AN EVALUATION OF THE EFFICACY OF MICROVASCULAR BREAST RECONSTRUCTION TECHNIQUES

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The aim of the study was to evaluate the efficacy of different microvascular techniques in breast reconstruction with the analysis of postoperative complications. The additional goal of the study is to analyze the quality of life of patients after microvascular breast reconstruction in comparison to the control group of patients who underwent only mastectomy without any reconstructive procedures. Also the algorithm of breast reconstruction is presented as the result of own experiences.

Material and methods. Clinical material contain 2 groups of patients – women after surgical treatment in Department of Oncological and Reconstructive Surgery, Cancer Center in Gliwice in the year 2004-2009 where in 53 cases immediate and in 26 delayed breast microvascular reconstruction were performed. In all cases the diagnosis of cancer was proved by histopathological biopsy before the treatment. The type of radical resection (mastectomy) depended on histopathological type of cancer and its localization. The reconstruction – immediate vs delayed was carefully planned together with oncological treatment of the cases. Everywhere this plan was established based on carefully examinations of inferior epigastric vessels and theirs perforators. The choice between immediate and delayed microvascular reconstruction was based on prognosis and predictive factors. The QOL was analyzed due to own questionnaire when functional, aesthetics and social effects were evaluated.

Results. Free flap survival rate for all types of free flap was 95%. In cases where classic TRAM was used the rate was 85%, in cases where muscle sparing TRAM was chosen the survival rate was 100% and in remaining cases of DIEP reconstructions the rate was 89%. Generally the complications after microvascular reconstruction occurred in 13 cases (16%). In 9 cases the problems with flaps perfusion were notified. Total flap necrosis was observed in 2 TRAM and in 2 DIEP cases. In all those cases salvage surgery was administered in which the microanastomoses were explored and repaired. In 5 cases the cause of the complications was venous thrombosis, in 2 cases the vascular pedicle was kinked, and in remaining 1 the arterial thrombosis was found. The second type of complication was fat necrosis (<25% of flap volume) which was observed in 5 cases between 1 and 4 months after surgery, and it request minor plastic surgery. Donor site complications were noted in 4 cases. In two of those hernia in cicatrices was diagnosed (both were classic TRAM’s), in remaining 2 in which also fully muscle TRAM was classic the weakness of abdominal wall was observed. In group were msTRAM and DIEP were used no donor site complications occurred.

Key words: breast reconstruction surgery

The cases of radical mastectomy which established the development of modern surgery in breast cancer patients date back to the end of XIX century and were described by Halsted. Starting from the 1970s the border of the resected tissue was being gradually reduced and a modified radical mastectomy was introduced. The analysis of several cases proved that the results of the modified mastectomy were no less efficacious than the ones where the Halsted method had been applied (1, 2). Due to permanent significant and noticeable chest wall asymmetry, efforts were dedicated to develop new techniques of breast reconstruction surgery in order to reduce or eliminate the aforementioned effects. The first attempts in -
An evaluation of the efficacy of microvascular breast reconstruction techniques

cluded using skin – fat tissue flaps, resected with the so-called tunnel method from the spot located closely to the site of mastectomy (e.g. the lateral side of patient’s chest wall and the epigastrium). However, the results were still far from satisfactory. Further attempts included transfers of tissue segments with their own vascularisation from a distant location of the patient’s body, in order to achieve even greater mobility and flexibility in the process of breast formation. A new technique based on a pedunculated flap stemming from the rectus abdominis muscle was developed and launched (Transverse Rectus Abdominis Myocutaneous flap – TRAM). In 1979 for the first time a free flap TRAM technique was described by Holmstrom (3). The use of a free TRAM flap instead of a pedunculated TRAM flap reduced greatly the number of cases where complications such as necrosis of the transferred tissue occurred and additionally decreased the risk of complications at the donor site (hernias, weakening and asymmetry of the abdominal wall).

A modification of the abovementioned inferior epigastric vessels flap is called DIEP (Deep Inferior Epigastric Perforator Flap). DIEP is a free cutaneous – subcutaneous perforator flap from the hypogastrium which is vascularized by 1-3 perforators of the deep inferior epigastric artery.

In the Cancer Centre in Gliwice surgical reconstructions following total breast resection due to cancer treatment have become a therapeutic standard since 2004.

The objectives of this work:

1) an evaluation of the efficacy of selected microvascular reconstruction techniques following surgical treatment in breast cancer patients;
2) an attempt to develop an algorithm for breast reconstruction techniques based on the analysis of our own cases;
3) an analysis of the perioperative and postoperative complications resulting from the microvascular techniques used in breast reconstruction.

MATERIAL AND METHODS

In a group of 79 women who underwent surgery in the years 2004-2009, in 53 cases an immediate whereas in 26 cases a delayed breast reconstruction surgery of one or both breasts was carried out using microvascular free flaps.

At the point of a radical breast cancer treatment (mastectomy) based on the histological type of cancer and the localisation of the primary tumor, the following surgical procedures were carried out: 29 radical breast resections with the Madden’s technique, 27 skin sparing mastectomies, 21 mastectomies sparing both the skin and the nipple-areola complex, 2 simple breast resections.

In patients undergoing the immediate simultaneous breast reconstruction, vessels of the recipient site were prepared for microanastomosis during the final stage of the resection. In patients undergoing the delayed breast reconstruction, the cicatrices from the mastectomy site had been removed during the initial stage of the reconstruction and having formed free skin flaps within the recipient site the recipient vessels were being prepared. In 71 patients the internal thoracic vessels were used to which the access was gained by resecting 5 cm of the cartilaginous parts of ribs 3 and 4 on the side of the mastectomy. In 5 cases a parasternal perforator of the internal thoracic artery with its vein were used for themicroanastomosis due to their relatively big diameters. In the remaining cases the thoracodorsalis vascular bundle was used at the recipient site.

The reconstruction stage consisted of an immediate or a delayed reconstruction of a breast, following a proper planning of the primary oncological treatment.

The choice between the immediate or the delayed reconstruction was based on the clinical stage of cancer and the prognostic factors. The delayed reconstruction was chosen after taking the negative prognostic factors into consideration. This procedure was only applied when there was no relapse of cancer within the 12 months following the primary oncological treatment. In case of the immediate reconstruction, the flap was chosen during the surgery, depending on the type of vascularisation and the volume of tissues needed to achieve acceptable chest wall symmetry.

The most commonly used flaps (over 90% of cases) were TRAM and DIEP. In 2 patients a bilateral breast reconstruction was performed (fig. 1). The flaps provided sufficient tissue volume also in cases of breasts of significant size. The correlated risk factor for the compli-
cations at the donor site was acceptable, with the possibility of subsequent treatment.

In case of the abovementioned vast surgical procedures, with the exposition of two such large operational sites, the complexity of planned surgery is high and therefore the risk of possible complications can be increased significantly. This justifies the introduction of the following preventive measures: observation of the condition of the transferred flap, i.e. its colour, the temperature and tension of the skin island on palpation, a Doppler test of the blood flow within the perforators, preventive use of antibiotics, prophylaxis of embolic and thrombotic events, early post-operative mobilisation and rehabilitation of the patient.

The aesthetical outcomes were evaluated 3 months after the reconstruction surgery by a team of specialist (fig. 2). In case the symmetry, the location of the submammary fold or the tissue distribution in a breast quadrant were not satisfactory, the patient was being qualified for corrective surgery. In order to achieve symmetry, the mastopexy of the healthy breast was performed or the tissue deficit was treated with lipoinjection of fat tissue, collected from the hip and anterolateral side of the thigh, which brought acceptable aesthetical improvement.

**RESULTS**

In the examined group the complications occurred in 13 patients (16%). In 9 of the cases flap perfusion disorders were noted at the recipient site following the reconstruction. The flap necrosis was observed to occur between the 1st and the 9th day after the surgery (3rd day on average). Complete necrosis was noted in 2 TRAM and 2 DIEP cases.

Among the problems related to vascularisation the predominant complication was the early venal thrombosis within the microanastomosis (5 of cases – 6%). In 2 cases (2.5%) the peduncle of the flap was found folded or twisted, whereas only in one case the problem with
the perfusion was related to the thrombosis in the arterial part of the microanastomosis.

The second most commonly noted complication was the fat necrosis of a flap occurring in less than 25% of its volume (usually in the external portion of the affected flap). It was noted in 5 cases (6%) over a longer period of observation, i.e. from 1 up to 4 months. Such a complication required a slight correction of the reconstructed breast which was performed by the injection under the local anesthesia of the patient's own fat tissue collected from the gluteofemoral region. The donor site complications were noted in 4 cases (5%). In 2 cases hernias within the cicatrix were reported. In both cases hernias occurred in patients where the TRAM flap had been used. Both cases were successfully treated surgically. In the remaining 2 cases weakening of the superficial layers of the abdominal wall was noted, resulting in their bulging, yet without the formation of a typical hernia. In the groups where msTRAM and DIEP flaps had been applied no donor site complications were noted.

According to the proposed algorithm, a breast cancer patient with positive prognostic factors should be offered immediate skin sparing mastectomy (fig. 3). However, a patient with negative prognostic factors is a candidate for the Madden mastectomy and should rather be considered for the delayed breast reconstruction.

Independently of the time division of the reconstructions (immediate or delayed), an important factor to be taken into consideration is the condition and the volume of tissues in the mid- and hypogastrum. If the hypogastrum is preferred, the type of a flap (TRAM, msTRAM or DIEP) depends mainly on the diameter, localization and number of skin perforators. If there is one dominant perforator with a diameter of over 1.5 mm or two perforators of over 1.2 mm each, both situated in a line, then a DIEP flap would be the first choice (fig. 1). If there are one or two perforators situated in a line, with each one of them less than 1.2 mm in diameter, then the optimal choice would be a msTRAM flap. The availability of one or two perforators of less than 1.2 mm in diameter, situated otherwise than in a line, or numerous small perforators of unrecognizable diameter should drive the choice of a TRAM flap.
DISCUSSION

The immediate breast reconstruction has much better aesthetical and psychosocial effects than the delayed reconstruction. This procedure allows to achieve the best cosmetic outcomes which are related to the skin sparing mastectomy and are often associated with the sparing of the nipple-areola complex. The great advantage of the sparing mastectomy is not only the fact of sparing the patient’s own skin, nipple and areola but also keeping the shape and localisation of the submammary fold.

Rogers and Allen’s analysis comparing the DIEP flap breast reconstruction in patients with or without the adjuvant radiotherapy proves that the group in which the post-operative radiotherapy was applied the occurrence of fat necrosis (23% of cases) as well as fibrosis and volume decrease in a reconstructed breast (56% of cases) were significantly higher than

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**Fig. 3.** Algorithm demonstrating the criteria for choosing microvascular breast reconstruction techniques
An evaluation of the efficacy of microvascular breast reconstruction techniques in the group where the radiotherapy was not applied (0% of fat necrosis and fibrosis cases) (4). The postoperative radiotherapy is therefore consider the main predictive factor when choosing the most optimal timing for abreast reconstruction surgery.

From among the modifications of the classic inferior epigastric vessels flap both msTRAM as well as DIEP provide great opportunity for breast reconstruction in which rectus abdominis muscle is spared totally or sub-totally. However, this results in an increased number of necrosis cases and a greater complexity of the whole procedure. According to the Chang’s analysis of a large number of cases, a small portion of the rectus abdominis muscle surrounding a perforator(s) diminishes the risk of its (their) damageduring the formation of the flap and constitutes its (their) protection while not increasing the risk of the donor site complications (5).

Post-operative complications of breast reconstruction could be related to either the site of the new flap formation or the donor site. In the Grotting’s analysis which comprises over 350 TRAM reconstructions, venous thrombosis occurred in over 3% of patients, whereas arterial thrombosis in only 0.8% of cases (6).

The proposed algorithm is the result of a study of our own patients and became an attempt to assume a logical approach towards the theory that the more of a fascia and tissue of the abdominis rectus muscle is spared while constructing the flap, the lower the risk of complications at the donor site. In addition, the risk of necrotic complications in the flap in over 90% of cases is a direct result of the circulation disorders within the vascular microanastomosis and/or the peduncle itself. For this reason, the choice of a flap with suitable vascularisation is crucial.

CONCLUSIONS

1. For breast cancer patients a microvascular breast reconstruction is an effective reconstruction method.
2. The choice of a free flap technique with the involvement of the inferior epigastric vessels should be individual and based on vascular characteristics and tissue morphology of the hypogastrium.
3. Microvascular breast reconstructions are highly effective methods with a low failure rate (5% in our patients), which leave space for the application of one’s own algorithm as a practical guideline for choosing the most suitable reconstruction technique in breast cancer patients.

REFERENCES


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