

The Utility of Vertical Rectus Abdominis-Myocutaneous (VRAM) Flap in Reconstruction of Oncologic Chest Wall Defects

BELAL A. MUBARAK, M.D., M.R.C.S.; MOHAMED IBRAHIM HASSAN, M.D.;
MOHAMED EL-SAYED MOHAMED, M.D. and MOHAMED OSAMA KOTB, M.D.

The Department of Plastic Surgery, Ahmed Maher Teaching Hospital, Cairo, Egypt

ABSTRACT

Aim of this Study: To demonstrate the versatility of VRAM flap in reconstruction of oncological chest defects.

Patients and Methods: 10 patients with Oncological Chest defect after resection of local advanced cancer breast, complicated mastectomy procedure, or radio-necrosis of the chest were treated by unilateral superiorly pedicled VRAM.

Result: 10 flaps were harvested with average dimensions (14.3 X 26.1) cm and maximum flap size (15 X 30) cm. No total flap loss or major complications were observed, although 2 patients had distal flap necrosis.

Conclusion: The Vertical Rectus Abdominis Muscle (VRAM) flap is considered a safe and simple option to cover chest defects especially in high risk patients not fit for other sophisticated lengthy reconstructive options.

Key Words: Rectus abdominis – Myocutaneous flap – Chest wall defects.

INTRODUCTION

The patient population presenting with osteo-cutaneous defects or wounds of the thoracic wall is heterogeneous. The defects result mainly from either local recurrence of breast cancer, osteomyelitis due to radiation therapy after malignancies, or postoperative sternal osteomyelitis following median sternotomy for coronary bypass or other heart surgery. However, these patients are often elderly and suffer from a variety of preexisting diseases or risk factors. Diabetes mellitus, obesity, and smoking are predisposing factors for post-operative complications [1].

Infection, scarring, and de-vascularization from irradiation represent some of the most difficult problems for reconstructive surgery. Irradiation alters the surrounding tissues and structures in a permanent and progressive manner. Among the changes to "normal" tissues are loss of healing capacity, skin atrophy, fibrosis, alterations of the microcirculation, and the potential for necrosis to occur [2].

Reconstructive goals include wound closure with maintenance of intrathoracic integrity, restoration of aesthetic contours, as well as minimization of donor site deformity. Recruitment of local muscles with or without overlying skin is often the first-line of reconstructive offense. These muscles include pectoralis major, latissimus dorsi, serratus anterior, rectus abdominus, and omentum may also be used [3].

Free flaps, though due to advanced microsurgical techniques playing an increasing role in the otherwise healthy patient, may require venous interposition grafts and overburden patients in critical condition and such with progressive malignant disease or high-risk patients. In these situations, sufficient soft tissue coverage needs to be achieved by simple and reliable techniques with moderate donor site morbidity. The pedicled VRAM /TRAM flap represents a safe and fast forward flap procedure for the primary reconstructive goal in oncologic patients [4].

The Rectus Abdominis-Myocutaneous (RAM) flap is one of the most commonly used flaps in reconstructive surgery. Many designs have been published since its first description by Holmström 1979 [5] and its popularization by Hartrampf et al., 1982 [6], but three designs were usually performed in their pedicled version: The horizontal paddle or Transverse Rectus Abdominis-Myocutaneous flap (TRAM), the vertical paddle or Vertical Rectus Abdominis-Myocutaneous flap (VRAM), or the oblique paddle (ORAM) as first described by Taylor et al., 1983 [7].

According to the classification by Mathes and Nahai [8], the rectus abdominis is a class III muscle with a dual blood supply of the Deep Superior Epigastric Artery (DSEA) and the Deep Inferior Epigastric Artery (DIEA). Usually, one of the vascular pedicles is sufficient for perfusion of the

entire musculocutaneous flap. The DIEA is the dominant artery of the abdominal wall (average size, 2.5-3.8mm), which is double the size of the DSEA. Thus, rectus abdominis musculocutaneous flaps can be transferred superiorly based on the DSEA, as well as inferiorly pedicled or free based on the DIEA [9].

Due to the long pedicle that consists of the rectus abdominis muscle, the flap has a high potential for rotation and constitutes a perfect material not only to reconstruct the anterior chest wall structures but also a resistant material for significant wall defect closures. The advantage of using VRAM in surgical closure of extensive chest tissue injuries is the use of the rectus abdominis muscle as the layer that stabilises the edges of pectoral muscles. This allowed, in the described case, to improve significantly the anterior chest wall stability and, as a result, the patient's respiratory efficiency [10].

The perforators that supply the skin overlying the rectus abdominis muscle are located predominantly above the level of the arcuate line, and detection of more than one perforator below this line is rare [2]. The superiorly based Vertical RAM (VRAM) flap would appear to have a better blood supply than the superiorly based Transverse RAM (TRAM) flap, because the flap is designed over the rectus muscle Fig. (1) [11].

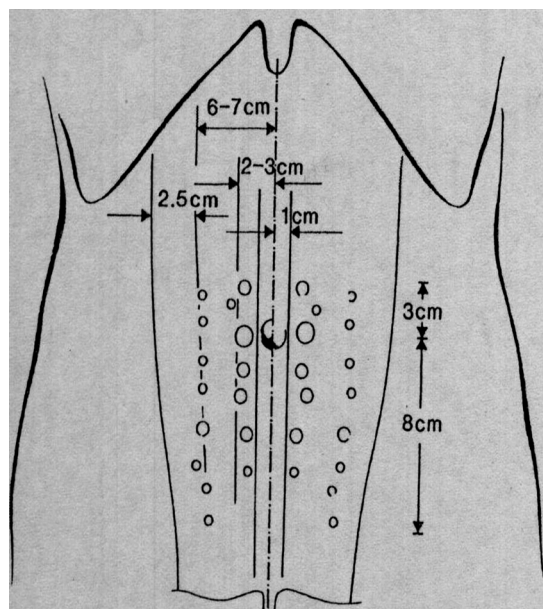


Fig. (1): Musculocutaneous perforators of vram; two rows of perforating vessels that pierce the rectus sheath. Most of vessels are located near the umbilicus, from 3cm above umbilicus to 8cm below it. The medial row of perforators is 2-3cm from midline and the lateral row is 6-7cm from it. The medial perforators generally have a larger caliber than the lateral ones. [11].

PATIENTS AND TECHNIQUE

Between 2014 and 2016, 10 vertical rectus abdominis myocutaneous flaps were used in reconstruction of oncologic chest wall defects for 10 female patients. The mean age was 52.7 years with range (46-61) years.

Five patients presented by chronic ulcers secondary to irradiation therapy after mastectomy, two of them had osteoradionecrosis while the other three patients the tissue injury confined to soft tissue of the chest wall. Two patients had invasive breast cancer underwent radical mastectomy with excision of the chest wall. One patient had recurrent breast cancer with invasion of the chest wall. Two patients presented by complications after radical mastectomy, one had skin flaps necrosis and the other had post-operative infection and wound dehiscence.

Four patients suffered from diabetes, two patients had hypertension and cardiovascular disease, and one patient suffered from chronic chest disease. 6 patients are obese; the mean Body Mass Index (BMI) of the whole patients was 28.7 with range from 23.6 to 32.5.

The usual preoperative history and physical examination, with attention to details of associated co-morbidities and risk factors relating to safety of surgery, should be performed as for any surgical procedure. Defect analysis regarding etiology, site size, layers, condition of surrounding tissues in addition abdominal area was examined. Assessment of cardiopulmonary functions, C.T scan of the chest, and patency of the internal mammary artery of the side of the muscle to be used.

Surgical technique of VRAM:

The skin markings were drawn while the patient is awake preoperatively. The flap may extend from the xiphoid process to the mons pubis. The level with the greatest width was determined by skin tension because the flap should be harvested so that the defect can be closed directly.

Excisional biopsy was taken with complete debridement of devitalized, infected, and radiation damaged tissues. In cases of breast cancer intra-operative frozen section was done to confirm adequate free margin.

Flap harvest started by incision of subcutaneous tissue to expose the anterior rectus sheath which was sutured to the dermis to prevent shearing strain on the perforators. The muscle was dissected from the posterior rectus sheath and raised to the sub-

costal margin after ligating the inferior epigastric vessels.

Donner site was closed by closing the anterior rectus sheath directly with a running or interrupted permanent suture (0 Prolene). If the remaining fascia appears weak or the edges of the sheath will not close directly, synthetic mesh (Prolene) was used and fixed in place with interrupted or running permanent sutures (3/0 Prolene).

All patients were followed-up postoperatively on regular base for 6-20 months to evaluate long-term functional outcome, including donor site morbidity.

RESULTS

Dimensions of chest wall defects ranged between (8-17) cm X (15-23) cm with mean defect

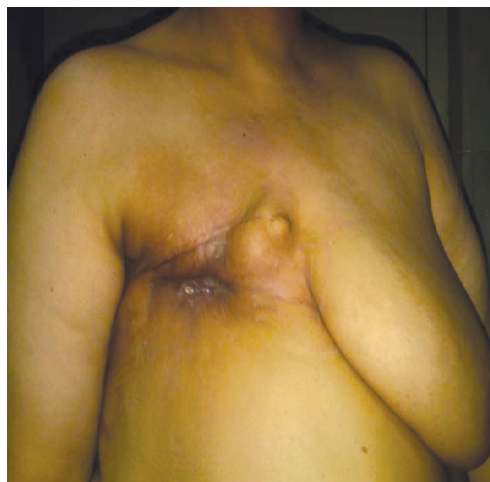
size (13.8 X 21.6) cm all flaps were harvested unilaterally superiorly pedicled flap. Dimensions of the flap ranged between (11-15) cm X (20-30) cm with mean flap size (14.3 X 26.1) cm and maximum flap size (15 X 30) cm. The donor sites were reconstructed using a non-absorbable prolene mesh. Reconstructive time ranged from 90 to 120 minutes, overall, hospitalization ranged from 8 to 12 days (mean, 10 days), and there was no operation mortality or patients necessitating intensive care and/or blood transfusions. No total flap loss or major complications were observed, although 2 patients had distal flap necrosis one case treated by local dressing while the other was managed by surgical debridement of distal third of the skin paddle of the flap and covered by skin graft. One patient had donor site seroma and wound infection who was successfully treated with antibiotics and local dressings.



Case (1): 58 years old female; with post radiotherapy radionecrosis.



Case (2): 44 years old female; with post radiotherapy radionecrosis.

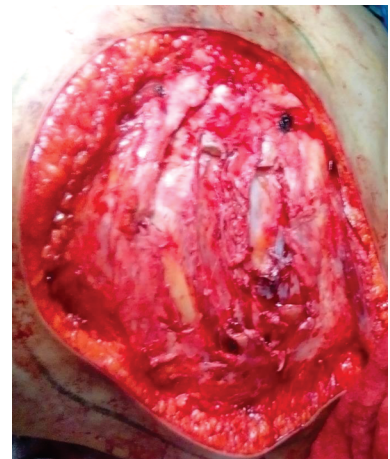
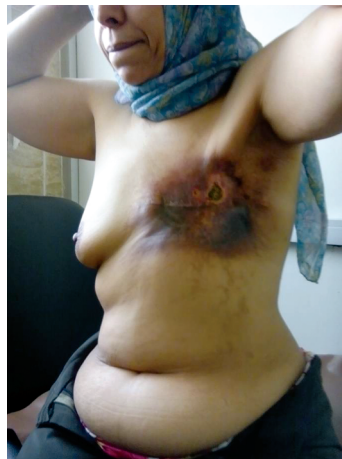
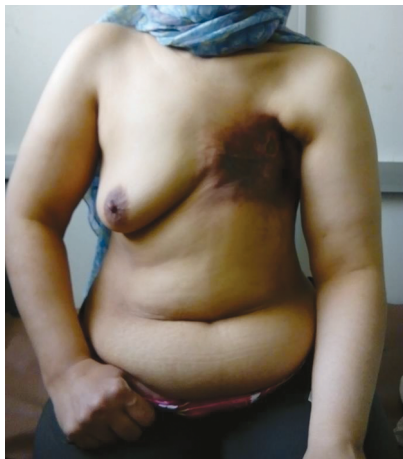


Case (3): 55 years old female; with post radiotherapy radionecrosis.





Case (4): 56 years old female; with post radiotherapy radionecrosis.



Case (5): 44 years old female; with post radiotherapy osteo-radionecrosis.

DISCUSSION

Large soft tissue defects after tumor resection or as consequence of radiation or wound-healing difficulties in patients with malignant disease require rapid and safe coverage. In cases of full thickness abdominal or thoracic wall defects, soft tissue reconstruction in combination with synthetic mesh is necessary, and postoperative radiation therapy requires stable soft tissue conditions [12].

The goals of chest reconstruction; (1) Structure: Support, protection, and obliteration of dead space. (2) Function: Pulmonary dynamics and hernia prevention. (3) Durability: Fistula prevention, radiation tolerance, need for future procedures.

Advanced stage of the tumor, radiotherapy complications in the surrounding tissue, and poor general conditions are all critical issues to choose the best reconstructive method for a chest wall reconstruction [13].

Use of a superiorly based RAM flap has become the standard method for reconstruction of the anterior chest wall, including breast reconstruction.

Alternative flaps can be used; pectoralis major muscle flap (thoraco-acromial artery), latissimus dorsi flap (thoraco-dorsal artery), Serratus anterior flap (thoracodorsal artery), omental flap (gastroepiploic artery), and local skin flaps.

The DIEP free flap is used predominantly in elective flap surgery, and usually in a population without severe preexisting diseases and risk factors. On the other hand, large full-thickness defects of the thorax, perineum, groin, and hip areas often result from tumor resection, chronic wounds, or complications following previous operative procedures in an elderly population with a high incidence of additional cardiovascular diseases and/or other risk factors such as diabetes or smoking. This patient population requires safe and fast forward procedures for defect coverage [1].

Within this context, this study aims to demonstrate the use of a series of VRAM flaps for a variety of indications, and to discuss the results with respect to alternative procedures and donor-site morbidity.

The superiorly based Vertical RAM (VRAM) flap would appear to have a better blood supply than the superiorly based Transverse RAM (TRAM) flap, because the flap is designed over the rectus muscle so vertical rectus abdominis myocutaneous

flap is extremely reliable due to rich perforator system.

Other advantages of VRAM are minimal donor-site functional deficit by meticulous closure of anterior abdominal wall, very large skin component can be raised with easy primary closure (flap dimension 15 X 30 cm).

In addition, this flap offers excellent skin color and texture match, no patient's repositioning on the operative table is needed to carry out the reconstruction.

In our study; two patients had partial necrosis with no total loss or major complications for patients or donor sites were observed. Pre-existing medical conditions mainly obesity and diabetes were identified as predisposing factors.

The disadvantages of the VRAM flap mainly aesthetic include long scars on the abdominal wall, displacement of umbilicus, and the preclusion of a further musculo-cutaneous Transverse Rectus Abdominal (TRAM) flap while not impairing the execution of a contralateral vertical rectus abdominal flap.

Conclusions:

Considering the poor clinical status and overall survival rate of patients with post-ablative chest wall defects, it is crucial to take advantage of a reliable technique, which can offer a conceptually simple solution to a highly complex reconstructive problem. VRAM musculocutaneous flap represents a safe and simple remarkable option for coverage of large chest wall defects in patients with advanced breast cancer, radionecrosis, and post operative complicated cases with associated morbid conditions that preclude more complex reconstructive options.

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