VASCULARISATION OF PECTORALIS MAIOR MYOCUTANEOUS FLAP - ANATOMICAL STUDY IN HUMAN FETUSES AND CADAVERS

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Abstract

Pectoral major flap is one of most frequently used flaps in head and neck reconstruction. The wide attractiveness of this flap is based on secure vascular stalk made from pectoral branch of thoracoacromial artery. The aim of study was to analyze the variations in vascular supply of pectoral major muscle. The investigation was performed on 30 fetuses from 20 to 36 gestation week both gender. For determining vascular network the samples injected with barium sulphate were subjected to Spalteholtz technique, and on 30 fresh cadavers where and we performed injection of Metilen blue 1% in pectoral branch of thoracoacromial artery. In 87% we found one pectoral branch and in 13 % two branches for pectoral muscle were found. Before entering the muscle, pectoral branch is dividing in two terminal branches (67%). In all cases lateral part of pectoral muscle is supplied by branch of lateral thoracic artery. The average area of dyed skin was 13 x 20 cm in region between III and VI rib and from parasternal line to anterior axillar line. The average distance of most distal part of dyed skin to midclavicular point was 24 cm. The pectoral branch of thoracoactomial artery obtains main blood supply for pectoral major muscle mass and despite of anatomical variations can be defined as main pedicle for musculocutaneous flap. Dyed skin confirms that pectoral major flap has defined skin territory sufficient for reconstructions in head and neck area.

KEY WORDS: pectoral major muscle flap, blood vessels, anatomy

Introduction

Soft tissue and skin defects in head, neck and thoracic region may be caused by tumor removal, thermal and other injuries or develop after infections. Pectoral major (PM) flap is one of the most used flaps in reconstruction of soft tissue defects in head and neck region. The flap is introduced by Ariyan 1979 for reconstruction of soft tissue defect in head and neck region, and opened new era in reconstructive surgery (1, 2). The flap is designed in anterior chest mostly as myocutaneous flap. Oval shaped skin incision is located in parasternal region and goes through subcutaneous tissue reaching pectoral fascia. When the lateral edge of pectoral major muscle is reached, the posterior aspect of muscle is explored and main flap pedicle found. Next step is cutting out the muscle around Skin Island and creating a strip of muscle bringing the pedicle in direction of middle of clavicle. This part of muscle is a protective muff bringing the vessels. All muscle fibers of pectoral major muscle laterally from pedicle must be mandatory cut because if we leave part of muscle, the fibrosis could cause flap necrosis. The flap is transposed in defect and sutured in layers. Suction drainage is obligatory. Donor region is closed primarily. Current reports present the use of different modification of pectoral major flap and broad indications for its use (3, 4, 5). The prerequisite for secure use of muscle as myocutaneous flap is well defined and sufficient blood vessel as flap pedicle. The wide attractiveness of PM flap is based on secure vascular stalk made from pectoral branch of thoracoacromial artery. Thoracoacromial artery (TA) is the second branch of axillar artery (AA) arising from anterior aspect in 3- 4 cm from its beginning. After passing through clavipectoral fascia this artery reach upper edge of small pectoral muscle it gave 4 terminal branches: pectoral, clavicular, acromial and deltoid. Pectoral branch goes between pectoral major and minor muscle and supplies them. Despite the pectoral major muscle has a pectoral branch of thoracoacromial artery as main stalk; more two vascular pedicles supply the muscle: lateral thoracic and perforating braches of internal thoracic artery (6). The aim of study based on seldom clinical use of pectoral major flap is to contribute the understanding of vascular supply and vascular stalk of pectoral major flap in human fetuses and adult cadavers. We analyzed the arising of pectoral branch of thoracoacromial artery, its course, topographic relations with surrounding tissues, as well as the vascular network in pectoral muscle. In next step we had to define the area vascularised by pectoral branch.

Material and Methods

The investigation of vascular network of pectoral major flap we performed in 30 human fetuses. We used fetuses both gender, gestation age 20 to 36 gestation week and performed dissection on both sides. All fetuses were medico legally provided from the Clinic of Gynecology and Obstetrics of the Faculty of Medicine in Nis, and were without anatomical deformities and systemic pathology.* Fetuses were previously fixed in 10% formalin and their blood vessels were injected with Micropaque solution (barium sulphate). The technique of macro and micro dissection with surgical microscope "Olympus" is performed. The incision is made along the clavicle, midsternal region and lateral thoracic region. The skin and subcutaneous tissue were removed and the humeral insertion of pectoral major muscle detached. The thoracoacromial artery is defined and its pectoral branch analyzed. For later studies we used whole pectoral major muscle. Samples were prepared as transluminiscent specimens by Spalteholtz technique. The digital camera on microscope was used for documentation. The other part of investigation is performed bilaterally in 30 human cadavers both gender, age 19 to 75 years. All cadavers were necropsied in Department for Pathology and Forensic Medicine at Faculty of Medicine Nibs. We performed horizontal incision of skin and subcutaneous tissue along the middle of clavicle in length of 3 cm. The attachment of deltoid muscle is raised from the clavicle and structures in subclavicular region were blunt dissected, and the origin of thoracoacromial artery found. We investigated sceletopic relation of origin of thoracoacromial artery and measured its diameter by micrometer in 0.1mm scale. The arteriotomy of pectoral branch of thoracoacromial artery was performed and an intravenous canula placed in. The position of canula and prevention of leaking is obtained making ligature with a surgical stitch. Metilen blue dying is injected in amount of 40 ml 1%. The most distal part of colored skin from the clavicle is measured as well as the length and width of colored skin.

Results

Thoracoacromial artery in 97% originates one stalk in right angle (29 fetuses) from axillary artery, than goes forward through clavipectoral fascia above the upper edge of pectoral minor muscle and divides in terminal branches. In only 3% (1 fetus) we found that from axil-

* All Clinics and Departments, as parts of the Faculty of Medicine in Niš, have integrated professional cooperation and internal ethical control.

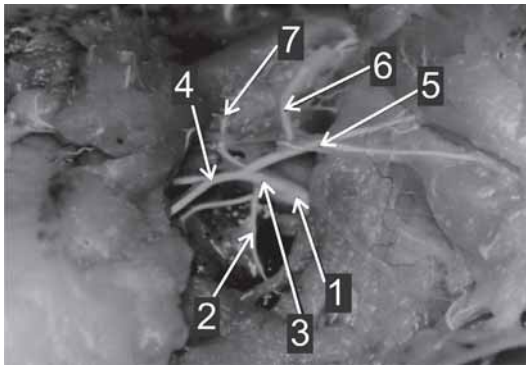

FIGURE 1. The branching of thoracoacromial trunk. (1. Axillary artery, 2. Thoracic supreme artery, 3. Thoracoacromial trunk, 4. Pectoral branch, 5. Acromial branch, 6. Deltoid branch, 7. Clavicular branch.)

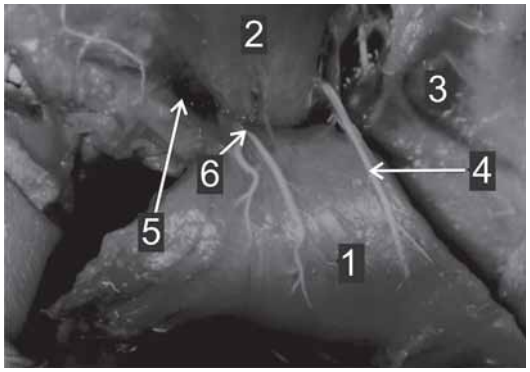

FIGURE 2. The supply of pectoral major by branch of lateral thoracic artery. (1. Pectoral major muscle, 2. Pectoral minor muscle, 3. Thorax, 4. Pectoral branch of lateral thoracic artery, 5. Axillary artery, 6. pectoral branch of thoracoacromial artery)

lary artery arise two arteries where the first branch gave acromial and deltoid and the other gave pectoral branch. In 87% (26 fetuses) we found 4 terminal branches of thoracoacromial artery (Figure 1.) and in 13% (4 fetuses) the clavicular branch was not found. In all cases lateral part of pectoral major muscle is supplied by branch of lateral thoracic artery (Figure 2). In 87% one pectoral branch is found but in 13% cases we found two pectoral branches (Figure 3). In cases of two pectoral branches the first reaches muscle more proximally than later. (FIG) Pectoral branch divides in two terminal branches before the entering muscle belly in 67%. In 13 % we found that it reach muscle without branching and in 20% gives three terminals before entering muscle belly (Figure 4a). We found a lot of anastomoses between terminal branches in pectoral major muscle (Figure 4b). In all cadavers thoracoacromial artery arise from anterior aspect of axillar artery. TAT arises in 80% of cases (24 cadavers) sharply in the middle of clavicle. In 13, 3% (4 cadavers) in arise 5 mm medially from the midpoint and in 6,7% of cases (2 cadavers) arise 5 mm laterally from the middle of the clavicle. The length of TA artery from arising to branching vas 8 to 17 mm. The average length of TA was 11,5 mm (SD 2.43 mm and coefficient of variation 20,5%) The diameter of TA artery was 1,5 to 3,2 mm. The average diameter of TA artery was 2,6 mm with SD 0,47 mm. In 83,3% of cases (25 cadavers) TAA branching in 4 terminals, in 6,7 % (2 cadavers) we found fifth branch supplying pectoral minor muscle and in 10% (3 cadavers) 3 terminal branches detected (clavicular branch did not found).

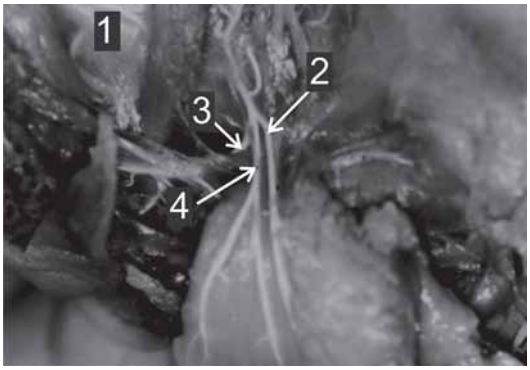

FIGURE 3. Doubled pectoral branch of toracoacromialis trunk (1. Axillary artery, 2. Proximal pectoral branch, 3. acromial branch, 4.distal pectoral branch)

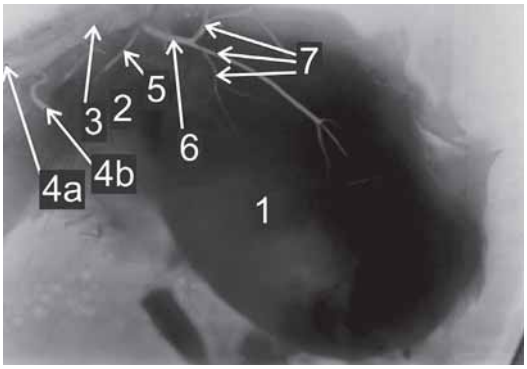

FIGURE 4 A. Pectoral branch of thoracoacromial trunk with three terminals.
(1. Pectoral major muscle, 2. Pectoral minor muscle, 3. Axillary artery, 4. Circumflex humeral artery: a.) anterior b) posterior, 5. acromial branch, 6. pectoral branch, 7. terminal branches)

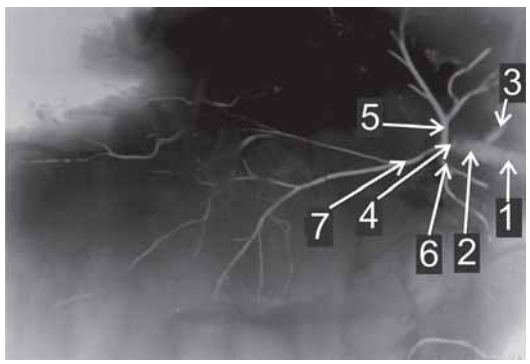

FIGURE 4 B. The vascular network of pectoral major branch. (1. Subclavian artery, 2. Axillary artery, 3. Transverse colli artery, 4. Thoracoacromial trunk, 5. Acromial branch, 6. Clavicular branch, 7. pectoral branch)

FIGURE 5. A. dyed skin area is measured 11 x 16 cm; B. the most distal point of dyed skin from mid clavicle was 28 cm; C. The dyed area of colored skin was measured max= 24 x 30 cm.

The area of skin dyed in cadavers was from 7x12 cm to 24x30 cm. The average area dyed was 13 x 20 cm. (Figure 5 a,b,c). In all cadavers we found that skin from 3rd to 6th rib and from parasternal line to anterior axillary line was colored. The distance from the midpoint of clavicle to most distal point of colored skin was 22 to 28 cm. The average distance was 24 cm and that distance can be defined as the arc of rotation of pectoral major flap.

Discussion

The use of musculocutaneous flaps bringing well vascularised muscle mass and proper skin quality island presents advance in reconstructive surgery. Pectoral major myocutaneous flap is used for long time but investigation of its blood supply is attractive because of understanding partial flap necrosis despite of excellent surgical technique. The results of our anatomical study certainly define that main blood supply of pectoral major flap is thoracoacromial artery, what is contributed by other authors. (1-4) Nakajima and al. (5) And Pandey and al. (4) in their studies pointed that vascularisation of pectoral major muscle arise from three arteries: pectoral branch of thoracoacromial artery, lateral thoracic artery and perforators from internal mammary artery. The main vascular supply is obtained by pectoral branch of thoracoacromial artery and it was found in all our cases. But in 13% we found two pectoral branches of TAA for pectoral major muscle. Moreover pectoral branch is dividing in two branches before reaching the muscle and form rich arterial network inside. In one dissection (3%) we found that two arteries arise from axillar artery, first giving acromial and deltoid branch and later artery goes strait same as pectoral branch. Park and al. (6) in 78.6% cases found that the pectoral branch arise from TAA but in rest of cases arise from medial or lateral roof of thoracoacromial artery. Freeman and Walkers (7) refers in 11% of dissections that a. thoracic supreme is a branch of TAA. We did not found this variation in our investigation. We found that TAA gives branch for pectoral minor muscle in 37% of cases. The same is found by Little (8). The route of pectoral branch is arc-like shaped and runs from the middle of clavicle along medioclavicular line and turns medially approaching xyphoid processus by the line connecting acromial part of scapula and xyphoid. The same rout of pectoral branch is described by other authors (1,5,6,7). In our study we found in 80% that TAT arises from anterior aspect of axillar artery in the middle of the clavicle and very rare laterally or medially from that point. Park and all (6) refer that in right side TAA arise laterally of midclavicular point in all cases but at the left side in 86% TAA arises medially from midclavicular line. Nakajima and al. (5) refer similar results. They discus about difference in both sides explaining in embryology: the right axillar artery develops from aortic arch but in left side from brachicephalic trunk. We did not find the difference in the sceletopic relations of TAA. The average length of TAA was 11,5 mm, The average diameter of TAA in arising was 2,6mm (SD=0,47), but others refers diameter of 2,8 mm and diameter of pectoral branch 1 – 2,5 mm.(9) Our study with injections of metilen blue in TAA confirm that the pectoral branch of thoracoacromial artery is constant and detectable vascular pedicle of pectoral major muscle and supply sternocostal part of muscle and pectoral skin from 3rd to 6th rib and from parasternal to anterior axillar line. According to referred data, the

vascular pedicle of pectoral major flap is defined (pectoral branch of thoracoacromial artery), extent of flap's skin and muscle territory (7x12 to 24x 30 cm - average 13 x 20 cm) as well as the arc of flap rotation (10,11). Yung and all refers that pectoral branch supplies 50,7%of pectoral major, lateral thoracic artery 6,6% and 43% of muscle parenchyma is supplied by perforator branches of internal mammary artery (3). They advocate that the almost half of the muscle mass is supplied by internal mammary artery and that is the main cause of flap loss. The anatomical vascular network is important for flaps with additional blood supply and it could be described as: primary vascular territory (main pedicle), secondary territory (anastomotic network with additional blood supply) and tertiary territory supplied by additional pedicle (in this case it is internal mammary artery) The anastomotic network in pectoral major flap is rich and obtains proper flap survival rising the flap on pectoral branch of TAA.

Conclusion

Pectoral major flap for head and neck reconstructions is supplied by pectoral branch of thoracoacromial artery and variations of beginning route and branching of this artery may be hazardous for operative success of modified pectoral flaps (e.g. double island pectoral major flap brings high risk in cases when artery approach muscle without branching). The area of vascularised skin defined with color injection (av. 13 x 20 cm) is sufficient for reconstructions in head and neck defects.

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