Hypotheses: Vertical rectus abdominus myocutaneous flap reconstruction facilitates healing within the irradiated pelvis and preserves the possibility of subsequent sexual function in patients with colorectal cancer who require partial or complete resection of the vagina.

Design: A retrospective review of a consecutive series of patients.

Setting: A tertiary referral center.

Patients: All patients undergoing surgical treatment of locally advanced or recurrent colorectal cancer and vertical rectus abdominus myocutaneous flap reconstruction of the vagina.

Intervention: Vertical rectus abdominus myocutaneous flap reconstruction.

Main Outcome Measures: Operative feasibility, complications, and sexual function.

Results: Twelve patients underwent extended resection for primary locally advanced or recurrent colorectal cancer including total or near total vaginectomy. Median age was 47 years. Tumors included 9 rectal adenocarcinomas, 2 anal squamous cell carcinomas, and 1 recurrent cecal adenocarcinoma. Surgical procedures included 8 abdominoperineal resections with posterior exenteration; resection of pelvic tumor and partial vaginectomy in 2 patients with previous abdominoperineal resection; 1 total exenteration; and 1 total proctocolectomy with posterior exenteration. The average operative time for tumor extirpation, irradiation, and reconstruction was more than 9 hours and all patients required blood transfusions. Despite 2 patients having superficial necrosis and 4 having mild wound infections, no patient required reoperation and all achieved complete healing. Five patients reported resuming sexual intercourse.

Conclusions: The vertical rectus abdominus myocutaneous flap can be successfully used for vaginal reconstruction following resection of locally advanced colorectal cancer. It provides nonirradiated, vascularized tissue that fills the pelvic dead space, allows for stomal placement, and provides a chance for sexual function.

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METHODS

We reviewed all patients undergoing VRAM flap for vaginal reconstruction concurrent to pel-
vic resection for locally advanced primary or locally recurrent colorectal cancer between 1994 and 1998. Patients with primary gynecologic malignancies were not included. Patient medical records were reviewed to establish operative and cancer details, preoperative and intraoperative therapies, postoperative complications, sexual activity, and follow-up.

SURGICAL TECHNIQUE

The extensive tumor resection involved a partial or total vaginectomy, requiring reconstruction. The technique of the distally based VRAM flap has been described both anatomically and clinically.8,9 Briefly, the flap extends vertically from the costal margin to below the umbilicus and includes the skin, subcutaneous tissue, anterior rectus sheath, and rectus abdominis muscle. The skin ellipse measures approximately 15 cm × 9 cm and incorporates the midline incision (Figure 1). The inferiorly based rectus muscle is released from the costal margin and dissected distally to its insertion on the pubic bone. At all times, the vascular pedicle, the inferior epigastric artery, is preserved and the flap checked for viability. The muscle is isolated on its insertion into the pubic bone and the pedicle skeletonized to allow for rotation into the pelvis without tension or kinking. To prevent a potential vascular stricture, the peritoneum is incised at the point where the muscle is rotated into the pelvis. When total vaginectomy is performed, a neovagina is created by inverse tubing of the skin paddle (Figure 2), which is transposed into the pelvis and anastomosed to the vaginal cuff (Figure 3). When reconstruction of the posterior vaginal wall is necessary, the flap is sutured to the anterior vaginal wall, with the cephalad portion becoming the new introitus (Figure 3 inset). The rectus fascia below the umbilicus is preserved, allowing for stomal placement and preventing hernia formation. The posterior rectus sheath above the umbilicus is approximated to the contralateral anterior fascia without the aid of synthetic mesh. The cutaneous donor site is closed directly and incorporated into the laparotomy incision.

RESULTS

Twelve patients underwent the VRAM flap procedure for vaginal reconstruction during the study period. The median age was 47 years (range, 29-68 years). Eight patients had recurrent and 4 had locally advanced primary colorectal cancer. Tumors included rectal adenocarcinoma (n=9), anal squamous cell carcinoma (n=2), and pelvic recurrence of cecal adenocarcinoma (n=1). For the 8 patients with recurrent cancer, this was the first recurrence in 7 and the second recurrence in 1. Previous operations in those 8 patients included low anterior resection (n=3), abdominoperineal resection (n=1), total proctocolectomy and Brooke ileostomy (n=1), Hartmann procedure (n=1), right hemicolectomy (n=1), and diverting colostomy (1 patient with anal cancer and anovaginal fistula treated with chemo-

Figure 1. The myocutaneous flap and associated skin paddle are raised and include the anterior fascia of the rectus sheath. The blood supply is provided by the inferior epigastric artery. Copyright 2001, Mayo Clinic, Rochester, Minn.

Figure 2. The myocutaneous flap is spiraled into a neovagina around a mold or stent and closed using interrupted sutures. Copyright 2001, Mayo Clinic, Rochester, Minn.

Figure 3. The flap is delivered through the pelvis to the perineal defect. Care is taken to avoid stretch or torsion on the inferior epigastric blood supply. Inset, The skin paddle is secured with interrupted sutures to the anterior vaginal wall and posterior perineal wound. Copyright 2001, Mayo Clinic, Rochester, Minn.
radiation). Five of the 8 patients with recurrent cancer had received adjuvant irradiation or chemotherapy for management of the primary tumor before this surgical procedure.

Ten patients received external beam radiation therapy (dose range, 0.45-0.55 rad [45-55 Gy]) and concurrent chemotherapy before the current surgery. Intraoperative radiation therapy (dose range, 0.10-0.20 rad [10-20 Gy]) was indicated in 10 patients owing to the extent of disease. Surgical procedures included abdominoperineal resection with posterior exenteration (n=8), resection of pelvic tumor and partial vaginectomy in patients with previous abdominoperineal resection (n=2), total exenteration (n=1), and total proctocolectomy with posterior exenteration in 1 patient with colonic Crohn disease and mucinous rectal adenocarcinoma. No sacrectomy was necessary in this group of patients. Surgical resection margins were negative in 9 patients. The posterior presacral and right pelvic fascia microscopic margins were positive in 2 and 1 patients, respectively. The average operative time for tumor extirpation, irradiation, and reconstruction was more than 9 hours, and all patients required blood transfusions.

There were no perioperative deaths, and only minimal complications were directly associated with the flap. Two patients had superficial wound necrosis and 4 had mild wound infections; none required reoperation. Despite the adverse conditions, no flaps failed and all healed without additional surgery. One patient had a postoperative ventral hernia. The mean length of hospital stay was 12 days (range, 10-20 days).

During follow-up, 5 patients reported resuming regular sexual intercourse. Ultimately, 2 patients died of their disease, 7 had disease progression to other sites, and 3 showed no evidence of recurrence.

**COMMENT**

Aggressive therapy, including multiple operations and both intraoperative and perioperative irradiation, is the only chance for cure or palliation of pelvic malignancies. Adverse conditions such as prior surgery, advanced tumor, and prior irradiation make the surgical management of advanced colorectal cancer a challenging problem. Pelvic reconstruction becomes important not only for the theoretic advantages of filling the pelvic dead space and promoting healing but also for restoring the body image of the patient. Multiple techniques of vaginal reconstruction have been described in the literature suggesting that no single procedure is ideal. The use of split-thickness skin grafts results in a thin neovagina with poor elasticity, little bulk, and a greater tendency for stenosis; furthermore, it requires patient compliance with a stent or obturator for several months. Reconstruction with segments of bowel is not always satisfactory because of the excessive production of mucus and odor, and it may cause additional morbidity associated with the bowel anastomosis. We have previously reported our experience with the gracilis myocutaneous flap and the modified Singapore flap for vaginal reconstruction. Although the gracilis muscle itself is reliable, the blood supply to the skin attachment is unpredictable, requiring frequent reoperations and debridement. In addition, the donor thigh incisions are a source of morbidity and cosmetic problems postoperatively. On the other hand, results from the pudendal-thigh flap (modified Singapore flap) for vaginal reconstruction have been impressive. The flap is more reliable than the gracilis, technically simple, and achieves good function and cosmesis. However, it requires harvesting tissue from a donor site in the groin that may be irradiated and provides little bulk after an exenteration. Moreover, when monitoring the flap, the most distal portion is the furthest away from examination and is the deepest and most difficult to see postoperatively.

Another alternative for vaginal reconstruction is the VRAM flap. Our experience with this flap for closure of perineal wounds following resection of pelvic malignancies has been reported previously. In our previous series, 13 patients underwent VRAM reconstruction following abdominoperineal resection with or without pelvic exenteration. In 4 cases, sacrectomy was also performed. The use of myocutaneous flaps was associated with a reduction in serious wound complications without a significant increase in operating times or length of stay compared with primary skin and pelvic closure or the use of an omental flap.

Here we present our experience with this technique for vaginal reconstruction following resection of primary locally advanced and recurrent colorectal cancer. In our small experience, no flap failed, 6 patients had minimal complications, and no patient required reoperation. Furthermore, 5 patients reported returning to sexual activity.

Proper patient and surgical selection is important for obtaining good results. This technique is particularly indicated in patients without significant comorbidity and interested in preservation of sexual function. Because the VRAM flap is indicated in very select patients,most series reported to date include a limited number of cases. Smith et al have reviewed reports of cases of VRAM flaps for vaginal and pelvic floor reconstruction and found 118 cases, most of them for gynecologic malignancies. Few of these reports include patients with advanced colorectal malignancies.

The advantages of the VRAM flap for vaginal reconstruction are many. The flap is commonly used by plastic surgeons, so it is fast and easy to perform. The blood supply is reliable, based on the large-caliber inferior epigastric artery, and it provides pliable tissue to fill the pelvis and avoid neovaginal stenosis. In contrast to the bilateral gracilis and pudendal-thigh flaps, the VRAM reconstruction technique restores the vagina with a single flap. In addition, the skin paddle is far away from the radiation fields, and the existing midline laparotomy incision leaves no additional donor defects or site complications. Furthermore, it allows for secure placement of stomas that are frequently required. A modification of this technique has recently been described using a peritoneal-lined rectus abdominis flap. It has been suggested that a musculoperitoneal flap is particularly useful when dealing with a nonexenterated pelvis in which there is not enough room for bulkier musculocutaneous flaps.

The VRAM flap for vaginal reconstruction is reliable; it fills the pelvic defect with nonirradiated tissue,
allows for stomal placement, incorporates into the existing midline laparotomy incision, and is functional in motivated patients.

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REFERENCES


Announcement

The Archives of Surgery will give priority review and early publication to seminal works. This policy will include basic science advancements in surgery and critically performed clinical research.