Urogenital tract fistulas in females

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INTRODUCTION

Urogenital fistulas are abnormal communications between the female genital tract and the bladder, urethra, or ureters. The etiology and incidence of urogenital tract fistulas vary geographically. In the United States and other developed countries, these fistulas are uncommon and are most often sequelae of gynecologic surgery, and less often as a result of obstetric injury, severe pelvic pathology or radiation therapy [1]. By contrast, in developing countries, urogenital fistulas are a common complication of obstructed labor during childbirth [2,3]. In developed countries, patients with successfully repaired bladder and ureteral fistulas usually have no residual problems. In developing countries, incontinence often persists due to bladder neck and urethral sphincter injury, abnormal detrusor activity, vaginal strictures, and fibrosis of the bladder [4].

Urogenital fistulas in women in developed countries are reviewed here. Obstetric urogenital fistulas in resource-limited settings are discussed separately. (See "Obstetric fistulas in resource-limited settings".)

In this topic, when discussing study results, we will use the terms "woman/en" or "patient(s)" as they are used in the studies presented. However, we encourage the reader to consider the specific counseling and treatment needs of transgender and gender diverse individuals.

TYPES OF UROGENITAL FISTULA

The type of urogenital fistula is based upon the anatomic location of the connecting tract (figure 1). Vesicovaginal fistulas are approximately three times more common than

ureterovaginal fistulas, with uretero-vesicovaginal fistulas being very infrequent. Clinicians rarely encounter vesico-uterine, vesico-cervical, vesico-peritoneal, and vesico-colonic fistulas (these usually occur only in the presence of colonic diverticula or cancer).

EPIDEMIOLOGY AND RISK FACTORS

In the United States, estimates of urogenital fistula formation range from less than 0.5 percent after simple hysterectomy to 10 percent after radical hysterectomy. Although radical hysterectomy is associated with an increased rate of urogenital fistula formation, it is not clear whether there will be an appreciable increase in the overall fistula formation rate with laparoscopic and robotic technique [5-7]. According to data in the United States National Hospital Discharge registry, among 2,329,000 operations performed on the female urinary and genital systems in 2007, there were less than 5000 procedures for vesicovaginal fistula repair [8].

Most urogenital fistulas occur after hysterectomy for benign disease. A study in the United Kingdom showed a 0.12 percent incidence of vesicovaginal fistula following all types of hysterectomy [9]. The highest incidence occurred following radical hysterectomy, with a rate of 1.14 percent, and the lowest rate was 0.02 percent following vaginal hysterectomy for pelvic organ prolapse. Among women having a hysterectomy for benign indications, patients over 50 years had a lower incidence of fistula formation than women less than 40 years [10-12].

Intraoperative risk factors for vesicovaginal fistula at the time of hysterectomy include: uterus weight >250 g, longer operative times (approximately five hours or more), and concurrent ureteral injury [13].

Most urogenital fistulas are due to urinary tract injuries that were not recognized intraoperatively [14]. Pelvic pathology that may have predisposed to injury is present less than half of the time.

In developing countries, vesicovaginal and other urogenital fistulas are estimated to occur in 2 percent of obstructed labors [4]. (See "Obstetric fistulas in resource-limited settings", section on 'Epidemiology'.)

ETIOLOGY AND PATHOGENESIS

- **Obstetric fistula** – Obstetric fistulas are uncommon in developed countries, but bladder and urethral injury have been associated with operative vaginal delivery and manual extraction of the placenta [15]. Vesicouterine and vesicovaginal fistula may occur after cesarean section, peripartum hysterectomy, and uterine rupture at term.

Occasionally, the ureter may be involved. (See "Obstetric fistulas in resource-limited settings".)

- **Postsurgical fistula –** Postsurgical urogenital fistula may be caused by direct injury during dissection, in which case, the injury is often recognized at surgery or in the immediate postoperative period. More subtle causes include clamp or crush injury, cautery, or suture impingement, kinking, or placement through the bladder or ureter. Blood supply is compromised to the affected tissues with resulting necrosis and eventual tissue breakdown. The process takes from days up to a month and urine leakage may not be observed until sometime after surgery [16]. Intraperitoneal leakage may also occur, in some circumstances without vaginal leakage.

  The use of synthetic mesh in repair of stress incontinence and pelvic prolapse has introduced another cause of bladder injury, as well as urethrovaginal fistulas. Synthetic mesh may be placed directly into the bladder, or it may be under some tension and gradually wear down the native tissue causing an opening into the bladder or urethra. (See "Transvaginal synthetic mesh: Use in pelvic organ prolapse".)

- **Radiation therapy –** Radiation therapy causes a progressive small vessel endarteritis that impairs the vascular supply of tissues within the radiation field and therefore can lead to problems with healing from surgical procedures and ultimately to urogenital fistulas [17]. Measures to prevent formation of urogenital fistulas in women who have undergone radiation therapy are limited to good surgical technique that includes sharp dissection and limited handling of tissue. For women who develop urogenital fistulas after radiation therapy, one surgical group has reported success with a technique that interposes a vascular rectus abdominis flap without closure of the fistulous tracts [18]. More data are needed before this approach can be recommended for either prevention or treatment.

- **Inflammation –** Inflammation, such as occurs with pelvic inflammatory disease, diverticulitis, or inflammatory bowel disease, can cause tissues to be both friable and hypervascular [19-22]. These changes lead to poor tissue healing, which makes tissue more susceptible to tearing or other damage during manipulation, and ultimately can lead to fistula formation.

PREVENTION

The best prevention for urogenital fistula is avoidance of the injury at the primary surgery. The risk of fistula formation depends upon both the location of injury and intraoperative diagnosis and repair. However, fistula formation may still occur despite recognition and repair of an injury [1]. In some cases, fistula may be impossible to prevent if tissue

devascularization causes a delayed injury. A "frozen pelvis" caused by endometriosis, cancer, or radiation, makes normal surgical dissection extremely difficult. Standard pelvic surgery technique requires an awareness of the bladder and ureteral anatomy in order to minimize urinary tract trauma and optimize safety.

Further details on the prevention of urinary tract injury in gynecologic surgery are available. (See "Urinary tract injury in gynecologic surgery: Epidemiology and prevention".)

CLINICAL PRESENTATION

Fistulas between the urinary tract and vagina typically result in painless urinary leakage from the vagina. Intermittent leakage, particularly when positional, can be a sign of ureterovaginal fistula, whereas continuous urine loss is more characteristic of vesicovaginal fistulas.

Intraabdominal drains are rarely placed at the completion of gynecologic surgery. But if a drain is used, a urogenital fistula may be noted if there is a marked increase in output a few days postoperatively. Systemic administration of a vital dye can aid in identification of a urogenital fistula or urinary tract injury when the dye colors the contents of the surgical drain. In our practice, we give 100 to 200 mg of oral phenazopyridine (dose determined by availability) which causes the urine to turn bright orange [23,24]. Another alternative is 10 percent sodium fluorescein given intravenously in doses ranging from 0.25 to 1.0 cc [25]. This causes the urine to turn bright green. (See 'Dye test' below.)

EVALUATION OF SUSPECTED UROGENITAL FISTULA

History — Eliciting the medical history is guided by the clinical suspicion of the presence of a fistula. This is typically based upon symptom development in relation to a recent surgery. The history should include standard questions regarding symptom onset and duration, pelvic health history (eg, cancer, radiation, trauma, obstructed labor), symptom characteristics (leakage volume, smell, color and consistency of vaginal fluid) to exclude hematuria or leakage of substance other than urine (eg, vaginal discharge), and flow characteristics (continuous, intermittent, positional).

The history should include questions to differentiate symptoms associated with urogenital fistula from other etiologies of urinary incontinence. Most of these patients are changing heavy pads frequently because they are constantly wet. (See "Female urinary incontinence: Evaluation", section on 'Etiology'.)

Pelvic examination — A split speculum examination (using just the lower blade of the speculum) should be performed, and the entire vagina should be visualized.

On vaginal examination, recently formed fistulas may appear as a small, red area of granulation tissue with no visible opening, or an actual hole may be seen. For more mature fistulas, it may be difficult to visualize the vaginal orifice. Very small fistulas may be difficult to visualize due to size and the anatomy of the vagina (eg, fornices are difficult to examine). An examination under anesthesia and use of dye tests may be needed to find the opening. It is important to remember that more than one fistula may be present and more than one structure may be involved (eg, a vesicovaginal fistula and a ureterovaginal fistula).

In a woman whose prior hysterectomy is related to the fistula, the vaginal orifice is typically located in the upper third of the vagina or at the vaginal cuff. Urine leakage may often be seen during the examination, and there may be a tell-tale odor or pooling of urine when commencing the examination.

Dye test — To find small fistulas, any dyed sterile fluid (eg, sterile infant formula, or indigo carmine or methylene blue mixed with saline, where available) may be instilled into the bladder through a bladder catheter [26]. The urethra may be compressed with a gauze sponge to prevent the inadvertent egress of dye from the urethra, and the bladder is filled incrementally with 60 mL aliquots of colored fluid. A tampon or large cotton swabs are placed in the vagina and then checked for dye. If no leakage is seen, the patient is asked to cough or perform a Valsalva maneuver. Blue staining on the swab or tip of the tampon from the vaginal apex indicates a vesicovaginal fistula, while wetness with clear fluid may indicate a ureterovaginal fistula.

If a ureterovaginal fistula is suspected, oral phenazopyridine (100 or 200 mg, in countries in which this drug is available) is taken on the day of the test (approximately one to two hours before examination) to turn the urine orange. In combination with the use of blue dye in the bladder, this will distinguish a fistula communicating between the vagina and ureter (orange urine) from located in the bladder (blue urine). However, the findings are less certain with complex fistulas (eg, uretero-vesical-vaginal) or if ureteral reflux occurs. Dye studies alone are not sufficient to completely evaluate the number and location of urogenital fistula.

Cystoscopy and imaging studies — Cystoscopy is used to assess the bladder for residual injury, surgical materials, and the number of intravesical fistula orifices. Retrograde pyelography documents ureteral integrity. The intravenous pyelography (IVP) is less useful for noting any disruption in ureteral integrity because it may miss ureteral leakage that is immediately adjacent to the trigone when dye filling the bladder obscures a small leak. Small amounts of dye may not show up on conventional radiography, and puddling may result from ureteral or bladder leakage or both. When a normal renal unit is seen on IVP, but the ureter is never visualized, complete transection preventing accumulation of dye in the ureter must be considered. A study of obstetric vesicouterine fistula demonstrated that pelvic magnetic resonance imaging (MRI) may be more sensitive than IVP or computed

tomography (CT) [27]. As MRI quality has improved, there is superior soft tissue contrast compared with CT cystogram [28]. Detection of intraoperative urinary tract injury is presented separately. (See "Urinary tract injury in gynecologic surgery: Identification and management".)

Less commonly, the use of a MRI or double balloon urethral catheter under fluoroscopic guidance may be useful for diagnosis of complex urethral fistula or urethral diverticulum. Ureteral obstruction with upper tract dilation may be seen on IVP, CT, or ultrasound. A dilated ureter or renal pelvis can be present with ureteral fistulas.

DIAGNOSIS

The diagnosis of a urogenital fistula is made on physical examination by visualization of leakage of urine into the vagina. This may be visualized grossly or by using a dye test. (See 'Evaluation of suspected urogenital fistula' above.)

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of urogenital fistula includes other etiologies of urinary incontinence. These can be differentiated from a fistula based upon the pattern of the urinary leakage. Stress urinary incontinence is typically preceded by an increase in intraabdominal pressure (eg, cough, laugh) and urgency incontinence is usually preceded by a sense of urinary urgency. Continuous leakage of urine is likely to be either overflow incontinence or a fistula. (See "Female urinary incontinence: Evaluation".)

In addition, leakage of fluid from the vagina may also represent a watery discharge, most commonly from the cervix. Rarely, endometrial (eg, a degenerated uterine fibroid) or fallopian tube (eg, fallopian tube cancer with hydrops tubae profluens) pathology results in a discharge [29]. (See "Epithelial carcinoma of the ovary, fallopian tube, and peritoneum: Clinical features and diagnosis", section on 'Vaginal bleeding'.)

Leakage from the vagina that has a thick consistency and is not clear should be evaluated as vaginal discharge. If the leakage is clear and thin, and particularly if the odor is consistent with urine, urogenital fistula or overflow incontinence should be suspected. In the early postoperative setting, transient drainage of a seroma may mimic the findings of a urinary fistula. (See "Vaginitis in adults: Initial evaluation".)

MANAGEMENT

The best management of urogenital fistulas, other than prevention, is the recognition and repair of the injury at the primary surgery. If diagnosed in the first few weeks after surgery, continuous urinary drainage may resolve a minority of vesico-vaginal fistulas. Similarly, early ureteral stenting can aid healing of an otherwise uncomplicated uretero-vaginal fistula. If these simple techniques are not successful, urogenital fistulas are managed with surgical repair. There are several procedures to accomplish this repair. The choice depends upon the type of fistula, patient's characteristics and preferences, and surgeon's experience and preference.

Vesicovaginal fistulas, as well as other urogenital fistulas, are very debilitating to patients. Early referral to individuals experienced in the management of fistula should be made, as the first repair attempt has the highest chance of closure via the vaginal route. Successful repair can be expected in 80 to 90 percent of patients, but multiple surgeries may be required [30]. These patients should be evaluated when they first become symptomatic and by practitioners experienced in treating these conditions.

In patients with advanced cancer, or medical comorbidities, surgical repair may not be feasible. These unfortunate women will benefit from intensive perineal care, a well-fitted diaphragm drained by a urinary catheter in its center or urinary diversion following placement of percutaneous nephrostomies.

Timing of surgery — The timing of fistula repair is dependent on the surgical-readiness of the surrounding tissue. If the tissue is healthy, early repair can be done. This is applicable for obstetric injuries, including urethral injury, bladder tears, and vesicouterine fistulas. After gynecologic surgery, 6 to 12 weeks is sufficient to allow most granulation tissue to dissipate, increasing the chance of a successful repair. In cases where the tissue is healthy, earlier repair can be considered. During the waiting period, catheterization of the bladder may decrease symptoms and allow for spontaneous closure [31,32]. Early excision and repair of the fistulous tract within one to two weeks of leakage has become more common [33-35], even with fresh obstetric fistulas [36].

Timing of surgical repair for ureteral fistula is controversial [37,38]. In an animal model, healing of the mucosa after ureterotomy is complete after three weeks and smooth muscle bridging is complete by six weeks [39]. If the ureter is allowed to develop extensive fibrosis, angulation, or poor smooth muscle regeneration, peristalsis may fail to return. This finding argues favorably for an immediate direct repair of the fistula, whenever possible. Two exceptions are:

- Spontaneous healing of a small (less than 5 mm) lesion in otherwise healthy tissue may occur if a stent can be placed across the fistula site and left in place for at least four to eight weeks [40]. During the first seven days after ureteral stents are placed, a separate transurethral catheter should be placed for bladder drainage to prevent any ureteral

reflux. We treat patients with transurethral catheters, or stents in the ureter, with prophylactic antibiotics to help reduce development of acute cystitis or pyelonephritis. We often use nitrofurantoin 50 milligrams per day [41].

- Active pelvic infection precludes an immediate surgical approach. Radiology-assisted percutaneous nephrostomy allows temporary urinary drainage until repair can be undertaken. Inflatable stents placed percutaneously or a ureteral stent placed via cystoscopy may be able to dilate ureters obstructed by surgical clips, suture, or areas of fibrosis and facilitate drainage.

Vesicovaginal fistulas

Posthysterectomy vesicovaginal fistula — Small posthysterectomy vesicovaginal fistulas can be cannulated with a lacrimal duct probe, small feeding tube, or pediatric Foley catheter into the fistula tract to allow the surgeon to draw the vagina toward the introitus, facilitating vaginal dissection. If the fistula tract is difficult to cannulate, a novel technique using a cystoscopically passed glidewire can be used to pull a small catheter through the vagina into the bladder [42].

Alternatively, stay sutures can be placed lateral to the fistulous opening and traction can be used to deliver it into the lower vagina, thus avoiding the need to enlarge the opening.

The vaginal epithelium is incised around the fistula, and then vaginal epithelial flaps are raised and removed in a wide circle (2 to 3 cm in diameter) around the fistula tract (Latzko procedure) [43]. Multiple layers (usually two) of 2-0 or 3-0 absorbable sutures are placed in a transverse interrupted fashion with an imbricating technique to facilitate closure without tension. Sutures at the lateral edges of the fistula are placed just beyond, and above and below, the fistula edges. The second layer utilizes transverse U-shaped sutures that actually tie even further beyond the lateral edges of the fistula tract. Curved needle drivers may be helpful in facilitating suture placement deep in the vagina. Three of four layers may be needed, but two usually suffice. There may be a minor amount of vaginal shortening as a result of this procedure.

Circumferential, longitudinal or vertical suture lines are best avoided, since these may bring the ureters too close to the midline and facilitate ureteral kinking, tissue ischemia, obstruction, and further fistula formation. Similarly, circumferential pursestring sutures are usually avoided since tissue ischemia at fistula edges may occur.

Occasionally, the posterior cul-de-sac (pouch of Douglas) is entered during repair of high vaginal vault fistulas. This may aid the repair since the posterior peritoneum may be raised from the pelvic floor as a flap and used as a third or fourth layer in the Latzko closure. The vaginal epithelium must be carefully reapproximated to close the cul-de-sac after this repair.

A modification to the traditional Latzko may also increase the chance of success. Prior to closure of the fistula, either anterior or posterior to the fistula, removal of a small rim of vaginal epithelium is performed. On the side where tissue was not removed, the epithelium is mobilized at least 1 cm lateral to the fistula on both sides, and approximately 2 cm distal. This allows a flap (wider than the fistula) to cover the fistula closure without any overlapping suture lines. Interposition of biologic grafts may also increase the rate of successful repair [44-46].

Layered closure is recommended for more distal and complex fistulas. The surrounding tissue is mobilized with special attention to minimizing tension followed by complete excision of the fistulous tract. It is important not to excise too much lateral tissue to prevent bleeding of the bladder edges and further decreasing bladder volume. The bladder defect is closed in one or two layers with 3-0 or 4-0 absorbable interrupted sutures. When near the trigone, the sutures should be placed in a transverse fashion to prevent kinking of the ureters. The dense connective vaginal tissue (endopelvic fascia) and vagina are closed over the bladder using 2-0 absorbable sutures. Prevention of overlapping suture lines is important to insure a water tight seal of the repair. Methylene blue, indigo carmine, or sterile milk may be instilled into the bladder to test the integrity of the repair [33].

If the fistula is close to a ureteral orifice, cystoscopy with carefully restricted volumes of fluid can be performed at the conclusion of the repair to confirm ureteral patency. Options for coloring the urine to aid visualization include indigo carmine (if available), a preoperative oral dose of phenazopyridine 100 to 200 mg (dose determined by availability), or intravenous fluorescein. Ureteral stents may be placed prior to commencing the repair and then removed at the end of the procedure if there is no ureteral compromise. (See "Urinary tract injury in gynecologic surgery: Identification and management", section on 'Procedure and findings'.)

Methylene blue solution, sterile infant formula, water, or saline should be instilled transurethrally after closure of the first layer to assure that the closure is water tight. A cystogram can be done postoperatively prior to removal of the catheter to confirm healing. If the cystogram is positive for leakage, there are no data to show that reinsertion of the catheter will increase the chance of a cure. For this reason, the cystogram may be of limited use. It is also important to make sure that the Foley catheter is properly taped to the patient's thigh with a "do not remove" warning so as to reduce the risk that the repair will be disrupted if the catheter is pulled. If complete closure of a large fistula does not occur, the procedure can be repeated.

High vaginal vault fistula from other causes — Other causative factors contributing to fistulas high in the vaginal vault include those secondary to radiation necrosis or a long obstructed labor with cesarean hysterectomy. These are typically vesicovaginal fistulas but

may involve ureter or, rarely, the urethra. A comparison of vaginal repair (Latzko) technique with abdominal repair technique in 91 women found no differences in patient sexual satisfaction or quality of life at six months postoperatively [47]. When compared with the abdominal repair technique, the vaginal repair technique was associated with significantly shorter operative time, lower blood loss, and shorter duration of hospitalization. However, fistulas that develop after surgery are usually larger, with more fibrosis and tissue scarring; therefore, they may require laparotomy for repair. Because of the morbidity associated with abdominal approach repair, in cases where a vaginal approach is feasible, this should be the route of first attempt.

Vaginal approach — In the Mackenrodt technique [48], the vaginal flaps are raised away from the bladder and preserved for use in the final closure layer. New tissue sources are also often brought into this repair. The Martius graft, or labial fibrofatty tissue graft, is most commonly used to reinforce repairs even high in the vaginal vault [49]. Gracilis muscle grafts are also used on occasion [50]. These grafts lend strength, support, a blood supply, and sealant to the fistula closure. Gluteal muscle and peritoneum are other sources of tissue interposition [51]. In one surgeon's series of 120 patients with complex vesicovaginal fistulas undergoing repair with tissue interposition (peritoneal, Martius, or labial), the cure rate was 95 percent after the surgeon's first repair [51]; many had had previous failed attempts at surgical repair elsewhere.

A newer approach is use of a Singapore flap (a fasciocutaneous flap from the inner thigh) in the treatment of complex obstetric fistula. One study including 45 women reported successful repair rates that were more than twice that of traditional repairs (46 versus 19 percent) [52]. This technique can be applied to distal nonobstetric fistulas as well.

In cases in which tissue interposition is difficult or not possible, alternative techniques have been proposed [53].

Abdominal approaches — For recurrent or complex fistulas, we consider an abdominal approach, which can include abdominal laparoscopic or robot-assisted techniques that involve mobilization and interposition of omentum. In general, the fistula is resected, the vagina and bladder are closed, and omental tissue is interposed between bladder and vagina to separate the suture lines and act as a neovascular pedicle [54]. This approach can be adapted for laparoscopic, robot-assisted, and open procedures. A case series of five women with vesicovaginal fistula reported all were successfully treated using a robotic procedure that included interposition of sigmoid epiploica between the repaired vagina and bladder [55]. The abdominal approach also may be preferred for patients having concomitant abdominal or pelvic procedures, as well as patients with a complex fistula involving the ureter, bowel, or cervix.

Transurethral approach — A small Canadian study reported fistula repair in three patients using a cystoscope, a laparoscopic needle driver, and an absorbable barbed suture in the bladder and separate sutures placed on the vaginal side [56]. This study is promising because the surgical technique allows for repair on the bladder side without having to open the bladder.

Urethrovaginal fistulas — The urethrovaginal fistula in the developed world most often follows attempted repair of urethral diverticulum repair, anterior colporrhaphy, midurethral sling placement, and obstetric forceps rotations [57,58]. These are usually readily closed by wide mobilization into the lateral periurethral spaces and layered closure in a tension-free manner. Vertically placed layers, when possible, reduce the risk of urethral shortening postoperatively. Careful dissection of distinct tissue layers will allow closure that does not place suture lines directly over one another. Martius graft placement is simple and often helpful in the repair of these fistulas. (See "Urethral diverticulum in females".)

Ureteral fistulas

Ureterovaginal fistulas — The repair of ureterovaginal fistulas requires an approach and technique that will both restore normal function of the ureter and close the fistulous defect. Ureteral injuries can be repaired using reimplantation or anastomotic procedures, as appropriate. Transurethral or percutaneous ureteral stenting may allow relief of obstruction and preservation of renal function and, in some circumstances, healing may occur.

Stenting — Ureteral stents will allow closure of the fistula in many cases. A small study of 19 cases of ureterovaginal fistula (18 from hysterectomy and 1 from cesarean section) treated with ureteral stenting reported an overall cure rate of 83 percent [59]. These fistulas were considered uncomplicated, and the stents were left in place for an average of 66 days. Stenting was less effective, and the patient required surgical repair, when concomitant vesicovaginal fistula was present. Complication rates were also low; 18 percent developed pyelonephritis, and 9 percent developed a stricture.

Reimplantation — A simple ureteral reimplantation is the most effective repair for most posthysterectomy ureterovaginal fistulas that persisted after a trial of ureteral stenting (see above). Ureterovaginal fistulas from gynecologic surgery are usually close to the bladder, beneath the trigone, or at the level of the uterine artery or infundibulopelvic ligament, thus facilitating reimplantation.

Identification and dissection of the ureter begins by opening the pelvic side wall peritoneum lateral to the iliac vessels, carrying the incision up to the pericolic gutter, and sharply freeing the ureter from its pelvic soft tissue attachments. Developing the paravesical and pararectal spaces mobilizes both ureter and bladder, leaving the ureter on the posterior leaf of the peritoneum. The ureters can then be sharply freed downward to the fistula site, paying close

attention to the ureteral blood supply [2]. The ureter can be seen on the medial aspect of the peritoneum, and can usually be found crossing over the bifurcation of the external and internal iliac arteries.

The ureter is often dilated from partial or total obstruction and periureteral fibrosis can obscure the site of the fistulous tract, making dissection difficult. If a surgical impasse is reached, the ureter can be cut on an angle (ie, spatulated) and a stay suture placed at the distal margin of the most viable aspect of the peristalsing portion of the proximal ureter. The distal portion of ureter, close to the fistula, should be ligated if it can be identified.

The bladder should be incised transversely to facilitate reimplantation under direct visualization. The transverse incision also allows for development of a Boari flap, which would allow reimplantation of an injury high as the pelvic brim, if necessary. Bladder mobilization by excising the lateral perivesical fibrofatty tissue bilaterally allows the bladder to be placed high on the sidewall where it can be secured with a "psoas hitch" (approximation of bladder serosa to psoas muscle with interrupted sutures) [34].

Reimplantation begins by pulling 1 to 2 cm of the distal tagged ureter into the bladder through a separate stab incision near the trigone, or as close as feasible. The spatulated end of the ureter is anchored to the bladder mucosa with interrupted 3-0 absorbable sutures. The serosa of the reimplanted ureter should be sutured to the outside serosa of the bladder, close to the reimplantation site. Complete bladder mobilization, selection of the reimplantation site, and suture placement are key to eliminating tension on the anastomosis. Stents may be used to support the anastomosis, although they are not necessary, and they do make handling the ureter easier. When used, stents can be left in the bladder, or secured to a transurethral or suprapubic catheter. The bladder incision is then closed.

A drain is placed next to the reimplantation site to minimize peritoneal irritation if urine leakage occurs [60]. The drain is removed when drainage is minimal (ie, less than 100 cc/24 hours). The catheters and stents have traditionally been left in place for at least a few weeks. However, removal of the stent immediately or within a week does not appear to compromise results. An intravenous pyelogram (IVP) should be obtained to confirm successful repair: persistent leaks are stented, and urinomas drained percutaneously if they occur.

Anastomotic repair — End-to-end or side-to-end anastomoses of ureteral segments carry a relatively high rate of subsequent ureteral stenosis, whether or not stents are used. However, for the rare injury above the pelvic brim, this may be the only option, rather than percutaneous diversion or ureterostomy.

End-to-end anastomoses are performed by spatulating the ends of the ureter to increase the suture line circumference. Closure is achieved in one layer using 4-0 or 3-0 absorbable

sutures. A drain, coming out of the overlying skin, may be placed to divert any escaping urine away from the peritoneal cavity. If stents are used, they are usually removed in two to four weeks, but this may be delayed if follow-up IVPs show continuous leakage.

If large defects in ureteral length exist, a segment of isolated small bowel can be anastomosed to the bladder and the ureter attached to the bowel segment. This is rarely required.

Anatomic considerations — The ureter consists of three layers. Its innermost layer is the epithelial mucosal tissue consisting of transitional cells. The middle layer, which is responsible for peristalsis, is composed of longitudinal, circular, and spiral fibers. The outer layer is composed of an adventitial sheath composed of collagen, elastic, and nonmyelinated nerve fibers, which protects and supports the blood vessels both within and around the ureter (Waldeyer's sheath) [61].

The ureters run from the superior aspect of the abdomen to the inferior portion of the pelvis. The pelvic brim divides the ureter into the pelvic and the abdominal portions, which are usually of equal length, measuring 12 to 15 cm in the adult. Originating from the renal pelvis, lateral to the first lumbar vertebrae, the ureters course inferiorly along the anterior border of the psoas muscle to the pelvic brim. The ureter enters the pelvis as it courses over the bifurcation of the internal and external iliac arteries. The ureter then runs under the infundibulopelvic ligament, with no space between them. This is a common site of ureteral injury, which can be avoided by identifying and lifting the vessels off of the ureter before clamping them. The ureter courses along the lateral sidewall in a retroperitoneal fashion where it can often be visualized, toward the ischial spine. It then turns and passes medially and posteriorly through the cardinal ligament, runs under the uterine artery (so-called water under the bridge), and then turns further medially and anteriorly to go up over the vaginal fornix and enter the trigone of the bladder. Its average distance lateral to the cervix at the level of the internal os is 2.3 cm (range 0.1 to 5.3) [62]. Passing through the cardinal ligament, the lowest 1 to 2 cm of the ureter can be palpated vaginally just medial to the vaginal apex. Attempts to control heavy bleeding from the vaginal cuff with large sutures are a common cause of ureteral injury.

The most important aspect of ureteral blood supply is its unpredictable source. Eighty percent of all ureters have a single artery that runs along the entire length. This artery usually originates from the renal artery, but may also be supplied by the aorta, ovarian, iliac, uterine, middle hemorrhoidal, superior vesicle, and vaginal arteries. Twenty percent of ureters do not have a single vessel running their course. These ureters are supplied by an anastomosing network of small vessels from the major arteries named above.

Care must be taken during dissection of the ureter not to compromise its blood supply. Above the pelvic brim, dissection should be done with a lateral approach, while in the pelvis;

the approach should be taken anteriorly [63]. Disruption of the ureteral blood supply may lead to loss of peristalsis, segmental dilatation, and eventual fistula formation after a delay of days or weeks.

Ureteroperitoneal fistulas — A leaking or completely transected ureter will drain into the peritoneal cavity. Patients will present with abdominal distention, and the fluid will be easily seen on computed tomography scan. A sample of the fluid will evidence markedly elevated urea nitrogen and creatinine. Reimplantation is the best management. Benign, malignant and chylous ascites are in the differential diagnosis of this rare type of urogenital fistula. A defect in the dome of the bladder can also lead to intraperitoneal urine collection. With documentation of intraperitoneal urine, a cystogram and cystoscopy with retrograde dye injection of the ureters is necessary to locate the defect.

Vesico-colonic fistulas — Occasionally at cystogram or barium enema, dye will be seen flowing between bladder and colon, usually the rectosigmoid. Typically these fistulas result from diverticular abscesses, less commonly from malignancies. Management is excision of the fistula track from both bladder and colon, and interposition of healthy tissue, such as omentum or peritoneum. Bowel resection may be necessary, and occasionally hysterectomy. At one time, these fistulas were approached in two- or three-step operations, with diversion of the gastrointestinal track to allow the urinary track to be sterilized. This is probably not indicated unless the patient is septic and unresponsive to antibiotics.

Obstetric fistulas — Obstetric fistulas are classified according to their anatomic location (figure 1). In developed countries with modern obstetric care, urogenital fistulas are more associated with abnormal placentation or surgical complications at cesarean delivery than with obstructed labor. The repair of vesicovaginal obstetric fistulas is discussed in detail separately. (See "Obstetric fistulas in resource-limited settings", section on 'Management'.)

Vesicouterine fistulas — This type of fistula is most often seen after cesarean delivery and represents 1 to 4 percent of urogenital fistulas [64]. This type of fistula has also been reported to occur after uterine scar dehiscence, placenta percreta, and intrauterine device-associated injury. These patients usually present with vaginal leakage of urine, which can be seen to be entering the vagina from the cervix. Some patients present with Youssef's syndrome, which is characterized by cyclic hematuria (menouria), absence of vaginal bleeding (amenorrhea), and urinary incontinence due to vesicouterine fistula [65]. Cystogram demonstrates flow of dye into the endometrial cavity and then into the vagina via the cervix. Spontaneous healing has been reported in 5 percent of patients treated only with bladder catheterization for up to eight weeks [66,67]. Closure requires resection of the fistulous tract from both bladder and uterus, closure of the openings, and then interposition of the omentum or peritoneum. Abdominal laparoscopic and robotic approaches have been

effective in surgical management. A vaginal approach can also be used. Hysterectomy can be performed, and the bladder portion of the fistula excised and closed in layers.

Surgical sealants — Fibrin-based surgical sealants have been described to aid in fistula repair, but there is no evidence regarding their efficacy.

COMPLICATIONS

The first repair is the best chance at successful repair of the fistula. Unsuccessful repairs occur in 7 to 20 percent of patients [68]. Unsuccessful repairs require complete evaluation of the bladder, ureters, and kidneys before planning subsequent surgeries. Repair failure often occurs as a pinpoint fistula seen at the lateral corners of the prior repair. Good lighting, adequate exposure, and patience are useful in the re-evaluation of a patient that continues to leak after a repair. Infection needs to be eliminated, and often repeat repairs will require consideration of using soft tissue grafts. Stenting or percutaneous drainage may be used to allow further periods of healing, or to drain urinomas or abscesses. Occasionally, stents or catheters are sewn in place, requiring limited exploration for removal. Sutures placed into the bladder lumen may cause gravel or stones, which can grow to several centimeters in diameter. Removal to control infection may be required long after a successful fistula closure.

Other complications are the same as for other types of gynecologic surgery (eg, infection, hemorrhage).

POSTOPERATIVE CARE

A bladder catheter should be left in place for at least 7 up to 14 days [69,70]. Drains and catheters need to be secured to prevent unintentional removal.

Prior to removal of the catheter, an imaging study can be performed to confirm the integrity of the repair. A cystogram may be performed to assess repairs of bladder fistulas and ultrasonography or computed tomography scan with/without contrast for ureteral repairs. (See "Urinary tract injury in gynecologic surgery: Identification and management", section on 'Imaging studies'.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Gynecologic surgery".)

SUMMARY AND RECOMMENDATIONS

- **Definition and etiology –** Urogenital fistulas are abnormal communications between the female genital tract and the bladder, urethra, or ureters. In resource-abundant countries, these fistulas are rare and are typically related to pelvic surgery, severe pelvic pathology, or radiation therapy. In resource-limited countries, urogenital fistulas are a common complication of obstructed labor during childbirth. (See 'Introduction' above.)

- **Anatomy –** There are several different types of urogenital fistulas based upon the anatomic location of the connecting tract. Vesicovaginal fistulas are the most common type of fistulas, followed by ureterovaginal and urethrovaginal types. Rare types of fistula include vesico-uterine, vesico-cervical, vesico-peritoneal, and vesico-colonic fistula. (See 'Types of urogenital fistula' above.)

- **Clinical presentation –** Fistulas between the urinary tract and vagina present with leakage of urine from the vagina. Continuous urine loss is characteristic of a vesicovaginal fistula and intermittent leakage, particularly when positional, can be a sign of ureterovaginal fistula. (See 'Clinical presentation' above.)

- **Diagnosis –** The diagnosis of a urogenital fistula is made on physical examination by visualization of leakage of urine into the vagina. This may be visualized grossly or by using a dye test. (See 'Diagnosis' above.)

- **Timing of surgical repair –** The timing of fistula repair is dependent on how the surrounding tissue appears. If the tissue is healthy, early repair can be done, especially after obstetric injury related to instrumented delivery or cesarean section. Usually 6 to 12 weeks of delay will allow most granulation tissue to dissipate after gynecologic surgery, increasing the chance of a successful repair. During the waiting period, catheterization of the bladder may allow for spontaneous closure. (See 'Timing of surgery' above.)

  - **Role of indwelling bladder catheter**

    - **For treatment of fistula –** For an uncomplicated ureterovaginal fistula, placement of an indwelling ureteral stent has a high degree of cure. (See 'Stenting' above.)

    - **After surgical repair of fistula –** Postoperatively, a bladder catheter is typically left in place for 10 to 14 days. Prior to removal of the catheter, an imaging study can be performed to confirm the integrity of the repair. (See 'Postoperative care' above.)

- **Complications of repair** – The most significant complication of fistula repair is failure of the repair, which occurs in 7 to 20 percent of cases. (See 'Complications' above.)

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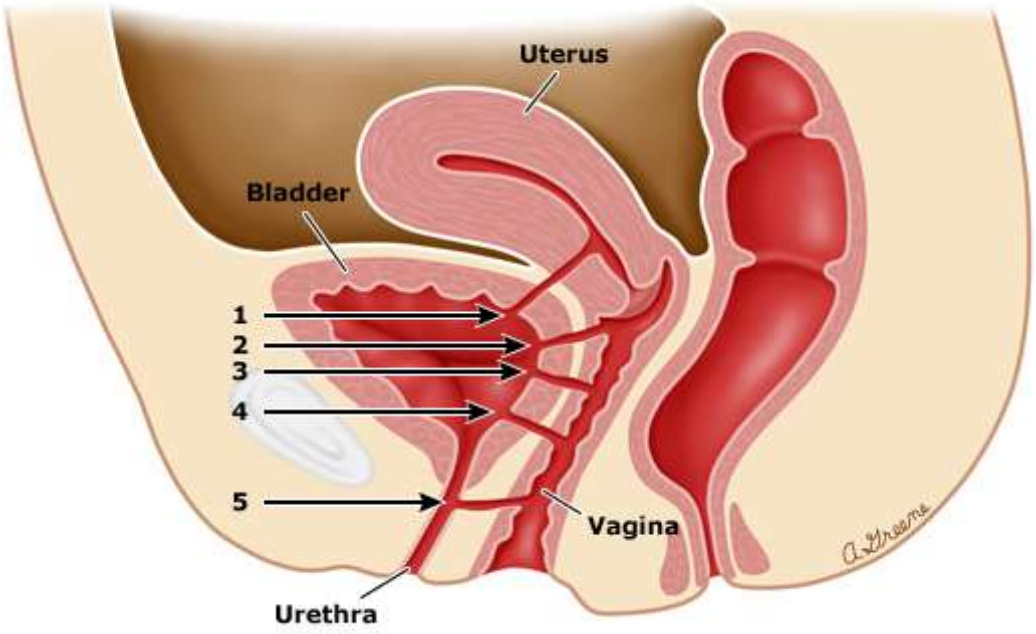
GRAPHICS

Anatomic types of female urogenital fistulas



1. Vesicocervical fistula
2. Juxtacervical vesicovaginal fistula
3. Midvaginal vesicovaginal fistula
4. Suburethral vesicovaginal fistula
5. Urethrovaginal fistula

Graphic 81096 Version 5.0

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