ALTERNATIVE VASCULARISATION OF LATISSIMUS DORSI FLAP THROUGH CLAMPING OF THE PRINCIPAL THORACO DORSAL PEDICLE EXPERIMENTAL STUDY

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Abstract: *Experimental findings have demonstrated an alternative vasculature of latissimus dorsi flap through collateral arterial supply from the dinsat muscle, which successfully substitutes the obliterated dominant pedicle in the conditions of clamping the thoraco dorsal artery.*

Cuvinte cheie: *lamboul miocutanat de dorsal mare, vascularizaţie alternativă, studiu experimental*

Rezumat: *Rezultatele studiului experimental au demonstrat că există alternativă de vascularizaţie a lamboului miocutanat de dorsal mare în condiţiile clampării arterei toracodorsale prin colaterala arterială a muşchiului dinţat care supleează cu succes pediculul dominant obliterat.*

INTRODUCTION

The musculocutaneous latissimus dorsi flap is considered an effective method for breast reconstruction, primarily due to vascular provisions that allow harvesting of large segments of muscle and skin tissue.

Mathes and Nahai classified latissimus dorsi muscle as type V, vascularised by a dominant pedicle and few secondary segmentation pedicle. Blood supply of latissimus dorsi muscle is by the thoraco-dorsal artery (with a branch towards serratus anterior muscle) which represents the dominant pedicle and intercostal and interspinal vascular perforators forms the secondary vascular sources.(1) When this flow is interrupted in thoraco-dorsal artery the blood goes from the branch of serratus anterior muscle towards latissimus dorsi muscle. In case of blocking the flux through the thoraco dorsal pedicle, vascularisation of the latissimus dorsi flap is dependent on vascular branches from the anterior serratus anterior muscle. However skin island necrosis is a very rare complication.(2)

To elucidate this phenomenon and provide plastic surgeons with practical elements in assessing and conservation of vasculature in breast reconstruction with latissimus dorsi flap, we conducted an experimental study on a laboratory pig.(3)

PURPOSE

The aim of this study was to assess the consequences of the lesion of main vascular pedicle.

METHODS

The research was conducted on large animals, common race pigs (sus scrofa domestics), weight between 23 and 32 kg. We chose the pig as an experiment laboratory animal because it represents an excellent experimental model because of the following advantages:

- Human anatomy resemblance to that of the pig;

Size and shape of vascular pedicles are similar to humans.

To achieve the research objectives, three animals were subjected to harvesting of musculocutaneous latissimus dorsi flaps by the open technique. Due to the reduced number of experimental animals, flaps were harvested bilaterally from each animal. The experiments were performed at Biobase Laparoscopic Surgery and Microsurgery Center "Pius Branzeu" Timisoara. Anesthesia was general, achieved on the base of halothane via endotracheal intubation.

Flap markings: The skin island of the flap is marked starting from posterior axillary flexion line. This determines the anterior margin of the latissimus dorsi muscle. Ventral edge mark was made caudally to the last rib. The midpoint between the olecranon and the tip of the scapula were determined and marked, which represents the projection of dorsal thoracic pedicle. From this point, it was drawn posteriorly through scapula to the cranial edge of the latissimus dorsi muscle.

A line was drawn laterally to the median line which represents the posterior margin of the latissimus dorsi muscle, which continues till the inferior part of the 6th thoracic vertebra. From here, the route is continued anteriorly around the last rib before encountering the anterior margin.

The technique of isolation and clamping the main vascular pedicle of latissimus dorsi muscle in pigs.

Skin incision starts anteriorly and follows the flap planning markings. The subcutaneous tissue is sectioned and the anterior margin of the latissimus dorsi muscle is revealed. It is penetrated beneath the muscle and the muscle is lifted medially. Cleavage must be done carefully, so as not to damage the perforator vessels and cause bleeding. As the perforators appear their electrocoagulation is performed. Harvesting of the muscle is continued towards the upper margin releasing it gradually deeper. Systematic dissection clockwise and vice versa helps to

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maintain correct dissection plane of the latissimus dorsi muscle from beneath trapezius and teres major muscle. Near the edge of vertebral muscle intercostal artery perforators should be cauterized. Cranial lifting of the muscle will reveal thoracodorsal pedicle which is dissected and isolated as high as possible towards axillary vessels, taking care not to injure the collateral artery or commitant veins of serratus muscle. Pedicle dissection is facilitated by cutting the muscle vertebral aponeurosis. Once the vascular pedicle is isolated, it can be clamped to study alternative vascularisation of the flap

RESULTS

The maximum time of operation was 181 minutes and the minimum time of 125 minutes. Average operating time was of 153 minutes. Operative time was extended for the first animal and decreased progressive experience for others. Thoraco dorsal artery clamping consequences were observed clinically and during ultrasound of the skin island of the flap.

Animals were followed postoperatively for 10 hours, observing full viability of the flaps. Changes in the skin in the form of slight pallor, cyanosis or moderate ischemic, were seen in two cases immediately postoperatively, but they disappeared transient after 2 to 3 hours of surgery.

In order to assess blood perfusion in the skin island of the latissimus dorsi flap during clamping of dominant vascular pedicles were performed linear scanning laser-Doppler

Quantitative and qualitative determination is based on density, number of points played by the presence of colour ranging from dark colours, with low perfusion in bright colours with high levels of infusion. Values found after the colour appearance can be classified according to the number of points scanned according to a scale ranging from 0 to 1000.

Measurements were made preoperatively, intraoperatively during dominant vascular pedicle clamping (thoraco-dorsal artery) and early surgery

I. Preoperator Laser Doppler Scan

Figure no. 1. Marking the flap and the cutaneous island

Figure no. 2. Colour aspect of the scanned area, corresponding to the cutaneous blood perfusion

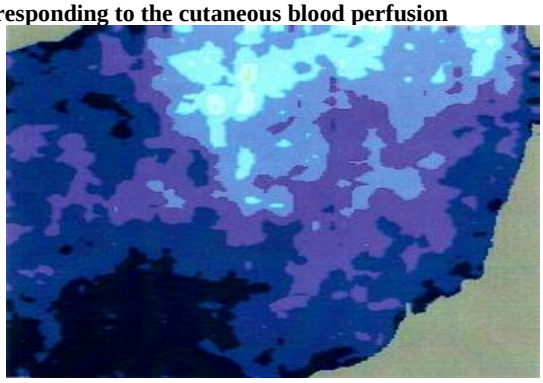


Table no. 1. Flux values

Median	Std	Median	Min	Max	Total	Valid	Valid %	Area
194,6	45,6	192	73	392	12985	12985	100,0	57,49

According to table no. 1, it is shown that an area of 57.49 cm^2 was found, areas with a minimum flow of 73 and a maximum flow of 392, totalling 12,985 all valid points (100%).

II. Intraoperative Scanning Laser Doppler

Examination performed mobilization of latissimus dorsi flap and isolation of thoraco-dorsal artery shortly after clamping the artery.

Laser Doppler image of the scanned region after thoraco-dorsal artery clamping (figures no. 3, 4).

Figure no. 3. Preoperative laser Doppler image

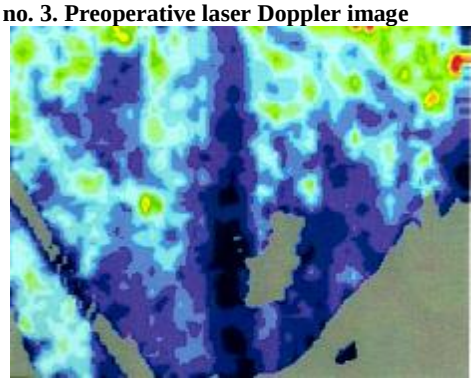


Figure no. 4. Clinical aspect

Table no. 2. Flow values

Mean	Std	Median	Min	Max	Total	Valid	Valid %	Area
212,5	94,6	205	22	578	12985	12604	97,1	35,66

In table no. 2, over an area of 35.66 cm2, it was determined a minimum flow of 22 and a maximum flow of 578, with an average of 205, compared to a total of 12,985 of the available 12,604 points representing a validation of 97.1 %.

III. Postoperative Scanning Laser Doppler

Examination was made 20 minutes after clamping the thoraco-dorsal artery. Exploration area is oriented towards the cutaneous area corresponding to the skin area of the flap (figure no. 5, 6).

Figure no. 5. Postoperative laser Doppler image

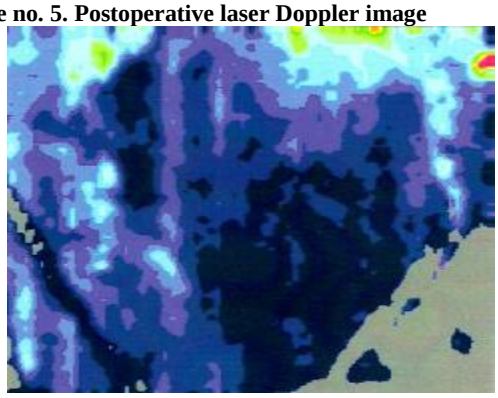


Figure no. 6. Postoperative clinical aspect

Table no. 3. Flow values

Mean	Std	Median	Min	Max	Total	Valid	Valid %	Area
98,1	52,2	86	6	281	12985	12985	100,0	45,94

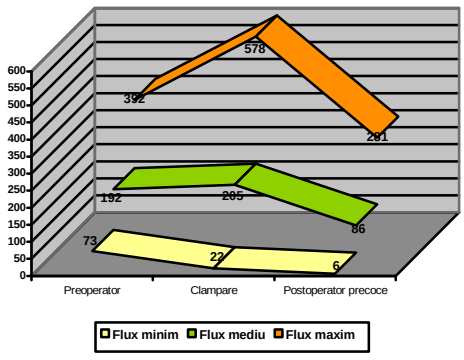
Over an area of 45.94 cm^2, it was assessed a minimum flow of 6 and a maximum flow of 281 with an average of 86, a total of 12,985 valid points 100%.

In order to comparatively assess the blood flow in the skin selected in all three circumstances, we made a table of the values found in the three previous tables and we have drawn a graphic.

Table no. 4. Representation of the values of the vascular flow

Mean	Std	Median	Min	Max	Total	Valid	Valid %	Area
194,6	45,6	192	73	392	12985	12985	100,0	57,49
212,5	94,6	205	22	578	12985	12604	97,1	35,66
98,1	52,2	86	6	281	12985	12985	100,0	45,94

Figure no. 7. Graphical representation of the values of the vascular flow



The chart shows that:

- Maximum flow is increased by 40% during clamping and decreases by 20% in early postoperatively.
- Minimum flow decreases by 69% while clamping and 91% postoperatively
- Median flow increases slightly during clamping (7%) and decreases by 54% in the immediate postoperative period, while the clamp is maintained on the artery

The study reveals that arterial flow after clamping the arterial trunk cutaneous flow decreases by 20%, Cutaneous minimum flow decreases dramatically (91%) and the average flow drops to half of its initial value (54%).

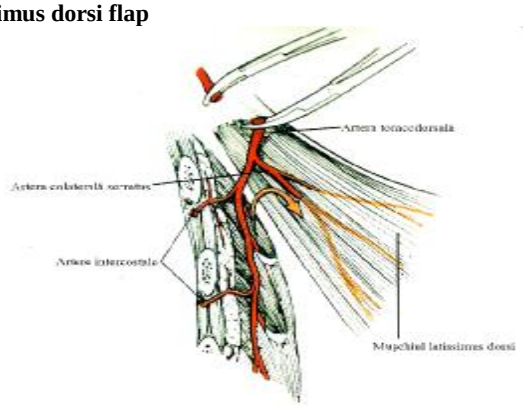
DISCUSSIONS

One of the major advantages of the miocutaneous latissimus dorsi flap is the substantial availability of vascularisation. Although dominant pedicle is long and wide enough, it is not always available for proper vascularisation of the flap; there are situations in which we need to use collateral vessels or perforators. Thoraco-dorsal artery may present obstructive lesions, by thrombosis, postoperative scarring, extrinsic compression (hematoma, tumour) congenital anomalies, that may cause haemodynamic and nutritional disorders of the flap.

These vascularisation deficiencies can be compensated by secondary vascular pedicle which should be known and preserved during dissection. One of the possibilities is provided by collateral branch of serratus anterior muscle provided thoraco-dorsal artery be permeable distal to its branches. Thoraco-dorsal artery obstruction was achieved by clamping and in one of the cases by ligature and section of the artery. The results obtained from the main pedicle clamping although it shows a reduction in blood flow to the latissimus dorsi skin flap, although there are no vital bearing on tissues. Resulting explanation is that there is another source of vascularity of the flap, and this source can only be through the branch of serratus muscle, because perforators were interrupted by electrocoagulation during the dissection. Due to the main arterial trunk clamping, there is a reverse circulation in arterial branch of serratus muscle due to changes in pressure gradient.

If in the event of a main free vascular axis, the pressure gradient causes that the arterial blood flow be made from the axillary artery towards the thoraco lumbar artery and the branch of the serratus muscle, in the conditions of dominant pedicle clamping, there is a modification in blood flow from the intercostal arteries, the branch from the serratus anterior muscle, the terminal branch of the thoraco-dorsal artery, latissimus dorsi muscle.

Figure no. 8. Interruption of the main vascular flow of latissimus dorsi flap



Changes in the pressure gradient modify the direction of the flow, bringing enough blood supply to maintain the vitality of the latissimus dorsi flap.(6)

CONCLUSIONS

1. Experimental model to study the consequences of obliteration or lesion of the dominant pedicle over the viability of myocutaneous latissimus dorsi flap allowed us to demonstrate that there is an alternative supplement of blood supply from the arterial branch of the serratus muscle.
2. The results obtained on laboratory animal experience can be perfectly adapted to the flap surgery of miocutaneous latissimus dorsi flap in humans.

REFERENCES

1. Maxwell GP, Mcgibbon BM, HOOPES JE. Vascular considerations in the use of a latissimus dorsi myocutaneous flap after a mastectomy with an axillary dissection. Curr Probl Surg. 1980;17:585.
2. Pearl RM, Johnson D. The vascular supply to the skin: An anatomical and physiological reappraisal - part II Ann Plast Surg. 1983;11:196.
3. Gant TD, Vasconez LO. Management problems in breast reconstruction In TD. Gant and LO. Vasconez (eds) Postmastectomy reconstruction. Baltimore: Williams and Wilkins; 1988. p. 170-180.
4. Blondeel PN, Beyens G, Verhaeghe R, Van Landuyt K, Tonnard P, Monstrey SJ, Matton G. Doppler flowmetry in the planning of perforator flaps. British Journal of Plastic Surgery. 1998;51;202-209.
5. Bostwick J. Anatomy and physiology of the breast: Plastic and reconstructive breast surgery, vol. 1, Quality Medical Publishing Inc., Saint-Louis; 1990; p. 57-97.
6. Isac F, Isac A, Bratu T. Lambourile pediculate, Ed. Mirton, Timişoara; 2000.