

CHAPTER II

REVIEW OF RELATED LITERATURES



1. The Pattern of the Thoracodorsal Artery in the Latissimus Dorsi Muscle

In 1981, Bartlett al. [14] reported the dissection of 50 fresh human cadavers. The thoracodorsal artery and vein entered the inferior surface of the latissimus dorsi muscle at a clearly defined neurovascular hilus a mean distance of 2.1 cm medial to the muscular border. At this point in 86 percent of specimens, the thoracodorsal artery and vein bifurcated. The upper branch coursed transversely across the muscle parallel to the superior border 3.5 cm from the edge. The lateral branch coursed longitudinally toward the iliac crest and ran parallel to the lateral border of the muscle remaining a mean distance of 2.1 cm from this lateral margin. The medial coursing vessels were found to have a mean arterial diameter of 1.1 mm and a mean venous diameter of 1.2 mm at their point of origin, while the laterally placed vessels were noted to measure 0.8 to 1.0 mm, respectively.

Tobin and colleagues [16] described the dissection of 60 cadavers (51 preserved cadavers and 9 fresh cadavers). The mean location of the neurovascular hilus was 8.70 ± 0.14 cm distal to the subscapular artery origin (range: 6.0-11.5 cm) and 2.60 ± 0.07 cm medial to the lateral border of the muscle (range: 1.0-4.0 cm). The constant branching of the thoracodorsal vessel, a horizontal and a lateral branch, ran on deep surface of the muscle. These anatomic findings led to the clinical refinement of the spilt latissimus dorsi flap.

The lateral neurovascular branch of the nerve and vessels was usually the larger, and its course paralleled the lateral border of the muscle at 1.0 to 4.0 cm medially throughout its length. The medial neurovascular branch paralleled the upper muscle border and separated from the lateral branch at the neurovascular hilum at a 45 degree angle. Within the substance of the distal to muscle, the lateral branch uniformly gave rise to one or more large branches, which took course parallel to the medial branch and to the distal muscle fibers.

In 1984, Rowsell et al. [17] reported the dissection of 58 cadavers (48 preserved cadavers and 10 fresh human cadavers). The thoracodorsal artery was a branch of the subscapular artery in 94% of the dissections. In five (5%) of the dissections, the thoracodorsal artery was a branch of the axillary artery; in four of these it originated from the second part and it originated from the third part of the axillary artery in the last one. In 1% of the dissections the thoracodorsal artery was a branch of the

lateral thoracic artery. The average length of the thoracodorsal artery was 8.4 cm (rang: 5.9-14.0 cm) and the average diameter of the thoracodorsal artery at its origin was 3.0 mm (range: 2.0-5.0 mm).

Later, Rowsell et al. [18] reported the dissection of 13 fresh cadavers. In all 20 (100%) dissections examined the thoracodorsal artery was seen to divide into two primary muscular branches immediately on reaching the deep surface of the latissimus dorsi muscle.

These primary muscular branches ran at 45 degree to one another and remained on the deep surface of the muscle for the whole of their course. The medial of the two primary branches ran parallel to the upper border of the muscle; the lateral branch ran parallel to the lateral border of the muscle. The corrosion casts revealed that each of the two primary muscular branches gave the origin to a multitude of secondary muscular branches, which arose at right angles and ran through the substance of the latissimus dorsi muscle from the deep to the superficial surface. The cast also demonstrated that the secondary branches formed a rich anastomosis between the two primary vessels within the substance of the latissimus dorsi muscle.

In 2003, Heitmann and colleagues [19] described the dissection of 16 fresh cadavers. The authors have detailed further the vascular anatomy of the thoracodorsal artery and its cutaneous perforator vessels. the thoracodorsal artery showed a constant bifurcation into a horizontal branch and a lateral branch, located on the deep surface of the latissimus dorsi muscle at 4.0 cm (range: 3.0-6.0 cm) distal to the inferior scapular border and 2.5 cm (range, 1-4 cm) medial to the lateral free margin of the muscle. The horizontal branch ran parallel to the superior border at 3.5 cm (range: 2.0-5.0 cm) from the edge, and the lateral branch ran parallel to the lateral free border of the muscle 2.0 cm (range: 1.0-4.0 cm) from the lateral margin. Both branches remained basically on the deep surface of the latissimus dorsi muscle throughout its course. The horizontal branch had an external diameter of 1.1 mm (range: 0.8-1.5 mm), and the lateral branch had an external vessel diameter of 1.0 mm (range: 0.8-1.5 mm).

2. The Number of the Cutaneous Perforator

In 1987, Taylor and colleagues [22] found that 374 cutaneous perforators were larger than 0.5 mm throughout the body, and the schematic diagrams revealed 5 to 9 perforators in the area of the latissimus dorsi muscle.

Later, Angrigiani et al. [1] reported an anatomic study performed in 40 fresh cadaver specimens injected with colored latex. The study demonstrated that the vertical intramuscular branch of the thoracodorsal artery was found to give off two to three cutaneous perforators.

In 2003, Heitmann et al. [19] described the dissection of 16 fresh cadavers. The authors have detailed further the vascular anatomy of the thoracodorsal artery and its cutaneous perforator vessels. In 20 specimens there was a total of 64 musculocutaneous perforators which were larger than 0.5 mm. Thirty-six perforators (56%) originated from the lateral branch and 28 perforators (44%) originated from the horizontal branch. There was an average of 1.8 perforators (range: 1.0-4.0 perforators) of the lateral branch and a mean of 1.4 perforators (range: 1.0-3.0 perforators) of the horizontal branch.

In 2004, Guerra and colleagues [20] reported the dissection of twenty cadavers for this anatomic study. Seventeen of 20 cadavers (85 percent) were found to have at least one perforator from the lateral branch of the thoracodorsal artery, which supplied the skin-soft-tissue paddle.

In 2005, Binu et al. [2] reported the dissection of 15 fresh human cadavers. The mean number of 5.5 ± 1.8 perforators with a mean diameter of 0.9 mm (range: 0.5-1.5 mm) supplied this zone. The ratio of musculocutaneous to septocutaneous perforators from the thoracodorsal artery was 3:2.

3. The Location of the Cutaneous Perforator of the Lateral Branch of the Thoracodorsal Artery

Angrigiani et al. [1] reported an anatomic study performed in 40 fresh cadaver specimens injected with colored latex. The study demonstrated that the proximal perforator exited the muscle into the subcutaneous tissue, approximately 8 cm below the posterior axillary fold and 2 to 3 cm posterior to the lateral border of the muscle. It measured 0.4 to 0.6 mm in diameter. The second perforator of the thoracodorsal artery arose 2 to 4 cm distal to the origin of the first perforator and measured 0.2 to 0.5 mm in diameter. The first and second perforators were consistently found in all dissection. A third perforator was found in 32 of 40 specimens and originated 2 to 4 cm from the take-off of the second perforator. The first perforator of the thoracodorsal artery was oriented obliquely from the deep surface to the superficial, appearing as a direct continuation of the thoracodorsal artery itself.

Later, Spinelli et al. [10] reported the dissection of 6 fresh cadavers. The fasciocutaneous flap composed of dorsal thoracic fascia and the overlying skin and subcutaneous tissue can be reliably supplied by blood from a predictable row of perforators from the lateral intramuscular branch of the thoracodorsal artery.

In 2001, Kim et al. [5] reported the use of thin latissimus dorsi perforator flaps using only the superficial adipose layer for resurfacing in 12 patients. The perforator ran in an oblique course of 3.0 to 5.0 cm through the thin latissimus dorsi muscle. Perforators near the lateral border of the muscle were usually selected because of their easy dissection considering the constant course of the proximal artery along the lateral border and underneath the muscle.

In 2003, Heitmann et al. [19] described the dissection of 16 fresh cadavers. All perforators originated within a distance of 8.0 cm from the neurovascular hilus and ran in proximity with the horizontal or lateral branches.

In 2004, Guerra et al. [20] reported the dissections of 20 cadavers for this anatomic study. Seventeen of 20 cadavers (85 percent) were found to have at least one perforator from the lateral branch of the thoracodorsal artery, which supplied the skin-soft-tissue paddle.

The first perforator was always the largest from this vessel system, measuring between 0.5 and 0.6 mm in diameter, originating 2 to 4 cm distal to the bifurcation of the thoracodorsal artery, and measuring 4 to 6 cm in length. Twelve cadavers had a second perforator about 2 to 6 cm distal to the main perforating vessel. A third perforator was found in only 10 cadavers. All perforating vessels were found within 8 cm of the vascular hilus. The perforators were observed to penetrate the dorsal thoracic fascia and traveled for a distance of 2 to 6 cm. The direction was quite variable. Importantly, the average distance from the axillary artery to the hilus was found to be 12 cm in length, making the average total length of the pedicle become 20 cm. Perforating vessels from the lateral branch were found on a line that began 2 cm posterior to the anterior border of the latissimus dorsi muscle and traveled along the muscle's anterior long axis. Identification of the cleavage plane that carried the neurovascular structures was facilitated by early identification of the thoracodorsal nerve in the distal portion of the latissimus dorsi muscle.

In 2005, Binu et al. [2] reported the dissection of 15 fresh human cadavers. The most proximal perforator was usually seen about 3.0 cm medial to the anterior border of the muscle in line with the inferior angle of the scapula. The second perforator was usually seen 2.5 to 4.0 cm inferior to the first. The location of other musculocutaneous perforators was variable. The intramuscular course of the perforators averaged 5.0 cm (range: 3.0-7.0 cm). The length of the thoracodorsal artery pedicle, which was harvested along with the perforator, was 14.0 ± 1.4 cm (range: 11.0 to 15.5 cm) with a mean diameter of 2.8 ± 1.2 mm (range: 2.4-3.0 mm).

4. The Relationship of the Nerve and Vessels to the Muscle

In 1981, Tobin et al. [16] reported the dissection of 60 cadavers (51 preserved cadavers and 9 fresh human cadavers). The mean site of division of the nerve to the latissimus dorsi occurred 1.3 cm proximally. The mean location of neural division was 7.40 ± 0.15 cm distal to the origin of the subscapular artery (range: 4.0-10.5 cm).

The lateral neurovascular branch of nerve and vessels was usually larger, and its course paralleled the lateral border of the muscle 1 to 4 cm medially throughout its length. The medial neurovascular branch paralleled the upper muscle border and separated from the lateral branch at the neurovascular hilum at a 45 degree angle. Within the substance of the distal muscle, the lateral branch uniformly gave rise to one or more large branches, which took course parallel to the medial branch and to the distal muscle fibers.

Bartlett and colleagues [14] reported the dissection of 50 fresh human cadavers. The innervation of the latissimus dorsi muscle is through the thoracodorsal nerve; derive from the posterior cord of the brachial plexus. In 100 percent of dissections, this was a constant finding. The nerve was seen a mean distance of 3.1 cm proximal to the subscapular artery and vein, joining them within 3 to 4 cm and paralleling the vasculature to the neurovascular hilus of the latissimus dorsi muscle. In those cases elucidated earlier in which the subscapular artery began quite proximal to the vein, the nerve was always seen between these two vessels.

At the neurovascular hilus, the branching pattern of the nerve paralleled that of the vasculature. In 86 percent of dissections, it branched into superior and lateral dominant groups of fascicle running with their vascular counterparts, while in 14 percent, no major branching was evident. In these 14 percent, the major lateral nerve only was identified, and tiny nerve branches arising from this nerve could be seen coursing medially. As a result of its lengthier proximal portion, the thoracodorsal nerve was somewhat longer than its venous and arterial counterparts, a mean length of 12.3 cm with a range of 8.5 to 19.0 cm.

5. The Direct Cutaneous Perforator of the Thoracodorsal Artery

In 1980, Cabanie and colleagues [23] described this branch in 75 % of 30 cadaveric dissections but remained somewhat variable in origin.

Later, Rowsell et al. [17] observed this direct cutaneous branch in 81 % of 100 cadaveric dissections, but found that it arose from the thoracodorsal artery in only 47%. In the remaining specimens it arose from the subscapular (27%) and axillary (7%) arteries. This branch did not pierce the latissimus dorsi muscle but rounded the lateral edge of the muscle to contribute the blood supply of the lateral thoracic skin and subcutaneous tissue.

In 2003, Heitmann et al. [19] described the dissection of 16 fresh human cadavers. In 11 dissections (55%) there was also a direct cutaneous branch originating from the extramuscular course of the thoracodorsal artery before the neurovascular hilus. This cutaneous branch did not pierce the latissimus muscle but rounded the lateral muscle edge and supplied the overlying subcutaneous tissue and skin.

In 2005, Binu et al. [2] reported the dissection of 15 fresh human cadavers. The septocutaneous perforators arose as a single branch from the thoracodorsal artery that was identified near the lateral border of the muscle in 60 percent of dissections, reaching the skin without penetrating the latissimus dorsi.

Although the detailed anatomy of the thoracodorsal artery perforator flap was described above by many authors, there were no further details given regarding the specific location, the number, the pattern of the perforator of the lateral branch of the thoracodorsal artery perforator flap, relationship of the vessel & nerve and the location of the direct cutaneous perforator have been still ambiguous. Therefore, this study emphasized the cutaneous perforator vessels of the lateral branch of the thoracodorsal artery, which was known to have the largest and most reliable perforating vessels of the thoracodorsal artery as it referred to the design of the thoracodorsal artery perforator flap.