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Reconstruction of total pelvic exenteration defects with rectus abdominus myocutaneous flaps versus primary closure

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Abstract

BACKGROUND: Total pelvic exenteration (TPE) is reserved for patients with locally invasive and recurrent pelvic malignancies. Complications such as wound infections, dehiscence, hernias, abscesses, and fistulas are common after this procedure. The purpose of this study was to determine whether tissue transfer to the pelvis after TPE decreases wound complications.

METHODS: Fifty-three patients who underwent TPE between 2004 and 2010 were reviewed. Two groups were identified, those who underwent pelvic reconstruction with a vertical rectus abdominus myocutaneous flap (n = 17) and those who underwent primary closure (n = 36). Demographics, clinicopathologic characteristics, and outcomes were compared.

RESULTS: The 2 groups were similar in demographics and histopathologic characteristics. Preoperative and surgical factors including comorbidities, nutrition, radiation, surgical times, blood loss, length of stay, and complications were similar between the groups. Of the 17 patients undergoing vertical rectus abdominus myocutaneous flap placement, complications were seen in 11 patients (65%), with most of them stemming from flap dehiscence (n = 7).

CONCLUSIONS: In our study, the transfer of tissue into the pelvis did not increase surgical times, blood loss, length of stay, or wound complications.

Total pelvic exenteration (TPE) is a radical surgery that has been applied to the treatment of varying pelvic malignancies. Most often performed for gynecologic malignancies, its use has been documented in colorectal and urologic malignancies.[1,2] This surgery also is used for recurrences of disease and complications secondary to radiation therapy. Since its description by Brunschwig[3] in 1948, advancements in anesthesia, surgical technology, and perioperative care have decreased the mortality associated with TPE, but morbidity rates remain persistently high. The morbidity of this procedure stems from the normal physiological response to a prolonged surgery, as well as from patients' previous therapies, nutritional status, and extent of resection.

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TPE is a consideration for patients with locally advanced disease with a potential for cure, metastatic disease with pelvic symptomatology, and nonhealing wounds causing significant morbidity and affecting quality of life. With this in mind, the goal of a TPE is to attempt to cure when the disease is localized to the pelvis and to palliate in all the other cases when other therapies have failed. Despite this aggressive therapy, the 5-year survival rates after total pelvic exenteration for primary disease range from 30% to 77%[1,4–11] and for recurrent disease range from 6% to 31%.[1,6,7,12,13] In addition to poor overall survival, morbidity rates have been as high as 78% in some series.[1,4–6,8,10,11,13–18]

The treatment effect of therapies directed toward cure or palliation of pelvic carcinomas is many times toxic and can cause multiple complications. The example of radiation therapy to the pelvis shows this balance. Radiation therapy is helpful for local control of many of the pelvic carcinomas, whether preoperatively, intraoperatively, or postoperatively. However, adverse effects on healing can cause significant morbidity for patients.[15,19] Jakowatz et al[15] found that patients receiving pelvic radiation before exenteration had a significantly higher complication rate (67%) compared with those who did not receive radiation (26%). Colorectal, plastic surgical, and gynecologic literature have shown that use of myocutaneous flaps can provide well-vascularized, nonirradiated, healthy tissue to aid in the closure of the perineum after radiation and surgical resection.[20–32] The data have focused mainly on less radical surgeries that create smaller defects, such as abdominoperineal resections (APR) and vaginal resections.[21–25,27–32] However, few reports discuss the role of myocutaneous flaps for larger multivisceral resections.[20,26–28] This study specifically compares patients undergoing total pelvic exenteration with myocutaneous flap reconstruction with patients undergoing total pelvic exenteration with primary closure (PC). The purpose of this study was to review our institution's experience with the use of vertical rectus abdominus myocutaneous (VRAM) flaps in conjunction with TPE to determine if its use decreased wound complications when compared with primary closure.

Methods

Between January 2004 and August 2010, there were 53 patients who underwent TPE at our institution for advanced primary, recurrent, or suspected pelvic malignancies. Complete information and long-term follow-up evaluation were available for all patients. After obtaining permission from The Ohio State University Institutional Review Board, we retrospectively reviewed the medical records of these patients.

Demographics, periprocedural events, and outcomes were compared between the TPE patients undergoing reconstruction with a VRAM flap and those undergoing standard PC. Selection of patients for the VRAM group was based on the absence of bilateral abdominal wall violation from the placement of previous ostomies and the presence of patent inferior epigastric vessels on preoperative evaluation. Demographic data included age, sex, and comorbidities. Significant comorbidities included factors that affected healing such as diabetes mellitus (DM), peripheral vascular disease, hypertension, chronic obstructive pulmonary disorder, chronic corticosteroid use, and presence of renal insufficiency.

Preoperative factors such as previous chemotherapy, presence of fistulas, albumin levels, and radiation therapy were included in the analysis. Overall morbidity was defined as complications related to wound infection, wound dehiscence, abscess formation, enteric fistulas, deep venous thrombosis, urinary tract infection, small-bowel obstruction, and ventral hernia formation. Outcomes data focused on surgical times, length of stay, morbidity, and mortality. Surgical and pathology reports were reviewed to analyze surgical times and blood loss, and to confirm pathologic diagnosis.

Descriptive statistics were calculated to summarize the data. Comparisons of continuous variables were made by the Student *t* test for paired groups and a nonparametric alternative (Wilcoxon rank-sum test) for data not distributed normally. For discrete data, contingency table analysis (chi-square and the Fisher exact test) was used when appropriate. Statistical significance was accepted at a *P* value of less than .05 and analysis was performed with SPSS statistics 17.0 (SPSS, Inc, Chicago, IL).

Techniques

All patients underwent a preoperative computed axial tomography with intravenous contrast to verify the patency of the inferior epigastric vessels. Preoperative marking identified the area of planned VRAM flap harvest and confirmed the location of ostomy placement on the contralateral rectus abdominus muscle.

After TPE was performed, fecal and urinary diversion was performed via the construction of a double-barreled wet colostomy[33,34] or an ileal conduit.[35] The vertical rectus abdominus myocutaneous flap then was raised. A rectangular skin paddle was centered over the rectus muscle in a vertical fashion, generally measuring 15 to 20 cm in length and 5 to 8 cm in width. The skin and subcutaneous tissues were dissected to the level of the anterior rectus sheath. The subcutaneous tissues then were dissected away from the fascia until the medial and lateral rows of perforating vessels entering the deep surface of the skin paddle were identified. Fascial preservation was the preferred method and entailed sacrificing the less dominant row of perforators. Such methodology allowed for lower tension closure of the anterior rectus fascia after the flap was harvested. The fascia then was divided and the rectus muscle was divided

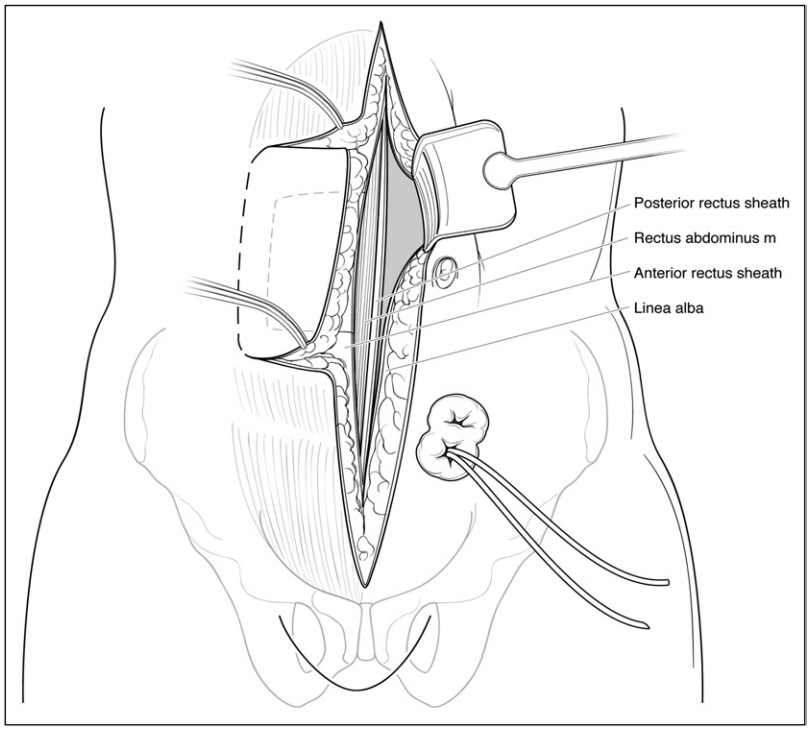

Figure 1 Vertical rectus abdominus flap harvest with a double-barreled wet colostomy brought through the contralateral side.

cephalad to the perforating vessels and raised from the posterior sheath toward its insertion at the pubis (Fig. 1).[36] The flap then was rotated into the pelvic defect (Fig. 2).

Results

Fifty-three patients underwent TPE; 17 patients (32%) underwent a VRAM flap for pelvic reconstruction and 36 patients (68%) underwent PC. The median age of the patients in the flap group was 62 years (range, 38–72 y) and 55 years (range, 40–80 y) in the standard primary closure group. The 2 groups were similar in terms of demographics, preoperative serum albumin levels, and the administration of preoperative radiation therapy (Table 1). The mean duration of follow-up evaluation was 11.5 months. The duration of the follow-up period ranged from 1 to 60 months.

The mean surgical times were 601 ± 165 minutes for the VRAM group and 530 ± 136 minutes for the PC group ($P = .11$). The mean length of stay was 19 ± 7 days for

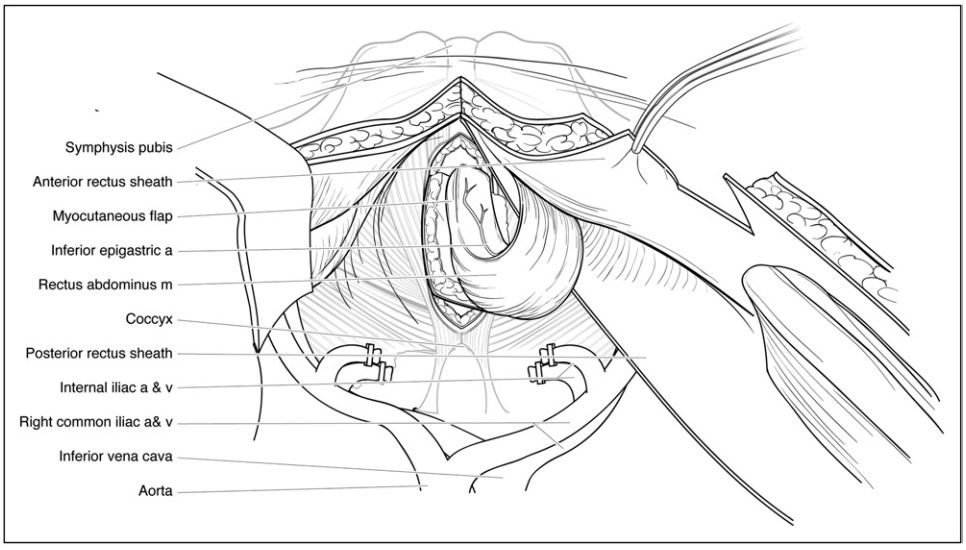

Figure 2 The VRAM flap is rotated into the pelvic defect created from the total pelvic exenteration so the flap skin can be sutured to the skin surrounding the perineal defect.

VRAM patients and 16 ± 11.7 days for patients with primary closure (P = .33). The most common pathology encountered in patients undergoing TPE was advanced or recurrent colorectal cancer (n = 36; 68%). Other pathologies included gynecologic (n = 6; 11%), urologic (n = 5; 9%), sarcomatous (n = 3; 6%), and anal (n = 2; 4%) malignancies, as well as 1 patient with severe infection (2%).

Thirty-seven (70%) patients underwent preoperative radiation, including 24 (67%) in the PC group and 13 (76%) in the VRAM group. A majority of patients received preoperative radiation at outside institutions and subsequently were referred to our institution for surgical intervention. Preoperative radiation doses were available for 23 of the 37 patients. In the VRAM group, the 10 patients for whom data were available received a mean dose of 5,254 cGy preoperatively. Dose data were available for 13 of the 24 patients in the PC group. They received a mean dose of 5,696 cGy preoperatively.

Overall complication and perioperative mortality rates were similar in both groups (Table 2). An examination of complications directly related to pelvic exenterations was performed in the VRAM and PC groups. Seven patients (41%) in the PC cohort and 15 patients (42%) undergoing VRAM flap reconstruction developed wound infections (P = .77). Superficial abdominal wound dehiscence was seen in 6 patients (35%) in the VRAM group and in 5 patients (14%) in the PC group (P = .14).

There was no significant difference between the 2 groups with respect to pelvic and perineal abscesses. Enterocutaneous fistulas developed in 3 patients (18%) in the VRAM group and 1 (31%) in the primary closure group. Two patients (12%) undergoing reconstruction with a flap developed deep venous thromboses, compared with 6 patients (17%) undergoing standard closure. There were 14 hernias in the VRAM group (82%), in comparison with 24 (67%) in the PC group (Table 2). No perioperative mortality existed in either group.

A focused examination on flap complications showed flap loss in 2 patients (12%), 1 of whom required a reoperation for repair. Flap dehiscence developed in 7 patients (58%). Six of these were partial (compromising <50% of the flap circumference), and 1 patient had a complete dehiscence of the flap. The patient with the complete dehiscence was treated successfully with a Vacuum Assisted Closure (Kinetic Concepts, Inc., San Antonio, TX) device and the patients with partial flap dehiscence were treated with local wound therapy. Overall, 65% of patients within the VRAM group had a flap complication (Table 3).

Table 1 Patient demographics and clinical characteristics of 53 patients undergoing total pelvic exenteration with PC or VRAM

Characteristics	PC (n = 36)	VRAM (n = 17)	P value
Median age, y (range)	55 (40–80)	62 (38–72)	.56
Sex, M:F	18:18	3:14	.03
Comorbidities	21 (58%)	8 (47%)	.56
Surgical time, min (±SD)	530 ± 136	601 ± 165	.11
Estimated blood loss, L (±SD)	2.4 ± 1.8	1.6 ± .8	.12
Mean length of stay, d (± SD)	16 ± 11.7	19 ± 7	.33
Median preoperative albumin level, g/dL (range)	3.7 (1.2–4.6)	3.4 (1.1–4.4)	.06
Preoperative radiation therapy	24 (67%)	13 (76%)	.54
Intraoperative radiation therapy	14 (39%)	6 (35%)	1.0

Table 2 Outcomes after PC or VRAM flap after total pelvic exenteration

Complication	PC (n = 36)	VRAM (n = 17)	P value
Overall	25 (69%)	15 (88%)	NS
Abdominal wound infection	15 (42%)	7 (41%)	.77
Abdominal wound dehiscence	5 (14%)	6 (35%)	.14
Perineal abscess	8 (22%)	2 (12%)	.47
Pelvic abscess	18 (47%)	8 (47%)	1.0
Enterocutaneous fistula	11 (31%)	3 (18%)	.5
Deep venous thrombosis	6 (17%)	2 (12%)	1.0
Urinary tract infection	13 (36%)	3 (18%)	.21
Small-bowel obstruction	8 (22%)	1 (6%)	.24
Ventral hernia	24 (67%)	14 (82%)	.35
Morbidity	25 (69%)	15 (88%)	.18
Mortality	0 (0%)	0 (0%)	1.0

NS = not significant.

Comments

Large perineal wounds are difficult problems that surgeons encounter when caring for patients with locally inva-

Table 3 VRAM flap complications

Complication	Number of patients (%)
Flap loss	2 (12)
Epidermolysis	0 (0)
Abdominal wall infection/seroma	0 (0)
Flap dehiscence	7 (58)
Perineal abscesses	2 (12)
Total	11 (65)

sive or recurrent pelvic malignancies. Previous attempts at resection and the use of multimodality treatment including radiation and chemotherapy make further surgical interventions more difficult and extensive. Upon completion of the surgery, either by way of an abdominoperineal resection or total pelvic exenteration, the remaining defect poses healing problems and increased complication rates. Colorectal and plastic surgery literature have shown that the use of well-vascularized, nonirradiated tissue can fill the defect that is present after an APR or vaginectomy and provide healthy tissue to promote healing.[20–32] Defect sizes after these procedures have not been described consistently and the maximum extent of a defect size that can be reconstructed successfully with transfer of tissue is not clear in the literature. To a lesser degree, the focus of how tissue affects larger defects has been addressed by certain investigators.[15,20,26-28] Khoo et al[20] found that after preoperative radiation, the use of immediate tissue transfer for pelvic defects after both APR and multivisceral resection significantly improved morbidity compared with those patients who underwent primary closure. Similarly, the series by Jakowatz et al[15] showed about half as many complications in patients who underwent preoperative radiation and pelvic reconstruction after anterior, posterior, and complete pelvic exenteration compared with those who did not undergo reconstruction. However, various methods of reconstruction—omental, colonic advancement, and myocutaneous flaps—were used and it was not specified which method was used or which type of exenteration was performed in each case, making this difficult to interpret for comparison.

Our patient population varied from other series in that several malignancies that required TPE were examined, not just colorectal cancer. Each malignancy had a different tumor biology, some more aggressive than others, and most presented with advanced disease. The surgeries were coordinated by the division of surgical oncology with assistance from the divisions of gynecologic oncology and urology, depending on the referral pattern. A majority of these cases were performed by a single surgical oncologist with assistance from both plastic surgery and gynecologic oncology teams for myocutaneous flap placement. During the fifth year of the study period, the introduction of highly skilled plastic surgery faculty members that focused on oncologic reconstruction and chronically draining wounds changed the manner in which these defects had been addressed. The plastic surgery department further expanded the following year, and all patients are now evaluated for flap placement as long as their rectus muscles are intact and have had no previous surgical manipulation.

In our series, the most common pathology in patients undergoing TPE was locally advanced or recurrent colorectal cancer (n = 36; 68%). Other indications for TPE included gynecologic, urologic, sarcomatous, and anal malignancies, as well as severe infection. With this variation in histology it is difficult to ascertain whether complications arise from treatment therapies, tumor biology, or from technical considerations.

The administration of neoadjuvant chemoradiation therapy is one of the most important factors affecting wound healing. Radiation therapy, by direct or indirect ionization, targets rapidly dividing cells in both normal and cancerous tissues. This leads to unstable bonds within the tissue, ultimately hampering the regenerative process and affecting wound healing. Bullard et al[37] described 160 patients who underwent an APR with primary closure of the wound over a 14-year period. Of these, 117 patients received preoperative radiation therapy. The patients who received preoperative radiation showed an overall wound complication rate of 41%, which was significantly higher than in the patients not undergoing preoperative treatment. In our study, 37 patients (70%) underwent preoperative radiation therapy and 20 (38%) underwent intraoperative radiation therapy. VRAM and PC patients did not statistically differ in the percentage of patients undergoing radiation therapy. However, the large number of patients receiving preoperative radiation therapy coupled with larger defects may provide insight as to why our complication rates overall and with VRAM flap placement are so high.

Preoperative conditions and technical issues play a role in healing and decreasing surgical complications. Our cohort of patients had significant underlying comorbidities related to healing. Four patients in the VRAM group had chronic steroid use and 1 patient had DM. In the PC group, there were 4 patients with DM and only 1 patient using steroids chronically. The presence of these comorbidities and others could impair further wound healing in a previously irradiated area.

Our study showed overall complication rates of 69% in PC patients and 88% in VRAM patients. In our cohort, we included any complication that caused an increase in hospital length of stay, interventions, or administration of further care outside of normal to treat an underlying problem associated with the surgery. As seen with our wide criteria for complications, morbidity related to VRAM flap placement in the pelvis was investigated in a similar manner. Any complication relating to the abdominal wall, pelvis, perineum, and flap location was designated a morbidity. By aggressively searching for complications, we likely overestimated overall complications. This could explain the discrepancy seen in complication rates when compared with other series. Overall complication rates after VRAM flap placement range from 22% to 72%,[23,26–32] although some studies did not characterize morbidities other than those related to the flap donor site or recipient site. Our VRAM group showed an overall flap complication rate of 65%.

The most common postoperative complications included wound infections, wound dehiscence, hernias, abscesses, and fistulas, all of which are challenging to manage in this patient population. Perineal complications are some of the most difficult, with chronic abscesses, draining wounds, and

fistulization to the perineum accounting for the main sources of patients' discomfort and complaints.

Abdominal wound complications were seen commonly in patients undergoing TPE. The prolonged surgical time, traction on tissues, and number of repeat laparotomies may be predisposing factors for developing these complications. However, our analysis revealed that an equal number existed between the groups. All wound infections were treated by opening the wound and aggressive local management. None of the wound infections required surgical intervention.

Development of abscesses comprised a significant percentage of the morbidity suffered in this overall cohort; however, there were no significant differences between the VRAM and PC groups with respect to rates of pelvic and perineal abscess formation. Inadvertent enterotomies, radiation damage to bowel preventing healing, multiple bowel resections, and technical considerations may have led to the development of these complications. All pelvic abscesses were treated with radiographic-guided percutaneous catheters and antibiotics. None required surgical intervention. Perineal abscesses were treated with local incision and drainage with aggressive wound care management.

The percentage of deep venous thromboses seen in our population were similar to those described in patients undergoing pelvic surgery.[22,38] The prolonged surgical time as well as patient positioning likely factor into their development. However, in our cohort the incidence between the 2 groups was similar.

The size of the defects in TPE patients is significantly larger than that seen in APR patients, although not reported consistently or systematically in the literature. A study by Glatt et al[39] investigated VRAM flap reconstruction of large defects created by partial sacrectomy in a series of 12 patients followed up over a 14-year period. It analyzed the efficacy of the procedure and outcomes, with a main focus on the presence of flap necrosis as a complication. Twenty-five percent of these patients developed flap necrosis, of which 66% required debridement. However, in the discussion of outcomes, wound infections, abscesses, dehiscence, and ventral hernias were not included as potential morbidities.

Buchel et al[21] thoroughly discussed complications present in the use of VRAM flaps for pelvic reconstruction. Their group retrospectively reviewed 73 patients over a 5-year period who underwent reconstruction to treat perineal wounds caused by surgery for various pelvic pathologies, most of which were anorectal carcinomas. Their data showed a complication rate of 22%, which consisted of flap loss, epidermolysis, abdominal wall infection/seroma, flap dehiscence, pelvic abscess, retained drain, and internal hernia. Despite these complications, the use of nonirradiated muscle bulk and skin to irradiated defects has a clear benefit in wound healing. We hypothesize the same is true for our patient population after TPE, but our study was underpowered to show any clear advantage of the use of VRAM flaps for reconstruction of pelvic defects.

This study suggests that at our institution the use of VRAM flaps for closure of pelvic defects after TPE is not associated with increased surgical time, blood loss, length of stay, or wound complications. The limitations of this study include the disadvantages associated with a retrospective study, the small sample size, samples that were not case-matched, and the inability to establish cause and effect. We hoped to show decreased wound complications after tissue transfer in TPE patients, similar to what has been shown in the colorectal literature. However, the larger defects compared with abdominoperineal resection, varying pathologies, and multiple previous surgeries in our cohort likely contributed to the overall higher rate of complications compared with other series of patients undergoing VRAM flap reconstruction. Future studies will randomize patients prospectively and follow their outcomes to draw definitive conclusions about the benefits, if any, of VRAM flap reconstruction in patients undergoing total pelvic exenteration.

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