Chapter 24
Surgical Conditions of the Vagina and Urethra

Y. Hernandez Suarez

John A. Rock

Ira R. Horowitz

DEFINITIONS

Genitoplasty—Surgical reconstruction of the external genitals.

Hematocolpos—A condition in which menstrual blood accumulates inside the vagina and distends it, most commonly associated with obstructing vaginal anomalies.

Hermaphroditism—A condition in which there is a combination of disparate or contradictory elements most commonly used to describe an individual who has both male and female sexual characteristics and organs (synonyms: intersex, androgyne).

Imperforate hymen—The hymen usually is perforated during embryonic life to establish a connection between the lumen of the vaginal canal and the vaginal vestibule, and it usually is torn early in the prepubertal years. If canalization fails and there are no perforations, the hymen is called imperforate.

Pseudohermaphroditism—A condition in which the gonads are of one sex (genetically XX or XY), but in which the physical/phenotypical appearance is of the opposite sex. Genetically female individuals (chromosomes XX, thus with female gonads/ovaries) presenting with significant male secondary sex characteristics and genetically male individuals (chromosome XY, thus with male gonads/testes) presenting with significant female secondary sex characteristics.

OBSTRUCTIVE LESIONS OF THE VAGINA

Imperforate Hymen

Imperforate hymen is the most common obstructive congenital lesion of the female genital tract. The hymen, the junction of the sinovaginal bulbs with the urogenital sinus (UGS), is a thin mucous membrane, sometimes cribriform in appearance, composed of endoderm from the UGS epithelium. The müllerian ducts meet the sinovaginal bulbs at the most cephalad tip of the invaginating UGS. The vaginal plate elongates and canalizes to form the vagina. If the vaginal plate does not canalize, a transverse vaginal septum is the result. Canalization of the most caudal portion of the vaginal plate at the UGS establishes a patent hymen. The hymen usually is perforated during embryonic life to establish a connection between the lumen of the vaginal canal and the vaginal vestibule, and it usually is torn early in the prepubertal years. If canalization fails and there are no perforations, the hymen is called *imperforate.* It is usually an isolated finding with no associated anatomic anomalies.

Although variations in hymen development occur, complete blockage by the hymen of the vaginal orifice is rare, occurring in approximately 0.05% to 0.1% of newborn girls. In 1986, Mor and colleagues described the types of hymeneal shape in the newborn infant from examination performed within

the first 24 hours of life. In 53.5%, a smooth hymen with a central orifice was observed; a folded hymen with a central orifice was seen in 27%; a folded hymen with an eccentric orifice occurred in 4.5%; an anterior opening of the hymen was found in 10.8%; a posterior opening was found in 0.6%. The researchers found that 3% had hymeneal bands and 0.3% of the newborns had imperforate hymens.

Stelling and colleagues have evaluated the genetic transmission of imperforate hymen and reported that the

occurrence of imperforate hymen in two consecutive generations of a family is consistent with a dominant mode of transmission, either sex linked or autosomal. Examination of newborns with a family history of imperforate hymen is of particular importance.

Symptoms

Cases that are recognized at birth present with a thin bulging membrane between the labia, which represents a mucocolpos. When the hymen is incised, the vagina is found to contain mucoid fluid that is the result of accumulated cervical secretion. This is caused by the stimulation of the infant's cervical mucous glands by maternal estrogen in the presence of an intact hymen. Prenatal diagnosis of imperforate hymen and mucocolpos has been described with second-trimester antenatal sonography demonstrating a thin membrane that distended the vagina and spread the labia majora.

Although by performing a careful inspection of the external genitalia, an imperforate hymen may be diagnosed at any age, most commonly imperforate hymen is not detected until puberty, with girls presenting at age 13 to 15 years when symptoms begin to appear with no external evidence of menstruation. In 2005, Posner and Spandorfer reported a bimodal distribution of age at diagnosis with 43% (*n* = 10) of girls diagnosed younger than age 8 and 57% (*n* = 13) at or older than age 8. Among older girls, 100% were symptomatic with abdominal pain and/or urinary symptoms. They found that in the young girls, in 90% of cases the diagnosis was incidental. On review of the older girls' medical records, they found that the majority lacked description of breast and pubic hair development, and almost half did not have menstrual history documented. The older group was more likely to present symptomatically and to undergo ancillary testing. They conclude that incorporating an examination of the external genitalia into routine practice of clinicians caring for children can prevent the significant delays in diagnosis of imperforate hymen, misdiagnosis, and potential morbidity associated with the latter group.

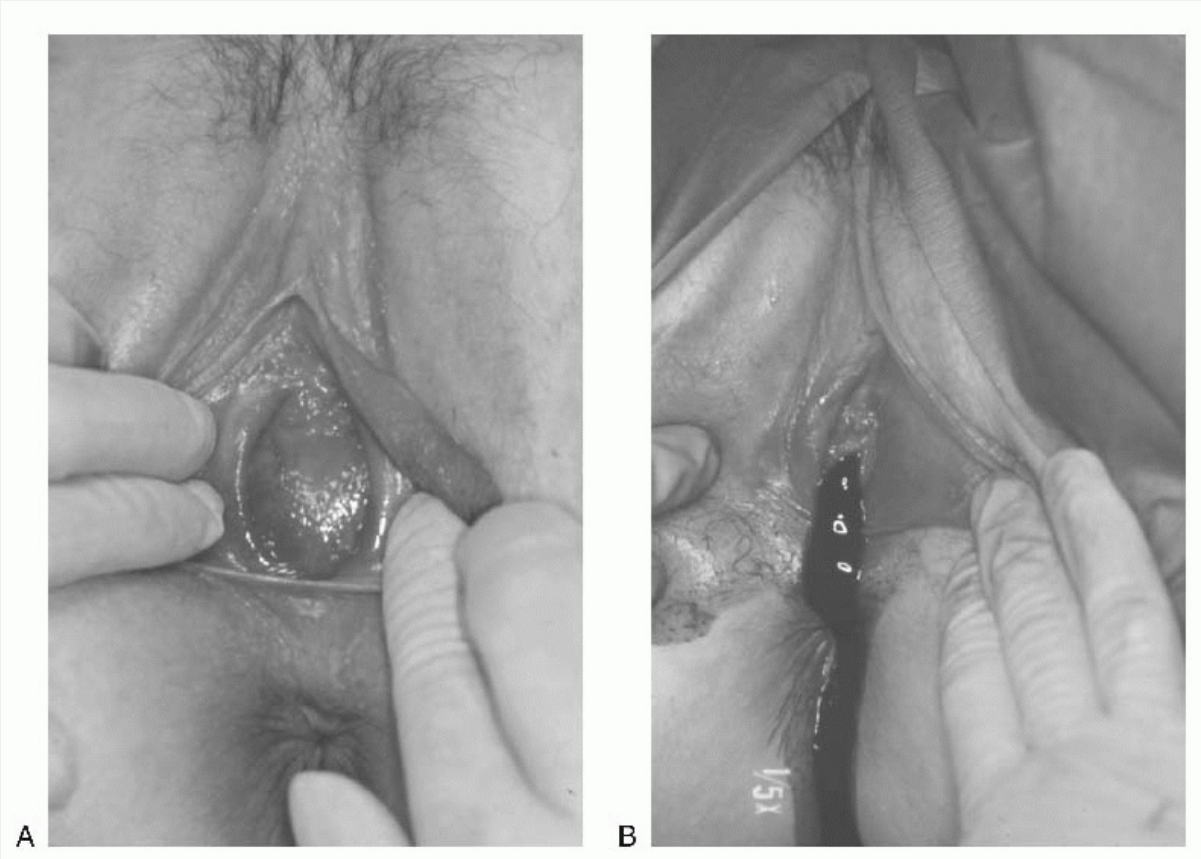

FIGURE 24.1 A: An imperforate hymen, membrane protrusion with a dark-tinged posterior representing a hematocolpos. **B:** Extrusion of accumulated blood at the time of incision into the membrane.

The symptoms of imperforate hymen after the onset of puberty are due to the accumulation of menstrual blood within the vaginal outlet tract. The blood of the first few cycles is collected in the vagina, which can hold a large volume of blood without undue stretching. This accumulated menstrual blood in the vagina is called

hematocolpos. The patient may feel slight fatigue and have cramping discomfort suggesting menstruation, but she has no history of any passage of menstrual blood through the vaginal outlet. **Figure 24.1A** shows bulging of the imperforate hymen, which may be dark in color because of occult blood showing through the stretched mucous membrane; **Figure 24.1B** shows extrusion of accumulated blood after the hymen is incised.

With continuing menstruation, the vagina distends, the cervical canal dilates, and hematometra (the filling of the endometrial cavity with blood) occurs. When the intrauterine pressure reaches a certain point, retrograde passage of blood into the tubes causes hematosalpinx. Rarely, blood passes freely into the peritoneal cavity (**Fig. 24.2**) causing all the symptoms and signs of peritonitis.

The most common symptoms of vaginal overdistention are lower abdominal pain, discomfort in the pelvis, and pain in the lower back. A tender mass may be palpable suprapubically, the result of uterine enlargement and upward displacement, bladder distention, or both. Hematocolpos should be included in the differential diagnosis of amenorrheic girls presenting with persistent lower back pain. Irritation of the sacral plexus is believed to be the etiology of this referred pain pattern. The lower abdominal discomfort often is aggravated on defecation, and if extensive blood accumulation occurs in the vagina,

constipation may result from pressure and obstruction of the underlying rectum. Urination can be difficult as a result of pressure of the distended vagina, which can compress the urethra and prevent emptying of the bladder; urinary obstruction can ensue. Bladder symptoms can present as cramplike pains in the suprapubic region, along with symptoms of dysuria, frequency, and urgency; overflow incontinence may eventually develop, and hydronephrosis is a rare complication. Girls presenting with severe dysmenorrhea and duplicate vagina and didelphic uterus should be evaluated for unilateral imperforate hymen.

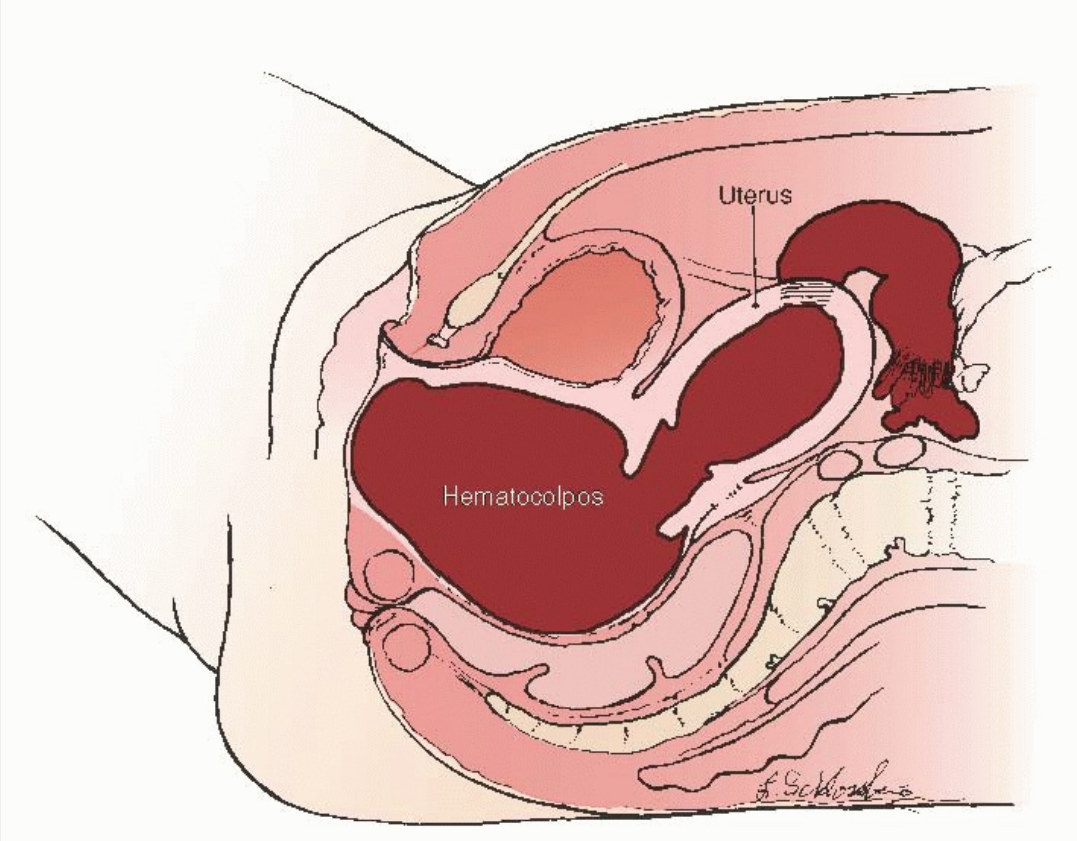

FIGURE 24.2 Hematocolpos, hematometra, hematosalpinx, and hemoperitoneum consequent to an imperforate hymen.

Pelvic ultrasound should be performed in the evaluation of imperforate hymen particularly prior to surgical intervention. Concomitant diagnostic laparoscopy in patients with imperforate hymen has not demonstrated an association with pelvic endometriosis, and laparoscopy should not be included in the standard evaluation of imperforate hymen.

Treatment

Approach to the surgical management of imperforate hymen requires cultural sensitivity. The importance of hymeneal integrity varies among cultures and religions. Options should be carefully explained to patients and their families, and the choice of surgical approach should be reached through shared decision making. In the patient diagnosed in infancy, surgery may be delayed until adolescence to ensure optimum long-term vaginal functionality and reduce the small risk of repeat surgery. The goals of surgical management of imperforate hymen are both long and short term. In the short term, the obstruction of the vagina is alleviated. In the long term, satisfactory cosmesis, sexual function, and fertility are preserved.

In the standard approach, the hymenal membrane is incised in a stellate fashion, preferably at the 2-, 4-, 8-, and 10-o'clock positions. The quadrants of the hymen are then excised, and the mucosal margins are approximated with fine delayed absorbable suture (**Fig. 24.3**). To prevent scarring and stenosis, the hymenal tissue should not be excised too close to the vaginal mucosa. The vagina should be carefully drained with a suction probe. In patients in whom hematometra is present, all intrauterine instrumentation should be avoided (**Fig. 24.2**), as there is significant risk of perforating the thin, overstretched uterine wall. Patients should be followed for 2 to 3 weeks to ensure adequate resolution of the hematometra. Rarely, secondary dilatation of the cervix may be needed.

For patients in whom the perception of hymeneal “integrity” is important, the procedure may be modified to exclude the excision of the hymen. A simple vertical incision of the hymeneal membrane is performed with oblique suturing of the hymen to form an annular opening. Sutures may be avoided with the placement of a Foley catheter and topical estrogen cream for 2 weeks postoperatively. These approaches have anecdotally resulted in satisfactory cosmesis and defloration.

Rock and colleagues followed pregnancy success subsequent to the surgical correction of imperforate hymen between 1945 and 1981 at the Johns Hopkins Hospital. Twenty-two patients of mean age 14.7 years were admitted for surgical correction of imperforate hymens. Associated anomalies, including urinary tract anomalies, were rare. Thirteen patients subsequently conceived, and 10 patients were observed to have living children. Liang and colleagues in 2003 reported on the long-term postoperative evaluation of 15 patients with imperforate hymen. They conducted questionnaires and telephone interviews regarding sexuality, fertility, menstrual problems, micturition, and defecation. The mean postoperative follow-up was 8.5 years, with the mean age at diagnosis being 13.2 years. The women reported being markedly relieved of their presenting symptoms after hymenectomy. There were some who reported having irregular menstruation, and 6/15 reported dysmenorrhea. The authors reported that most patients fared well in terms of fertility and sexual function. It is important to counsel patients and their families about the favorable prognosis of fertility and pregnancy in women with correction of imperforate hymen.

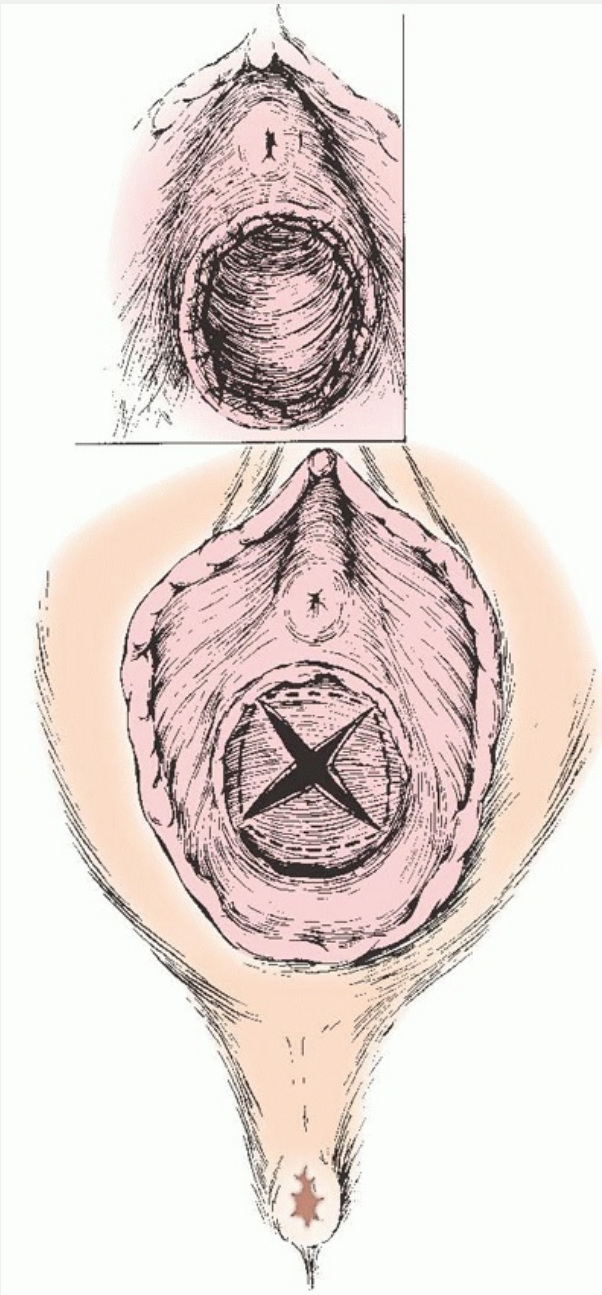

FIGURE 24.3 Excision of imperforate hymen. Stellate incisions are made through the hymenal membrane at the 2-, 4-, 8-, and 10-o'clock positions. The individual quadrants are excised along the lateral wall of the vagina, avoiding excision of the vagina (**inset**). Margins of vaginal mucosa are approximated with fine delayed absorbable suture.

Transverse Vaginal Septum

Transverse vaginal septum is a rare cause of congenital vaginal obstruction. Presenting symptoms are identical to imperforate hymen, but diagnosis is frequently delayed in the setting of a normal vulvovaginal exam. Transverse vaginal septum is diagnosed on pelvic ultrasound with hematocolpos identified cephalad to the septum. Concomitant uterine and renal malformations have been described. Magnetic resonance imaging (MRI) may be helpful in identifying the anatomy. Joki-Erkkila and Heinonen in 2003 identified 26 women with obstructive vaginal malformations. Thirteen underwent incision of an imperforate hymen and 3 excision of a complete transverse vaginal septum, with a mean follow-up period of 13 years. The remaining 10 had obstructive hemivagina and incision of a “longitudinal” vaginal septum with a mean follow-up period of 16 years. The women with transverse obstruction (imperforate hymen or transverse vaginal septum) were diagnosed within a month from their primary symptoms compared with 27 months for those with longitudinal obstruction. None with imperforate hymen required reoperation, but 2/3 with transverse vaginal

septum did for vaginal constriction, and 3/10 with longitudinal vaginal septum had reexcision of their septum. All of the 10 women with longitudinal obstruction had uterine and renal malformations, whereas in those with a transverse vaginal obstruction, only 6 underwent renal evaluation, and of these, 2 had double ureters. Dysfunctional uterine bleeding was reported by 19% of those in the transverse group and 40% of those in the longitudinal obstruction group, dyspareunia was reported in 30% of the transverse and none in the longitudinal, and dysmenorrhea was reported in 19% of transverse and 20% of longitudinal. No endometriosis was found in women who subsequently had a laparotomy or laparoscopy (18/26). In the 14 who were attempting to conceive, difficulty with fertility was not diagnosed. Twenty-five (89%) out of twenty eight pregnancies ended in delivery, the live birth rate of the longitudinal group being 82%, and 94% in those with transverse obstruction. The authors concluded that accurate diagnosis, along with adequate treatment, can reduce the need for reoperations and that no specific longterm clinical gynecologic symptoms were identified in these women with obstructing vaginal anomalies.

Sequelae of Female Genital Mutilation

Female genital mutilation (FGM) is defined by the World Health Organization as “all procedures that involve partial or total removal of the external female genitalia, or other injury to the female genital organs for non-medical reasons.” The WHO estimates that more than 100 million worldwide have undergone some type of FGM. It is estimated that approximately 250,000 girls and women with FGM are currently living in the United States. Female genital mutilation is practiced in Africa, Southeast Asia, and the Middle East, and is most commonly performed in puberty. Late complications of FGM include strictures, obstruction, and fistula formation. Complete obstruction of the vagina resulting in hematocolpos and hematometra has been reported. Women with FGM may seek gynecologic consultation to alleviate dyspareunia or dysmenorrhea or in preparation for childbirth. Defibulation is a vertical incision made to open scarring and reconstruct external genitalia. In a study by Nour et al. at the African Women's Health Center at the Brigham and Women's Hospital, 40 women were identified as having undergone defibulation between 1995 and 2003. Indications for defibulation were pregnancy (30%), dysmenorrhea (30%), apareunia (20%), and dyspareunia (20%). Almost 50% were found to have an intact clitoris underneath the scar. More than 90% of women stated they would highly recommend the procedure to others. 100% were satisfied with appearance and sexual function. The American Congress of

Obstetricians and Gynecologists has prepared a toolkit for clinicians caring for patients with FGM that includes photographs and detailed instructions.

Anomalies of the External Genitalia and Vagina

Sexually Ambiguous External Genitalia

Sexually ambiguous external genitalia defects of the UGS are remarkably constant in appearance, regardless of the etiology of the anomaly. Such genitalia differ only in their degree of malformation and occupy a range of positions somewhere intermediate to the genitalia of a normal female and that of a normal male. These anomalies can be anatomically identical to each other, whether their etiologic factor is congenital adrenal hyperplasia (CAH), male hermaphroditism, true hermaphroditism, or some other intersex syndrome. External genitalia proceeds along the female lines except in the presence of some virilizing influence acting on the developing embryo (i.e., androgens). The conversion of testosterone to dihydrotestosterone by 5α-reductase activity occurs in the skin of the external genitalia and UGS in early gestation. Masculinization of the external genitalia ensues in the presence of functional androgens regardless of genetic sex. In the case of female pseudohermaphroditism— XX chromosomes in the presence of a virilizing influence—the fusion of the scrotolabial folds may be sufficient to obscure or conceal the vagina from the outside or even to entirely suppress its formation. The urethra can be formed for varying distances or along the entire length of the phallus. Therefore, the operative procedure for reconstruction of ambiguous genitalia into feminine genitalia does not vary in its essential elements, regardless of the cause of the intersexuality. The common goals for the female reconstruction of ambiguous genitalia include reduction of clitoral size, creation of labia minora, and exteriorization of the vagina.

Any reconstruction of the external genitalia with the objective of producing normal female appearance and function requires a full understanding of the surgical anatomy. It is essential to accurately identify the site of communication of the vagina with the UGS. In their classic paper in 1969, Hendren and Crawford recognized the variability of the communication of the vaginal insertion into the UGS. **Figure 24.4** illustrates the spectrum of vaginal communication with the urethra, with **Figure 24.4A** representative of a low distal communication (infrasphincteric) and **Figure 24.4B** representative of a high proximal communication (suprasphincteric). In *95%* of cases, the vaginal communication is in relation to the caudal UGS derivatives (infrasphincteric) with the vagina communicating with that portion of the UGS that in a man gives rise to the membranous portion of the male urethra and that in the woman becomes the vaginal vestibule. If this usual relation is confirmed at surgery, the persistent, anomalous UGS may be incised to the vaginal communication without fear of disturbing the urinary sphincter. In less than 5% of cases, the vagina communicates high, with the portion of the UGS that becomes the prostatic urethra in the man or the entire urethra in the woman (suprasphincteric). Knowledge of the possible variants in communication of the vagina with the UGS is critical before entertaining surgical correction. Preoperatively, genitography showing the relationship of the UGS, urethra, vagina, and bladder may be helpful. Contrast is injected retrogradely through the perineal meatus of the UGS. Delineation of this anatomy can be elucidated at the time of surgery with the use of endoscopy to evaluate where the vagina communicates with the UGS. In 1989, Bargy and colleagues described the anatomic lesions in the intersexual states based on clinical and anatomic observations.

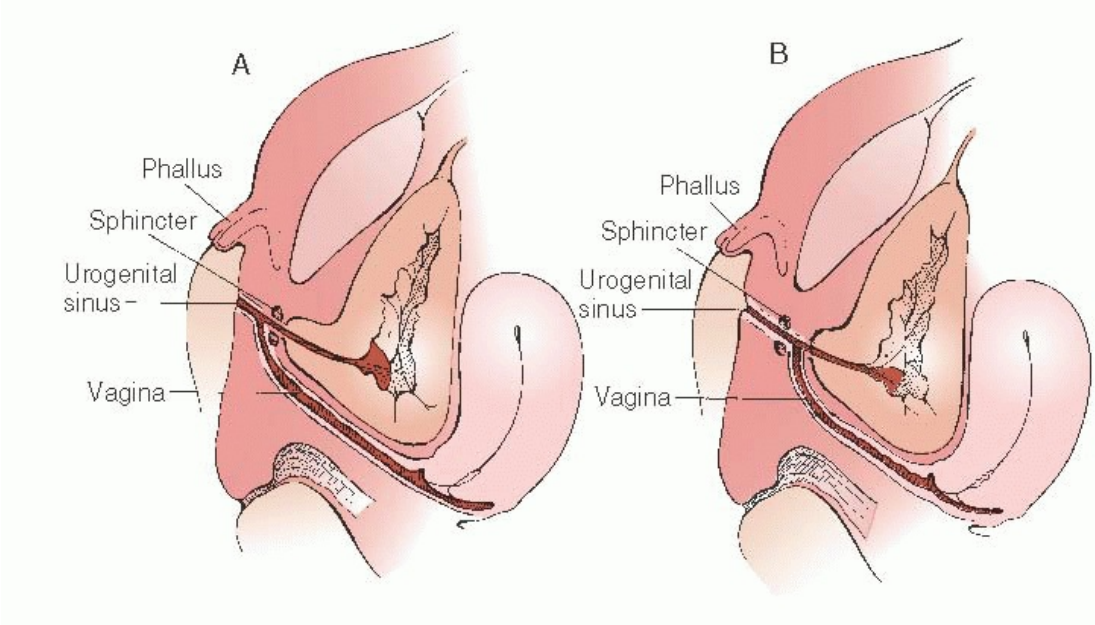

FIGURE 24.4 Illustration of the spectrum of vaginal communication with the urethra. **A:** Representative of a low distal communication (infrasphincteric). **B:** Representative of a high proximal communication (suprasphincteric).

One objective of the reconstruction procedure for external genitalia is to delay the procedure until the anomalous structures are of a size to permit easy identification of all structures. As observed by Azziz and coworkers, vaginal repair may be delayed until menarche, when maturity and the desire for sexual activity are usually well established. There is present debate in the need for early reconstruction for the sole purpose of cosmesis to prevent embarrassment or anxiety to the patient's family. Crouch and Creighton revisited the longstanding dictum of early surgical correction of ambiguous genitalia for intersex conditions. They report that some advocate the “one-stage” procedure in infancy, but that others advocate deferral of vaginal surgery until after puberty, especially given that many patients require further surgery at adolescence. It has been believed that the intersex child may be psychologically damaged by the “appearance” of uncorrected external genitalia if not performed at infancy, but unfortunately to date little research on this exists.

Most hermaphrodites reared as girls have a vagina or vaginal pouch, although in some instances, it is rudimentary. Only rarely is there no vagina, despite ambiguity of the external genitalia. The choice of operative procedure must conform to the observed anatomy. Thus, these choices are considered in the context of several categories based on

anatomic structure of the anomaly.

When the Vagina Is Present and the Vaginosinus Communication Is Low

The basic operation is, in essence, a modification of one described at length by Young that was previously performed successfully by various surgeons, notably in Europe. Patients with adrenal hyperplasia usually require only reconstruction of the external genitalia. However, when exploratory laparotomy is necessary to remove contradictory sex structures in other types of intersexuality or to establish the diagnosis, reconstruction of the genitalia may be considered at the same operation.

If an operation is deemed necessary at a very young age, the structures can be so small that it is impossible to introduce a finger into the UGS, and all tissues must be grasped throughout the operation with fine delicate tissue forceps. Operating loupes (2.5 to 3) are of great benefit to the surgeon. Small bipolar forceps and microscissors are also useful. Fine 5-0 or 6-0 synthetic absorbable sutures on an atraumatic needle are used throughout the procedure.

In cases of simple labial fusion, a cutback vaginoplasty (**Fig. 24.5**) would be sufficient to restore “normal” female genital anatomy. In cases of low vaginal confluence with the UGS (**Fig. 24.4A**), reconstruction may be done either by freeing the posterior vaginal wall and suturing up to the perineal external opening (**Fig. 24.6**) or—if a patient has copious subcutaneous fat and difficulty exists in approximating the vagina to the perineal skin—by use of a posterior flap technique, as used by Fortunoff and coworkers (**Fig. 24.7**).

Initially, the UGS may be thoroughly investigated with a small McCarthy panendoscope to determine accurately the position and size of the vaginal communication. If a sound or catheter can be easily introduced into the meatus of the UGS and into the vagina, use of the endoscope may be omitted. Special care is needed not to introduce the sound into the urethra. A sound accidentally introduced into the urethra poses the danger of incising the distal urethral meatus. After the UGS is incised (to within 2 or 3 cm of the anus), the urethral orifice may be identified (**Fig. 24.6A, B**). A small Foley catheter may then be introduced through the urinary meatus for purposes of identification throughout the remainder of the operation. To attach the edges of the vagina to the skin, it is usually necessary to free the vagina posteriorly and laterally to secure sufficient mobilization so that these structures meet with no tension. It is unnecessary to free the vagina anteriorly, because this requires its separation from the urethra. Sufficient mobilization can ordinarily be obtained by lateral and posterior dissection. When sufficient freedom has been attained, the edges of the vagina may be secured to the skin with interrupted 5-0 sutures on an atraumatic reverse cutting needle. In the infant, four or five sutures around the edge of the vagina are usually sufficient. The edges of the incised sinus membrane may then be sutured to the skin anteriorly (**Fig. 24.6D-G**). A small sponge impregnated with petroleum jelly may be introduced into the vagina to maintain its patency during the healing process. The indwelling catheter may be left in place for a few days until edema of the surrounding structures has subsided. An indwelling catheter is particularly useful in children with metabolic disorders that require accurate urine collection. A pressure dressing for 24 hours reduces the incidence of incisional hematoma.

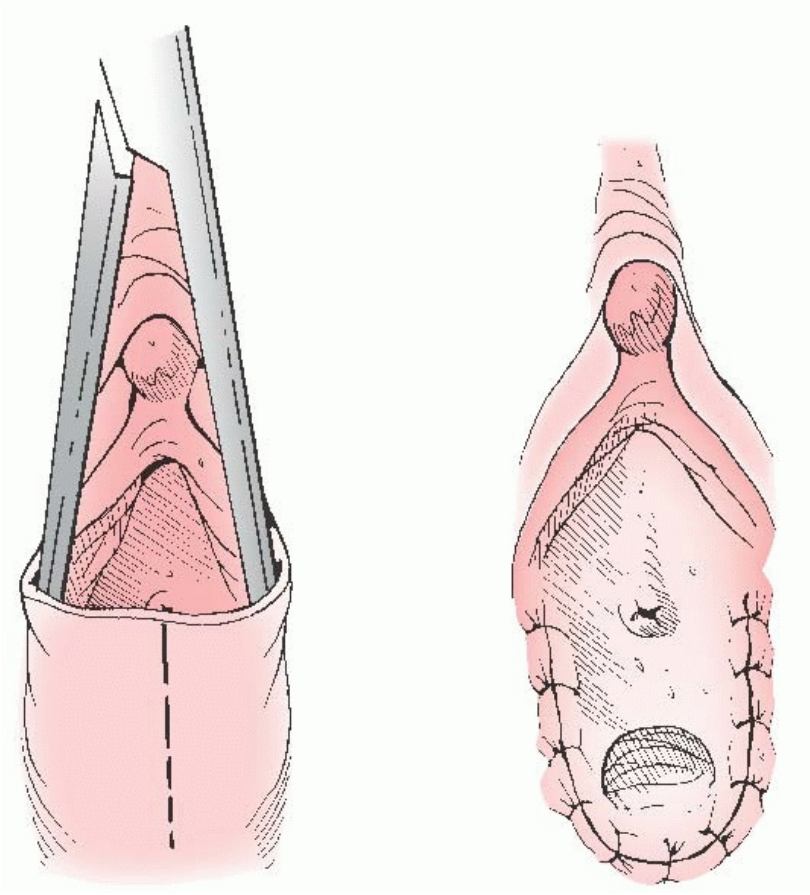

FIGURE 24.5 In cases of simple labial fusion, a cutback vaginoplasty is sufficient to restore “normal” female genital anatomy.

Figure 24.7 illustrates vaginoplasty with a posterior flap as advocated by Fortunoff and is useful in cases with anticipated difficulty in bringing the vaginal orifice to the outside. Briefly, a posterior-based U-flap is drawn, with corners on either side of the perineal body near the rectum (Fig. 24.7A-C). This flap must be wide enough for tension-free anastomosis. This posterior flap is dissected in the midline and is carried out between the rectum and UGS.

Sutures are individually placed through the posterior-based flap and into the split posterior vagina. Sutures are tied after all have been placed. Because the anterior wall is not disturbed, no anterior flap is required. Finally, the phallic skin is divided in the midline and moved inferiorly to create the labia minora.

Surgical reconstruction of an enlarged clitoris has undergone significant evolution. Traditionally, the clitoris was simply amputated, and a nonfunctioning cosmetic clitoris was fashioned. Although several children so treated now have normal adult sexual function, the literature is lacking in followup data on large patient groups. Surgical efforts now focus on concealment, plication, resection, and reduction, with an attempt to provide a normal cosmesis without sacrificing sensation or vascularity of the glans.

The clitoral flap technique has provided a somewhat better cosmetic result than simple amputation. This procedure attempts to preserve a shell of the glans on a pedicle flap. The shaft of the clitoris is subtotally resected, and the stumps are reanastomosed (Fig. 24.8). The nerve supply to the glans is severed during this procedure, with the result that sensation in the glans is diminished. Sexual function, however, seems to be satisfactory.

Rajfer and colleagues have suggested a dorsal approach to the subtotal resection of the corpora (Fig. 24.9), which has the advantage of preserving the ventral nerve supply and which should preserve sensation in the glans. This approach is theoretically desirable and can be recommended for suitable cases. As mentioned earlier, however, lack of clitoral sensation does not seem to significantly affect the later sexual behavior of patients treated by procedures that sever the dorsal nerves to the glans.

In 1999, Baskin and colleagues described the anatomic studies of the human clitoris. As in the human penis, the

nerves in the clitoris form an extensive network surrounding the tunica

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of the corporeal body with a nerve-free zone at the 12-o'clock position. The normal clitoris has corporeal bodies that are smaller but analogous to those of the penis. The surgeon should be mindful of their function if extensive resection is considered with care to preserve the dorsal aspect of the glans.

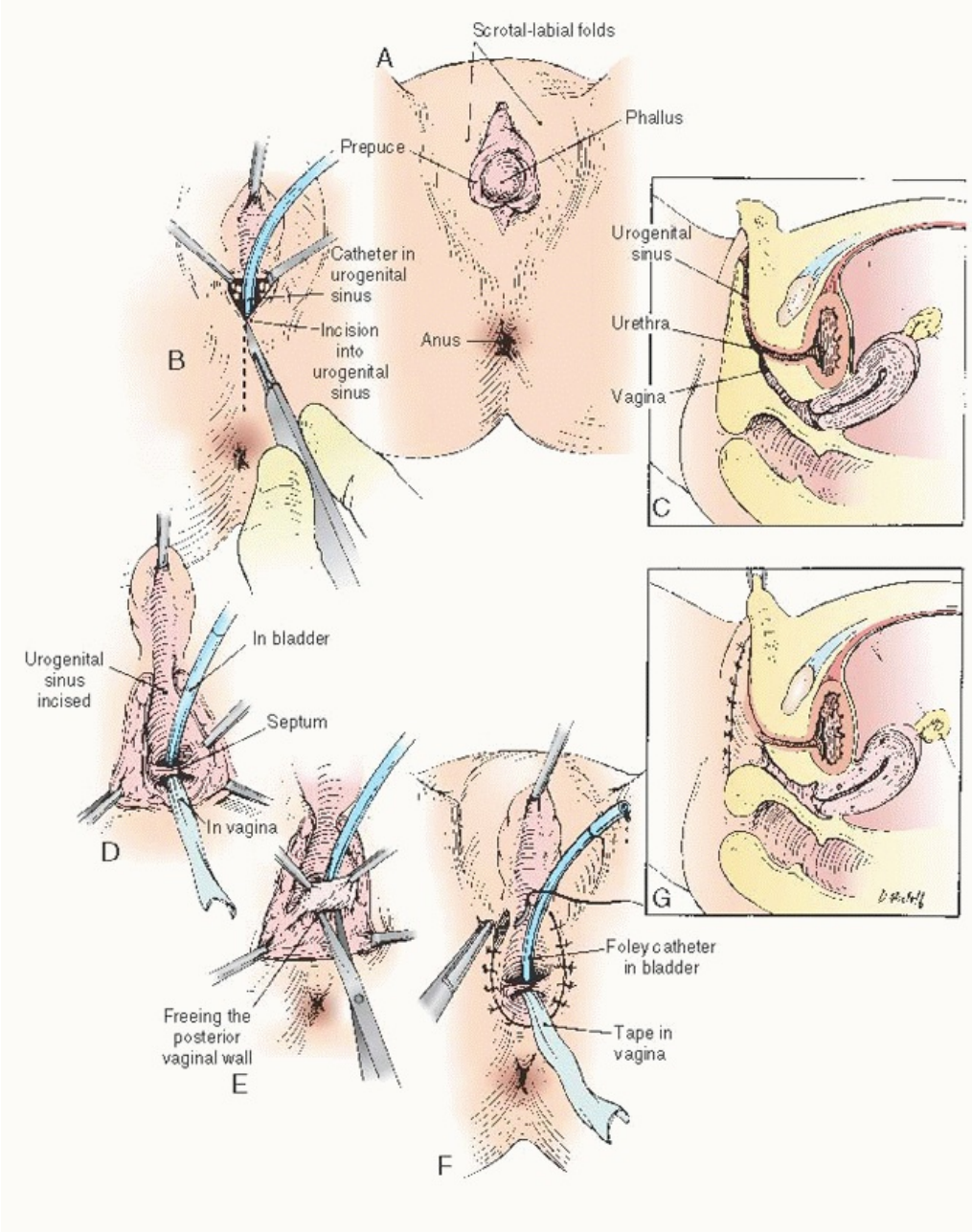

FIGURE 24.6 A: The external genitalia of an 18-month-old girl with CAH. The operation is the same, regardless of the etiology of the "virilizing" deformity. **B:** Beginning of the operation. Incision into the UGS. If the external meatus is large enough and the UGS will accommodate it, it is sometimes possible to introduce a catheter into the bladder through the urethra and introduce a sound into the vagina beside this. When the structures are large enough, this maneuver greatly facilitates the operative procedure by ensuring their identification. **C:** Lateral view showing the relations among the various structures. **D:** Situation after incision of the UGS. **E:** With the glass catheter in the bladder, the posterior vaginal wall is freed to make it possible to bring it to the skin edge without undue tension. **F:** The operative situation after the edges of the vagina are sutured to the skin and after the edges of the mucous membrane of the UGS are also sutured to the skin along the line of incision. **G:** Lateral view at the completion of the operation.

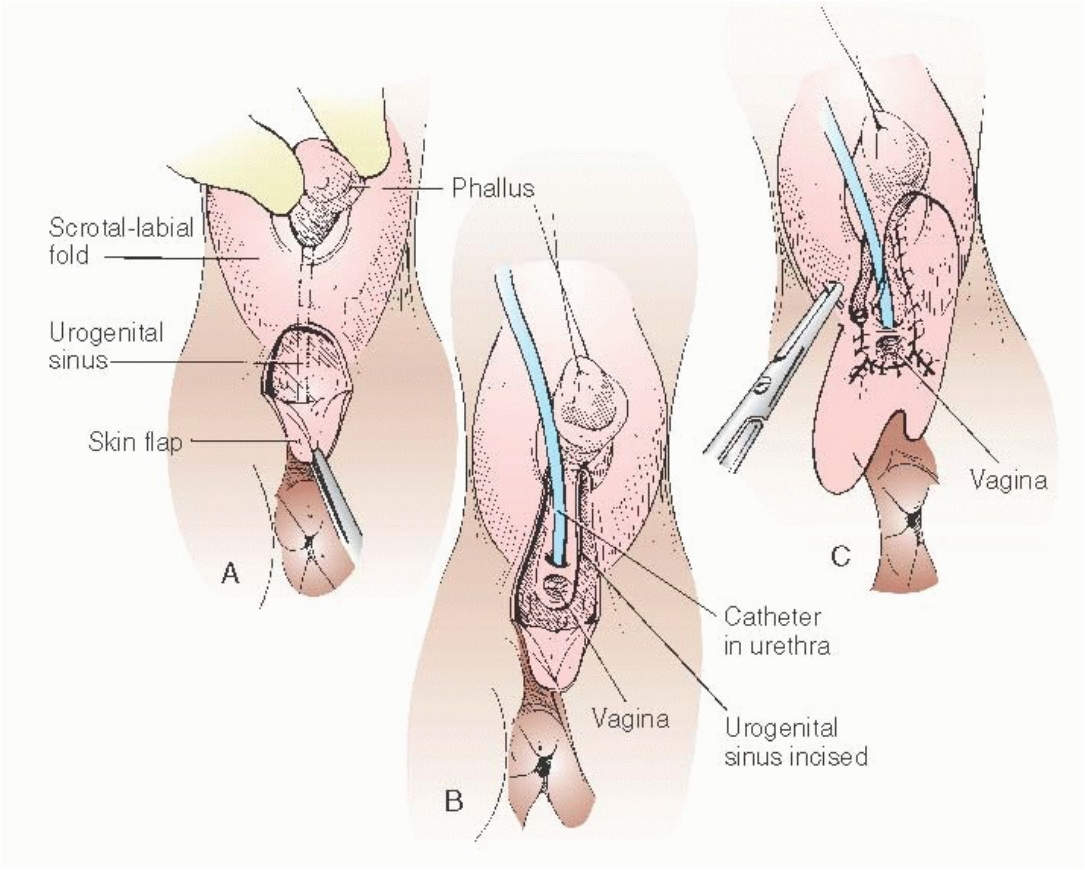

FIGURE 24.7 A posterior flap technique for when there is difficulty bringing the vaginal orifice to the outside.

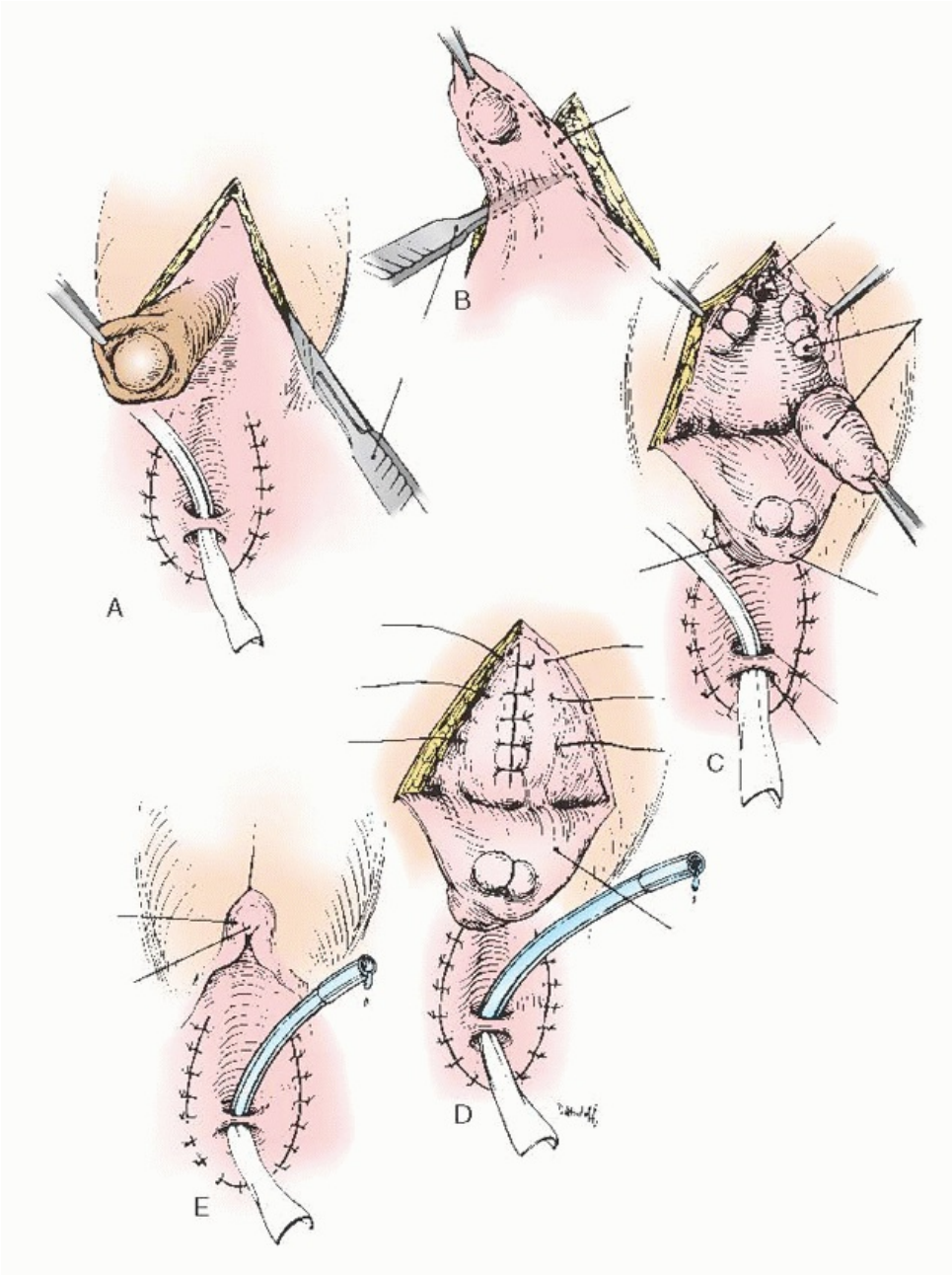

FIGURE 24.8 Clitoral reduction via the clitoral flap technique. **A:** The initial incision. **B:** The flap must be as wide as possible at the base to preserve the circulation for the glans. The glans cannot be preserved completely because the blood supply will be insufficient to maintain it. It must be as thin a shell of the glans as possible. **C:** The shaft of the phallus has been removed. **D:** There has been some closure of the space from which the corpora were removed. **E:** The flap has been sutured into place.

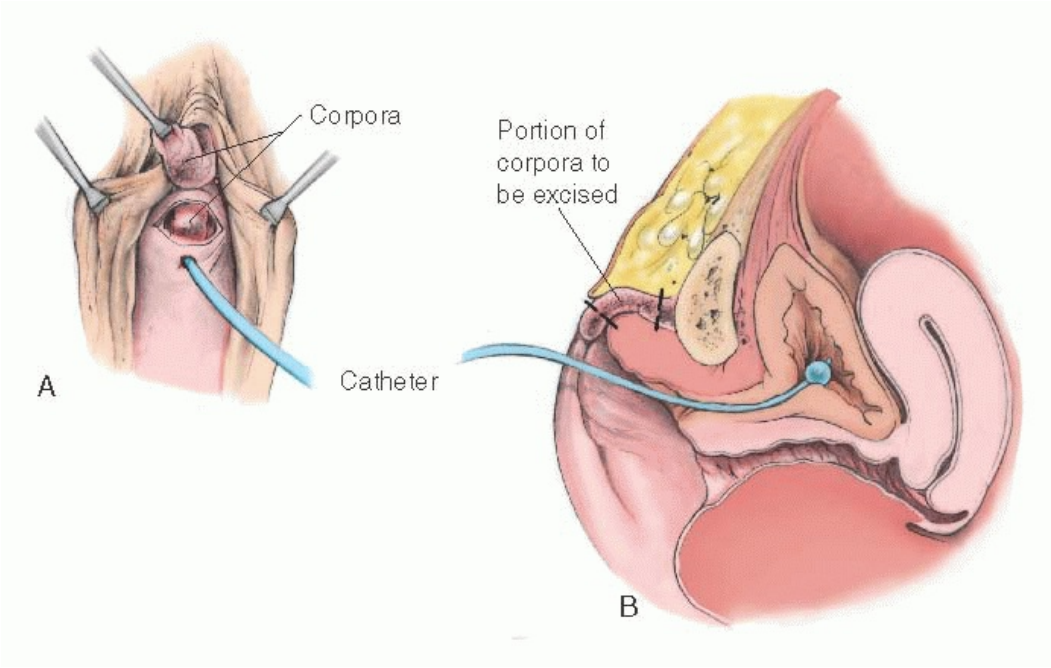

FIGURE 24.9 Clitoral reduction with the corpora exposed through a dorsal incision (operation of Rajfer et al.). **A-C:** Corpora are approached and removed through a posterior incision in the phallus.

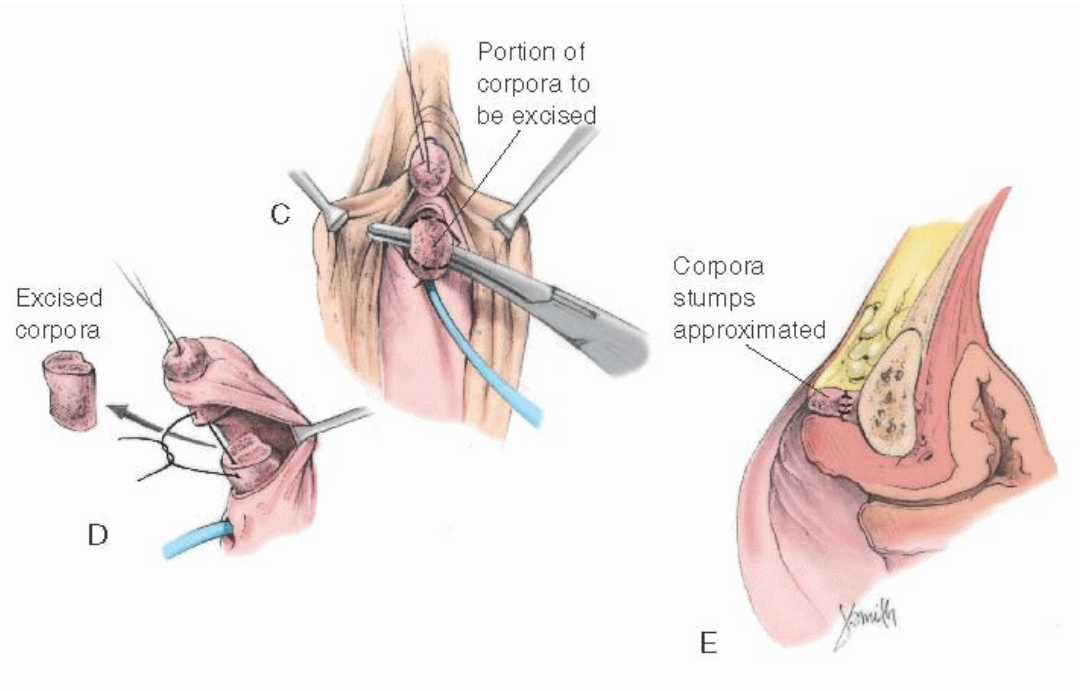

FIGURE 24.9 (*Continued*) D: Diagram of the excised portion of the corpora. E: The corpora are removed and stumps approximated.

Rink and Adams in 1998 reviewed feminizing genitoplasty. They advocated clitoral reduction without sacrificing sensation or vascularity of the glans, recommending a subtunical reduction of erectile tissue as described by Kogan and colleagues in the 1980s. The glans is preserved with its neurovascular supply intact along Buck fascia and the dorsal tunic of the corpora, yet the cavernous erectile tissue is excised. **Figure 24.10** illustrates this surgical management; additionally, the phallus is degloved, and this skin is used to create the labia minora. An incision is made around the corona of the phallus and continued inferiorly around the urethral meatus. Preservation of this meatal plate improves cosmesis and increases blood supply to the glans. The neurovascular bundle is identified, with lateral incisions into the tunica of the corpora along the phallus from the glans backward proximal to the corporal bifurcation. The cavernous erectile tissue is dissected from the inferior aspect of the dorsal tunic and excised, and the proximal and dorsal corpora are suture ligated. The glans is secured to the inferior aspect of the pubis or to the corporal stumps.

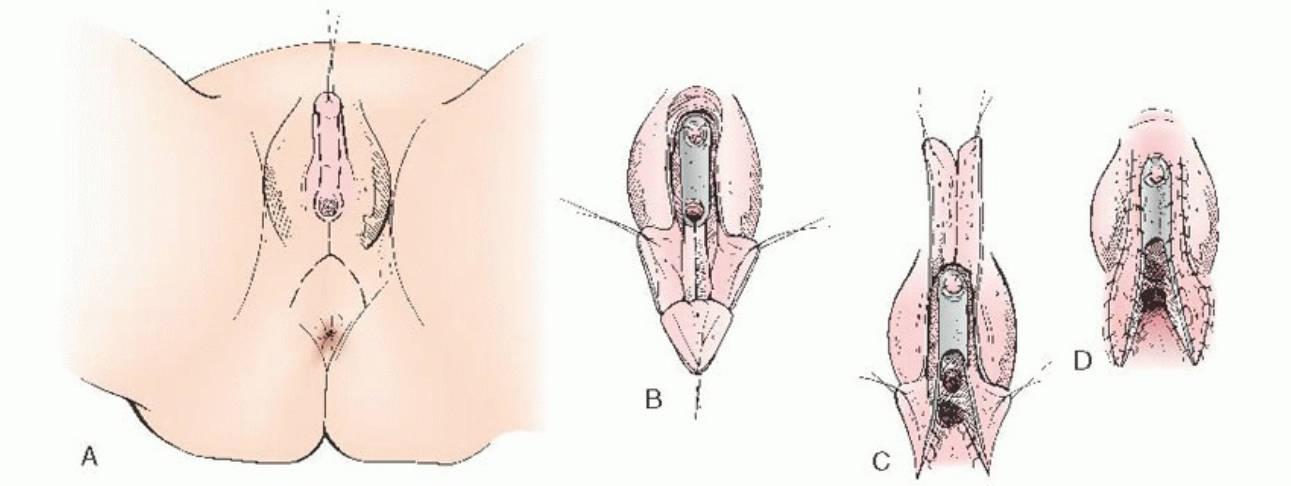

FIGURE 24.10 Surgical management of the clitoris with creation of labia minora and a posterior flap technique for vaginoplasty. **A:** Incision around the corona of the phallus continued inferiorly around the urethral meatus. **B:** Proposed incision into the posterior wall of the UGS. **C:** Degloving of the phallus. Sutures are individually placed through the posterior-based flap and into the split posterior vagina. **D:** The phallic skin is divided in the midline and moved inferiorly to create the labia minora. (From Rink RC, Adams MC. Feminizing genitoplasty: state of the art. *World J Urol* 1998;16:212. Copyright © 1998, Springer-Verlag Berlin Heidelberg. With kind permission from Springer Science and Business Media.)

In a pilot study of six women in 2003, Crouch and colleagues reported on genital sensation after feminizing genitoplasty for women with CAH. These women were assessed for thermal, vibratory, and light touch sensory thresholds in the clitoris and vagina using a genitosensory analyzer and Von Frey filaments. Highly abnormal results for sensation in the clitoris were found in the six women studied. In three who had an introitus capable of admitting a vaginal probe, the vaginal sensory data was considered normal. Given an abnormal clitoral sensation and normal vaginal sensation, the authors hypothesize that the abnormal clitoral findings may result from the surgical reconstruction rather than an effect of CAH. A self-administered sexual function assessment revealed that these women had sexual difficulties, particularly in the areas of infrequency of intercourse and anorgasmia. The authors voiced their concerns with the stated superiority of modern surgery. They stated that the vascularity of the glans remains vulnerable and that the risk of damage to the neurovascular bundles is inherent in any technique that

entails their separation from the corporal tissue. They concluded that even after seemingly successful clitoral reduction, the sensory function is significantly impaired, and this should be taken into consideration during counseling. Larger studies are presently under way to further evaluate these findings.

When the Vaginal Orifice Is Obscured

As mentioned previously, preoperative identification and catheterization or sounding of the vaginal orifice is key to the performance of a successful, one-stage procedure. When the vagina cannot be located by sounding, it sometimes can be seen by endoscopy. When sounding and vision both fail, an attempt before surgery to introduce a small (no. 4 or 5) ureteral catheter into the vagina by blindly probing through the endoscope along the posterior wall of the UGS may assist in the identification of the vagina. Sometimes, this catheter finds the orifice. If so, it may be left within the vagina as a guide during surgical exposure of the area (**Fig. 24.11**). If the vaginal orifice cannot be located, a planned two-stage operation is indicated. The objective of the first stage is to obtain cosmetically satisfactory female genitalia by reducing the clitoris and partially excising the UGS without exteriorizing the vagina. During the planned second stage, exteriorization of the vagina can be performed. The second stage should be postponed until identification of the vaginal orifice by sounding becomes possible. This may require waiting for puberty for estrogenization of the area. If dilators are needed for patency postoperatively, this surgery should be delayed until the girl is sufficiently mature for their appropriate use. This will maximize the success of the reoperation.

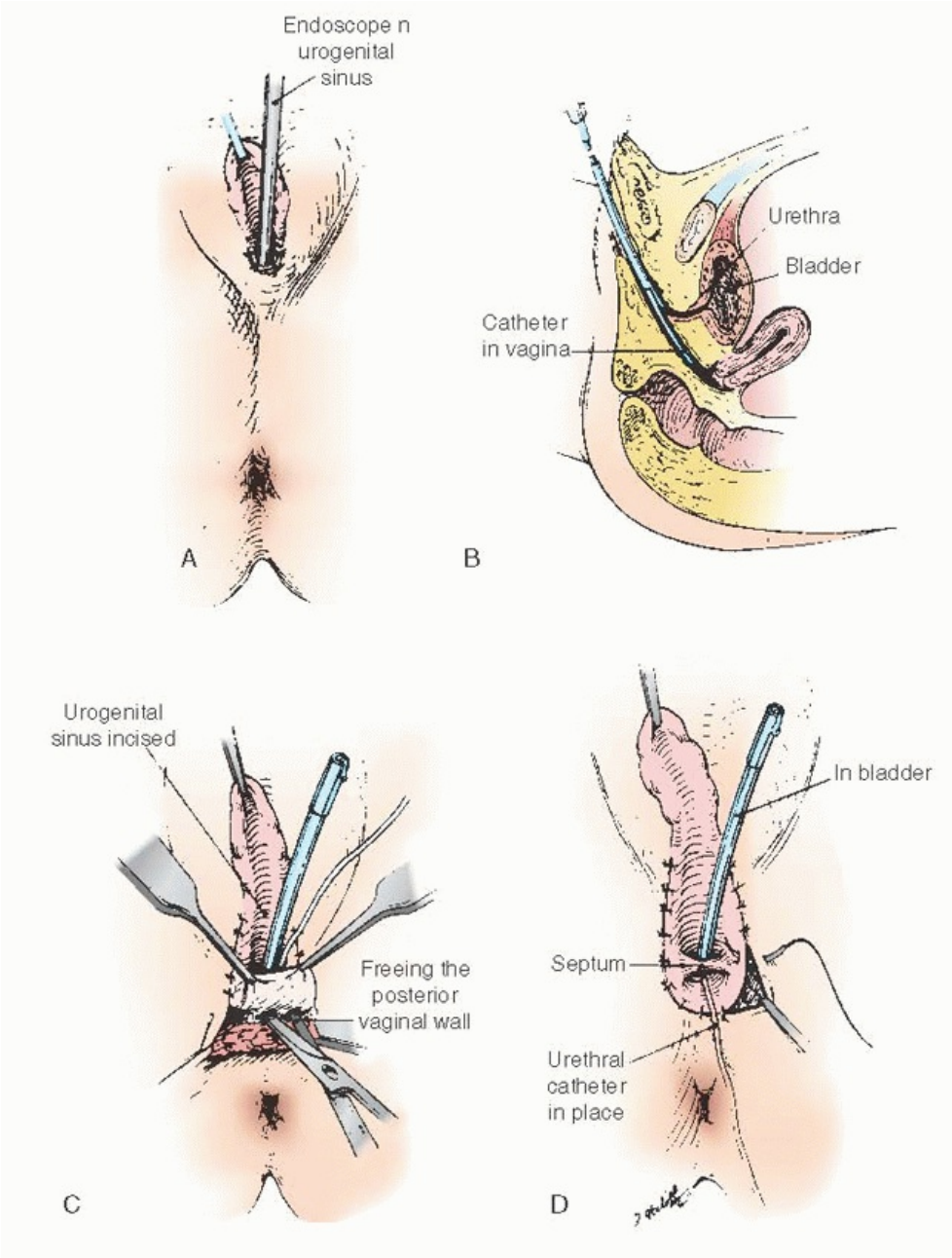

FIGURE 24.11 Operative procedure when it is difficult to locate vaginal orifice by sounding. An operative endoscope can be used to probe with a small ureteral catheter. **A:** The orifice is enlarged to accommodate the endoscope. **B:** The tip of the catheter has found the vaginal opening and entered the vagina. **C:** Freeing the posterior vaginal wall with the ureteral catheter in the vagina and a stiff catheter in the urethra. **D:** The vaginal portion of the operation is complete.

When the Vaginosinus Communication Is Blocked

Rarely does the vagina not communicate with the UGS. The vagina with the UGS is homologous with the hymenal area, and the hymen rarely is imperforate in an otherwise normal woman. For such a circumstance, we have found it helpful to pass a uterine sound downward through the fundus via hysterotomy into the vagina, thus forming a protrusion on the perineum. With such a guide, the edges of the vaginal epithelium can be located and sutured to the skin (Fig. 24.12). Until the uterus enlarges somewhat from its infantile state, the cavity is not large enough to accommodate even a uterine sound. Therefore,

if such an operation is contemplated, it should not be done until there is a palpable enlargement of the uterus at the onset of puberty. Evaluation of uterine volume sonographically as a predictor of uterine size adequacy may be helpful.

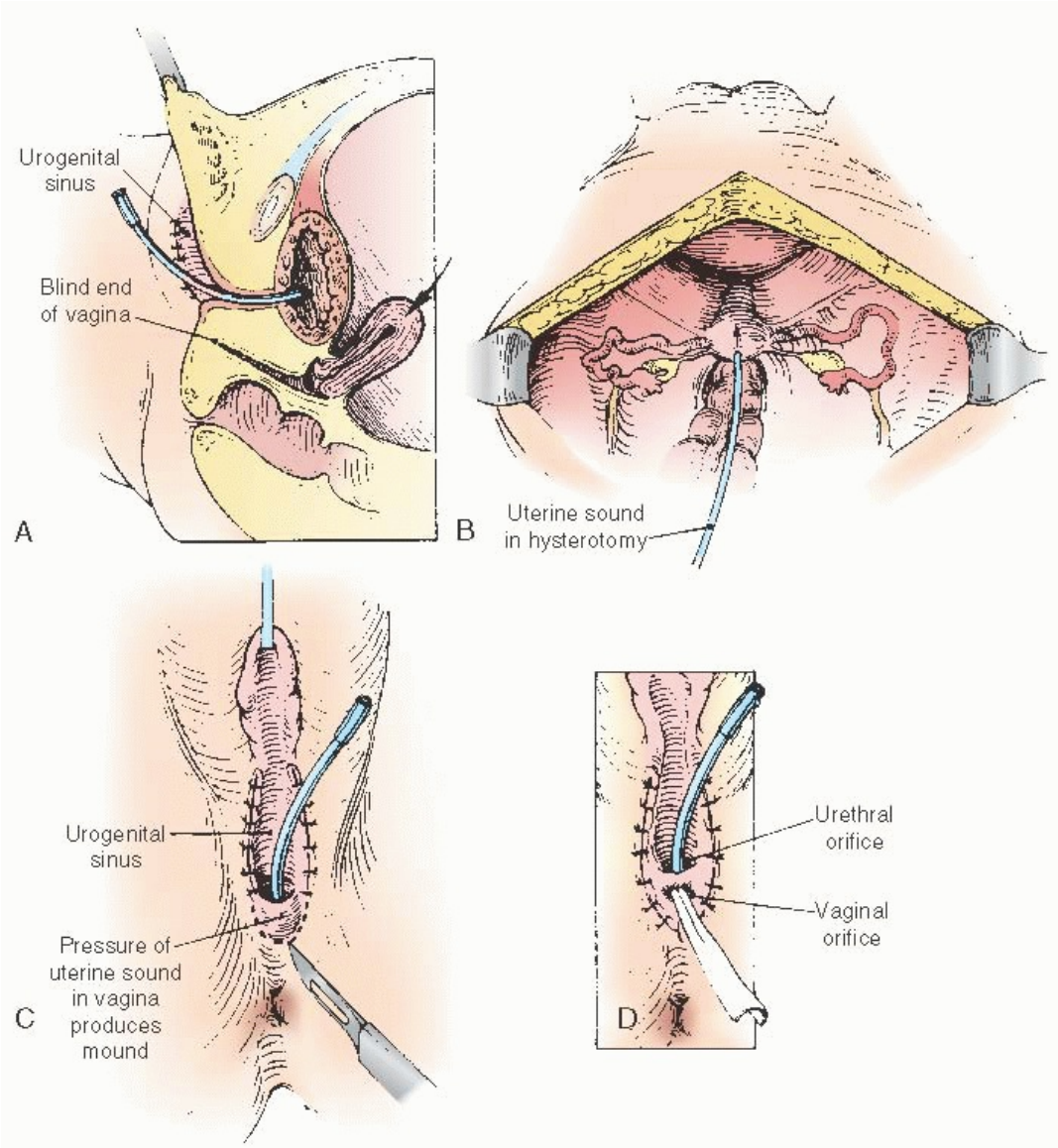

FIGURE 24.12 A: A situation in which the vaginal orifice is imperforate. **B:** A uterine sound has been passed through the fundus into the vagina. **C:** The tip of the sound can be palpated in the perineum. **D:** The completed procedure.

When the Vaginosinus Communication Is High

Hendren has been especially interested in patients whose vaginosinus communication involves the proximal urethra (suprasphincteric). He has advocated an operation that disconnects the vagina from the urethra and repositions the vaginal orifice in the perineum, the “pull-through” vaginoplasty. In his hands, this procedure seems to have been satisfactory for some patients. The procedure requires positioning the new vaginal orifice in the perineum (**Fig. 24.13**). The vast majority of patients with ambiguous external genitalia and a vagina have a vaginosinus communication well distal to the proximal urethra (infrasphincteric), and consideration of the procedure advocated by Hendren is not necessary. In patients in whom the vagina enters the UGS proximal to the external sphincter, the pull-through vaginoplasty of Hendren and Crawford or the method described by Passerini-Glazel can be used to prevent incontinence. Hendren and Crawford's vaginal pullthrough remains the basis for reconstruction today. Modification to this procedure has evolved in an attempt to decrease the complexity and decrease the tendency of an isolated vagina toward stenosis. Rink and coworkers have favored a one-stage procedure using a perineal prone approach with no division of the rectum.

Results of Revision of External Genitalia

Among 28 patients with adrenogenital syndrome and good follow-up treated at the Johns Hopkins Hospital, 22 (87.6%) needed further vaginal reconstructive surgery to achieve an adequate vaginal size to allow comfortable intercourse. Of the 22 patients, 5 had undergone more than 1 surgical attempt at reconstruction. The mean age of patients undergoing

repeat procedures was 7.1 years. The mean age at first surgery for the whole group was 23.6 months. Vaginal reconstructive surgery was performed on 18 of these patients and was successful in 13 (72%) of the procedures. It generally is recommended that exteriorization of the vagina be postponed until near puberty, when feminization occurs and the young woman is sufficiently mature to comply with a postoperative dilatation program. The results of exteriorization performed during infancy must be followed up carefully for evidence of narrowing. In 1997, Costa and colleagues evaluated the vaginal size and sexual activity after different techniques of feminization of external genitalia in patients with pseudohermaphroditism. In their series of patients, all who underwent clitoroplasty reported orgasms, and 29% of the patients who had clitoridectomy reported no orgasms. Fifty percent of the patients who submitted to neovaginoplasty reported pain or bleeding during sexual intercourse. Satisfactory sexual intercourse was reported by 87% after vaginal dilation with acrylic molds.

In 2000, Krege and colleagues reported on the long-term follow-up of female patients with CAH from 21-hydroxylase deficiency, with special emphasis on the results of vaginoplasty.

They reported that the main problem during the long-term follow-up was intravaginal stenosis, with all those affected—9 of 25 (36%)—having undergone a single-stage procedure early in life to correct ambiguous genitalia (mean age, 4.7 years; range, 2 to 9 years). The authors suggested that vaginoplasty should be undertaken at the beginning of puberty, because higher estrogen levels may prevent stenosis and dilatation may be performed. In addition, 16 patients answered questionnaires that included psychological profile, and the researchers found that 14 had problems with their overall body image. Patients with correction of vaginal stenosis were particularly anxious about sexual intercourse and had problems with orgasm. Creighton and colleagues in 2001 retrospectively evaluated the cosmetic and anatomical outcomes of 44 adolescent patients who had undergone feminizing surgery for ambiguous genitalia during their childhood. The authors reported that cosmetic results were judged as poor in 18 (41%) and that 43/44 (98%) required further treatment to the genitalia for cosmesis, tampon use, or intercourse. Of the genitoplasties planned as onestage procedures, 23/26 (89%) required further major surgery.

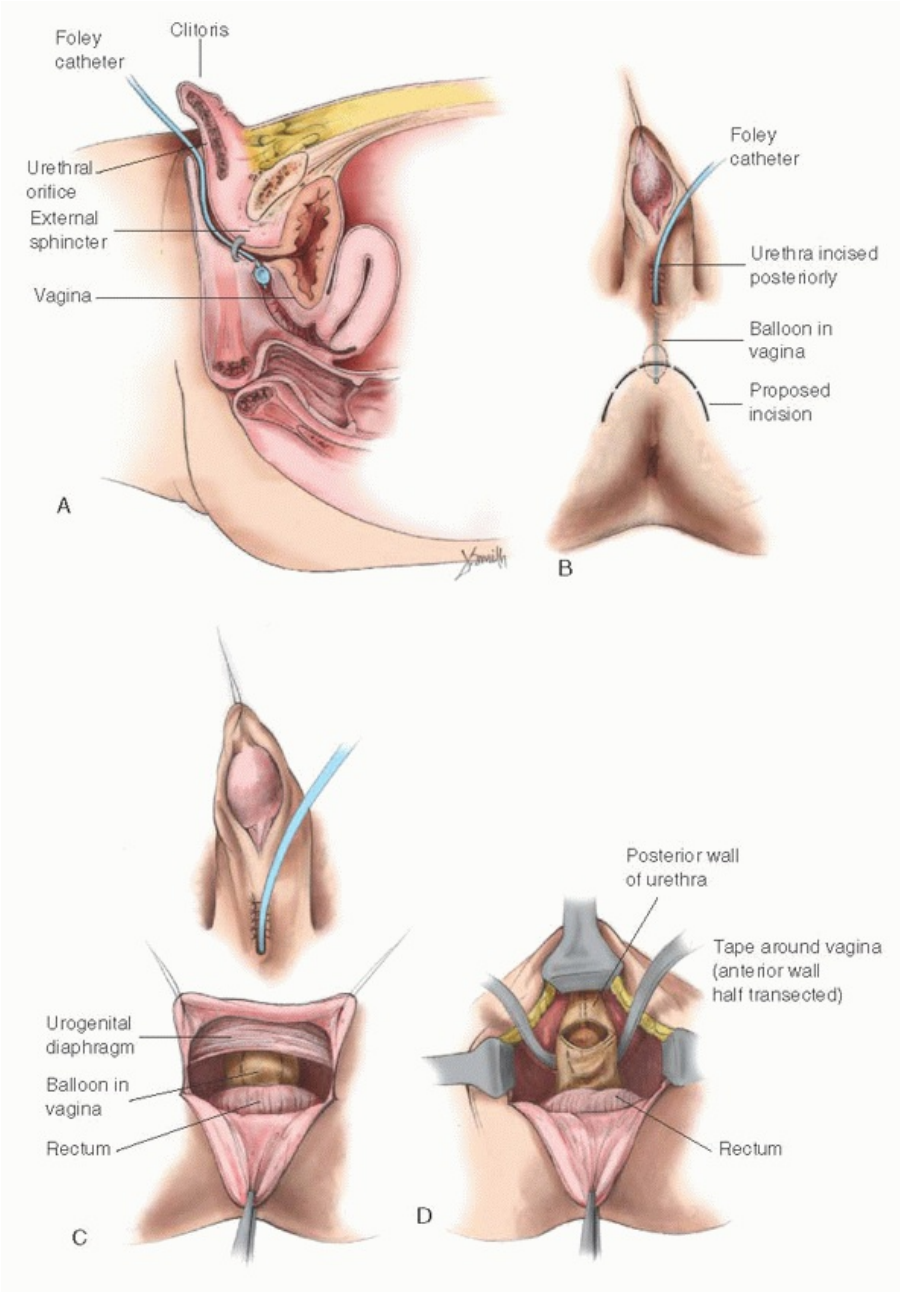

FIGURE 24.13 A perineal pull-through vaginoplasty according to Hendren. **A:** Sagittal view in diagram of high suprasphincteric vaginal communication to the UGS. A small Foley catheter is placed in the vagina to aid in its manipulation and localization. **B:** The location of the initial incision in relation to the balloon in the vagina. **C:** The flap is retracted posteriorly, and the dissection is carried along the anterior wall of the rectum until the vagina (as identified by the balloon) is approached. **D:** The vagina is identified by the Foley balloon catheter. The vagina is open. Care should be taken to pull a flap of vagina distal so that there will be no problem in closing the urethra.

Davies and colleagues in 2005 reported on urinary symptoms in adult women with CAH. The authors reported on

19 women with CAH, of whom 16 had childhood feminizing genital surgery, and compared them with age-matched women without CAH. The Bristol Female Lower Urinary Tract Symptoms (BFLUTS) questionnaire was given to all of the women. Sixty-eight percent of the women with CAH reported urge incontinence compared with 16% of controls (P = 0.003). Stress incontinence was present in 47% of CAH and 26% of the controls. Nine of the CAH women reported that their urinary symptoms had an adverse effect on their lives, whereas only one of the controls did (P = 0.008). The authors concluded that women with CAH are more likely to have urinary symptoms than controls. It is important to emphasize that it is not known whether these results are associated with the surgical procedures that the women underwent or an effect of CAH itself. For counseling purposes, this information is important because in two thirds of these CAH women, urinary symptoms persisted.

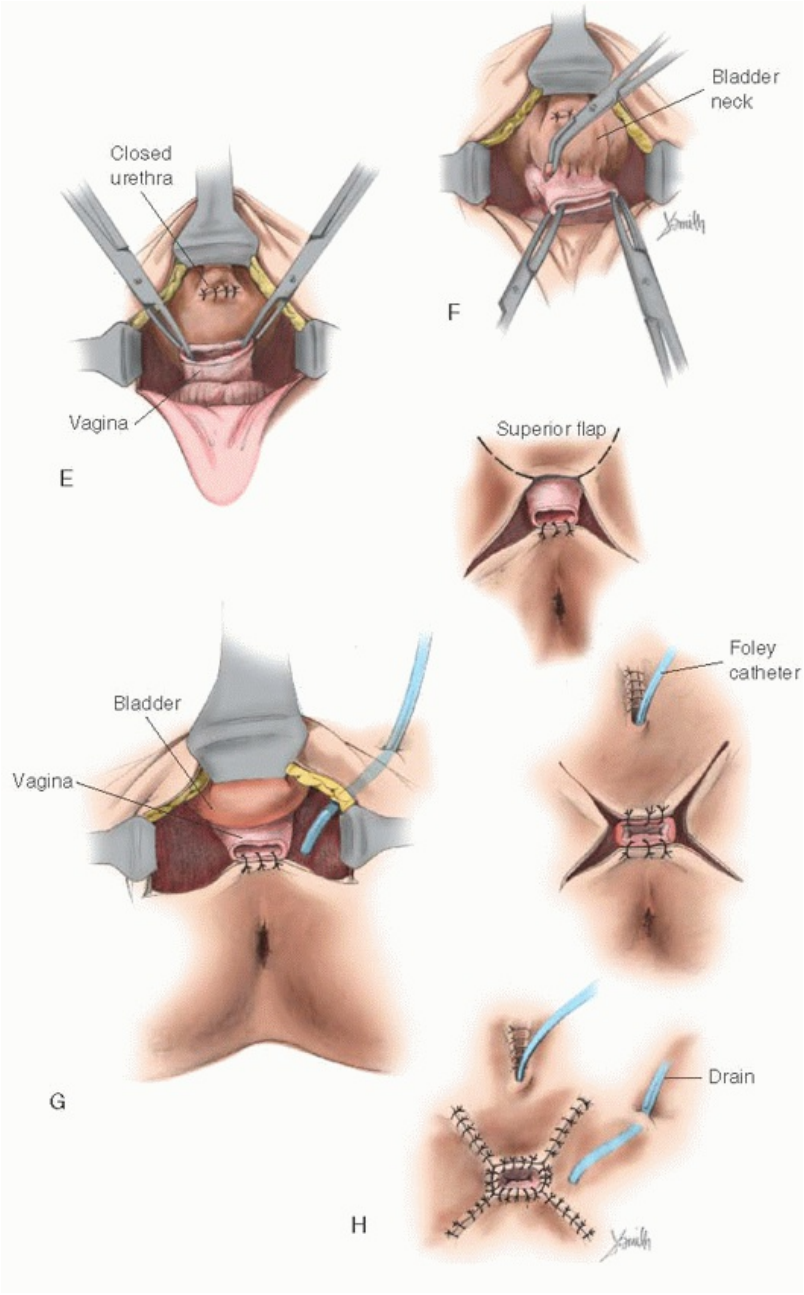

FIGURE 24.13 (*Continued*) **E:** The urethra is closed. Clips are placed on the vagina to bring it down to the perineum. **F:** The vagina is further mobilized. **G:** The edge of the vagina is attached to the original flap of perineal skin. **H:** Anterior and lateral flaps are attached. Note the use of a drain in the perivaginal space. (From Hendren WH. Reconstructive problems of the vagina and the female urethra. *Clin Plast Surg* 1980;7:207, with permission.)

Historically, it has been assumed that psychosexual development of infants with intersex disorders is mostly due to rearing rather than being intrinsic. Over the past decade, the role of testosterone imprinting of the fetal brain has been studied to evaluate the role of this hormone in determining male sexual orientation. Studies in the 1990s of girls with CAH have confirmed that such children engage in more rough-and-tumble

play than their affected peers and that difficulties with adjustment to their assigned sex may exist. Nonetheless, few studies have been conducted to address the social, psychological, and sexual outcomes for affected adolescents and adults, although it appears that most function in the normal range and are well adjusted. The majority of girls appear not to overtly demonstrate sexual identity problems.

Ozbey and coauthors reported on the experience of sex (re)assignment in genotypic female (46XX) patients with CAH when complicated by delayed presentation and inadvertent assignment. They reported on 70 patients with CAH who between 1983 and 2002 were counseled for sex assignment. They evaluated age at diagnosis and operation, the

degree of virilization, parental consanguinity, and the sex preference of the families as factors determining sex (re)assignment decision-making. Forty-one of 70 (59%) presented after the neonatal period, and in these cases, all of the parents had assumed or were advised of a sex based on external genitalia appearance. Forty-nine of 70 were reared as girls, and 21 were reared as “boys.” Of these 21 “boys,” only 9 could be reassigned as girls (mean age, 7.9 months), and the other 12, with mean age at presentation of 55.8 months, were reared as “boys” in compliance with the parents' and the study group's decision. These “boys” underwent appropriate masculinizing reconstructive surgery. They concluded that age of presentation was critical for the ability to correctly assign the sex of patients with CAH.

Secondary Operations

A secondary operation on the vaginal outlet may be required. This is generally the case if the basic operation is deliberately accomplished in two stages, whatever the reason. A secondary operation may be indicated, for example, when an infant's vaginal orifice is not readily identifiable, yet it seems desirable to construct cosmetically acceptable female genitalia at a very early age. Care should be taken when considering the appropriate age for performing a clitoroplasty. Some have recommended that this can be done in the newborn and that the vagina may be exteriorized at puberty as a second operation. Alizai and colleagues reported on the outcome of feminizing genitoplasty in 14 postpubertal girls (mean age, 13.1 years) with CAH. These girls were assessed under anesthesia by a pediatric urologist, plastic/reconstructive surgeon, and gynecologist. Thirteen of fourteen had previously undergone feminizing genitoplasty in early childhood. The authors reported that the outcome of clitoral surgery was unsatisfactory (clitoral atrophy or prominent glans) in six of the girls. Additional vaginal surgery was necessary for normal comfortable intercourse in 13 of the girls. In the girls with a history of vaginal reconstruction in infancy, fibrosis and scarring were prominent. The authors concluded that these results were disappointing, even in the girls who had their surgery performed by specialist surgeons. The authors highlighted the importance of late follow-up and the challenges in the prevailing assumption that total correction can be achieved with a single-stage operation in infancy. When the complete operation is attempted at an early age, the vagina is sometimes not satisfactorily exteriorized. Vaginal stenosis may require reconstruction at the time of puberty (**Fig. 24.14**). In this circumstance, there usually has been a failure to carry the midline incision far enough posteriorly, and a second procedure is required to complete the first one by continuing the midline incision far enough posteriorly.

In other cases, contraction at the vaginal outlet may occur even if the operation is adequately performed. A minor revision of the vaginal orifice is required to enlarge the vaginal orifice by making an incision in the midline and closing it at 90 degrees to the original axis of the incision (**Fig. 24.15**). In some instances, it may be necessary to create flaps to enlarge the vaginal orifice (**Fig. 24.16**).

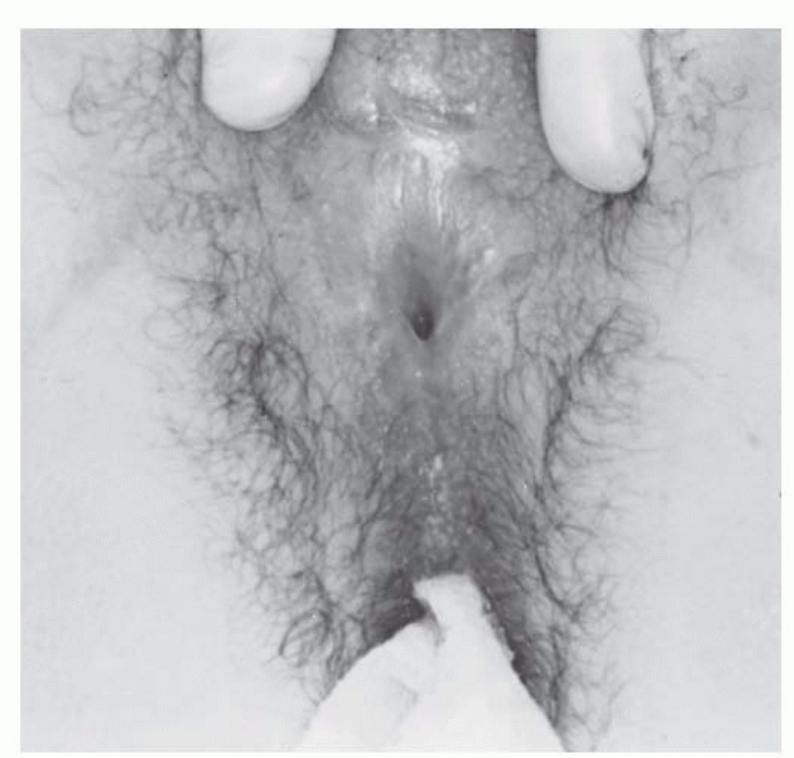

FIGURE 24.14 External genitalia of a 15-year-old patient with vaginal stenosis. Revision of the external genitalia, including an exteriorization of the vagina, had been performed in infancy.

It should be emphasized that simple exteriorization of the lower vaginal tract can be combined with cosmetic correction of virilized external genitalia in infancy, but in most cases, it is best to defer definitive reconstruction of the intermediate or high vagina until after puberty.

Exstrophy-Epispadias Complex

Exstrophy-epispadias complex (ECC) is a rare congenital anomaly occurring in live births in a 1:25,000 to 1:40,000 ratio. There is a male predominance over females in a ratio of about 2:1. Classic ECC is characterized by (a) absence of the lower anterior abdominal wall, (b) absence of the anterior wall of the bladder so that the posterior bladder wall and the ureteric orifices are exposed, (c) a poorly defined bladder neck and urethra, and (d) wide separation of the pubic symphysis. A genital abnormality typically present in girls with bladder exstrophy is anterior displacement and narrowing of the vagina (**Fig. 24.17**) and separation of the clitoris into two distinct bodies (**Fig. 24.18**).

Bladder exstrophy, cloacal exstrophy, and epispadias are variants of the ECC. These defects have been attributed to failure of the normal process of ingrowth of mesoderm and the consequent lack of reinforcement of the cloacal membrane. The normal cloacal membrane is bilaminar and occupies the caudal end of the germinal disc. An ingrowth of mesenchyme between the ectodermal and endodermal layers of the cloacal membrane forms the lower abdominal wall musculature and the pelvic bones. After mesenchymal ingrowth occurs, descent of the urorectal septum divides the cloacal membrane into the bladder anteriorly and the rectum posteriorly. The urorectal septum eventually meets with the posterior remnant of the cloacal membrane, which perforates to form the anal and UGS openings. The paired genital tubercles migrate medially and fuse in the midline anterior to the

cloacal membrane before perforation. Without its normal support from mesenchymal derivatives, the cloacal membrane is subject to premature rupture. Depending on the extent of the infraumbilical defect and the stage of development when rupture occurs, bladder exstrophy, cloacal exstrophy, or epispadias develops (**Fig. 24.19**). Jones reviewed the records of all female patients diagnosed with bladder exstrophy at Johns Hopkins Hospital over a 20-year time span. Of 18 patients with adequately described external genitalia, 13 had small, anteriorly displaced vaginal orifices, and the remaining five patients had vaginal orifices of normal size and location. In this series, only a third of patients with ECC demonstrated the defect of narrowing of the vagina.

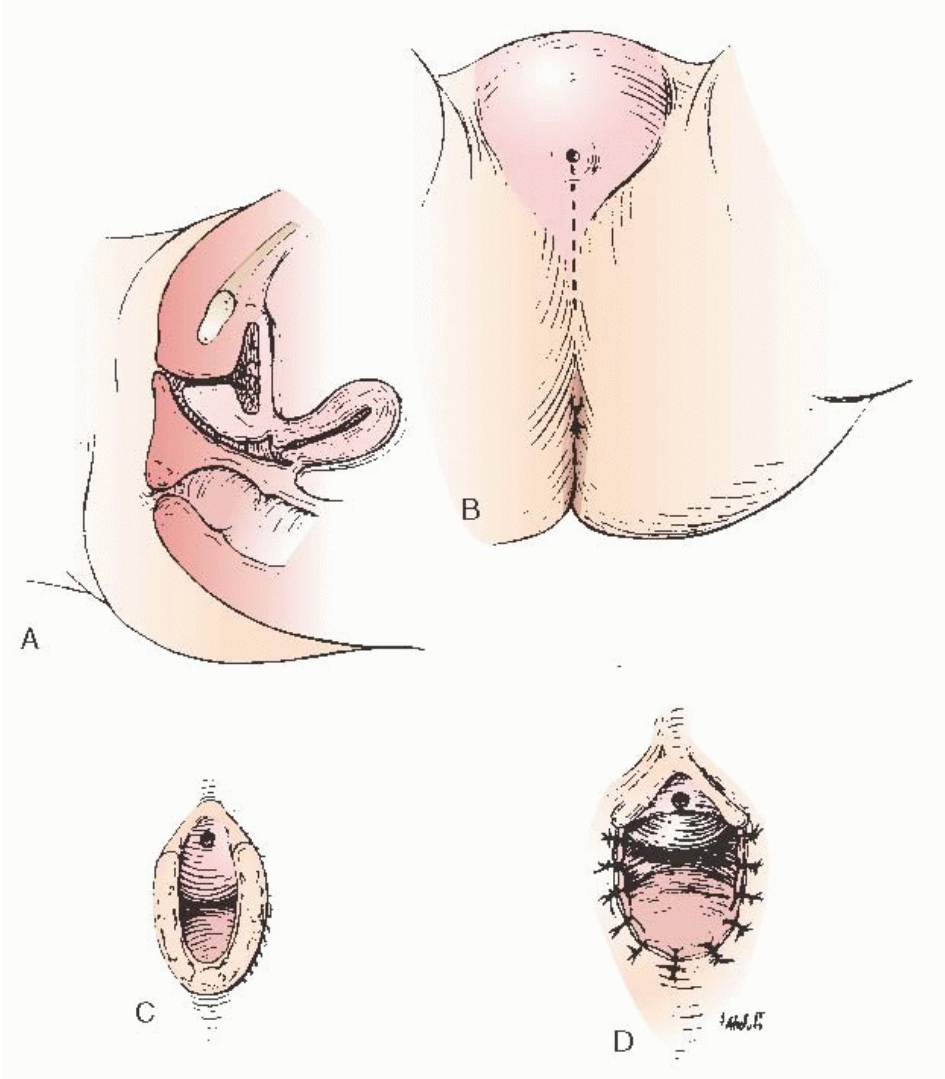

FIGURE 24.15 A: Repeated operation on the vaginal outlet when the operation was not completed at the first procedure. **B:** The posterior incision. **C:** The vagina is exposed. **D:** The closure.

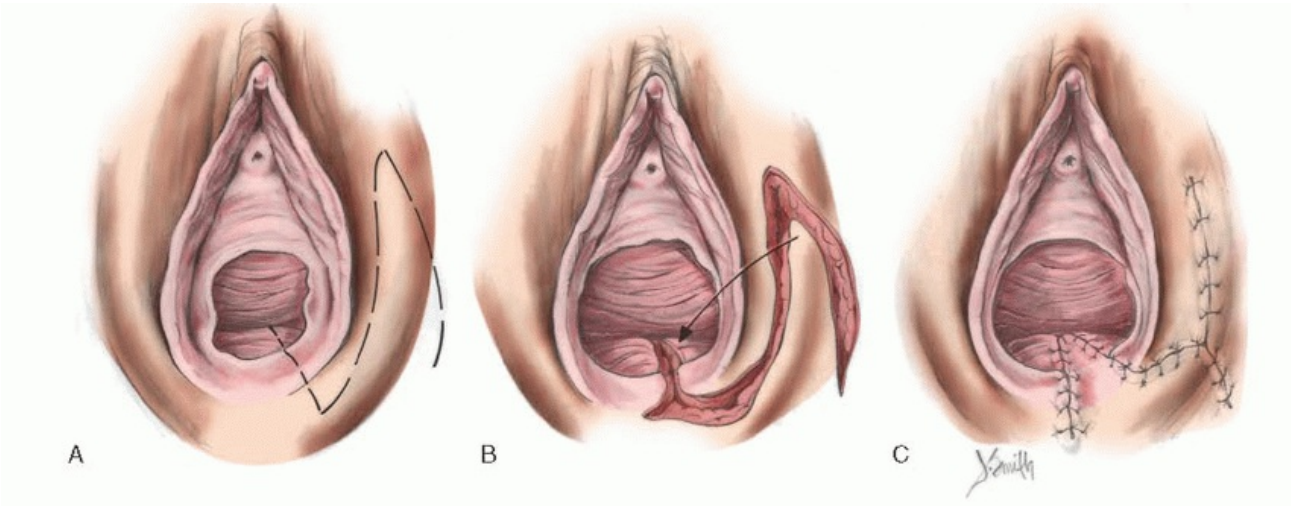

FIGURE 24.16 Labial cutaneous flap. **A:** An incision is made through the labia skin and subcutaneous fat. **B:** The flap is rotated into the perineotomy incision. **C:** The flap is sutured in place by interrupted 3-0 delayed absorbable sutures. This may be repeated on the other side if required.

Exstrophy-epispadias complex may be associated with a wide range of both genital and extragenital abnormalities. Stanton reviewed 70 patients with bladder exstrophy and observed an increased incidence of various müllerian anomalies. Eleven patients were observed to have associated rectal

prolapse. Blakely and Mills observed various extragenital abnormalities in their series, including rectal prolapse, imperforate anus, exophthalmos, renal agenesis, and spina bifida.

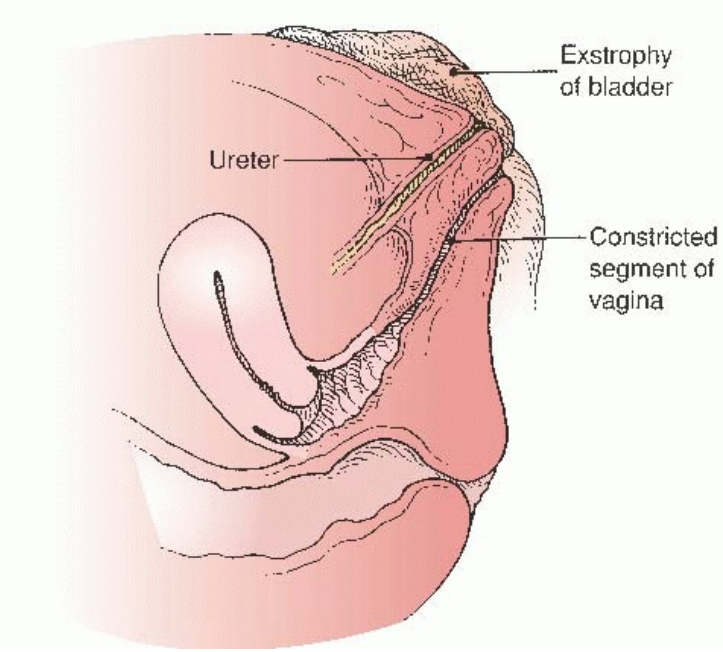

FIGURE 24.17 Common gynecologic anomaly seen in women with bladder exstrophy. The vagina is rotated anteriorly and constricted over its distal portion.

Treatment

Our understanding of appropriate urologic management of bladder exstrophy has evolved greatly over the past few decades; improved management has markedly increased the life expectancy and quality of life of these patients. Historical methods of treatment involved bladder excision and a urinary diversion procedure such as ureterosigmoidostomy. These techniques were complicated by serious sequelae, including pyelonephritis, hyperchloremic acidosis, rectal incontinence, ureteral obstruction, and later development of malignancy. Modern care of the patient with complex pelvic congenital disorders mandates a multidisciplinary approach that includes gynecologic surgeons, urologists, neurologists, endocrinologists, pediatricians, and allied health professionals.

Urologic management of bladder exstrophy relies on a staged approach to functional bladder closure. The initial procedure consists of primary bladder closure with or without iliac osteotomies to aid closure of the pelvic ring and growth and improvement of bladder capacity. The second-stage procedures usually involve bladder neck reconstruction to improve continence and bilateral ureteral reimplantations to prevent reflux. Both failures and primary reconstruction have also been performed using continence urostomies, such as the Mainz II pouch. Mingin and coworkers and Gerharz and colleagues have reported their success using this technique.

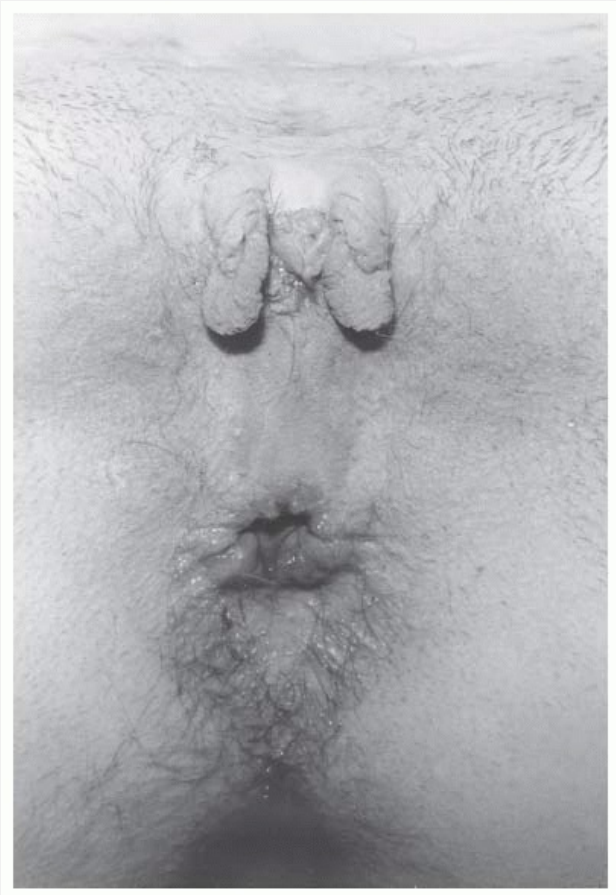

FIGURE 24.18 Preoperative photograph of a patient undergoing reconstruction of the external genitalia. Note the bifid clitoris and small anterior vaginal orifice.

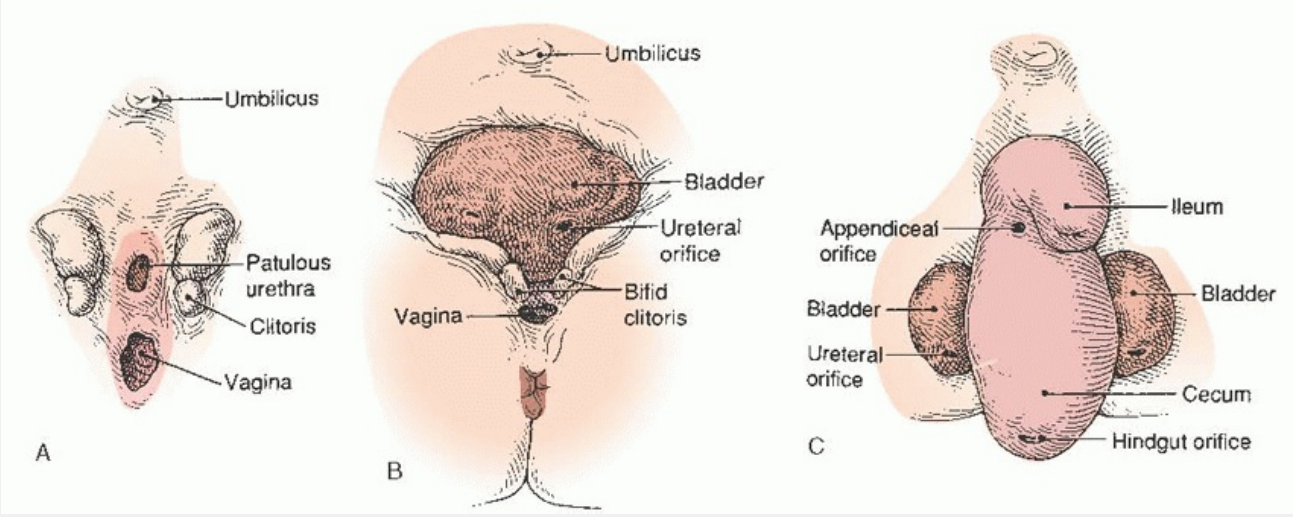

FIGURE 24.19 Anatomic features of **(A)** epispadias, **(B)** classic bladder exstrophy, and **(C)** cloacal exstrophy in females.

Genital anomalies in ECC can usually be sufficiently corrected to allow for sexual activity and pregnancy. The adjunctive gynecologic procedures in ECC attempt to correct the

anterior displacement and narrowing of the vagina and the bifid separation of the clitoris.

The surgical approach to the external genitalia in patients with ECC has evolved from that first described by Howard Jones Jr. in 1973. Particular emphasis is placed on attainment of an adequate vaginal diameter without further predisposing to subsequent prolapse. The first step is vertical incision into the posterior raphe of what resembles fused scrotolabial folds; next, Allis clamps are placed laterally for traction. Fine-needle point electrocautery is then used to further open the incision, with special care taken not to take this incision too far

posteriorly. The lateral portions of the incision are secured with 3-0 nonreactive absorbable sutures for further traction. The posterior vaginal edges are undermined to allow their mobilization to the exterior. The vaginal mucosa is then approximated to the perineal surface with interrupted and figure-of-eight sutures, incorporating the superficial perineal muscles into the closure. In the more posterior portion of the closure, 2-0 nonreactive absorbable suture is used, because this is the area of greatest tension. At completion, there is a significant increase in the diameter of the vagina, and the vaginal orifice usually accommodates two fingers.

Experience with management of ambiguous genitalia has shown a decrease in the incidence of postoperative vaginal stenosis if dilatation therapy is employed during the constrictive phase (the first 6 weeks) of healing. For this reason, following reconstruction of the external genitalia and exteriorization of the vagina, appropriately sized Lucite dilators are used once or twice a day for this 6-week period or until healing is complete. Patients who undergo surgical correction in early infancy are at risk for vaginal stenosis as they age. In a series by Cerveillone, one third of patients corrected in infancy underwent vaginoplasty by age 15.

Reapproximation of the bifid clitoris (**Fig. 24.20**) is primarily cosmetic and may disrupt erogenous sensitivity. The technique involves excising a diamond-shaped area of skin and subcutaneous tissue between the clitoral bodies. The medial aspect of each side of the clitoris is then denuded and undermined to allow a central reapproximation with a side-to-side closure.

Other surgical approaches have been described to optimize cosmesis. Stanton performed perineotomy in six patients with bladder exstrophy in which the labia and clitoris were reapproximated by a Z-plasty technique. Still others have described extraordinary efforts to restore the mons pubis and female escutcheon with skin flaps of hair-bearing areas. These latter reports, however, fail to mention correction of the vaginal anomaly.

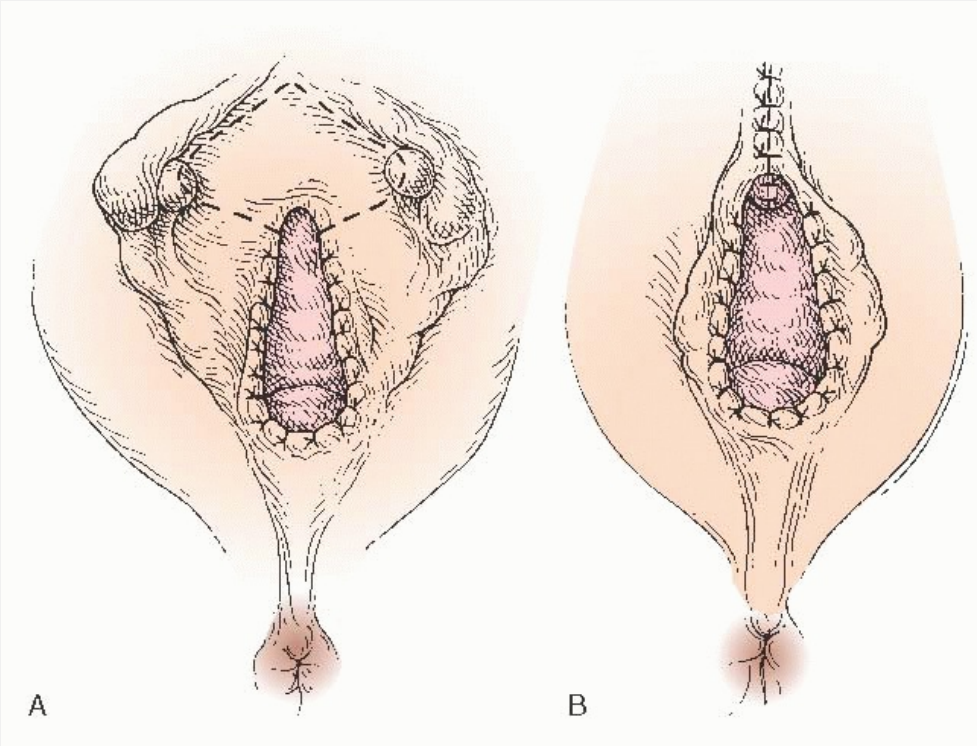

FIGURE 24.20 Schematic depiction of procedure to reapproximate the clitoris. A vulvovaginoplasty has already been performed to exteriorize the vagina. **A:** A diamondshaped piece of skin and subcutaneous tissue between the clitoral bodies is excised. **B:** The clitoral bodies are then undermined and mobilized to the center for a sideto-side reapproximation.

Pregnancy and Exstrophy-Epispadias Complex

Several series have reviewed subsequent pregnancy outcomes in patients with bladder exstrophy. Clemetson extensively reviewed the literature in 1958 and found 45 patients who underwent 64 pregnancies. A very high incidence of uterine prolapse was observed both before and after pregnancy. In addition, there was a higher incidence

of premature labor and malpresentations (24%). Krisiloff and colleagues also reported a high incidence of uterine prolapse related to pregnancy, which occurred in 6 of 7 women. Burbige and coworkers reported on 14 pregnancies in patients with a history of bladder exstrophy. Uterine prolapse occurred in 7 of 11 patients, all of whom had undergone a previous urinary diversion procedure.

The mode of delivery in patients with prior urinary diversion procedures has primarily been spontaneous vaginal delivery. The increased incidence of premature labor and malpresentation, however, has warranted an increased rate of cesarean sections for obstetric indications. In patients with a prior bladder reconstruction, most surgeons advocate an elective cesarean section to eliminate stress on the pelvic floor and to avoid trauma to the delicate urinary sphincter mechanism.

Pelvic Prolapse and Exstrophy-Epispadias Complex

Several mechanisms have been proposed to explain the high incidence of uterine prolapse in patients with bladder exstrophy. These mechanisms include (a) a deficiency of the pelvic floor that is due to the wide separation of the pubic symphysis, (b) an inherent deficiency of the cardinal ligament complex, and (c) the abnormal axis and short length of the vagina.

Because wide separation of the pubic symphysis results in an enlarged genital hiatus and deficiency of the pelvic floor, it is possible that iliac osteotomy may be helpful in deterring pelvic organ prolapse by closer approximation of the levator ani and puborectal muscles. Although Gearhart and Jeffs suggest

that iliac osteotomies may not be necessary if primary bladder closure is performed in the first 72 hours of life, perhaps the procedure should be given increased consideration in female patients who present such a high risk for uterine prolapse later in life.

It appears important not to extend the midline perineal incision too far posteriorly in revision of the genitalia in these patients. As the incision proceeds posteriorly, the midline septum thickens to approximately 2 cm. At this point, the levator ani muscles may be severed, further enlarging the genital hiatus. It is prudent, therefore, to be more conservative; postoperative dilator therapy may aid in achieving further vaginal diameter if needed. A case referred to us illustrates this point. A 16-year-old nulliparous patient with bladder exstrophy and a history of staged bladder reconstruction underwent revision of the external genitalia. A large posterior incision into the perineal body had left a gaping introitus, and uterine prolapse had occurred several months after this procedure. Our initial approach was to reconstruct the perineal body to help contain the uterus and improve support to the pelvic floor. This reconstruction has been successful, without further prolapse 5 years after the procedure. Blakely and Mills, who observed uterine prolapse occurring very soon after enlargement of the vaginal introitus, reported a similar case.

Management of uterine prolapse associated with bladder exstrophy is particularly difficult when the patient desires preservation of childbearing. Sacrospinous fixation of the cervix may be considered, although an abnormally short vagina may produce difficulty in obtaining the suspension without significant suture bridges. An abdominal sacrocervicopexy may also be considered. Dewhurst and coworkers described this approach in 1980. They suspended the uterus to the sacrum using Ivalon sponge in a patient with procidentia following repair of bladder exstrophy.

Of note, the multiple operative and cystoscopic procedures performed on this group of patients have resulted in latex sensitization rates similar to that seen in health care workers. Ricci and coworkers evaluated 17 patients (15 children, 2 young adults) with bladder exstrophy for latex allergy. Twelve had latex sensitization, with five demonstrating serious symptoms.

Cosmetic Gynecologic Surgery

Women may seek surgical procedures to address the appearance of their external genitalia. It is the obligation of gynecologic surgeons to educate women on the wide range of normalcy of the female genitalia. Medical indications for labioplasty may include labial hypertrophy or asymmetrical labial growth. This procedure may be performed via simple linear removal, wedge resection, or Z-plasty. Some women may seek surgical procedures to enhance sexual function.

There are few long-term safety or efficacy studies to support these interventions, which include reduction of the clitoral hood, perineoplasty, vaginoplasty, and hymenoplasty, and are often bundled under the lay term "vaginal rejuvenation." These procedures are not sanctioned by the American Congress of Obstetricians and Gynecologists and, like all vulvovaginal surgery, carry the risk of infection, dyspareunia, scarring, and unsatisfactory cosmesis.

Vaginal Trauma Post Sexual Assault

The National Violence Against Women Survey estimates that more than 300,000 women are the victims of sexual assault every year. Of these, about half are under the age of 18. Although the risk of surgical injury to the vagina is low in most cases of sexual assault, the risk increases under certain circumstances. These include when the perpetrator utilizes a weapon in the assault and/or is under the influence of drugs or alcohol at the time of the assault. Careful history and a judicious examination are needed to rule out acute genital trauma. In most urban settings, rape is initially evaluated in hospitalbased programs. Gynecologists who are called to evaluate the victims of sexual assault should be familiar with the forensic and legal implications of the examination.

THE URETHRA

The female urethra develops from the caudal end of the UGS after it separates from the vaginal canal between the eighth and twelfth week of embryologic life. Because the vagina and urethra are so closely integrated, the urethra shares many common disease processes and anatomic defects with the vagina. Bacteria in the lower genital tract frequently colonize in the outer urethra, harbor in the paraurethral glands, and enter the bladder to produce acute infections. A bacterial infection in the lower genital tract may not become clinically manifest for several years, until a Skene duct cyst or a urethral diverticulum develops. Estrogen deficiency causes atrophic changes of the vaginal mucosa and can have a similar effect on the urethral mucosa. Thinning of the epithelium and irritation of the sensory nerve fibers can cause urinary frequency and dysuria. Prolapse at the external meatus also may result from atrophic changes of the urethra.

Diverticulum of the Urethra

Urethral diverticulum is characterized by urethral mucosa herniating into surrounding tissues. The condition probably occurs more frequently than it is diagnosed; whenever an article reporting on urethral diverticulum appears in the literature, there is a coincident upsurge in the number of cases diagnosed. According to the National Hospital Discharge Survey (1979 to 1998), 27,000 inpatient procedures were performed for the repair of urethral diverticula in the United States over a 19-year period.

Etiology

In *1941,* Parmenter suggested several congenital factors that could develop into a urethral diverticulum, including Gartner duct, a faulty union of primal folds, cell nets, and wolffian ducts or vaginal cysts that rupture into the urethra. Additional possible causes include trauma at childbirth, surgical trauma, urethral stone, urethral stricture, and infection of the urethral glands. Malignancy has been reported in a small percentage of cases.

The most probable etiology of urethral diverticulum is chronic infection of the suburethral tissue by vaginal flora. Huffman's experiments support the notion that a suburethral infection can develop into an abscess that becomes lined with epithelium. Huffman demonstrated periurethral openings by constructing wax models of infected urethras. The usual organisms cultured are *Escherichia coli, Aerobacter aerogenes,* and other gram-negative bacilli; *Staphylococcus aureus;* and *Streptococcus faecalis.*

Symptoms

Dysuria, urgency, frequency, and hematuria occurred together in 85% to 90% of 32 cases reviewed by Peters and Vaughn. Other frequently occurring symptoms are a lump in the vagina caused by protrusion of the diverticulum sac into the vagina,

dyspareunia (intermittent discharge from the urethra), and pain on walking. Pyuria and cystitis also occur,

depending on the location of the diverticular orifice. If the opening is sufficiently close to the outer end of the urethra, there may be no leakage of purulent exudate back into the bladder, which may explain the absence of symptoms of cystitis in 5% of cases. If the diverticulum is located in the posterior urethra near the urethrovesical junction, stress urinary incontinence may be a significant symptom. In a review of 70 cases from the Johns Hopkins Hospital, Ginsberg and Genadry found that 17% of the diverticula were located in the proximal (outer) urethra, 43% in the midurethra, and 31% in the distal (posterior) urethra; in the remaining cases, the site was not specifically identified. Urethral diverticulum should be considered in all cases of refractory urinary tract infection in women.

Diagnosis

Urethral diverticula usually are small, varying from 3 mm to 3 cm in diameter. Some of the larger sacs cover the entire length of the urethra. They are almost exclusively present on the distal two thirds of the posterior wall of the urethra. On palpation of a suburethral mass, tenderness commonly is found. Pressure on the mass may cause the escape of urine or exudate from the urethral meatus.

An examination of the floor of the urethra through the water cystoscope while suburethral pressure is being applied reveals an opening in 50% to 70% of cases. The pressure may force contents of the diverticulum into the urethra while it is being viewed. Some of the openings are extremely small and may be missed. Inflammatory swelling can result in edema of the orifice, which makes visualization difficult or impossible.

The diagnosis of urethral diverticulum is firmly established by means of positive-pressure urethrography (PPUG). A special catheter is used to block the urethra at both ends and to fill it and the diverticulum under pressure with water-soluble contrast medium (**Figs. 24.21**,24.22 and **24.23**). If the urethral orifice to the diverticulum is quite large, a voiding cystourethrogram together with a positive pelvic film may demonstrate the diverticulum. Although not as sensitive as PPUG, voiding cystourethrography (VCUG) may assist in identifying a urethral diverticulum. Wang and Wang compared VCUG and PPUG in evaluating 120 women. Twenty of 120 women demonstrated diverticulum. Thirteen were positive on PPUG and 10 with VCUG. If the surgeon's suspicion is high for urethral diverticulum, MRI should be considered if both the PPUG and VCUG studies are negative.

Gerrard and colleagues have shown that transvaginal ultrasound is effective for evaluating patients with suspected urethral diverticulum. The technique is accurate, low cost, readily available, and should be considered as an initial screening technique for women when one suspects a urethral diverticulum. Computerized tomography and MRI have better defined diverticular anatomy. Neitlich and colleagues have suggested MRI to be more sensitive than double balloon urethrography. These techniques should be considered after other conventional methods have not defined the diverticulum.

Occasionally, a diverticulum occurs with no clinical evidence of inflammation. If the diverticulum is diagnosed during a careful pelvic examination, and if the patient is completely asymptomatic except for a previous history of urinary tract problems, surgery is not necessary. With a complication rate of 15% to 20%, diverticulectomy should not be considered a quick and easy procedure. Removal of an asymptomatic urethral diverticulum may create more problems than it prevents, particularly if the sac is small

or located in the floor of the posterior urethra. Only if a patient experiences acute or recurrent symptoms should urethral surgery be performed. Leng and McGuire classify urethral diverticulum as true versus pseudodiverticulum (**Table 24.1**).

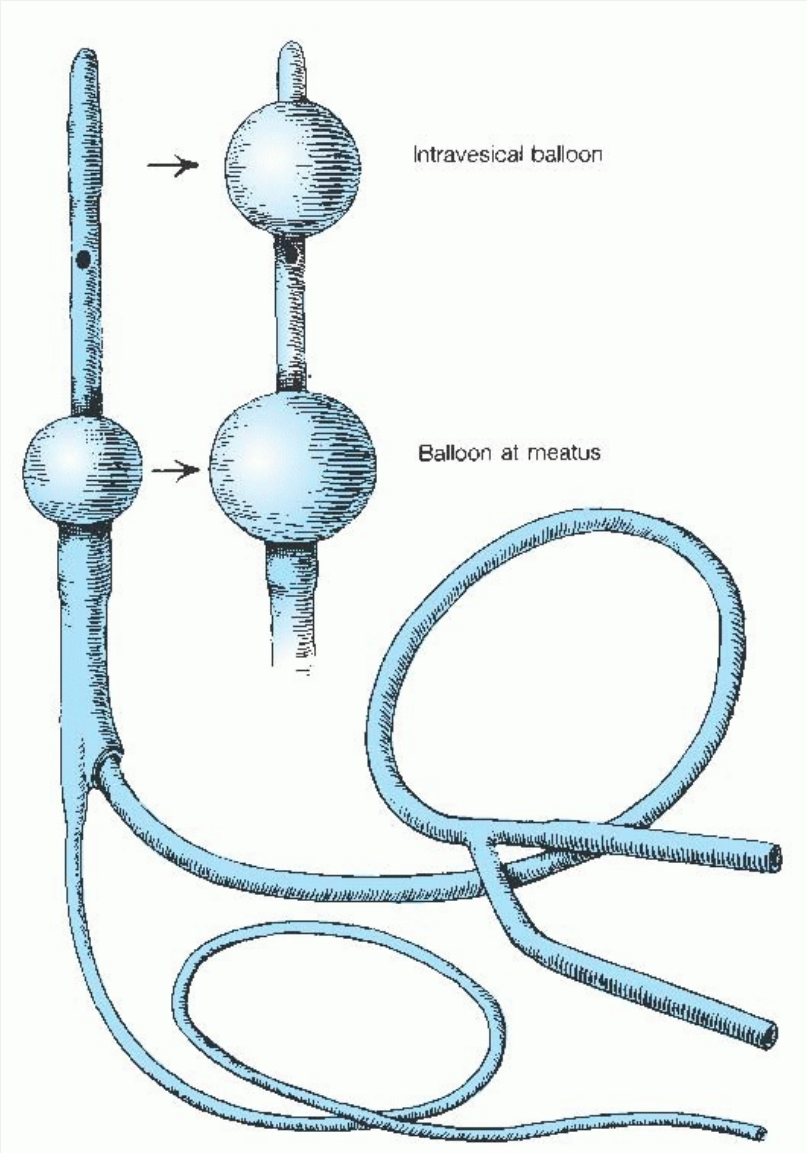

FIGURE 24.21 Double-ballooned catheter for PPUG. (From Davis HJ, Cian LG. Positive pressure urethrography: a new diagnostic method. *J Urol* 1958;80:34, with permission.)

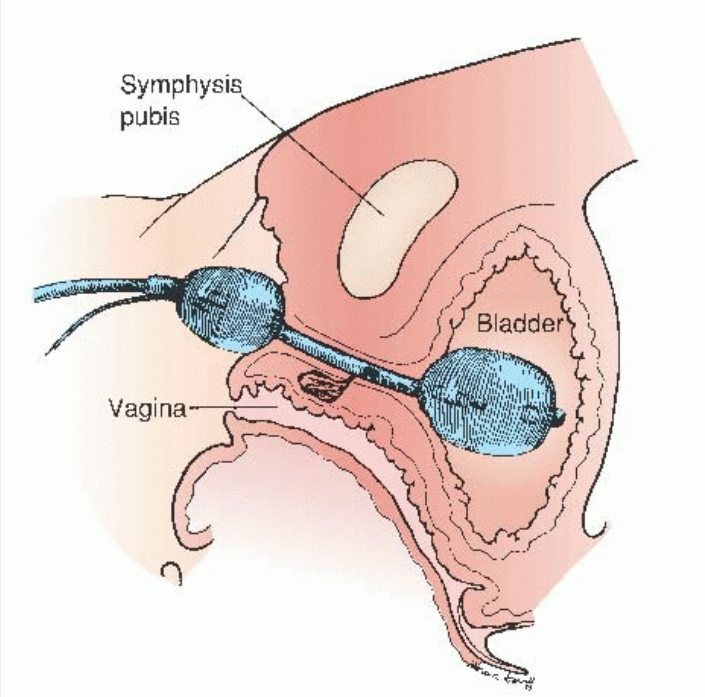

FIGURE 24.22 Double-ballooned catheter inserted for PPUG. (From Davis HJ, Cian LG. Positive pressure

urethrography: a new diagnostic method. *J Urol* 1958;80:34, with permission.)

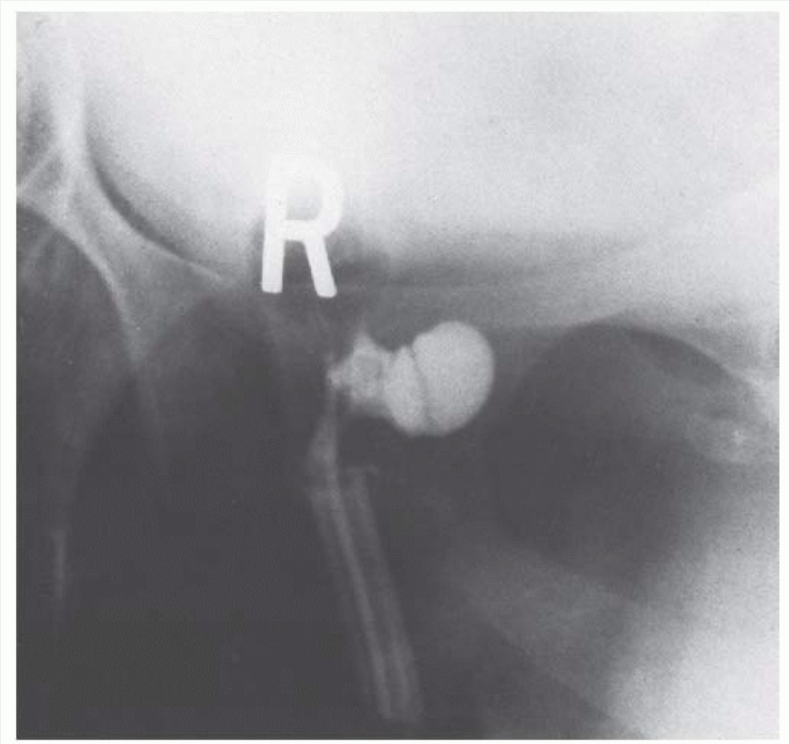

FIGURE 24.23 A large urethral diverticulum filled with contrast medium.

Treatment

A diverticulum that requires treatment must be completely excised before the defect in the urethra can be closed. Failure to remove the entire diverticulum results only in recurrence of the problem. Many techniques have been used to identify the anatomic boundaries of the diverticulum. One popular method is to pass a sound into the diverticulum through the urethral orifice. Another method is to distend the diverticulum by injecting it with fibrinogen and thrombin mixed in a syringe to form a firm fibrin clot. However, direct anatomic dissection of the diverticulum from the paraurethral fascia and vaginal wall without visual enhancement of the anatomic boundaries offers a better success rate. The smooth covering of a diverticulum protruding into the vagina can be easily distinguished from the rugal folds of the vaginal mucosa.

TABLE 24.1 Urethral Diverticulum

TRUE DIVERTICULUM	PSEUDODIVERTICULUM
No prior urethral surgery	History of urethral surgery
Chronic recurring symptoms of urgency, dysuria, dyspareunia, dribbling	Relatively few voiding symptoms
Chronic lower urinary tract infections	Cystoscopy demonstrates broad-mouthed ostium to diverticulum
Narrow-necked ostium not readily apparent on radiography or cystoscopy	More likely to have stress incontinence

Reprinted from Leng WW, McGuire EJ. Management of female urethral diverticula: a new classification. *J Urol* 1998;160:1297.

If the wall of the diverticulum is left unopened until the dissection has reached the base of the diverticulum sac, its neck can be visualized directly while it is removed. Inadvertent removal of a portion of the urethral floor along the base of the diverticulum is too common an error; if the mucosa is closed with too much tension, a urethral stricture or a postoperative fistula may result.

Excision and Layered Closure

A midline incision is made through the vaginal mucosa, which is then separated from the wall of the diverticulum (**Fig. 24.24A**). The wall of the diverticulum also is dissected from the paraurethral fascia in as wide a circumference as can be developed.

The diverticulum is opened, and the interior of the cavity is inspected. If the orifice of the diverticulum is large, the opening of the urethra can easily be seen, especially if a catheter has been placed in the urethra and bladder (**Fig. 24.24B**). The rest of the thin, friable mucosa of the diverticulum is separated from the vaginal mucosa and fascia before the neck of the diverticulum is trimmed near the urethral orifice. The lining of the diverticulum is friable because of inflammatory changes and the thin layer fragments during the dissection. Meticulous sharp dissection is required to separate the lining completely from the vagina and from the floor of the urethra. We repeat, in caution, that the neck of the diverticulum should be carefully resected to avoid eversion and to prevent the removal of mucosa from the urethral floor.

The urethral defect is closed with 3-0 delayed absorbable sutures interrupted so that the edges can be inverted (**Fig. 24.24C**). After the interrupted sutures are tied, the paraurethral fascia is closed in a double-layer "vest-over-pants" technique in which the layer of fascia from one side of the urethra is sutured beneath the opposite and overlapping fascia and fastened to the urethral wall on that opposite side. The top layer of fascia is then sutured at its edge to the underlying fascial layer. The fascial margins are sutured by more durable 2-0 delayed absorbable sutures (**Fig. 24.24D, E**), and the vaginal mucosa finally is trimmed and closed, also with interrupted 2-0 delayed absorbable sutures. Faerber as well as Leng and McGuire have advocated diverticulectomy and placement of pubovaginal slings. Faerber uses the sling for intrinsic sphincter deficiency, whereas Leng and McGuire have recommended fascial slings to close the defect if it is too large for reinforcement.

The bladder is filled with 300 mL of distilled water, and a suprapubic Silastic catheter is inserted and left in place until the morning of the fifth postoperative day. A suprapubic catheter is used in preference to a urethral catheter for three major reasons: to avoid trauma to the operative site, to avoid the necessity for transurethral catheterization during attempts to initiate voiding, and to avoid the discomfort of a urethral catheter. On the fifth day after surgery, the patient should attempt to void with the three-way stopcock of the suprapubic catheter closed to allow the bladder to fill.

Urethrotomy

Urethrotomy has been used by Edwards and Beebe and by Kropp to treat diverticula. Splitting the floor of the urethra from the meatus down its full length to the site of the orifice of the diverticulum allows the sac to be well visualized during excision. As a rule, however, cases of urethral

diverticula can be successfully repaired without such an extensive incision that requires the floor of the urethra to heal along its entire length. Healing is particularly a problem if there has been recent infection in the diverticulum.

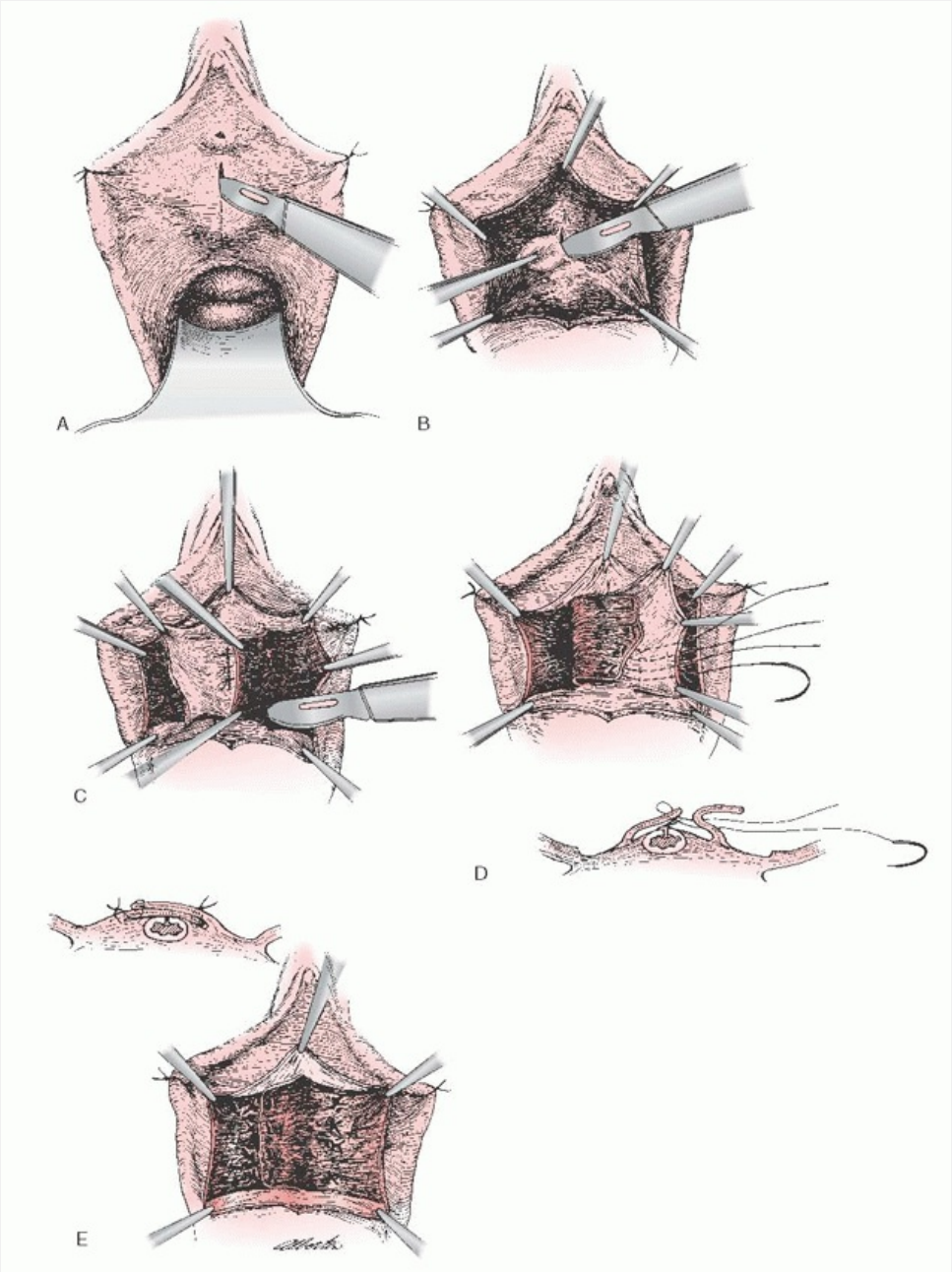

FIGURE 24.24 Suburethral diverticulum. **A:** A midline vaginal incision is made over the diverticulum. **B:** The diverticulum is dissected from the vaginal mucosa and surrounding fascia. Freed diverticulum is excised from the floor of the urethra, avoiding removal of an excessive amount of the urethral wall. **C:** The urethra is closed with interrupted 3-0 delayed absorbable sutures placed through the muscularis and mucosa to ensure mucosa-to-mucosa approximation. The paraurethral fascia is mobilized with sharp dissection from the vaginal mucosa. **D:** The paraurethral fascia is plicated beneath the urethral incision, using the vest-over-pants technique. The inner layer of fascia is sutured to the undersurface of the outer layer using horizontal mattress sutures of 2-0 delayed absorbable material. The inset is a cross-sectional view of suture placement. **E:** Completion of vest-over-pants plication of paraurethral fascia over the floor of the urethra. The free margin of the outer fascia is sutured to the inner fascial layer. The inset is a cross-sectional view of suture placement.

Marsupialization

In 1970, Spence and Duckett recommended marsupialization of the diverticulum to prevent recurrence, to minimize operating time, and to reduce blood loss. This procedure has been endorsed by Lichtman and Robertson and by Ginsberg and Genadry. Stress urinary incontinence has not been reported as a complication, but only, we suspect, because marsupialization is not used to treat lesions in the posterior urethra near the bladder base. Marsupialization is a useful procedure when diverticula occur in the outer third of the urethra, where a permanent opening in the outer floor of the urethra would not adversely influence intraurethral pressure.

Complications of Diverticulectomy

Complications arise in about 20% of cases treated for diverticula of the urethra. Urethral stricture can occur when too much urethral mucosa is removed, but strictures usually can be resolved by urethral dilatations. Urethral fistula, a serious and troublesome complication of diverticulectomy, occurs in about 5% of treated patients.

Postoperative fistulas frequently develop when acute or subacute infection in the walls of the diverticulum causes the urethral mucosa to become friable; the urinary incontinence that develops from urethral fistulas is far more troublesome than the initial symptoms of the diverticulum.

Closure of a urethral fistula is difficult because the blood supply to the floor of the urethra is delicate, and scarring and infection often develop with repeated efforts to close the urethra. A fistula in the outer part of the urethra may be asymptomatic and may not need to be repaired, but there normally are reports with an outer fistula of spraying of urine when voiding.

Urethral Prolapse

Although there have been few recent reports of urethral prolapse, nearly 400 cases have been published in the English literature since 1732. More than half of these cases occurred in infants and children; the remainder occurred in elderly patients.

Urethral prolapse is characterized by a sliding outward of the urethral mucosa around the entire urethral meatus. The urethra may become cyanotic, edematous, and infarcted (**Fig. 24.25**). Symptoms vary greatly. Prolapse may cause no discomfort, in which case it is detected only by bloody discharge of congested tissues that are breaking down, but more often there are reports of severe and continuous pain, urinary frequency, and tenesmus. Occasionally, in a small child, tissue reaction and edema of the outer urethra produces urinary retention rather than the more usual urinary frequency.

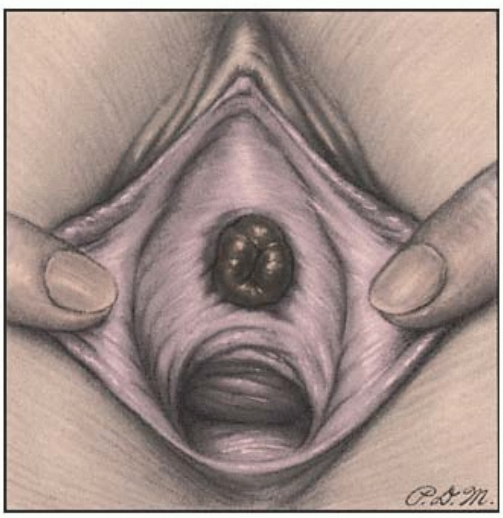

FIGURE 24.25 Prolapsed urethra.

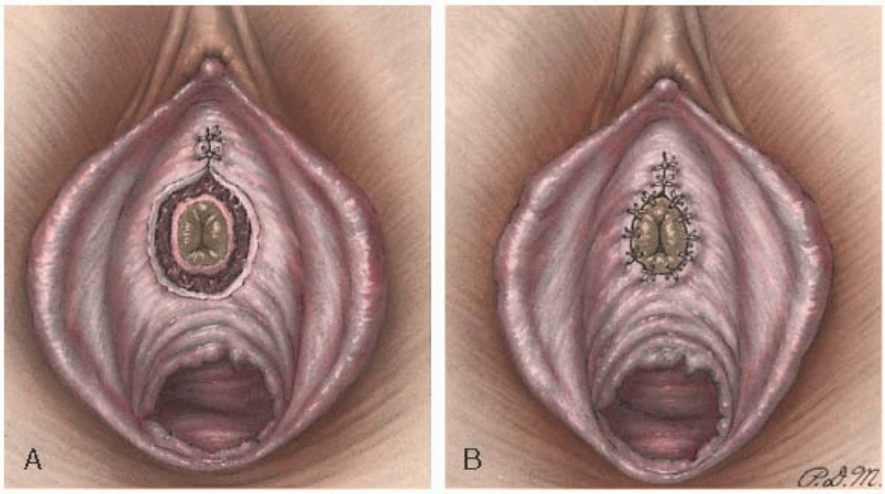

FIGURE 24.26 Operation for urethral prolapse. **A:** The prolapsed mucosa has been excised. **B:** Completed operation. Cut edges of urethral and vaginal mucosa are sutured with 3-0 delayed absorbable sutures.

Urethral prolapse is thought to be the result of poor development of or atrophic changes in the collagen and elastic tissues of the submucosa. In infants, prolapse usually follows a severe coughing or crying spell. In some older patients, too, prolapse has followed paroxysms of coughing. In older patients, diminished tone and elasticity of tissue alone may be sufficient to cause some cases of urethral prolapse.

Treatment of urethral prolapse may be palliative or surgical. Hot, moist compresses provide temporary comfort. A small mass of tissue can be reduced, but recurrence is common.

Surgical Techniques

Several surgical procedures have been suggested, including the one advocated by Kelly and Burnam, in which the prolapsed mucosa is excised by a circular incision (**Fig. 24.26A**). The cut edges are then sutured with 3-0 delayed absorbable suture material, avoiding an excessive number of stitches, which can result in stricture of the urethral meatus (**Fig. 24.26B**). In most cases, this circumcision technique has proved to be the preferred method of correction.

Cryosurgery also has been used to treat urethral prolapse. The method is extremely effective in producing complete annular necrosis and healing of the prolapsed tissue (**Fig. 24.27**). The cryosurgery procedure can be performed without anesthesia, although for a young child, a local anesthetic is advisable. A suprapubic Silastic catheter is inserted and is left in postoperatively to permit bladder drainage until complete, spontaneous

voiding can occur. The catheter also helps to prevent postoperative trauma at the suture line around the meatus.

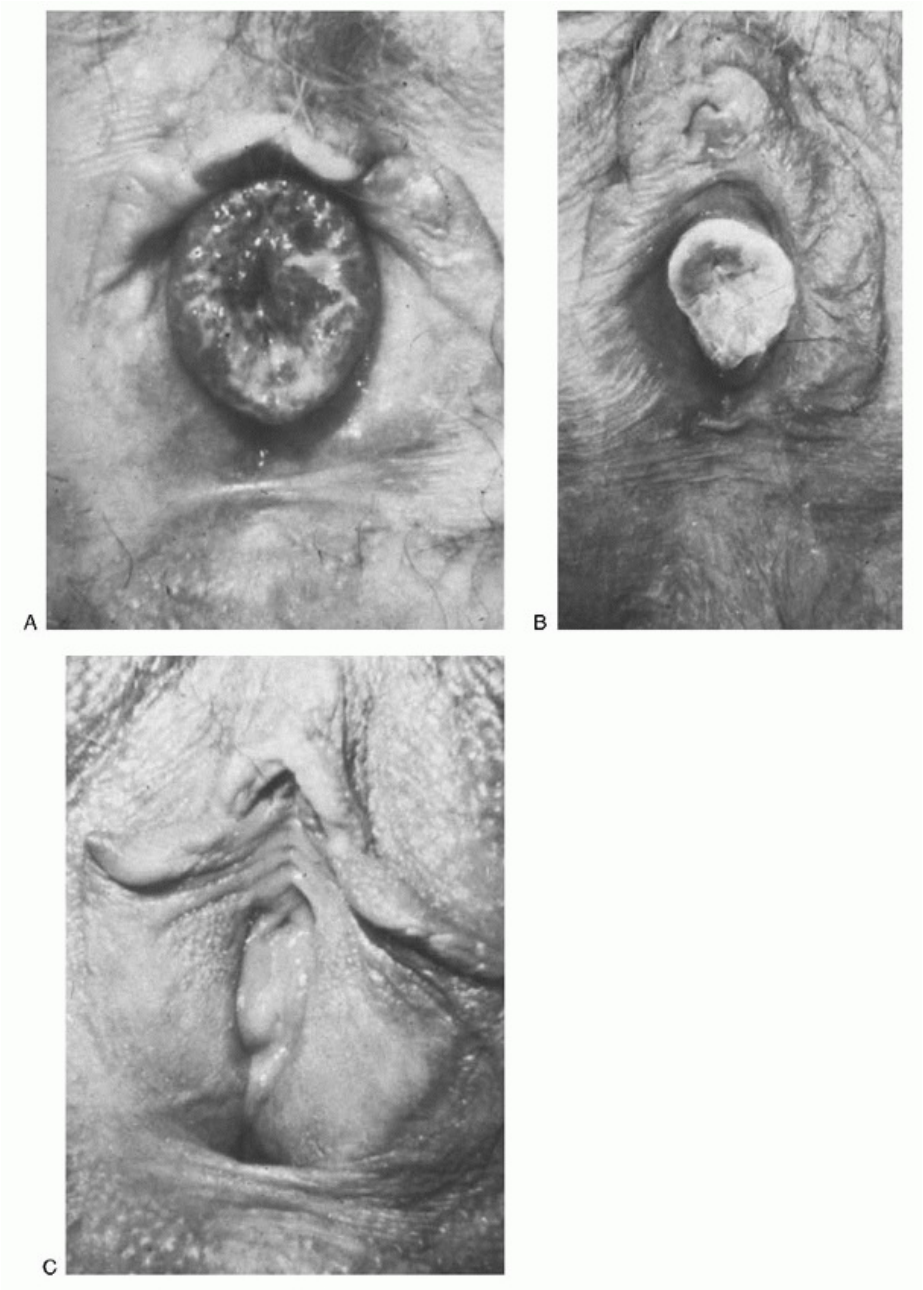

FIGURE 24.27 Cryosurgery in the treatment of urethral prolapse. **A:** Urethral prolapse in an elderly woman. **B:** Regression of urethral prolapse after cryosurgery. **C:** Repeated cryosurgery of urethral prolapse resulted in complete regression and healing of the urethral meatus within 8 weeks.

Carcinoma of the Vagina

Carcinoma of the vagina is uncommon, occurring in less than 2% of patients with gynecologic malignancies. The average age at presentation is 60 years. Vaginal carcinoma is most frequently secondary to metastases from tumors of the cervix and vulva rather than originating in the vagina. Lesions that encroach on the outer vagina from the vulva must be separated from lesions that originate in the vaginal canal to be considered a vaginal primary.

The International Federation of Obstetrics and Gynecology (FIGO) has agreed on the following exclusionary criteria for the classification of vaginal cancer:

- A vaginal growth extending to the portion of the cervix and reaching the area of the external os should always be considered a carcinoma of the cervix.
- A vulvar growth that has extended to the vagina should be classified as carcinoma of the vulva.
- A vaginal growth that is limited to the urethra should be classified separately as carcinoma of the urethra.

Clinicians now satisfy the staging criteria for the diagnosis of primary carcinoma of the vagina by showing a histologically negative cervix, urethra, vulva, and endometrium.

The criteria for the definition of primary carcinoma of the vagina were established after many clinicians reported the recurrence of vaginal lesions after treatment of carcinoma in situ of the cervix. Tumors recurred in 1% to 6% of cases. Today, extension of carcinoma in situ and invasive carcinoma of the cervix to the vaginal fornices or upper vagina can be easily identified with the use of colposcopy.

The clinical stages of carcinoma of the vagina agreed on by FIGO are listed in **Table 24.2**. In 1973, Perez and coworkers proposed that stage II be divided into stages IIa and IIb to provide a more accurate definition of the extent of the lesion. In the proposed modified FIGO classification, stage IIa includes subvaginal infiltration not extending into the parametrial regions, whereas stage IIb includes parametrial or paravaginal infiltration not extending to the pelvic wall. This classification has not been accepted by FIGO. Creasman and colleagues queried the National Cancer Data Base (NCDB), a central registry of hospital case data, from 1985 through 1994. Of the 4,885 cases, 75% were invasive and 90% epithelial. Survival at 5 years was as follows: stage 0, *96%;* stage I, 73%; stage II, 58%; and stage III to IV, 36%. The overall 5-year survival rate with melanoma was 14%.

Symptoms

The diagnosis of vaginal tumors frequently is delayed because of the lack of early symptoms. Progressive vaginal discharge and postmenopausal bleeding are the most frequent symptoms. Postcoital bleeding can also herald the presence of a vaginal or cervical carcinoma. More than 10% of patients are asymptomatic at the time of diagnosis.

Women with a history of vaginal, vulvar, and cervical intraepithelial neoplasia have an increased risk of vaginal carcinoma. These patients should receive annual Papanicolaou smears even if they have undergone a hysterectomy. Having a hysterectomy for other than preneoplastic or neoplastic conditions does not increase the risk for developing vaginal carcinoma.

TABLE 24.2 International Federation of Obstetrics and Gynecology Classification of Vaginal Carcinoma

Preinvasive Carcinoma	
Stage 0	Carcinoma in situ, intraepithelial carcinoma
Invasive Carcinoma	
Stage I	Carcinoma limited to the vaginal wall
Stage II	Carcinoma involving the subvaginal tissue,
	but not extending onto the pelvic wall
Stage III	Carcinoma extending onto the pelvic wall
Stage IV	Carcinoma extending beyond the true pelvis or involving the mucosa of the bladder or rectum. Bullous edema that does not permit a case to be allotted to stage IV

Stage IVa	Spread of the growth to adjacent organs
Stage IVb	Spread to distant organs

From Pettersson F, ed. *Annual report on the results of treatment in gynecologic cancer.* Stockholm, Sweden: FIGO, 1988:174

The symptoms of vaginal carcinoma resemble those of cervical carcinoma, except that obvious bleeding occurs later than with neoplasms on the cervix. The overt bleeding eventually forces the patient to see her physician for diagnosis. The type of pelvic pain is frequently indicative of lesion location. The posterior vagina, the most common location of vaginal carcinomas, presents with tenesmus and other bowel symptoms. Anterior tumors, on the other hand, result in urethral and bladder symptoms.

Histopathology

The most common histologic type of primary vaginal tumor is squamous carcinoma, which accounts for 84% to 90% of all vaginal cancers (**Table 24.3**). Adenocarcinoma, including diethylstilbestrol (DES)-related cases, represents approximately 4% to 9% of vaginal cancers. Sarcomas, including leiomyosarcoma and sarcoma botryoides, account for 2% to 3% of vaginal lesions, and melanomas account for 1% to 2% of malignant neoplasms of the vagina. Rare tumors, such as endodermal sinus tumors or neoplasms originating in embryologic cloacal remnants, may form a transitional cell neoplasm that involves the vagina.

Squamous carcinoma of the vagina is discovered in 10% to 15% of cases after the finding of squamous cancer in other parts of the lower genital tract, such as the vulva or cervix. This has led to the theory of multicentric origin of squamous cancer in the lower genital tract. Woodruff and Parmley and others emphasize this correlation and have recommended that patients with squamous cancer in one area be categorized as high risk for the development of squamous carcinoma in other sites of the lower genital tract. A viral etiology, such as the human papillomavirus, is most likely responsible for these findings.

Carcinoma may arise in the neovagina lined with a splitthickness skin graft from the buttock or lateral thigh. Carcinoma of the neovagina is a rare cancer; only nine cases have been reported. The primary carcinoma seems to be related to the transplanted tissue. In three cases, adenocarcinoma was associated with the use of a large or small bowel intestinal graft for vaginal reconstruction. Five cases of squamous cell cancer arising from the graft have been documented. The transplanted epithelium in the vagina may be exposed to an unidentified carcinogen or mutagen, as has been documented with the vulva, and can undergo malignant transformation in

this environment. These observations underscore the need for regular pelvic examinations after operative vaginoplasty with either a bowel graft or a split-thickness skin graft.

TABLE 24.3 Histologic Types of Vaginal Cancer and Frequency of Occurrence

TYPE	FREQUENCY (%)
Squamous carcinoma	85-90
Adenocarcinoma (including DES related)	4-9

Sarcoma	2-3
Melanoma	2-3
Other	1-2

DES, diethylstilbestrol.

Diethylstilbestrol, a nonsteroidal estrogenic hormone thought to enhance embryo implantation and placental development, was introduced into clinical obstetrics in 1944 in Boston and became popular and widely used during the next two decades. Women with a history of previous spontaneous abortions or other risk factors for early pregnancy loss of multiple gestations were given DES. It is known now that DES use during the first trimester of pregnancy may cause vaginal neoplasia. It was not until the late 1960s, however—when a cluster of cases of adenocarcinoma appeared in young women younger than age 25 years (all offspring of DES-treated women)—that Herbst and colleagues connected the result with the unusual cause.

From 1944 to 1970, approximately 1.5 to 2 million female offspring were exposed to DES. Fortunately, the incidence of vaginal adenocarcinoma in these young women has been quite low, ranging from 0.14 to 1.4 in 1,000 exposed women. More than 500 documented cases have been reported to the DES registry to date.

Observations of the development of vaginal adenosis and adenocarcinoma in teenage girls whose mothers were given DES before the eighteenth week of pregnancy brought new insights to the study of squamous tumor cells in the lower genital tract and greatly increased our understanding of the embryologic development of the vagina. The effect of the DES drug provided an indisputable histologic foundation for the development of an uncommon vaginal adenocarcinoma in women younger than 29 years of age. Twenty-five percent of women exposed in utero have anatomic cervical, vaginal, and urinary tract abnormalities.

The DES-associated adenocarcinoma originally was thought to arise from mesonephric remnants in the vagina, and the disease consequently was mislabeled as a clear cell carcinoma. However, electron microscopic analysis of the ultrastructure of both the adenocarcinoma and the vaginal adenosis allowed Fenoglio and colleagues to clearly define these lesions as composed of columnar epithelium, similar in all respects to endocervical epithelium, and of paramesonephric (müllerian) origin. The colposcopic studies of Stafl and Mattingly and of others confirm these observations.

Vaginal adenosis has been found by colposcopic examination to occur in 34% to 90% of exposed offspring and vaginal adenocarcinoma in 50%. Although the hypothesis is still unproven, there is a strong possibility that the benign vaginal lesion is the cell of origin for vaginal adenocarcinoma. The risk of development of clear cell adenocarcinoma in an exposed woman between birth and age 34 is 1 in 1,000.

Etiology

During embryologic development, the vagina is formed from the columnar epithelium of the müllerian ducts and UGS. The tissue then transforms into squamous epithelium, so that the vaginal and cervical epithelium have a common embryologic origin. Squamous metaplasia within the vaginal adenosis has been observed with a colposcope, and transformation of the metaplastic tissue also has been demonstrated in the development of intraepithelial neoplasia. Although many agents have been postulated as carcinogenic factors, none have been positively demonstrated. It is quite possible that squamous carcinoma arises from the effects of an oncogenic agent on the transformation zone within the foci of vaginal adenosis. The studies now being done on the effects of DES may find some interesting causative factors that influence vaginal carcinoma.

Carcinoma of the vagina also may share a common causative denominator with cervical carcinoma. Because slightly

more than 50% of the cases occur in the posterior wall of the upper third of the vagina, which is the end point of vaginal coitus, vaginal carcinoma could be venereally induced. As with cervical carcinoma, primary carcinoma of the vagina usually occurs in sexually active women. Except for the cases of adenocarcinoma in young women exposed to DES, squamous carcinoma of the vagina is unquestionably associated with sexual activity. As with cervical intraepithelial neoplasia and carcinoma, the human papillomavirus is probably responsible for the majority of vaginal carcinomas.

Site of Lesion

Plentl and Friedman found that 51% of vaginal carcinoma lesions occur in the upper third of the vagina, 30% in the lower third, and 19% in the middle third. In the lower third, lesions most often occur in the anterior wall, whereas in the upper third, lesions most often appear in the posterior vaginal wall. Although the location is observed on diagnosis, the precise site of origin is difficult to pinpoint because the tumors usually have spread to various parts of the vagina by that time.

Pathways of Spread

The lymphatic drainage of the vagina takes place through different pathways. The upper third drains by way of the cervical lymphatics, the lower third passes by way of the vulvar lymphatics, and the middle third communicates with both the upper and the lower lymphatic channels. The vaginal vault and the anterior wall of the upper vagina drain to the interiliac pelvic lymph nodes, where they communicate with the external iliac, the hypogastric, and the common iliac nodes. The lymphatic drainage of the posterior vagina communicates directly with the deep pelvic nodes, including the inferior gluteal, sacral, and rectal nodes.

Because the major pathways of lymphatic drainage are to the superior and inferior gluteal muscles and the common iliac lymph nodes, the potential for extrapelvic spread of vaginal carcinoma is great. When extrapelvic spread occurs, prognosis usually is poor. The primary site of origin of the tumor is an important indicator of lymph node metastases, whether the tumor will metastasize to the inguinal-femoral chain or to the deep pelvic lymph nodes. When the disease involves the lower third of the vagina, 6% to 7% of patients have metastases to the inguinal-femoral lymph nodes.

Diagnosis

In general, invasive carcinoma of the vagina appears as either a raised exophytic lesion or an ulcerative, depressed lesion in the vaginal wall. Biopsy can be performed on both types of lesions easily, and diagnosis can be established without difficulty. Vaginal cytology usually is positive if an adequate cell sample is obtained from the exfoliated lesion, although, as often happens with cervical carcinoma, many cases of false-negative cytology occur even when an invasive lesion is present. Colposcopy, Lugol solution, or both can be used to demarcate the areas for biopsy, although iodine staining usually is unnecessary if the lesion is clearly visible.

Identifying vaginal carcinoma at an early stage can be a major problem because the first lesions appear within the epithelial cells, frequently indistinguishable from the remainder of the vaginal epithelium. Only by colposcopic examination or with iodine staining can alterations in the surface epithelium of the vagina be identified. Ng and associates have achieved an accuracy of 88% to 90% in detecting dysplastic lesions

in DES-exposed patients with adenosis, but their technique requires separate, four-quadrant vaginal smears from the walls of the vagina to increase the sensitivity of the Papanicolaou smear. Herbst and coworkers emphasize the advantage of iodine staining of the vagina to reveal occult lesions that may be associated with adenosis. Stafl and Mattingly reported an accuracy of *96%* in detecting abnormal epithelial lesions of the vagina in DES-exposed women by careful examination and colposcopy.

Because the vaginal speculum can obscure surface lesions and delay early diagnosis, the instrument should be rotated during the examination so that the entire canal can be inspected. With iodine staining, the clinician can detect multifocal lesions, but the entire vagina also should be cytologically tested. A thorough colposcopic examination can be used to detect vaginal carcinoma if the clinician has that expertise.

Treatment

Primary vaginal carcinoma is treated either with surgery or with radiotherapy. The choice of treatment depends on three factors: the size of the lesion, the location of the tumor in the vagina, and the clinical stage of the disease.

Stage 1 Lesions

Easiest to treat by far is vaginal intraepithelial neoplasia **III** (VAIN **III),** and it offers the most hopeful prognosis. Either surgery or radiotherapy can be used, depending on the location of the lesion. If the disease is located in the upper vagina and the margins of the disease are distinct, a partial vaginectomy, with or without hysterectomy, is a practical and successful method of treatment.

The carbon dioxide laser has proved to be a simple, effective means of treating noninvasive vaginal carcinoma. Laser therapy offers conservative treatment for both focal and multicentric lesions without impairment of normal coital function. Because there is a risk of residual disease in 10% of lasertreated patients, careful colposcopic and cytologic follow-up are critical. Histologic study is difficult after the carbon dioxide laser vaporizes the treated lesions. An alternative ablative technique is the ultrasonic surgical aspirator, the tip of which vibrates 23,000 times per second, fragmenting and aspirating the tissue in contact with it. This technique permits histologic evaluation of the collected tissue fragments. The operative site also heals faster secondary to decreased thermal damage. Robinson and colleagues reported their experience in treating 46 patients with VAIN. Sixty-six percent (29) of those initially treated with ultrasonic surgical aspiration did not have recurrence. Fifty-two percent of patients treated for recurrent disease (17) did not experience a recurrence. The mean duration of follow-up was 21 months.

Nonsurgical methods such as administration of 5-fluorouracil vaginal cream have also proved efficacious in treating VAIN.

Radiation therapy is rarely used to treat VAIN. However, radiation is an excellent modality for suspected invasion when the medical risk for further evaluation by surgery is too great.

A vaginal cylinder, such as the Bloedorn applicator, can be used for radiotherapeutic treatment to deliver 70 Gy to the vaginal surface over a period of approximately 72 hours. If the lesion is confined to the vaginal fornices, vaginal colpostats can be used to deliver a similar dosage. Lesions in the lower third of the vagina may be treated by partial vaginectomy or by intravaginal irradiation using a variety of brachytherapy techniques.

Surgery, radiation, or both are the primary modalities for treating vaginal carcinomas. Lesions in the vaginal fornix can be treated with a radical Wertheim hysterectomy, partial vaginectomy, and bilateral pelvic lymphadenectomy. Treatment for this lesion is similar to that for stage Ib cervical carcinoma. If pelvic lymph nodes are histologically positive or if paraaortic lymph nodes look suspicious, a paraaortic lymphadenectomy should be performed. If the lymph nodes are histologically positive for carcinoma, pelvic radiation with or without paraaortic radiation should be administered. As with cervical carcinoma, the size of the lesion is prognostic of our ability to adequately treat these patients with primary surgery. Large lesions not permitting clear surgical margins (e.g., proximity to the bladder or rectum) should be treated with primary radiation therapy. Radical surgery also may require the replacement of the upper vagina with a split-thickness skin graft to reestablish normal vaginal length for a sexually active woman. Irradiation therapy is an alternative treatment for this stage of disease.

The radical Wertheim hysterectomy has been quite successful in treating stage I adenocarcinoma in young women who were exposed to DES in utero. More than 75% of patients are cured. Magrina and associates treated a patient with stage I disease at their institution with laparoscopic radical parametrectomy and pelvic and aortic lymphadenectomy. The role of laparoscopy in the treatment of vaginal carcinoma will continue to expand. Although its role in parametrectomy may be debated, laparoscopy to excise the pelvic and periaortic nodes before radiation may be beneficial to patients with advanced disease.

Sentinel Node Detection

Sentinel node detection in vaginal carcinoma has not gained universal acceptance. Gynecologic tumor—such as

cervical and vulvar—have been much more amicable to sentinel node detection and biopsy. Van Dam and colleagues used ^{99m}TC-labeled nanocolloids in primary and recurrent vaginal carcinomas. Nodes were identified laparoscopically and resected. Three of four patients had nodes identified through sentinel node detection. Frumovitz and colleagues evaluated fourteen patients with pretreatment lymphoscintigraphy. Eleven patients had at least one sentinel node identified: five (45%) inguinal, four (36%) pelvic, and two (18%) inguinal and pelvic. Contrary to present beliefs, the location of positive sentinel nodes did not correlate to the location of the lesion.

Radiation therapy is the preferable treatment for large proximal lesions or middle or distal vaginal tumors. A combination of teletherapy (external beam) and interstitial or intracavity therapy is used.

Stage II and Stage III Lesions

More extensive lesions of the vagina pose an extremely difficult therapeutic problem for the gynecologist. Because the levator ani muscles of the pelvic diaphragm surround the vagina, penetration of the lateral wall of the vagina by the invasive tumor frequently is associated with fixation of the disease to the adjacent pelvic musculature. Even radical surgery cannot effectively control the disease when it extends beyond the confines of the vagina into the paravaginal tissues. Instead, the major method of treatment for stage II and stage **III** lesions is radiotherapy.

When stage II lesions involve the anterior or posterior wall of the vaginal septum, an anterior or posterior exenteration with pelvic node dissection may be required. When the disease includes the lower third of the vagina, a groin dissection also is necessary. Because surgery must be so extensive, its usefulness is limited when the disease affects the paravaginal region (stage IIb) or the lateral vaginal wall (stage **III).**

Stage IV Lesions

When advanced lesions involve only the bladder or the rectum, exenteration may be required to control the disease effectively. Unfortunately, pelvic exenteration, either anterior or posterior, can be used only when there is no other extension of the disease, and it is rare for the bladder and rectum to be involved without involvement of the adjacent paravaginal tissues. If the patient is not an acceptable surgical risk for exenteration, external beam megavoltage irradiation therapy followed by intravaginal or interstitial irradiation can be used to control the local disease and to offer palliation. If the tumor does not respond after 5,000 cGY of irradiation treatment to the whole pelvis, an exenteration may be required to control the disease in properly selected patients. Exenteration is also recommended for central recurrences without lymph node metastasis.

Advanced/Recurrent Disease

Pelvic exenteration is the best treatment for patients who have failed primary irradiation therapy of vaginal carcinoma. As with cervical carcinoma, it is imperative that the recurrences be central and nodes radiographically negative. Before performing the exenteration, pelvic and periaortic nodes are sent for frozen section. Depending on the age of the patient, continent urinary diversions, neovaginal, and primary end-to-end colon anastomosis are performed when possible. Berek and colleagues reported on their 45-year pelvic exoneration experience at UCLA. Survival for cervical/vaginal cancers was 73% at 1 year, 57% at 3 years, and 54% at 5 years (**Fig. 24.28**). Positive margins had a deleterious effect on survival (**Fig. 24.29**).

Irradiation Therapy

Irradiation treatment of vaginal carcinoma is easily divided between lesions in the upper and middle thirds and the lower third of the vagina.

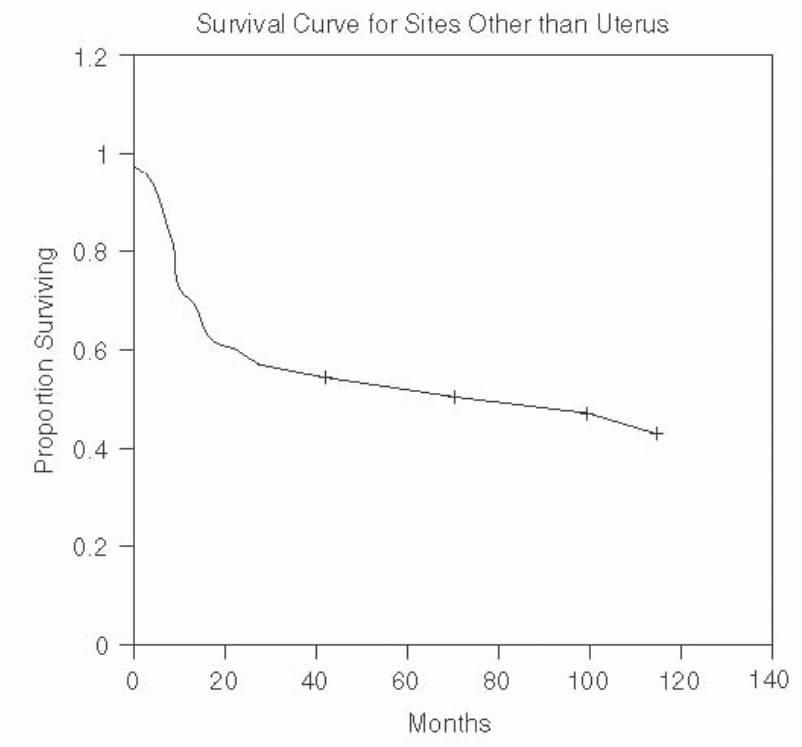

FIGURE 24.28 Survival of patients with recurrent cervical and vaginal cancers following pelvic exenteration. (Reprinted with permission from Berek JS, Howe C, Legasse LD, et al. Pelvic exenteration for recurrent gynecologic malignancy: survival and morbidity analysis of the 45-year experience at UCLA. *Gynecol Oncol* 2005;99:157. Copyright © 2005 Elsevier Inc.)

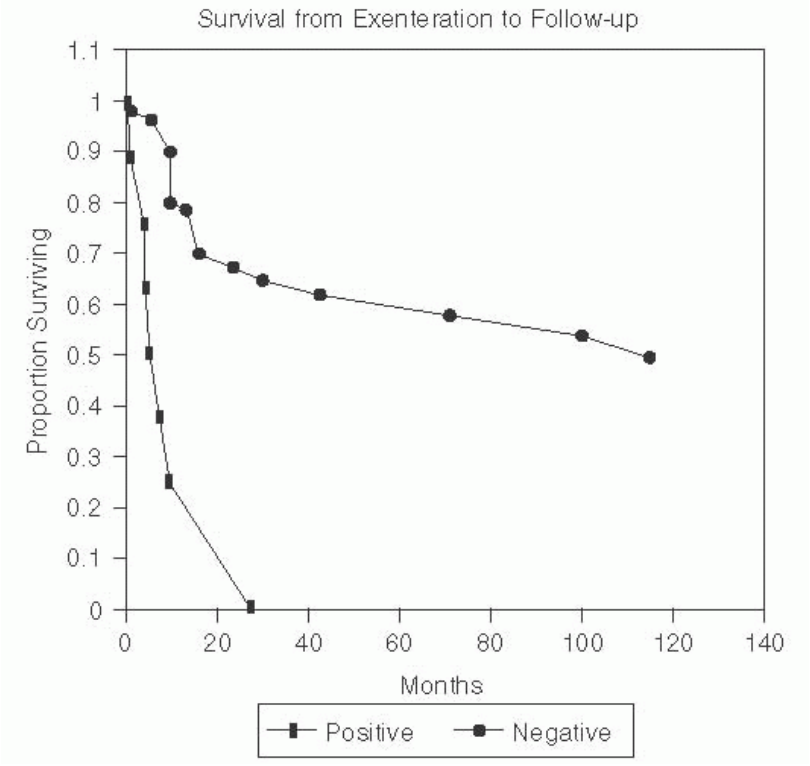

FIGURE 24.29 Survival based on status of surgical margins. (Reprinted with permission from Berek JS, Howe C, Legasse LD, et al. Pelvic exenteration for recurrent gynecologic malignancy: survival and morbidity analysis of the 45-year experience at UCLA. *Gynecol Oncol* 2005;99:158. Copyright © 2005 Elsevier Inc.)

Upper and Middle Thirds of the Vagina

Because the lymphatic drainage of the upper and middle vagina extends through the hypogastric and pelvic nodes, full

pelvic irradiation is necessary. Treatment usually includes a combination of techniques.

External beam megavoltage therapy using 4,500 to 5,000 cGY focused on the midplane of the pelvis is used to treat the full pelvis and to encompass the vagina. A vaginal implant of radium, cesium, or iridium follows, delivering an additional 3,000 to 4,000 cGY to a depth of 0.5 to 1.0 cm or more, depending on the thickness of the lesion.

At the MD Anderson Hospital, Brown and coworkers demonstrated the efficacy of using a radium needle implant for localized lesions. When the implant is used, high doses of radiation to the entire vagina, bladder, and rectum are avoided. Interstitial needles and iridium wires have been used as a primary treatment for localized vaginal lesions, and they can be used for persistent disease.

Lower Third of the Vagina

Lesions in the lower third of the vagina frequently metastasize to the inguinal-femoral lymphatics and must be treated with full external and intravaginal irradiation followed by external beam irradiation treatment to the inguinal-femoral lymph nodes. The inguinal-femoral regions require either a surgical groin dissection or the application of 5,000 to 6,000 cGY of electron beam teletherapy in addition to full pelvic irradiation. When vaginal lesions have metastasized to the groin lymph nodes, the cure rate is equally poor for both methods. In general, the presence of tumor in the groin nodes is a poor prognostic sign, suggesting that the deep pelvic nodes also may be involved in approximately 6% to 7% of cases. Because the incidence of vaginal cancer is so low, the exact frequency with which the deep pelvic nodes are involved has not been documented.

Chemoradiation for large bulky lesions may play a role in vaginal carcinoma, just as it does in cervical or vulvar lesions. Agents such as cisplatin, 5-fluorouracil, and hydroxyurea have been successfully used.

The number of patients with vaginal carcinoma reported to the FIGO registry by international clinics between 1979 and 1981 totals 547. Seventy-eight percent of these patients were treated by radiation. Only 38.6% of these patients were alive at 5 years. Results from other institutions that primarily have followed radiation therapy show that only stage I lesions have an adequate 5-year survival rate (**Table 24.4**).

In a retrospective analysis of 134 patients with carcinoma of the vagina treated at Washington University, Perez and Camel report an actuarial disease-free, 5-year survival rate of 85% for stage I lesions, 51% for stage IIa lesions, 33% for stage IIb lesions, 33% for stage III lesions, and 19% for stage IV lesions. The actuarial study demonstrated that beyond stage I of the disease, control is poor. For stage IIa lesions, local control of the disease was achieved in only 65% of cases at the University of Maryland because external irradiation was not used in all cases. Pelvic control was achieved in 48% of stage IIb and stage III lesions, but in none of the seven patients (0%) with stage IV disease.

Overall survival rates for stages I through IV from published reports are outlined in **Table 24.5**. The highest survival rates are observed in stage I disease, whereas few patients survive for 5 years after the diagnosis of stage IV disease. Shah and colleagues reviewed the Surveillance, Epidemiology and End Results program (SEER) data on 2,149 women from 1990 to 2004. The average age at diagnosis was 65.7. The 5-year survivals were stage I (84%), stage II (75%), and stage III/IV (57%). Mortality decreased by 17% after the year 2000.

TABLE 24.4 Absolute 5-Year Survival after Irradiation Therapy for Carcinoma of the Vagina

	PROPORTION SURVIVING					
FIGO STAGE	MD ANDERSON HOSPITAL[a] 1948-1967	UNIVERSITY OF MARYLAND[b] 1970-2000	WASHINGTON UNIVERSITY[c] 1957-1970	VIENNA UNIVERSITY[d] 1950-1977	1950-1977	INDIANA UNIVERSITY[f] 1987-2007

I	/16 (69%)	/50 (85%)	/6 (83%)	/39 (85%)	/60 (75%)	92%
II	/19 (68%)	/97 (78%)	/31 (64%)	/60 (47%)	/95 (45%)	82%
IIa		/20 (65%)	/39 (51%)			
IIb		/11 (63%)	/21 (33%)			
III	/15 (27%)	/39 (58%)	/20 (40%)	/12 (33%)	/145 (30%)	
IV	/11 (0%)	/7	/7 (0%)	/8 (19%)	/62 (19%)	20%
I-IV	/61 (46%)		/64 (52%)	/119[e](53%)	/362 (40%)	

[a]Data from Hilgers RD. Squamous cell carcinoma of the vagina. *Surg Clin North Am* 1978;58:25.

[b]Data from Pecorelli S, ed. FIGO annual report on the results of treatment in gynecological cancer. *Int J Gynecol Obstet* 2003;83:27

[c]Data from Perez CA, Camel HM. Long-term follow-up in radiation therapy of carcinoma of the vagina. *Cancer* 1982;49:1308.

[d]Data from Kucera H, Langer M, Smekal G, et al. Radiotherapy of primary carcinoma of the vagina: management and results of different therapy schemes. *Gynecik Ibcik* 1985;21:87.

[e]Not included in the figure 119 are 15 patients of the total patient group of 134 who were stage 0. /Data from Sinha B, Stehman F, Schilder J, et al. Indiana University experience in the management of vaginal cancer. *Int J Gynecol Cancer* 2009;19(4):686-693.

BEST SURGICAL PRACTICES

- Incorporating an exam of the external genitalia into routine practice of clinicians caring for children can prevent delays in diagnosing imperforate hymen, misdiagnosis, and potential morbidity. To prevent scarring, stenosis, and subsequent dyspareunia in women with imperforate hymen, the hymenal tissue should not be excised too close to the vaginal mucosa.
- Sexually ambiguous external genitalia defects of the UGS are remarkably constant in appearance regardless of the etiology and differ only in degree of malformation, ranging somewhere intermediate to that of a normal girl and that of a normal boy. Thus, operative procedure for reconstruction of ambiguous genitalia into feminine genitalia does not vary in its essential elements.
- The common goals for the female reconstruction of ambiguous genitalia include reduction of clitoral size, creation of labia minora, and exteriorization of the vagina. Any reconstruction of the external genitalia with the objective of producing normal female appearance and function requires a full understanding of the surgical anatomy.
- It is essential to accurately identify the site of communication of the vagina with the UGS in female reconstruction of ambiguous genitalia. Knowledge of the possible variants in communication of the vagina with the UGS is critical before entertaining surgical correction.
- One objective of the reconstruction procedure for external genitalia is to delay the procedure until the anomalous

structures are of a size to permit easy identification of all structures. Repair may be delayed until menarche, when maturity and the desire for sexual activity are usually well established.

- Surgical efforts of clitoral reduction focus on concealment, plication, resection, and reduction, with an attempt to provide

a normal cosmesis without sacrificing sensation or vascularity of the glans. Even after seemingly successful clitoral reduction, the sensory function is significantly impaired, and this should be taken into consideration during counseling.

- Preoperative identification and catheterization or sounding of the vaginal orifice is key to the performance of a successful, one-stage procedure.
- It generally is recommended that exteriorization of the vagina be postponed until near puberty because higher estrogen levels may prevent stenosis, and sufficiently, maturity in the patient is needed to comply with a postoperative dilatation program.
- When the complete operation is attempted at an early age, the vagina is sometimes not satisfactorily exteriorized. It should be emphasized that simple exteriorization of the lower vaginal tract can be combined with cosmetic correction of virilized external genitalia in infancy, but in most cases, it is best to defer definitive reconstruction of the intermediate or high vagina until after puberty.
- Preinvasive lesions of the vagina can be treated with excision or ablative techniques.
- Early stage I carcinoma of the vulva can be treated with radiation therapy and/or surgical excision. Radical vaginectomy and pelvic lymph node dissection has few complications and excellent 5-year survival. In more advanced-stage vaginal cancers, radiation therapy is superior.

TABLE 24.5 Carcinoma of the Vagina: Comparison of Survival (%)

		STAGE				
INVESTIGATORS	**YEARS STUDIED**	**I**	**II**	**III**	**IV**	**TOTAL**
Puthawala et al. (1983)[a]	1976-1979	100	75	22	0	56
Gallup et al. (1987)[a]	1971-1984	100	50	0	25	43
Brown et al. (1971)[a]	1948-1967	69	68	27	0	46
Nori et al. (1983)[a]	1950-1974	71	61	33	0	42
Perez (1981)[a]	1965-1981	81	42	30	9	50
Prempree (1982)[a]	1957-1975	78	57	39	0	48
Benedet et al. (1983)[a]	1950-1980	71	50	15	0	45
Manetta et al. (1988)[a]	1976-1986	71	47	33	33	48

Eddy et al. (1991)[b]	1970-1989	84	70	45	35	28
Stock et al. (1995)[b]	1962-1992	100	67	53	0	15
Creasman et al. (1998)[b]	1985-1994	792	73	58	58	58
Frank et al. (2003)[b]	1970-2000	165	78	56	37	46
Viswanathan et al. (2003)[b]		58	70	64	32	0
Tabata et al. (2002)[b]	1957-1995	51	82	70	0	0
Mock et al. (2003)[b]		86	41	43	37	0
Otton et al. (2004)[b]	1982-1998	70	71	48		

[a]Adapted from Manetta A, Perito JL, Larson JE, et al. Primary invasive carcinoma of the vagina. *Obstet Gynecol* 1988;72:77.

[b] Adapted from Creasman WT. Vaginal cancers. *Curr Opin Obstet Gynecol* 2005;17:71.

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