penetrate at a distance of 4.4 cm.

In our study, we did not take the principal branch into consideration for making the measurements. We measured the distance from the lower edge of the coracoid process to the point of penetration of the most proximal branch of the musculocutaneous nerve in the coracobrachialis muscle (base), which ranged from 2.38 to 4.30 cm, with a mean of 3.42 cm and a standard deviation of 0.59 cm. In the literature consulted, we did not find any studies that measured the area and the height. The mean height measurement was 2.75 cm, ranging from 1.03 to 3.80 cm and the mean area was 4.92 cm\(^{2}\), ranging from 1.22 to 7.99 cm\(^{2}\) (95% confidence interval for the study population). No difference was found between the right and left sides.

**CONCLUSION**

In relation to surgical approaches to the shoulder, the musculocutaneous nerve is located between 2.38 and 4.30 cm distally and 1.03 to 3.80 cm medially to the lower edge of the coracoid process. These measurements are important and should be respected during surgical approaches to this region, so that injury to the musculocutaneous nerve is avoided. We believe that the present study may help towards preventing injuries to the musculocutaneous nerve during surgical procedures.

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