Vesicovaginal Fistula

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The most common cause of vesicovaginal fistula (VVF) in North America is injury to the bladder during a hysterectomy. In underdeveloped countries, childbirth is the leading etiology of these fistulae. Although the diagnosis of a VVF usually can be readily made in an outpatient setting, care must be exercised not to overlook a second fistula or concomitant ureteral injury. The timing of repair of the VVF is dependent on its etiology, comorbidities, and the anticipated approach for repair of the fistula. The transvaginal approach is more amenable to an early repair, is less invasive, and is accompanied by a 90% or higher success rate. Fistulae related to pelvic irradiation and recurrent fistulae are complex and may require interposition of vascularized tissue for successful repair.

Introduction

Incontinence due to vesicovaginal fistula (VVF) is the most miserable of all possible types of this disorder affecting women. Continuous and unrelenting incontinence secondary to VVF has a powerful and understandably negative impact on the quality of life of the woman with this disorder.

Because the vast majority of VVF defects are the result of an elective gynecologic procedure for benign disease, the management of these incontinent women is somewhat exigent. Fortunately, fistulae associated with gynecologic procedures are commonly amenable not only to early correction, but are most likely reparable by the less invasive transvaginal approach. Fistulae repaired in this manner will have a success rate ranging between 82% and 100% [1,2].

Although the surgical scenario of VVF formation is the most common, the management of difficult and potentially intractable fistulae secondary to obstetric or radiation injuries can be very daunting. This article focuses on the etiology, prevention, diagnosis, and timing of repair of the VVF. In addition, I discuss the transvaginal approach to uncomplicated fistula surgical repair, followed by brief descriptions of different types of repair for complex fistulae.

A number of articles and chapters have been written about VVF defects. The issues revolving around management of these fistulae have not undergone a revolutionary change during the past 10 to 20 years. I will make an effort, therefore, to discuss observations I have noted about the nuances and vicissitudes of the VVF that are not commonly discussed in customary reviews of this topic. In addition, to make this discussion as practical as possible, I focus on the posthysterectomy fistula occurring at or near the vaginal cuff, the most common type of fistulae observed in the clinical setting.

Etiology of Vesicovaginal Fistula

The vast majority of VVF defects diagnosed in the United States are related to the surgical removal of the uterus [3,4]. Injury to the bladder, either during a vaginal or transabdominal hysterectomy, may result in the development of a VVF. Although the mechanism of fistula development is not known exactly, it is most likely related to an unnoticed injury to the bladder during the mobilization of the bladder off the anterior vaginal wall, or possibly to inadvertent placement of a wayward suture into the bladder during closure of the vaginal cuff.

Vesicovaginal fistula due to childbirth is very rare in societies where modern obstetric techniques are practiced. In underdeveloped countries, VVF due to childbirth can occur as a result of ischemic pressure on the anterior vaginal wall and the base of the bladder during prolonged labor [5]. These fistulae are commonly located in the distal (towards the introitus) vagina. Although these fistulae may be larger than their surgically induced counterparts, vaginal access for operative repair is easier because of their proximity to the introitus.

Vesicovaginal fistulae may also result from therapeutic irradiation for pelvic malignancies [6]. The formation of these fistulae may occur as soon as a few weeks and as late as 10 or more years after the patient has been irradiated. Because the fistula may be due not only to tissue deterioration from irradiation but also from recurrent cancer, a biopsy of the fistula site is appropriate in the management of these particular patients.

Long-term catheterization in wheelchair-bound patients may result in VVF. The combination of internal catheter intraluminal pressure and pressure-necrosis effects on the perineum of patients with neurologic impairment is the most likely explanation for these fistulae. Although not a VVF in the true meaning of the word, the insidious effects of these conditions on the urethra, and subsequently the bladder neck, may eventually result in a malady very similar to VVF. The management of these patients

will require techniques akin to the repair of VVF, with the addition of a suprapubic cystostomy or bladder reconstruction in the absence of a urethra after closure of the incompetent bladder neck and urethra.

Finally, bizarre causes of VVF have been reported and include large bladder stones, pessaries, and retained foreign bodies, such as sex toys, in the vagina [7–9].

Diagnosis

A physician generally becomes suspicious of the presence of a VVF when, after undergoing a pelvic procedure, the patient complains of a continuous leakage not associated with abdominal straining, urinary urgency, or changes in body position. Occasionally these postoperative fistulae may not develop until a few weeks to a few months after the causative event. Certainly, fistulae due to radiation, foreign bodies, and neoplasms can manifest quite some time after the precipitating etiology.

If you are suspicious of a VVF, office cystoscopy and examination may be diagnostic. The cystoscopic finding of a divot or ostium, and the unequivocal presence of perfusate moving from the bladder and pooling in the apex of the vagina is compelling evidence of a VVF. What remains to be determined at this examination is the presence of other fistulae and the amenability and accessibility of this fistula to being repaired with a transvaginal approach.

Because VVF defects are commonly associated with what the referring surgeon would describe as a "difficult" procedure, documenting the status of the upper urinary tracts with appropriate imaging studies (intravenous pyelogram, CT, and others) should be completed to rule in or rule out concomitant ureteral damage. Patients with very small fistulae may still have normal voiding, even though they have a persistent, albeit small, amount of leakage. These minute fistulae may elude the skilled diagnostician. If the physician continues to suspect the presence of a fistula that cannot be demonstrated by a standard cystoscopy and vaginal examination, indigo carmine can be instilled into the bladder followed by placement of a tampon into the vagina. After the patient ambulates for a reasonable time, inspection of the removed tampon must reveal blue solely at its most proximal tip to substantiate a VVF. If the tampon is negative for blue staining, the patient should be given intravenous indigo carmine. If blue staining is now noted at the tip of the tampon the patient is most likely suffering from a ureterovaginal fistula. On more than one occasion I was only able to make the diagnosis after I gave the patient a prescription for urine staining phenazopyridine hydrochloride with instructions to take the medication and wear a tampon. The patient is asked to take extraordinary precautions to insert and remove the tampon without falsely staining the proximal tip. After completing their homework assignment, the discomfited patient discreetly returns with a package of evidence that my nurse and I lay out for inspection. If multiple tampons show consistent evidence of a VVF, I feel an examination under anesthesia with a probable repair of a VVF is justified.

Intraoperative Prevention

Entering the bladder during any type of surgery performed with a vaginal approach creates the potential for the development of a postoperative VVF. We have reported on 10 vaginal procedures in which the bladder was unintentionally entered and recognized [10]. Improving exposure with additional dissection and closure of the bladder opening in two layers, combined with uninterrupted postoperative catheter drainage, successfully prevented the formation of fistulae in these 10 patients. In these cases we recommended that the surgeons proceed with the intended operation because of the absence of any infections or complications related to the intraoperative cystotomy. Although these procedures utilized a liberal amount of nonabsorbable suspension sutures, autologous slings, and even an artificial sphincter, intuition dictates not to incorporate a synthetic device if it will lie over or be adjacent to the cystotomy closure. A drain was not used, however, all the patients had suprapubic and urethral catheter drainage until a cystogram 7 to 21 days postoperatively demonstrated no contrast extravasation [10].

Occasionally, the urologist is asked for an intraoperative consultation for an unplanned cystotomy during a pelvic operation. In the patient undergoing a transabdominal pelvic operation the bladder should be closed in two layers, with careful attention that a suture line not be placed in juxtaposition with other suture lines (*ie*, vagina, colon, and others). Interposition of viable tissue should be considered in patients whose closure is tenuous. If the operation is via a vaginal approach, adequate mobilization and exposure not only will provide for a tension-free closure, it will also help determine if there are any other bladder injuries. Regardless of the operative approach, the urologist performing an intraoperative consultation for an unplanned cystotomy must be confident that the ureters have not been simultaneously injured or incorporated into any suture line from either the planned operation or the subsequent repair of the unintentional cystotomy. Assurance of ureteral patency may require intraoperative imaging or the passing of a ureteral catheter. If the ureters are intact but concerns persist about their postoperative status, the placement of double pigtail ureteral catheters for 2 to 12 weeks may be prudent.

It is not uncommon for the urologist to work sequentially with the gynecologist in pelvic surgery. If the urologist is slated for an anti-incontinent procedure immediately following a hysterectomy or other vaginal operations, it behooves the urologist to perform an initial cystoscopy to assure an intact bladder. If cystoscopy demonstrates a bladder injury appropriate repair is best performed prior to the anti-incontinent procedure. Indeed, the urologist may opt not to implant a synthetic sling if a bladder injury is discovered.

Preoperative Management and Timing of Repair

If the patient with VVF is dry with a catheter in place, a delay of 1 to 3 weeks may be sufficient for the fistula to heal spontaneously. Fulguration of the fistula has been reported to be successful and may be attempted in the presence of a very small fistula that has minimal to no leakage with a catheter in place [11]. If the fistula shows no evidence of healing or if the patient continues to experience incontinence despite the catheter, proceeding to operative repair is appropriate if other criteria are met. Regardless of when the repair is scheduled, the postmenopausal patient may benefit from a daily application of estrogen cream to the vagina to improve tissue integrity and enhance healing.

When to repair a VVF that shows no evidence of spontaneous closure continues to be controversial [2,12–14]. Because the optimal time of repair is based on several factors it is difficult to establish specific guidelines that apply to all patients. The customary repair delay of 3 to 6 months is extrapolated from obstetric patients whose fistulae resulting from complications in childbirth have not completed demarcation of their ischemic borders before this time. Other reasons for lack of fistula stabilization leading to postponement of repair are the presence of neoplastic tissue, ongoing infection, or continued tissue changes arising from pelvic irradiation.

There is little need to delay the repair of fistulae caused by bladder injury during an operation for benign disease. As previously stated, early repair will not only sooner relieve the patient's misery associated with continuous incontinence, but it will also allay more quickly the anxiety of the referring surgeon.

Another factor in the timing of repair is the operative approach. A transvaginal approach lends itself to earlier intervention than a transabdominal approach. In the patient whose fistula is a result of an abdominal operation, the transvaginal repair obviates the need to traverse intraperitoneal tissue that is in its peak inflammatory healing stages. In addition, a well-vascularized and unscathed vaginal wall is optimal for advancing over the fistula closure. Other factors influencing the timing of repair include the mental and physical health of the patient and her perception of the negative impact the fistula has on her quality of life.

In summary, early repair by a surgeon skilled in the vaginal approach is best for the healthy motivated patient whose fistula is the result of a clean operative procedure for benign disease. On the other side of the spectrum, however, a delayed repair of more than 3 months should be reserved for a patient with comorbidities (obesity, anemia, to name a couple) whose fistula is related to pelvic irradiation or ongoing infections.

Operative Repair of Uncomplicated Vesicovaginal Fistula

Repair of the VVF can be accomplished with either a transabdominal or transvaginal approach. The transabdominal approach is selected when a concomitant operative procedure in the abdomen is planned, simultaneous augmentation is anticipated, reimplantation of the ureter may be required, or access to the vagina is compromised because of lower extremity contractures or limited vaginal vault capacity. If interposition of a vascularized graft is deemed necessary (from the omentum or rectus abdominis) the transabdominal approach may be the best option to achieve this coverage.

Because the most common cause of VVF defects in North America is a clean operative wound the bulk of these are amenable to the vaginal approach. I will not dwell, therefore, on the well-reported and well-known techniques of the transabdominal repair of the VVF. I have provided references for articles authored by surgeons who discuss the transabdominal approach [15•,16]. I do, however, describe the common transabdominal procedures for the treatment of complex fistulae that require the mobilization and interposition of well-vascularized grafts [17]. Recently introduced novel techniques, such as fibrin glue, bovine collagen, and the endoscopic transvesico-transurethral approach, have not yet become popular in the treatment of this disorder [18–20].

Transvaginal technique

Our technique of transvaginal repair is performed with the patient in the high dorsolithotomy position. Cystoscopy confirms the position of the VVF. If the fistula is close to one of the ureters a ureteral catheter is placed for better localization of this structure. Transvaginal exposure of the high lying fistula is optimized by the use of the Scott ring retractor with its provided hooks. If the fistula is of sufficient caliber, a 10- or 12-F Foley catheter is inserted into the bladder from the vaginal side and the balloon is inflated. If the fistula is small, a guide wire is passed from the vagina, grasped through the cystoscope and brought out of the urethra. Progressive dilators are threaded over the guide wire until a 16-F Foley catheter can be passed through the fistula from the vaginal side. After the balloon is inflated, outward traction on the catheter will prove invaluable in providing better exposure of the fistula (Fig. 1A). Other instruments that facilitate the repair include right-angle scissors, Bonney toothed forceps, Haney handheld retractors, and narrow Deavers. Illumination of the apex of the vagina is best achieved with a headlamp. If, however, an attending surgeon is teaching a resident, a sucker with an offset fiberoptic light can be effective. The teaching surgeon can use this sucker as both a retractor and illuminator even though he or she does not have straight-on vision into the vaginal vault.

Next, a suprapubic catheter (usually a 22F Foley) is inserted with the assistance of a 90° angled Randall stone forceps that is passed retrograde through the urethra. The forceps is then directed to the dome of the bladder where it is palpated 2 cm above the symphysis pubis. A small (1 cm) skin and fascial incision is made over the tip of the Randall stone forceps. The balloon end of the Foley catheter is then grasped by the forceps and withdrawn into the bladder.

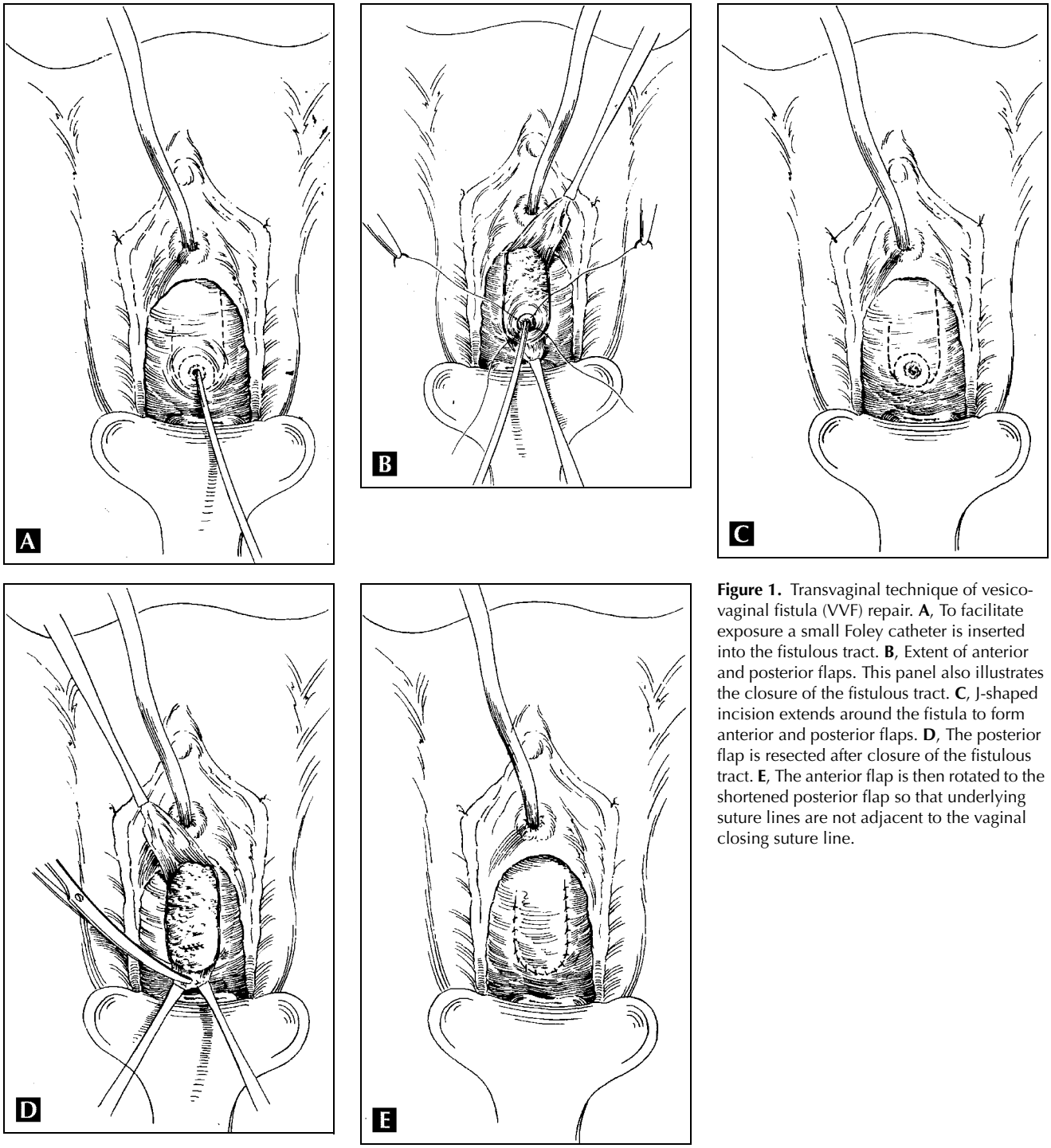

Figure 1. Transvaginal technique of vesicovaginal fistula (VVF) repair. **A**, To facilitate exposure a small Foley catheter is inserted into the fistulous tract. **B**, Extent of anterior and posterior flaps. This panel also illustrates the closure of the fistulous tract. **C**, J-shaped incision extends around the fistula to form anterior and posterior flaps. **D**, The posterior flap is resected after closure of the fistulous tract. **E**, The anterior flap is then rotated to the shortened posterior flap so that underlying suture lines are not adjacent to the vaginal closing suture line.

Because the fistula is high lying, the two flaps (anterior and posterior) are based towards the introitus and extend to the apex of the vagina as a J (Fig. 1B). I outline the flaps with a pen prior to the incision. The anterior flap will be longer than the posterior flap. The long end of the J should extend toward the introitus of the vagina. The lower convex portion of the incision reaches towards the vaginal cuff and circumscribes the fistula (Fig. 1C).

The two flaps are raised in a way that leaves a collar of vaginal wall (1–2 mm) circumscribing the fistula. Although experienced surgeons differ on whether to retain or remove the collar, I believe that preservation of the collar will prevent the fistula from enlarging and provide a foundation on which to anchor the first layer of closure. Creation of the anterior flap is begun at the edge of the fistula (Fig. 1B). To assure adequate mobilization of the underlying bladder I also raise lateral flaps by undermining the surrounding vaginal wall lateral to the fistula. The anterior, posterior, and two lateral flaps are retracted away from the bladder by securing them to the hooks provided

by the Scott ring retractor. It is the combination of these hooks, the traction on the Foley catheter in the fistula, and the mobilized flaps of the vagina that make the transvaginal approach to the operative repair of these high lying fistulae possible.

After the underlying bladder is well mobilized to ensure a tension-free closure, partial thickness of the bladder with full thickness vaginal wall remaining on the fistulous tract is closed with 3-0 chromic catgut or polyglycolic acid suture. A second layer of interrupted 3-0 polyglycolic acid suture is used to invert and close the perivesical fascia. The axis of this latter closure should ideally be at right angles to the underlying suture line. The previously raised posterior flap is then trimmed (Fig. 1D), which allows the anterior flap to rotate and extend beyond the closure of the underlying fistula in such a way as to avoid adjacent and overlapping suture lines (Fig. 1E). The vaginal wall is closed, a vaginal pack is placed, and the catheters connected to gravity drainage. I do not use drains. The patient is usually discharged from the hospital the next day with a prescription for anticholinergics to prevent bladder spasm and specific instructions on continuous dependent catheter drainage. The urethral catheter is removed and the suprapubic catheter is plugged approximately 7 to 10 days after the operation. If the patient is able to void without difficulty the suprapubic tube is removed on the 10th to 14th postoperative day. Cystograms are obtained only if I am concerned about the integrity of the closure.

Operative Repair of Complex Vesicovaginal Fistula

Although the repair of an uncomplicated VVF under the conditions described above is very rewarding, producing a greater than 90% success rate, a large and recalcitrant fistula in an area of irradiated or neoplastic tissue may be challenging at the very least, if not daunting.

Supravesical urinary diversion with or without a continent urinary pouch may be the treatment of choice if the surgeon believes that an operative repair of the VVF is at unacceptably high risk for recurrence. The adroit and experienced surgeon, however, should not be lulled into giving up on the bladder and proceeding with a urinary diversion procedure that potentially will have a negative impact on the patient's quality of life. Instead, for patients who are motivated to keep their bladder intact, the surgeon needs to consider primary repair of these fistulae with concomitant interposition of a mobilized and vascularized graft. The criteria I use to determine if such reconstruction is appropriate includes the presence of a continent urethra, adequate vascularized tissue capable of being mobilized to the fistula site, negative biopsies of the fistula, and intact and functional ureterovesical junctions and distal ureters. In the absence of these criteria supravesical diversion may be the treatment of choice. The following paragraphs briefly describe different techniques that I have personally employed for the treatment of complex VVF defects, with literature citations from authors who have performed the same procedures.

Transabdominal repair of complex vesicovaginal fistula

The interposition of omentum between a vaginal wall that has been well-mobilized off of the overlying mobilized bladder is the procedure most commonly used in the transabdominal approach to the repair of a complex VVF. The omentum is taken down from left to right, and remains anchored by the right gastroepiploic artery. Potential pitfalls with this procedure include tension on the interposed omentum and failure to mobilize the vagina and bladder sufficiently on the distal (towards the bladder neck and vaginal introitus) side of the fistula [21•].

A rectus abdominis myocutaneous flap can be mobilized and positioned between the vagina and two edges of the posterior bladder. The rectus is commonly employed by plastic surgeons for a variety of reconstructive procedures, and because of its excellent vascularity allows for augmentation of the bladder with an extraperitoneal approach. The ideal patient is one with a fatty lower abdominal wall and without a previous incision transecting the inferior rectus muscle below the umbilicus [22].

Utilizing an ileocystoplasty concomitant to the repair of the difficult fistula not only provides tissue with abundant blood supply, but like the rectus myocutaneous flap simultaneously resolves the problem of limited bladder capacity commonly seen with fistulae due to pelvic irradiation [23]. The surgeon selects a suitable piece of ileum that can be mobilized to the bladder base without tension. The length of ileum isolated from the normal bowel stream will be determined by the measured preoperative bladder capacity. The ileum is opened entirely along its antimesenteric border and interposed between the posterior bladder edges and the anterior vaginal wall. Prior folding of the open ileum may be required in patients whose limited bladder capacity requires a larger augmentation. Patients should be forewarned that intermittent catheterization may be required.

Transvaginal repair of complex vesicovaginal fistula

If the surgeon is uncomfortable with the adequacy of the tension-free multiple layer closure of the bladder and/or vagina during the transvaginal approach then interposition of a vascularized tissue graft is appropriate. The types of grafts available are peritoneum, labial fat pad (Martius), gracilis muscle, and buttock.

Peritoneum

Because most fistulae are related to the removal of the uterus (an intraperitoneal organ) and located at or near the apex of the vagina, the nearby peritoneum can be mobilized and advanced to interpose the separate vaginal and bladder closures [17]. After the vaginal flaps have been

raised and the bladder closed as securely as possible, the peritoneum and the preperitoneal tissue can be identified abutting the posterior aspect of the dissection. Further dissection of the underlying tissue under the posterior vaginal wall will allow the surgeon to advance this tissue up and over the bladder closure.

Martius flap

The fibrofatty labial flap is commonly known by its eponym, Martius. Because it is easy to mobilize, rich in blood supply, and close in proximity, the surgeon repairing a fistula should have a low threshold when deciding if the graft's use is indicated. Although the Martius flap is reported to have a blood supply from both its anterior and posterior aspects, I prefer to mobilize the flap from anterior to posterior, keeping the posterior blood supply intact.

After the vaginal flaps have been generously mobilized and the bladder has been closed (preferably in at least two layers), the surgeon's attention is turned towards the labia majora. A vertical incision is made on the outer fold of the labia at the level of the clitoris and extended posteriorly. With the use of skin hooks, the underlying fibrofatty tissue is separated from the overlying skin both laterally and medially. At the graft's most anterior aspect circumferential dissection is completed by lifting the flap off of the underlying pubic ramus. The tip of the graft is divided between ligatures and carefully mobilized posteriorly with special attention paid to the preservation of the posterior blood supply.

Blunt and sharp dissection close to the medial labial wall is initiated on the medial aspect of the labial incision and completed by keeping the dissection just under the lateral vaginal wall. The dissection proceeds until the scissors reach the vaginal wall opening previously made at the time of the fistula repair. An absorbable suture is liberally secured to the tip of the Martius flap and the suture needle left on the suture. An appropriate clamp secures the suture and transfers the tip of the graft from the labial incision, under the raised vaginal flaps, and into the area of the vaginal dissection. The intact needle is used to secure the tension-free graft so that it is comfortably interposed between the underlying bladder closure and the soon-to-be-accomplished vaginal closure. Diagrams for this technique are commonly found in textbooks on incontinence, female urology, and atlases on pelvic or vaginal surgery [24,25].

Myofascial flap

In some cases, a large intractable fistulae may only be closed with the use of a gracilis muscle or rotated buttock/gluteal flap. Because a functional vagina is unlikely after an operation of this magnitude these procedures are reserved for patients whose options are otherwise very limited. The gracilis muscle flap technique involves an incision in the medial thigh overlying the course of this muscle. The gracilis is divided at the medial femoral condyle and dissected upwards, remaining attached by its blood supply located approximately 8 cm from its origin. The muscle is then brought through a tunnel between the thigh and the fistula site and secured in position. A gluteal skin flap is employed in patients whose vaginas have no potential for reconstruction. The fistula is freed from the surrounding bladder and vaginal walls. The abutting gluteal skin is incised and rotated into the remaining vaginal vault and laid over the fistula. The remaining vaginal flaps are attached to the gluteal flap, which essentially acts as viable tissue to accomplish a colpocleisis.

Conclusions

Simple nonirradiated VVF defects occur most frequently after gynecologic procedures, most commonly after hysterectomy. Because injuries to the bladder under these circumstances are commonly clean operative traumas uncomplicated by previous irradiation, the dictum of waiting 3 months or more before repair is probably not necessary [2].

The transvaginal approach is a simple procedure that avoids a cystotomy, involves minimal blood loss, and is followed by less postoperative discomfort and a shorter hospital stay. Important principles for successful repair include a closure with tension-free viable tissue with multilayered, nonoverlapping suture lines, advancement of healthy vaginal flap over the fistulous tract, and uninterrupted postoperative urinary drainage.

Recognition of possible injury to the bladder after a gynecologic operation should be followed by early investigation aimed at establishing diagnosis. If the fistula is small, urethral catheter drainage and/or cystoscopic fulgurations of the fistulous tract may result in spontaneous closure. However, if the patient continues to have leakage with no change in fistula size after a 10-day trial of conservative therapy, continued delay before operative repair is unwarranted. Nondelayed transvaginal repair is our method of choice for simple nonirradiated VVF defects. High lying lesions are commonly amenable to the vaginal approach. In our experience the location of the VVF is not the limiting factor influencing the use of the transvaginal approach. Abnormal vaginal anatomy (*eg*, vaginal stenosis) or a simultaneous intra-abdominal pathologic condition requiring operating intervention (*eg*, concomitant ureteral injury) would preclude a vaginal repair.

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This article and the editorial comment that accompanies it reflect the wide disparity that exists in opinions on the appropriate operative approach to the management of VVF. Proponents of the transabdominal and transvaginal techniques articulate their preferences with fervor in this article.

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