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Evaluation of Abdominal Wall Integrity After Using the Transverse Rectus Abdominis Myocutaneous Flap for Breast Reconstruction

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ABSTRACT

24 cases of breast reconstruction have been achieved by the transverse rectus abdominis myocutaneous flap (TRAM), either as unipedicled (16 patients) or bipedicled (8 patients) flaps. The abdominal wall is restored by either the direct myofascial release and approximation in cases with preoperative lax abdominal wall and diastasis of the recti (6 patients) or by the use of prolene mesh reinforcement (18 patients) in patients with relatively preoperative tight abdominal wall which do not allow easy myofascial release and approximation or after bipedicled flap utilization. In our series we have found out that 33% of the patients presented to us were complaining of either early mastectomy wound complications as wound dehiscence, mastectomy flaps necrosis or severe infection (25%), or late as radionecrosis (8%). Primary or immediate breast reconstruction was done in only 25% of cases while secondary reconstruction is done in 38% of the cases and one case of Poland syndrome was treated in the same way (4%). Complications were 4.17% abdominal wound infection, 8.3% partial sloughing of the abdominal flap, 12.5% abdominal bulge and 4.17% abdominal hernia. We have not been encountered with any complication with the mesh as regard exposure or infection. Umbilical complications in the form of stenosis and infection have occurred in 3 cases (12.5%). We conclude that abdominal closure after TRAM flap utilization in breast reconstruction is dictated by the preoperative condition of the abdominal wall as myofascial release and approximation is possible in lax abdomens as the stretched fascia allows, while the use of synthetic mesh reinforcement is indicated tight abdomens to replace the fascia used in the flap.

INTRODUCTION

Breast reconstruction after mastectomy is becoming increasingly popular as surgical techniques improve, so patients achieve reconstructive results that allow them to live without handicaps or limitations caused by their disease [1]. The TRAM flap is used in breast reconstruction in patients undergoing modified radical mastectomy with very satisfactory results [2]. In one hand the abdomen as a donor site for this flap is improved as regard the concomitant benefit of abdominoplasty, but in the other hand it will be vulnerable to donor site morbidity. Hartrampf, one of pioneers of this technique, reported a very low complication rate by closing the abdominal wall without the use of prosthetic mesh. However, his results are not reproducible as numerous authors, following his technique, have reported abdominal hernias and started to use prosthetic reinforcement [3]. Kroll et al., [4] have studied the incidence of postoperative abdominal bulge, hernia and the ability to do sit-ups in a series of 268 patients who had undergone free TRAM or conventional TRAM flaps for breast reconstruction. They found out that the incidence of abdominal bulge and hernias were 3.8% and 2.6% respectively and he also found out that Synthetic mesh was required for reinforcement of donor site closure twice as often in the conventional TRAM patients than in the free TRAM patients. He also concluded that the incidence of abdominal bulge or hernia is relatively independent of the type of TRAM flap used and the number of muscle pedicles harvested. Another study reports 0% abdominal hernias and 10% epigastric bulge after TRAM flaps in 48.5 month follow-up period [5]. The concept of partially preserving the rectus abdominis muscle by splitting the muscle and leaving the lateral portion in situ as advocated by Hartrampf is theoretically attractive. If only part of the muscle is needed to maintain blood supply to the flap, it would seem reasonable to leave the remainder in place to preserve strength in the weakened abdominal wall. By splitting the muscle and using only the central or medial portion to supply blood to the flap, part of the muscle remains in situ. Thereby reducing the postoperative incidence of abdominal weakness, bulge and hernia. As evidence of the clinical effectiveness of this concept, Mizgala

et al., had reported a very low incidence of postoperative abdominal wall problems. Even though the muscle is deprived of its intercostal innervation by removal of the central portion (which presumably contains the motor end plates), it would not be unreasonable to think that some functional connections between the severed intercostal nerve endings and viable muscle tissue could become reestablished. This possibility was supported by Kroll et al. [6,7,8].

Abdominal compartment syndrome (ACS) is defined by the deleterious effects of intra abdominal hypertension on the pulmonary, cardiovascular, splanchnic, urinary and central nervous systems. Abnormal and sudden increase in the volume of any component of the intraperitoneal or retroperitoneal space occurring postoperatively causes intra-abdominal hypertension. Sustained intra-abdominal hypertension leads to ACS which if left unrecognized or untreated is always fatal. Measurement of urinary bladder pressure is the best validated technique for diagnosis of intra-abdominal hypertension. It should be used routinely for minimally invasive surveillance of intra-abdominal pressure if ACS is suspected [9].

Determinations of the bladder pressure represents an easy method for early recognition of ACS. Decompressive laparotomy should be performed with a bladder pressure 30 cm of water or more. Abdominal wall closure after transverse TRAM flap in breast reconstruction is often performed under considerable tension and may theoretically cause a component of ACS. A transient component of ACS does exist after TRAM flap breast reconstruction. Bipedicle flaps, nulliparous women and increased body mass index were considered risk factors for elevated intra-abdominal pressures while Tension-free mesh closure seemed to have a protective effect [10].

A study clearly demonstrated that there is a significant and persistent reduction in abdominal sensibility following TRAM flap surgery. The distribution of the deficits is consistent and involves the midline supraumbilical and infraumbilical regions [11].

PATIENTS AND METHODS

From March of 1999 to February of 2002, twenty four cases of breast reconstruction by TRAM flaps have been done by the authors. 6 cases were referred to the authors for management of unhealed mastectomy incisions due to either mastectomy flaps necrosis or due to severe infection with subsequent chronic ulceration of the wound and adherence to the underlying muscle. 2 cases was referred to manage radionecrosis of the wounds after overdose with radiation. While 15 patients requested breast reconstruction either primarily at the same sitting with the mastectomy operation (6 cases) or later on they came for secondary reconstruction (9 cases). One young lady 19 years old with Poland syndrome had the same procedure. We utilized the TRAM flap either as a unipedicled (16 cases) or as bipedicled flap (8 cases) for the reconstruction of the breast. We preferred the bipedicled TRAM flap in older patients or those who are diabetics to augment the blood supply of the flap, we had no patients who were smokers. Preoperative routine laboratory and radiological investigations and oncologic consultation were done for all patients before reconstruction. Preoperative and postoperative photography was done for all the patients showing the donor and recipient areas (Tables 1,2,3 and Charts 1,2).

Surgical technique:

Flap elevation:

The degree of preoperative abdominal wall laxity was determined preoperatively while the patient was standing, as well as the inframammary line which was recognized and marked preoperatively as an important landmark in reconstruction. The patient was placed in semisitting position with the knees slightly bent to facilitate abdominal closure. The recipient area was prepared by debridement or scar excision followed by undermining of flaps in secondary reconstruction. The amount of tissues required can be estimated. With a new sit of instruments to guard against possible implantation of tumor cells the abdominal skin was incised at its lower border down to the fascia, then the upper border was divided tangentially cutting obliquely in an upward direction to include as many perforators as possible but without hindering the blood supply of the abdominal flap. We have found out that intraoperative Doppler ultrasound probes were very helpful in many cases to determine and mark the perforating vessels to the rectus flap, which enabled us to spare as much as we can from the rectus sheath and facilitate abdominal closure. The wings of the ellipse-shaped flap were dissected from lateral inwards till 3

cm medial to the lateral edge of the rectus sheath where we can find the perforator vessels around the umbilicus. The abdominal flap was dissected upwards to the costal margins on the contralateral side and to the inframammary line in the ipsilateral side to create a tunnel for the flap to pass through. The rectus fascia was incised vertically about one to two centimeter lateral to the linea alba from the costal margin to the umbilicus. The anterior rectus sheath was cut around the flap on its undersurface. Taking care that this incision should be more lateral in lax abdomens where the linea alba is stretched and the rectus sheaths are laterally displaced especially in the center of the abdomen around the umbilicus. The umbilicus was circumscribed and separated. Then the muscle was dissected carefully by insinuating the hand below it and exposing its posterior surface where the epigastric vessels can be seen and this is elevated. The flap is separated from below by cutting the anterior rectus sheath and the muscle just above the lowermost tendinous intersection to prevent muscle retraction below and behind the pubis which well start abdominal weakness and possibly hernia. The flap was then transferred to the breast for reconstruction. We have paid more attention for fascial conservation than muscle sparing. In bilateral TRAM flap the same was done on the other side.

Abdominal closure:

This was divided into two groups according to the technique of abdominal closure:

Group 1 (6 cases): where direct abdominal repair was done without the use of mesh enforcement, this was done whenever there was preoperative abdominal wall laxity and rectus muscles diastasis. In these cases there were stretched linea alba and lateral displacement of the rectus sheaths and so abdominal closure is achieved better by using the available fascia to restore abdominal competence. This was done by straightforward direct repair of the anterior rectus sheath by approximating the lateral edge of the anterior rectus sheath after its release to the linea alba and the fascia deep to it. This midline fascia is accessible from inside the rectus sheath at the transition from anterior to posterior sheath near the midline it is very strong and resists tearing by the suture material. To include this fascia in the repair the needle tip was inserted just posterior to the reflection between anterior and posterior rectus sheaths, pass it through the fascia and exit anterior to it from the inner surface of the anterior sheath. This was done by continuous number one nylon sutures. The other anterior rectus sheath is plicated to balance the forces working in the abdomen and prevent shifting of the umbilicus (Figs. 1,2).

Group 2 (18 cases): whenever there was tight abdominal wall like in most nullipara or young ladies, trying to close the abdomen by the previous technique will not only be very difficult technically but also hazardous as this will cut through the tissues predisposing to hernias and bulge. Umbilical shifting also may occur due to inability to plicate the anterior rectus sheath in the other side of the abdomen. Also, the theoretical presumption of development of ACS in very tight closure has lead us to replace the same area of removed anterior rectus sheath with synthetic mesh. We have used the polypropylene mesh (Ethicon Co) universally in all these patients. Once the flap is used the mesh is held by hemostats and sutured to the remnants of the anterior rectus sheath. We keep the mesh always 1 cm larger than the defect of the sheath and fix it by continuous number 0 nylon running sutures. This running sutures in our opinion well act as a purse string during instances of increased intra-abdominal pressure like coughing (Figs. 3-7).

In both groups after reconstruction of the myofascial layer we did the umbilicoplasty by coring it out through circular incision in the abdominal flap after determining its position central and at the level of iliac crests like in abdominoplasty. This has led to constriction and stenosis of the umbilical scar in some cases. So, in the last ten cases we did the V-umbilicoplasty through a V incision of the abdomen which is turned to Y by abdominal stretch in downwards direction and inserting the V flap in a notch in the umbilical stump. Suction drains were applied and the incisions were closed in layers. Postoperative abdominal binders were used for 2 months.

Measurement of the intra abdominal pressure (IAP) was done in all patients by insertion of Foley catheter. 100 ml of sterile saline was injected into the empty bladder through the catheter and a T-piece connector was attached between the catheter and the drainage bag. Water manometer was used to measure IAP. With the patient in the supine position, the zero reference point was the symphysis pubis and the height

of the water column above this point represented IAP in centimeters of water [12].

RESULTS

Evaluation of the abdominal wall integrity after using the TRAM flap for breast reconstruction was done in all the cases by examining the patients in the early and late postoperative follow up visits and assessment of their postoperative photographs. The follow up ranged between 4 months to 30 months. Early complications like wound infection of the abdominoplasty incision has occurred in one case (4.17%) and resolved completely on antibiotics. Sloughing of the abdominal flap has occurred in 2 cases (8.3%) in one case skin graft was required to coverage the raw area, this lead to ugly abdominal scar (Figs. 8,9). This occurred in the diabetic patient who had wound dehiscence after mastectomy indicating compromised wound healing. While in the other case the indurated lower abdominal flap is repeatedly curetted and left to heal spontaneously.

Seroma of the abdominal wall occurred in 2 cases (8.3%) and managed by repeated aspiration and antibiotics. ACS has not been detected in any of our cases by monitoring of the intra abdominal pressure through urinary catheter as the pressure was not exceeding more than 30 cm of water (Table 4). We have not seen any complications with the mesh which was used in 18 cases (10 unipedicled and 8 bipedicled TRAM). Late complications as abdominal weakness leading to lower abdominal bulge has occurred in 3 cases (12.5%). While true abdominal hernias occurred in one case (4.17%) after bilateral TRAM and mesh application and the hernia involved the lower abdominal wall and necessitated repair by another prolene mesh application. Umbilical complications has occurred in 3 cases in the form of necrosis in one case and umbilical scar stenosis in 2 cases which required repeated dilatation to prevent its contraction (12.5%). This could be avoided in last 10 cases by the new method of V-umbilicoplasty. We have been encountered with 2 cases of ugly abdominal scars, one case due to severe sloughing of the abdominal flap and subsequent skin graft and another due to hypertrophic scar formation (Table 4). Abdominal sensation to superficial touch is affected in all cases and involved the suprapubic, umbilical and frequently the epigastric regions. This was improved in the epigastric region by 6 months. 19 patients were satisfied with the cosmetic outcome of their abdomens, while 5 patients were not happy with the abdominoplasty incisions or the abdominal weakness or hernia they have developed.

Table (1): Late abdominal complications after unipedicled or bipedicled TRAM flap for breast reconstruction after abdominal wall closure with or without synthetic mesh reinforcement.

Case number	Age	Type of TRAM bipedicle or unipedicle	Mesh closure of abdominal wall defect	Abdominal bulge	Abdominal hernia	Umbilical complications	Ugly abdominal scar
1	33	Unipedicle	+	-	-		-
2	35	Unipedicle	+	-	-	-	-
3	41	Bipedicle	+	-	-	-	-
4	35	Unipedicle	+	-	-	Stenosis	-
5	44	Bipedicle	+	-	-	Necrosis and disappearance	++
6	56	Unipedicle	-	+	-	-	-
7	43	Bipedicle	+	-	-	-	-
8	41	Unipedicle	+	-	-	-	-
9	19	Unipedicle	-	-	-	-	-
10	43	Unipedicle	-	-	-		-
11	58	Bipedicle	+	-	+	-	-
12	54	Unipedicle	+	-	-	Stenosis	-
13	47	Bipedicle	+	-	-	-	+
14	42	Unipedicle	+	-	-	-	-
15	34	Unipedicle	+	-	-		-
16	49	Bipedicle	+	-	-	-	-
17	40	Unipedicle	+	+	-	-	-
18	39	Unipedicle	+	-	-		-
19	36	Unipedicle	-	+	-		-
20	56	Bipedicle	+	-	-	-	-
21	62	Bipedicle	+	-	-	-	-
22	35	Unipedicle	-	-	-	-	-
23	34	Unipedicle	+	-	-	-	-
24	32	Unipedicle	-	-	-		-

Table (2): Number of patients with unipedicled and bipedicled TRAM flaps.

Total number of cases	Number of unipedicled TRAM	Number of bipedicled TRAM
24	16	8

Table (3): Number of patients according to the type of breast reconstruction.

Method of reconstruction in the 24 patients	Primary reconstruction	Secondary reconstruction	Poland syndrome	Radionecrosis	Complicated mastectomy wound
	6	9	1	2	6

Table (4): Number of cases with early and late abdominal complications after TRAM flaps.

Abdominal complications	Early complications				Late complications		
	Wound infection	Skin sloughing	Seroma	ACS	Bulge	Hernia	Umbilical complications
	1 (4.17%)	2 (8.3%)	2 (8.3%)	0 (0%)	3 (12.5%)	1 (4.17%)	3 (12.5%)

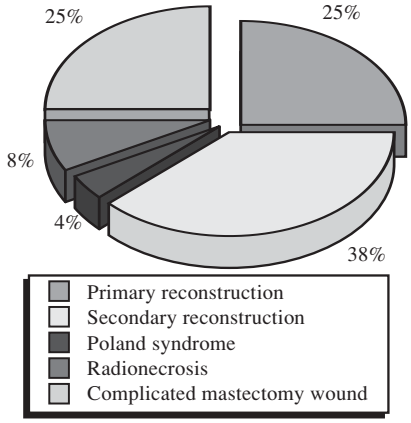

Chart number (1): Percentage of patients according to the presentation.

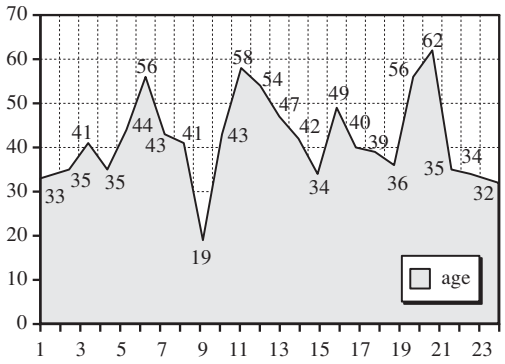

Chart number (2): Age distribution of patients with breast reconstruction.

Fig. (1): Patient after modified radical mastectomy with lax abdominal wall.

Fig. (2): Same patient after reconstruction of the breast after TRAM flap and abdominal wall repair by direct myo-fascial approximation.

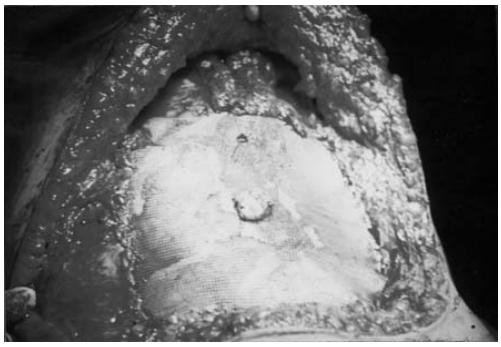

Fig. (3): Abdominal wall repair by replacing the abdominal fascia with prolene mesh.

Fig. (4): Patient after breast reconstruction with TRAM flap and abdominal wall repair with prolene mesh reinforcement.

Fig. (5): Patient with mastectomy wound dehiscence with failure of secondary tension sutures.

Fig. (6): Same patient after breast reconstruction with bipedicled TRAM flap and abdominal wall repair with prolene mesh reinforcement.

Fig. (7): Lateral view of the same patient.

Fig. (8): Diabetic patient with mastectomy wound dehiscence due to sloughing of the mastectomy flaps.

Fig. (9): Same patient after breast reconstruction with TRAM flap complicated by infra umbilical abdominal skin sloughing and grafting.

DISCUSSION

The chief disadvantage of the TRAM flap is its potential for creating weakness in the abdominal wall [2,6]. Although most patients tolerate the loss of these muscles without difficulty, some do not. Complaints of abdominal weakness, bulging (stretching out of the lower abdominal fascia without true hernia formation) and true hernias were encountered by many surgeons who perform the TRAM flap procedure. The concept of partially preserving the rectus abdominis muscle by its splitting and leaving the lateral portion in situ, as advocated by Hartrampf, is theoretically attractive. If only part of the muscle is needed to maintain blood supply to the flap, it would seem reasonable to leave the remainder in place to preserve strength in the weakened abdominal wall. Those who perform the operation in this way believe that the preserved muscle will continue to function and will improve the strength and integrity of the abdominal wall, thereby reducing the postoperative incidence of abdominal weakness, bulging and hernia. As an evidence of the clinical effectiveness of this concept, Mizgala et al., have reported a very low incidence of postoperative abdominal wall problems [8]. While Kroll et al., have concluded that the lowest incidence of hernia and abdominal wall bulge occur in patients with anatomical repair [7]. Drever et al., have stressed upon the fact that surgeons have to reestablish the function of the anterior abdominal wall by regaining the same widths and lengths of fascia removed with the rectus abdominis muscle by replacing this structure with a synthetic mesh claiming that repairing the area below the semicircular line of Douglas is not enough as hernias can occur in the upper abdominal part, also the pull of the lateral edge of the remaining anterior rectus sheath on the removed side and suturing it to the edge of the linea alba will distort the abdominal midline and shift the umbilicus to the same side. Their opinion again is criticized by Hartrampf who indicated that available tissue repair is almost possible if a muscle and sheath sparing technique is followed. As a prove of the effectiveness of this repair he reported only one hernia in 145 cases of unipedicled TRAM and 55 cases of bipedicled TRAM flaps without mesh application (78%). He had recorded that the incidence of using the mesh in his series of the bipedicled TRAM flaps is only 22%. Also, he adviced plication of the anterior rectus sheath in the contralateral side to balance the forces on the abdomen [13], however, Hartrampf results could not be reproduced [3]. In our study we have proposed that the most important determining factor in whether to use the mesh or the available myofascial tissues for the repair is the preoperative condition of the anterior abdominal wall. If the abdominal wall is lax with diastasis of the recti and stretch of the fascial layers, then the abdominal wall repair can be done easily by using the available myofascial layers without difficulty in addition to plication of the contralateral anterior rectus sheath to prevent unbalancing of the abdomen and shifting of the umbilicus toward the ipsilateral side of the flap. Those are the patients who are candidates for abdominoplasty so there is no point of denying them the benefits of the myofascial excision and plication even if a lateral myofascial release is needed as a modification of the "component separation method" described by Ramirez et al. [14,15]. In patients with no abdominal wall laxity or diastasis of the recti like most of young ladies and nullipara, myofascial release and plication will not be only difficult but hazardous due to repair under tension, which eventually leads to complications as hernia, bulging and postoperative pain, in addition to the possible occurrence of the theoretical previously unrecognized ACS.

In our study the intra-abdominal pressure has not increased more than 24 cm of water (normally should not exceed 30 cm of water). We have used the mesh in 18 cases (10 unipedicled and 8 bipedicled TRAM). We had a total of 12.5% abdominal bulge and 4.17% abdominal hernia with no recorded complication in the mesh group as regard exposure or infection. In the mesh group we had 4.17% bulge and 4.17% hernia compared to 4% bulge and 0% hernia by Drever et al. [13]. While in the group of patients with direct fascial repair we recorded 8.35% abdominal bulge and 0% hernia, compared to 43% abdominal weakness, bulging and hernia after myofascial closure without mesh by Drever et al. [13]. Contrary to this Hartrampf reported a single lower abdominal hernia in 145 cases (0.7%) of unipedicled TRAM flaps without mesh utilization. Kroll et al., have reported 33% to 40% abdominal wall weakness and bulge after myofascial closure without prolen mesh application [7]. We propose that the aim should be a tension-free repair with correction of abdominal wall weakness if needed, so application of a mesh in a pendulous abdomen is neither logic nor cosmetic, while direct abdominal repair under tension to avoid the application of the safe synthetic mesh is not convincing.

Umbilical complications like stenosis and infection have occurred in 3 cases (12.5%). Prevention of stenosis of the umbilical scar was possible in later cases by the use of the new technique of umbilicoplasty described by Ramirez [14]. In our study we have found out that 33% of the patients presented to us were complaining of either complicated mastectomy wound (25%), or radionecrosis (8%). Reconstruction of the breast after complicated mastectomy wound is associated with higher complications of the donor site due to two factors, first the presence of ulceration, infection and radionecrosis of the mastectomy wound may complicate the abdominal repair especially if synthetic mesh is applied, second the fact that patients with complicated mastectomy wound may be originally have compromised wound healing due to lowered immunity or diabetes. We are reporting 4% abdominal wound infection and 8.3% partial sloughing of the abdominal flap which required skin graft in one case (4.1%). Perhaps if we do more primary reconstructions these results could be improved.

We conclude that TRAM flap is still the best method for autologous repair of the breast, its donor site which is the abdominal wall should not be thought of as a morbidity but as an additional advantage which the patient can win in addition to breast reconstruction. This can be made possible by proper understanding of its condition preoperatively.

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