Anatomical bases of medical, radiological and surgical techniques

Anatomical basis of modern thoracotomies: the latissimus dorsi and the «serratus anterior-rhomboideus» complex

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Summary. The latissimus dorsi and the «serratus anterior-rhomboideus» complex are the muscles most often involved in present-day thoracotomies for lung surgery. The present anatomic study emphasizes: the continuity between the serratus anterior and the rhomboideus levator scapulae mass as a wide muscular sheet with a deep common fascia, extending the serrato-thoracic space (of Gillis) to the vertebral column as the rhombo-serrato-thoracic space (the levator scapulae is situated higher up, above the ordinary thoracotomy); the presence of a “composite fascia” in the posterior angle between the serratus anterior and the rhomboideus; the long costal attachment area and the presence of two differently oriented layers for the muscular digitations of the middle and inferior parts of the serratus anterior. With a rich vascular supply from multiple sources, the serratus anterior and latissimus dorsi are two large flat muscles with a single longitudinal nervous pedicle proceeding from the brachial plexus. To avoid esthetic (winged scapula) and functional sequelae, it is imperative to safeguard this single innervation as far as possible: by halting the division of the serratus anterior before reaching its neurovascular pedicle in lateral or anterolateral thoracotomy, and by transecting the latissimus dorsi very low down in standard posterior-lateral thoracotomy. The other muscles are simply freed and retracted.

Le latissimus dorsi et le complex «serratus anterior-rhomboideus»

Résumé. Le grand dorsal (latissimus dorsi) et la nappe «grand dentelé plus rhomboïde» (serratus anterior, rhomboideus) sont les deux muscles-clés des thoracotomies courantes. La présente étude apporte quelques précisions anatomiques intéressantes au point de vue chirurgical : continuité entre le grand dentelé et le rhomboïde (l’angulaire de l’omoplate est trop haut situé pour nos thoracotomies) en une large nappe musculaire dotée d’une aponevrose profonde commune, étendant ainsi jusqu’à la colonne vertébrale le classique espace de Gillis qui devient l’espace rhombo-serrato-thoracique; la présence d’une «aponevrose composite» dans l’angle postéro-inférieur formé par le grand dentelé et le rhomboïde, occupant ainsi l’aire du triangle de la 8ª côte; longue surface d’insertion costale et présence de 2 couches différemment orientées sur les digitations du grand dentelé (en particulier du faisceau de pointe). Pourvu d’une riche vascularisation relevant de sources multiples, grand dentelé et grand dorsal sont deux muscles à pédicule nerveux longitudinal unique émané du plexus brachial. Pour éviter les séquelles esthétiques et fonctionnelles sur la pompe ventilatoire, il est donc impérieux de sauvegarder au maximum cette innervation unique : arrêter la «section-dissociation» du grand dentelé en avant de son pédicule vasculo-nerveux dans les thoracotomies latérales ou latéro-antérieures; sectionner très bas le grand dorsal — les autres muscles étant simplement libérés et reclinés — dans les grandes thoracotomies postéro-latérales.

Key words: Latissimus dorsi — Serratus anterior — Thoracotomy — Serrato-thoracic space (of Gillis) — Auscultatory triangle

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For the last two decades, many authors have protested about the long-term esthetic and functional complications of the classic thoracotomy incisions which were too direct, dividing every structure to get straight to the rib aimed at. This has prompted us to take up, in the present work, the anatomic study of the two muscular formations most often involved in the common thoracotomy incisions of present-day thoracic surgery: the latissimus dorsi, and the large "serratus anterior-rhomboid" expanse which we have already studied at some length in an article published in 1952 [14].

We emphasize particularly their vascularization and, above all, their innervation via a single longitudinal pedicle. It is the interruption of this neurovascular supply that is responsible for the reported esthetic and functional complications [4, 7, 8, 9, 12].

**Latissimus dorsi**

We need not dwell on the classic description of this extensive myofascial lamina, roughly triangular in shape and stretching from the lumbosacral area to the upper end of the humerus. It is only its muscular portion, which moulds itself around the posterolateral convexity of the thorax, that is involved in thoracotomy. The junction between this muscular lamina and its fascia insertion describes a large curve, convex downwards and backwards, reaching to within 1.5 to 2 cm of the posterior midline (Fig. 1 B, D): its upper end is at the 6th rib, about 6 cm from the spinous processes, and its lower end is 1 to 1.5 cm above the iliac crest. Medially, towards the thoracic spinous processes, our dissections show the continuity of the fascial fibers of the latissimus dorsi and of the rhomboids.

The upper margin of the muscle appears clearly in the posterolateral thoracotomies: it constitutes the lower border of the auscultatory triangle and covers the inferior angle of the scapula to a greater or lesser degree.

The lateral margin, thick and rounded where it constitutes the posterior fold of the axilla, becomes thinner as it descends towards the iliac crest. In lateral or anterolateral thoracotomies, incision of the fascia along the margin enables us to separate the latissimus dorsi from the serratus anterior, and then gain access to the cleavable serrato-dorsal space, in direct continuity with the well-known serrato-scapular space. This is the space in which the surgeon much search for the single longitudinal nervous pedicles of these two muscles in order to protect them (Fig. 4).

The vascularization of the latissimus dorsi is dependent, on the contrary, on many sources which can be reduced to two groups: the subscapular artery and the intercostal and lumbar perforating arteries.

The main artery of the latissimus dorsi (figs 1, 4) is the thoraco-dorsal branch of the subscapular artery, a large collateral of the third part of the axillary artery. In its vertical descent, it approaches the anterior aspect of the latissimus dorsi, opposite the 3rd intercostal space. After giving off the long thoracic artery (Merkel) for the serratus anterior, it soon bifurcates into two branches, one longitudinal one and one transverse, whose routes and ramifications are superimposed on those of the nerve described in some detail below (figs 1, 4).

The second source of blood-supply is constituted by the lateral perforating branches of the intercostal and lumbar arteries, covered by the muscle (fig. 1 B). Their oblique route, threading their way through the planes of the musculo-fascial layers, allows them to send many twigs to the latissimus dorsi, before, during and after crossing the muscular lamina. The most important contributions are those of the 9th and 10th intercostals and we can easily identify the rich anastomoses between this system and that of the subscapular artery.

Distal atrophy of the muscle after transection is, therefore, not due to its devascularisation but to interference with its innervation — a longitudinal innervation with a single pedicle coming from the brachial plexus.

The thoracodorsal nerve, usually arising from the posterior cord (C₆, C₇, C₈), of the brachial plexus, runs downwards and outwards, joins the thoracodorsal artery, crosses behind it at the level of the third rib, becomes lateral to it, and descends with it towards the deep surface of the latissimus dorsi (fig. 4). When it bifurcates, which is generally earlier than for the artery, it too produces two branches (figs 1, 4): one longitudinal and anterior which continues downwards almost parallel to the lateral margin of the muscle, and one transverse and posterior which makes its way backwards and medially and tends to follow, at a distance, the upper margin of the latissimus dorsi.

With the satellite veins and arteries, these two branches and their successive ramifications spread out like a fan and cover almost all of the muscular lamina. A thorough dissection allowed us to follow the final arborizations to within 1 to 2 cm of the junction of the muscle with its lumbo-dorsal fascia. On the other hand, after the 4th division, these ramifications embed themselves in the thickness of the latissimus dorsi, become intramuscular but remain easy to locate thanks to the areolar-adipose tract that accompanies them (fig. 1 D).

The distance separating the longitudinal pedicle from the anteroinferior border of the muscle increases slightly in a craniocaudal direction and varies between 1.5 and 2.5 cm at the level of the 4th, 5th and 6th ribs (extremes: 0.8 and 3 cm).