Surgical Views

In collaboration with the American College of Veterinary Surgeons

Surgical Treatment of Urethral Sphincter Mechanism Incompetence in Female Dogs

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Abstract: *Urinary incontinence—loss of voluntary control over the retention and expulsion of urine—is a common medical problem in small animal patients. Incontinence occurs when pressure within the bladder exceeds urethral pressure. Incontinence may result from a variety of etiologies, including congenital anatomic abnormalities of the lower urinary and reproductive systems (ureter, bladder, bladder neck, urethra, vagina, vestibule) as well as neurologic, neoplastic, infectious, and inflammatory diseases.*

At a Glance

Urethral Sphincter Mechanism Incompetence

Urethral sphincter mechanism incompetence (USMI), also referred to as *idiopathic incontinence, spay incontinence,* and *hormone-responsive incontinence*, is the most common and important cause of acquired urinary incontinence in adult female dogs.[1–4] USMI is largely a condition of spayed dogs, but in some breeds, such as greater Swiss mountain dogs, soft-coated wheaten terriers, Doberman pinschers, and giant schnauzers, incontinence may precede ovariohysterectomy (OVH). Congenital USMI has also been recognized as a cause of incontinence in juvenile dogs and is frequently associated with other anatomic malformations, such as ureteral ectopia and ureteroceles.[1–4]

Approximately 20% of female dogs have been reported to develop some degree of USMI after OVH performed between the first and second heat cycles.[5] In dogs spayed before first estrus, the incidence is reported to be 9.7%.[5] The incidence of incontinence may be as high as 30% in large-breed female dogs (>20 kg); in some breeds, including boxer, Doberman pinscher, rottweiler, Old English sheepdog, and giant schnauzer, it is even higher.[1,2,4,6–8] Urinary incontinence is most often reported within 3 years of spaying.[1–4] There is no reported difference in the incidence of incontinence between dogs in which ovariectomy alone was performed and dogs that underwent OVH. Decreases in maximal urethral closure pressure (MUCP) and functional urethral length predictably occur during the first 12 to 18 months after neutering, resulting in a caudal shift of the urethral pressure profile and deterioration of urethral closure function. It is speculated that the decline in MUCP continues with advancing age, further contributing to the development of incontinence in later life.[1,2,7,8]

The term *urethral sphincter mechanism incompetence* was first suggested to describe weakness of the "urinary sphincter" despite the fact that no true anatomic sphincter exists at the bladder neck or proximal urethra. The smooth muscle of the proximal urethra is continuous with the detrusor muscle layer of the bladder trigone.[1] Therefore, congenital anatomic abnormalities affecting the ureters, bladder neck, and proximal urethra can impair development of the normal smooth

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muscle architecture in this region, contributing to incontinence.[1–4] Varying amounts of fibrovascular tissue located throughout the length of the bladder neck and urethra may also play a role in maintenance of continence.[1–3]

Caudal displacement of the bladder into the pelvic canal is recognized as *pelvic bladder syndrome*.[9,10] The hallmark radiographic appearance of a pelvic bladder shows abnormal elongation of the bladder, persistent caudal displacement of the bladder and bladder neck into the pelvic canal on distention, an indistinct or blunted vesicourethral junction, and a shortened urethra.[9,10] Shortening of the urethra reduces exposure of the bladder neck and proximal urethral wall to the intraabdominal pressure that acts as an external occluding force.[1,2,4,6–8] Abnormally short urethras are frequently noted in dogs with USMI. Pelvic bladder has been reported in male and female dogs with and without urinary incontinence.[9,10] The significance of pelvic bladder and its role in the pathophysiology of USMI are not completely understood, but pelvic bladder is thought to be a contributing factor in patients with USMI.[9,10] USMI is considered to be a multifactorial disorder, and the specific etiopathogenesis remains unclear.[1–4,6–8]

USMI in dogs has been likened to stress incontinence diagnosed in women after pregnancy, childbirth, or menopause. In women, sudden increases in abdominal pressure from actions such as coughing, sneezing, and laughing can result in loss of bladder control.[1,2,6,7] Varying degrees of urinary incontinence have been reported in dogs with USMI. Most owners report leakage of urine when the dog is recumbent or sleeping. Increased periods of incontinence have also been reported in dogs after strenuous exercise, excitement, and steroid administration. In our experience, swimming and eating snow can also lead to increased incontinence in dogs.

Diagnosis

The diagnosis of USMI is established by ruling out structural and functional abnormalities of the urinary and reproductive systems in patients that are neurologically normal. Physical examination findings are frequently unremarkable. Specific examination of the vulva and perivulvar region is necessary to assess vulvar conformation and degree of vulvar recession. Perivulvar dermatitis and hyperpigmentation of the perivulvar skin secondary to chronic incontinence are frequently noted in dogs with USMI.

Cystocentesis to collect a urine sample for complete urinalysis and bacteriologic culture is a critical first step in the diagnosis and management of patients with urinary incontinence. Infection, inflammation, uroliths, or neoplasia of the lower urinary system can result in loss of continence. If a urinary tract infection exists, treatment with appropriate antibiotic therapy for 14 to 21 days, followed by reevaluation of a urine culture 5 to 7 days after the completion of antibiotic therapy, should precede other diagnostic procedures.

Abdominal radiography may detect radiodense urinary calculi or caudal displacement of the urinary bladder into the pelvic canal. Contrast radiography (e.g., retrograde vaginocystography) and contrast-enhanced computed tomography can enable more specific evaluation of the vestibule, vagina, and lower urinary and reproductive structures, including detailed information regarding the location of the bladder neck, urethral length, ureteral size, location of ureteral orifices, bladder wall thickness or irregularity, and presence of small uroliths. Uroendoscopy is useful to evaluate the luminal surfaces of the lower urinary and reproductive systems under magnification.

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QuickNotes

Cystocentesis to collect a urine sample is a critical first step in the diagnosis and management of patients with urinary incontinence.

FIGURE 1

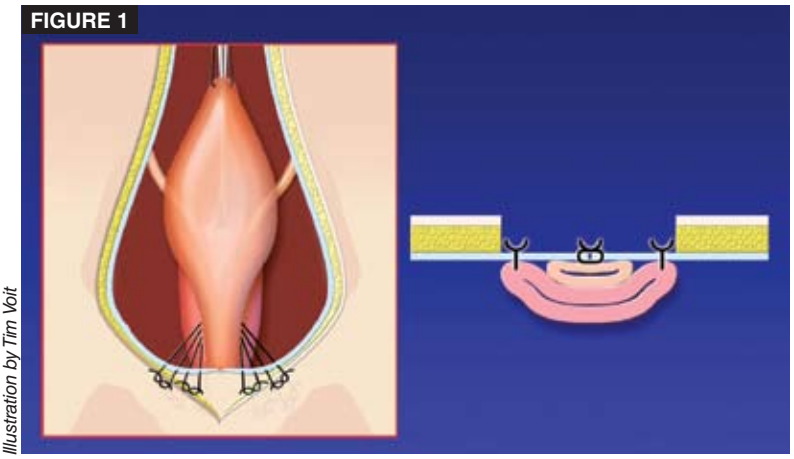


Illustration by Tim Voit

Illustration of colposuspension. Cranial traction is applied to the bladder and uterine body remnant. The vagina is exposed on either side of the urethra immediately cranial to the pubis. Nonabsorbable monofilament sutures are placed between the prepubic tendon and the seromuscular layer of the vagina, positioning the bladder neck cranially into the abdomen.

Anatomic abnormalities such as ureteral ectopia, ureterocele, and structural defects of the trigone and urethra can be definitively diagnosed with this method of imaging. Specific diagnostic confirmation of USMI is made based on the results of urodynamic studies, including a urethral pressure profile and leak point pressure. Patients with USMI have a decreased MUCP and leak point pressure compared with continent dogs.[6,7,11–13]

QuickNotes

Surgical treatment is typically reserved for patients in which appropriate medical management has failed or is not possible.

Surgical Treatment of Urethral Sphincter Mechanism Incompetence

Medical therapy (**BOX 1**) is the first line of treatment for dogs with USMI. Surgical treatment of USMI is typically reserved for patients in which appropriate medical management has failed, that have adverse reactions to recommended medications, or that have medical conditions precluding the use of medical therapies. The goal of surgical treatment of USMI is to increase urethral resistance to the outflow of urine. To accomplish this, surgical procedures focus on correcting caudal displacement of the bladder neck to (1) increase intraabdominal forces and provide improved MUCP within the urethra (colposuspension, urethropexy, and urethral lengthening), (2) increase urethral resistance by reducing the diameter of the urethral lumen (urethropexy and submucosal collagen implants), and (3) improve functional urethral length (colposuspension, urethral lengthening). The surgical procedures reported in the veterinary literature to improve USMI in small animal patients have all been adapted and modified from procedures performed on women with diagnosed stress incontinence.

Colposuspension

Description

Colposuspension uses the placement of sutures between the vagina and the prepubic tendon to create urethral resistance to urine outflow. This procedure results in cranial advancement and repositioning of the bladder neck and proximal urethra, exposing these structures to intraabdominal pressure. In addition, the urethra, cradled by the vagina, is positioned over the edge of the pelvic brim, which applies additional external compression (**FIGURE 1**). Colposuspension is the surgical procedure most commonly performed to treat spayed dogs with USMI. Colposuspension alone was reported to be curative in approximately 50% of patients; in approximately 40% of the remaining patients, continence was improved.[1,2,6–8]

A recent study evaluated the immediate urodynamic response to colposuspension in normal beagles.[6] Leak point pressures were significantly increased, while MUCPs were decreased. Urethral length was assessed using measurements from vaginourethrograms and urethral pressure profiles and was determined to be slightly increased based on evaluation of lateral radiographs. Urodynamic studies indicated that the total profile length and the functional profile length were significantly increased.[6] The long-term effects of colposuspension also have been examined in female dogs with USMI.[7] Two months after colposuspension, 12 of 22 female dogs achieved complete continence. However, only three dogs remained completely continent 12 months after surgery. When medical therapy was instituted after surgery, an additional eight dogs regained complete urinary continence and nine were improved.[7]

Technique

With the patient in dorsal recumbency, clip and aseptically prepare the ventral abdomen from the xyphoid over the pubis, including the perivulvar region. Aseptically pass an appropriate-size balloon-tip urethral catheter transurethrally

into the bladder. Perform a caudal midline celiotomy from the umbilicus, extending over the cranial aspect of the pubis, and identify and isolate the insertion of the rectus abdominis muscles and prepubic tendon (**FIGURE 2**). Expose the bladder, proximal urethra, and uterus or uterine body remnant. If the patient is intact, OVH is performed at this point.

Place a stay suture through the apex of the bladder for traction and manipulation and an Allis tissue forceps on the uterine body remnant for cranial traction. A peritoneal reflection forming the vesicogenital pouch exists between the dorsal aspect of the pelvic urethra and the ventral aspect of the vagina, tethering these structures together (**FIGURE 3**). This intimate anatomic association allows cranial traction of the uterine body remnant and vagina to result in cranial movement of the bladder neck and urethra.

With cranial traction applied to the bladder and uterine body remnant, use a curved mosquito hemostat or right-angled forceps to bluntly dissect a small window through the periurethral fascia along each side of the urethra immediately cranial to the pubic brim, exposing the vagina dorsal to the urethra (**FIGURE 4**). Take care to avoid excessive dissection and disruption of the neurovascular supply to the vagina and urethra, positioned dorsolaterally within the pelvic canal. Identify the lateral wall of the vagina and grasp it with atraumatic forceps positioned on each side of the urethra. Based on the size of the patient, pre-place one or two 2-0 nonabsorbable monofilament sutures through the seromuscular layer of the vaginal wall on each side of the urethra and through the prepubic tendon, entering and exiting lateral to the insertion of the rectus abdominis muscle (**FIGURE 5**). Firm cranial traction on both the bladder and uterine remnant is needed to achieve cranial positioning while these sutures are tied on either side of the urethra. Insert a mosquito hemostat between the ventral aspect of the urethra and the pelvic brim to ensure that the urethra is not completely obstructed (**FIGURE 6**). Close the abdomen in a routine manner.

Postoperative Care

A urethral catheter with a closed urinary collection system should be maintained for 24 hours after surgery. Transient dysuria and stranguria due to urethral inflammation and partial urethral obstruction can occur after catheter removal. Complete urethral obstruction after colposuspension is rare. If complete urethral obstruction occurs, replacement of the urethral catheter for an additional 24 to 36 hours and administration of an NSAID are indicated. Attempts to manually express

Medical Management of Urethral Sphincter Mechanism Incompetence in Female Dogs

QuickNotes

Medical therapy is the first line of treatment for dogs with urethral sphincter mechanism incompetence.

Urethral sphincter mechanism incompetence (USMI) may be fully, partially, or transiently responsive to medical management.

α-Adrenergic Agonists

Phenylpropanolamine (PPA; 1.0 to 1.5 mg/kg PO bid to tid) effectively controls incontinence in approximately 74% to 92% of dogs with USMI by stimulating α-adrenergic receptors in the urethra, increasing urethral tone. Many patients that are not completely continent following administration of PPA have improved continence.[1,2,11–13,a] In one study, more than half of the dogs that failed to respond when treated with the standard formulation of PPA became continent when treated with a sustained-release formulation (75-mg capsules; dose based on body weight).[a] The ability of PPA to control USMI decreases over time in some dogs.

Not all α-adrenergic agonists are as effective as PPA in controlling incontinence. A recent study showed PPA to be more effective than pseudoephedrine.[13] Minimal adverse effects (restlessness, mild behavioral changes) associated with PPA administration have been reported in some dogs. Dogs with systemic hypertension or clinically relevant cardiac or renal disease should not be treated with α-adrenergic agonists.[11–13,a]

Estrogens

Estrogens have also been shown to be effective in controlling USMI by increasing the number or sensitivity of α-adrenergic receptors in the urethra. Estrogens may have other, less well understood effects, including increased urethral tone arising from vascular changes and reduction in circulating concentrations of follicle-stimulating hormone (FSH) and luteinizing hormone (LH).[1–4,11,b] Estriol increases urethral resistance in sexually intact and spayed female dogs without urinary incontinence.

Estrogen therapy alone improves incontinence resulting from USMI in approximately 65% to 83% of treated dogs.[1,2,b] Diethylstilbestrol (DES; 0.5 to 1.0 mg/dog [0.02 mg/kg]), which is available from veterinary compounding pharmacies, is often effective in reducing incontinence attributed to USMI. A maximal induction dose of 1 mg/dog is given for 3 to 7 days; the dose is then decreased to every other day and then to the lowest dose that will maintain continence. Some dogs cannot tolerate DES at the doses required to maintain continence without manifesting clinical signs of estrus. Conjugated estrogens such as Premarin (Wyeth Pharmaceuticals, Philadelphia) are more readily available than DES and can be administered at 20 µg/kg every 4 days as an alternative therapy.

Bone marrow toxicity is a potential adverse effect of estrogen therapy, but treatment with low doses of DES or conjugated estrogens appears to be safe. Intermittent low-dose maintenance with DES or conjugated estrogen to control incontinence may be preferred by owners over multiple daily doses of PPA, despite the fact that PPA is often more effective. In some patients with refractory incontinence, DES can be administered simultaneously with PPA to achieve a synergistic response that may effectively control incontinence.

Other Therapies

Detrusor instability or hyperactive bladder may contribute to incontinence in some dogs with USMI. A therapeutic trial with anticholinergic agonists (e.g., oxybutynin, flavoxate) to relax spasms of the detrusor muscle may be warranted. Oxybutynin (0.2 mg/kg PO q8–12h) and flavoxate (100 to 200 mg PO q8h) have been effective in the treatment of potential detrusor instability in dogs.

BOX 1

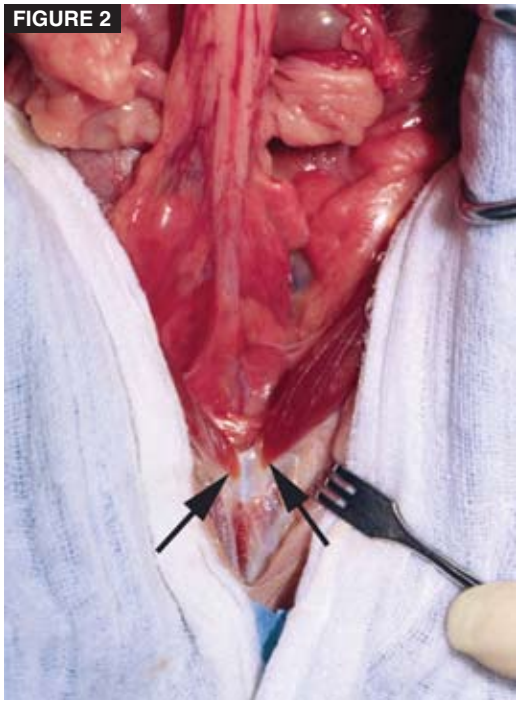
Treatment with gonadotropin-releasing hormone (GnRH) analogues was recently reported to result in complete continence in more than half of dogs with USMI in which traditional medical therapies failed.[c,d] An average of 253 days of continence was observed in seven dogs that became fully continent with a GnRH analogue as the sole treatment. An additional five dogs that had partial improvement with GnRH analogue treatment became fully continent when PPA was also administered. Treatment with GnRH analogues reduces the concentrations of FSH and LH that develop after OVH in dogs.[e] Increased concentrations of FSH and LH may play a role in development of USMI in susceptible dogs. However, MUCP does not appear to be directly related to circulating concentrations of FSH or LH.[e] Treatment with leuprolide, a GnRH analogue, did not increase MUCP in dogs with USMI that regained urinary continence.[c,d] Receptors for GnRH, FSH, and LH have been demonstrated in various regions and densities in the canine urethra and bladder. With a success rate of 71%, long-acting GnRH analogues are effective as a first-line treatment for USMI, but this rate is lower than that achieved with PPA.

[a]Bacon NJ, Oni O, White RAS. Treatment of urethral sphincter mechanism incompetence in 11 bitches with a sustained-release formulation of phenylpropanolamine hydrochloride. *Vet Rec* 2002;151(13):373-376.
[b]Angioletti A, DeFrancesco I, Vergottini M, Battocchio ML. Urinary incontinence after spaying in the bitch: incidence and oestrogen-therapy. *Vet Res Commun* 2004;28(Suppl 1):153-155.
[c]Reichler IM, Jöchle W, Piché CA, et al. Effect of long acting GnRH analog or placebo on plasma LH/FSH, urethral pressure profiles and clinical signs of urinary incontinence due to sphincter mechanism incompetence in bitches. *Theriogenology* 2006;66(5):1227-1236.
[d]Reichler IM, Barth A, Piché CA, et al. Urodynamic parameters and plasma LH/FSH in spayed beagle bitches before and 8 weeks after GnRH depot analogue treatment. *Theriogenology* 2006;66:2127-2136.
[e]Reichler IM, Pfeiffer E, Piché CA, et al. Changes in plasma gonadotropin concentration and urethral closure pressure in the bitch during the 12 months following ovariectomy. *Theriogenology* 2004;62(8):1391-1402.

QuickNotes

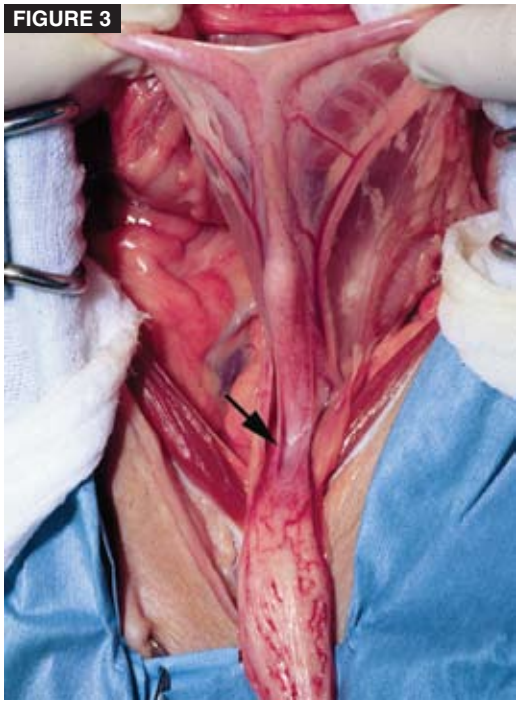
Colposuspension is the surgical procedure most commonly performed to treat spayed dogs with urethral sphincter mechanism incompetence.

FIGURE 2



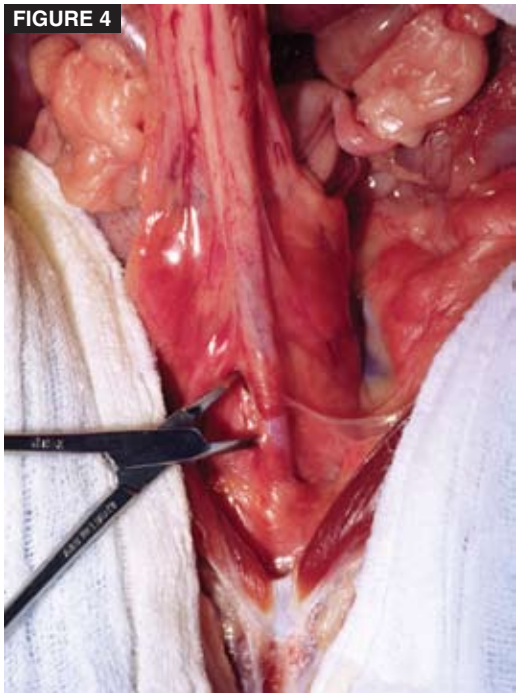
Surgical exposure of bladder and urethra for colposuspension. The abdominal incision extends over the pubis, exposing the insertion of the rectus abdominis muscle and prepubic tendon (*arrows*).

FIGURE 3



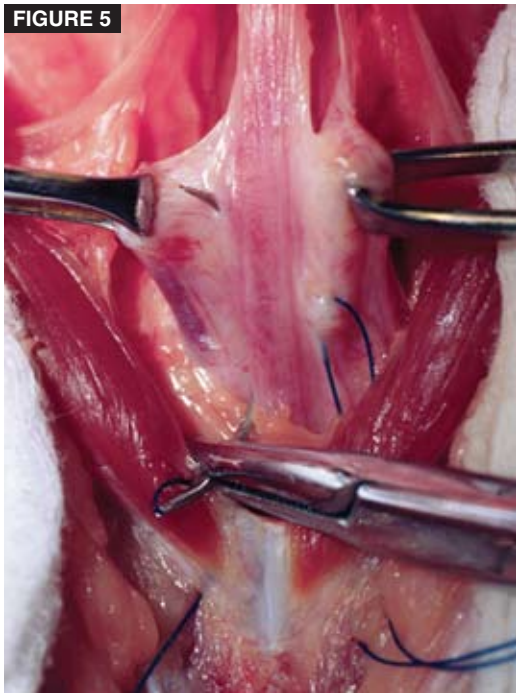
The bladder is reflected caudally, demonstrating the vesicovaginal fold (*arrow*) between the dorsal aspect of the urethra and the vagina. Cranial traction of the vagina facilitates repositioning of the bladder neck cranially into the abdomen.

FIGURE 4



Dissection of the periurethral fascia on either side of the urethra immediately cranial to the pubis exposes the dorsally positioned vagina.

FIGURE 5



Placement of colposuspension sutures. Nonabsorbable monofilament sutures are pre-placed between the prepubic tendon and the seromuscular layer of the vagina on either side of the urethra.

the bladder to void its contents may cause patient discomfort. Persistent complete urethral obstruction that does not respond to appropriate conservative treatment over a period of 3 to 5 days after surgery may require removal of the colposuspension sutures between the vaginal wall and prepubic tendon.

Urethropexy

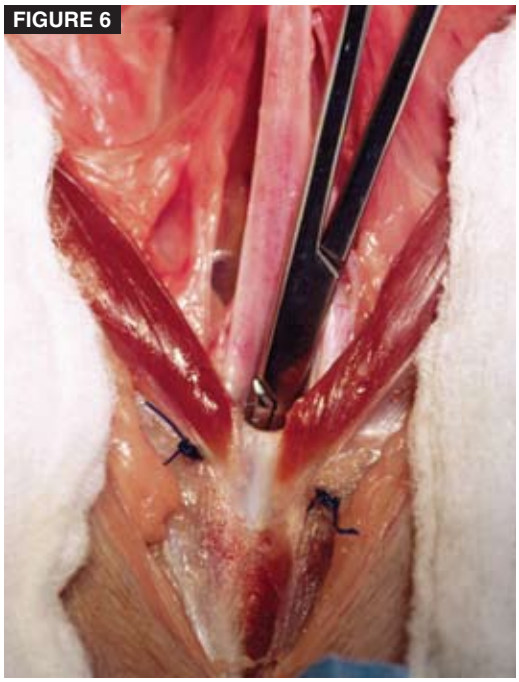
Description

Urethropexy is an alternative to colposuspension that is aimed at restoring the bladder neck and proximal urethra to an intraabdominal position while simultaneously increasing resistance to urine flow by reducing the diameter of the urethral lumen.[14,15] Cystourethropexy was initially reported in 10 female dogs diagnosed with USMI and pelvic bladder. The results of surgery alone were considered excellent in two dogs, and urethropexy combined with medical therapy (phenylpropanolamine [PPA]) resulted in marked improvement in an additional six dogs. One dog did not improve with surgery.[14] A later study reported the results of treatment of 100 female dogs with urethropexy for incontinence due to USMI.[15] Surgery alone led to complete control of incontinence in 56 dogs and improvement of continence in 27 dogs. Of the other 17 dogs, nine failed to respond and eight showed initial improvement but later relapsed. Nine of these 17 dogs underwent a second urethropexy procedure, resulting in complete continence in six dogs and improvement in three. Postoperative complications were observed in 21 dogs, including increased frequency of urination (14 dogs), dysuria (six), and anuria (three).[15] As with other procedures intended to increase tension within the urethral wall, transient or persistent dysuria as a result of partial urethral obstruction and failure to improve continence were the most common complications noted in both studies.[14,15]

Technique

Position the patient in dorsal recumbency and clip and aseptically prepare the ventral abdomen. Perform a caudal midline celiotomy from the umbilicus, extending over the cranial aspect of the pubis. Expose the bladder, urethra, and uterine body remnant and place a stay suture through the apex of the bladder for cranial traction. Using blunt dissection, clear the periurethral fat from the ventral aspect of the bladder neck and pelvic urethra. Pre-place six to 10 horizontal mattress sutures bilaterally using a 2-0 nonabsorbable monofilament suture material. The sutures should enter the abdominal cavity, passing full thickness through the ventral abdominal wall, including the rectus fascia. They should

FIGURE 6



Cranial traction is applied to the uterine body remnant while the pre-placed sutures are tied to complete the colposuspension. A mosquito hemostat is gently inserted between the pubis and the urethra to ensure that the urethra is not completely obstructed.

then pass through the seromuscular layer of the urethra in a horizontal mattress pattern at either the nine or three o'clock position in the transverse section without penetrating the urethral lumen. The sutures then exit from the abdominal cavity through the abdominal wall, including the rectus fascia, on the same side (**FIGURE 7**). The two most caudal sutures on either side of the urethra are engaged through the prepubic tendon as they enter and exit the abdomen. Tighten and tie the pre-placed sutures from caudal to cranial on each side of the urethra. Close the abdomen routinely.[14,15]

Postoperative Care

Some degree of stranguria and dysuria will occur after surgery due to the increased outflow resistance created within the urethral lumen. Stranguria may persist for several weeks after surgery. The patient's voiding patterns should be observed daily for the first few days after surgery to be sure a small stream of urine is passed with each voiding effort. Complete urethral obstruction is uncommon. Attempts to pass a urethral catheter after surgery may be difficult and traumatic to the surgical site within the urethra and should be avoided if at all possible. Administration of an NSAID for 7 to 10 days after surgery is indicated to reduce discomfort and soft tissue swelling.

Urethral Lengthening

Description

Urethral lengthening has been used to treat congenital USMI in cats and dogs with a notably shortened urethra resulting in pelvic displacement of the bladder neck. A significantly short urethra (urethral hypoplasia) prohibits cranial movement of the bladder neck into the abdominal cavity, eliminating the ability to use surgical procedures such as colposuspension, urethropexy, and urethral slings to treat USMI. Reconstruction of the bladder neck and the use of ventrally based bladder tube flaps have been reported to taper the bladder neck, thereby elongating the proximal urethra. Excellent or good results were reported in seven of eight cats treated with this technique, and a good outcome was described in one dog.[16,17] Urethral lengthening using bladder wall flaps has also been described for treatment of urinary incontinence in people. This technique may warrant further consideration with expanded clinical evaluation for the treatment of USMI in small animals with pelvic bladder.

Technique

Position the patient in dorsal recumbency and clip and aseptically prepare the ventral abdomen. Perform a caudal midline celiotomy from the umbilicus, extending over the cranial aspect of the pubis. Expose the bladder, urethra, and uterine body remnant. Make a ventral cystotomy incision, extending into the proximal urethra, and create two V-shaped flaps in the ventral aspect of the ventral bladder wall, using the caudal extent of the incision in the proximal urethra as the point of both V flaps (**FIGURE 8**). The widest portion of each V flap is located at the level of the ureteral orifices, at the tip of the trigone. Use 4-0 monofilament absorbable sutures in a continuous or interrupted pattern to primarily close the linear defect created in the ventral wall of the bladder neck and proximal urethra, thereby decreasing the diameter of

*Quick***Notes**

A significantly short urethra prohibits cranial movement of the bladder neck into the abdominal cavity, eliminating the ability to use some surgical procedures.

the bladder neck lumen and elongating the proximal urethra.

The initial descriptions of this procedure recommended suturing the bladder flaps to each other to prevent a loss in bladder capacity.[17] Alternatively, resection of the bladder flaps makes the surgical procedure and closure much simpler, and the resultant loss of bladder capacity is usually inconsequential. Due to the tremendous regenerative capacity of the bladder, presurgical vesicular capacity is restored within a few weeks to months after surgery.

Postoperative Care

Increased frequency of urination and stranguria are the most commonly anticipated adverse effects after reconstructive procedures to lengthen the urethra. Stranguria may be noted for several weeks. Avoid placement of a urethral catheter unless complete urethral obstruction occurs. Intermittent cystocentesis can be performed over a 24- to 36-hour period, and administration of an NSAID is indicated to reduce soft tissue inflammation of the lower urinary tract. Acepromazine administered at a low dose (0.01 to 0.025 mg/kg SC, IM, or IV q8h) may help relax the urethra, reducing stranguria and facilitating urine flow.

Urethral Slings

Description

Urethral sling procedures using seromuscular flaps created from the bladder wall or a synthetic material passed transpelvically through the obturator foramen have been combined with colposuspension to provide additional external compression of the pelvic urethra, increasing resistance to urine flow.[18,19] These procedures are technically more difficult to perform. The reported outcomes are similar to those of colposuspension alone. It remains unclear whether there is an advantage to the use of a combined procedure.[18] The modified sling urethroplasty procedure creates external compression at the vesicourethral junction by wrapping two seromuscular flaps created from the bladder neck region around the proximal urethra to increase resistance to urine flow.[19]

Technique

Perform a colposuspension as previously described. Following colposuspension, make a 2- to 2.5-cm ventral midline incision through the seromuscular layer of the bladder neck, extending to the junction of the proximal urethra. Raise two rectangular seromuscular pedicle flaps with a caudal base from the ventral surface of the bladder neck region (**FIGURE 9**). These flaps should be between 4 and 10 mm in width, depending on the size of the patient. Place a 4-0 absorbable monofilament stay suture through the free end of each flap. Pass the flaps around each side of the proximal urethra and secure them on the dorsal aspect to provide compression at the vesicourethral junction.[19] Primarily close the remaining seromuscular defect on the ventral bladder neck with a simple continuous or interrupted pattern using 4-0 absorbable monofilament sutures. Remove the urethral catheter to permit complete closure of this defect. If necessary, additional sutures can be placed dorsally in the sutured flaps to adjust the tension of the sling. Compression provided by the sling should be such that gentle digital pressure on the bladder is necessary to exceed the urethral pressure that permits urine flow.[19] Close the abdomen in a routine manner.

Minimally Invasive Urethral Bulking

Description

If the results of medical or surgical treatment of USMI are incomplete or unsatisfactory, endoscopic submucosal implantation of urethral bulking agents such as polytetrafluoroethylene (Teflon) or medical-grade collagen can be performed to create intraluminal resistance to urine outflow.[20–22] Successful urethral bulking with submucosal collagen has been reported in women and dogs.[21,22]

Collagen products are commonly used in people to correct defects of the skin and soft tissues. A specific collagen product for urologic use (Contingen, Bard Urological, Covington, GA) has been commercially developed and approved for use in humans. This product is composed of highly purified bovine dermal collagen that is cross-linked with glutaraldehyde and dispersed in phosphate-buffered saline. The collagen component is composed of approximately 95% type I collagen and 5% or less type III collagen. This product is packaged in a sterile 2.5-mL syringe for single use. Collagen has a higher degree of biocompatibility compared with other products previously reported for urethral bulking (e.g., polytetrafluoroethylene).

Initial reports showed a control rate (complete continence) of 53% for USMI treated with one or two series of submucosal injections of collagen. This rate improved to 75% when PPA was administered to dogs in which collagen injections provided inadequate urinary control.[21] More recently, a success rate of 68% was reported in 40 female dogs with USMI treated with submucosal collagen injections.[22] Some dogs may require a second series of collagen injections if incontinence is uncontrolled or relapses. Repeat injection procedures are usually easier to complete because the previous urethral bulking site is readily identified and augmented.

FIGURE 7

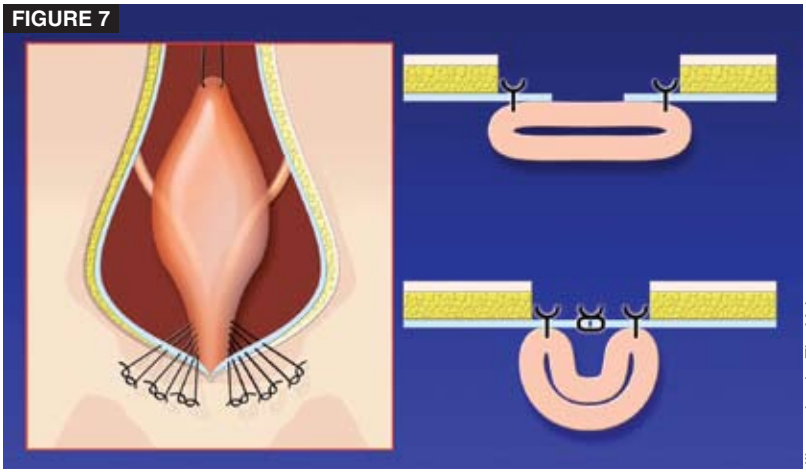


Illustration by Tim Voit

Illustration of urethropexy procedure. Six to 10 sutures are pre-placed bilaterally between the body wall incision and the seromuscular layer of the urethra in a horizontal mattress pattern at either the three or nine o'clock position when viewed transversely. The most caudal sutures on either side engage the prepubic tendon as they enter and exit the abdomen.

FIGURE 8

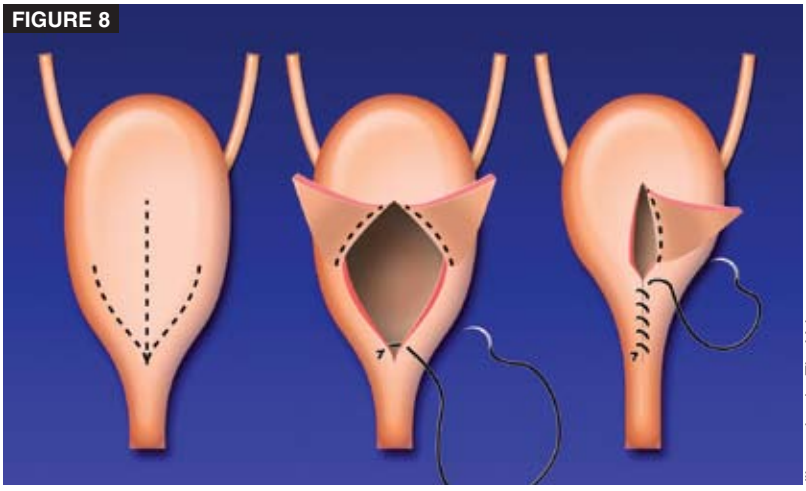


Illustration by Tim Voit

Illustration of urethral lengthening using the bladder-flap reconstruction technique. A midline cystotomy incision is made extending to the proximal urethra. Two V-shaped full-thickness flaps are created in the ventral bladder wall (*dashed lines*). The point of each V is the caudal extent of the incision in the proximal urethra. The widest portion is at the level of the ureteral orifices. The flaps can be excised with little consequence to bladder capacity. Primary closure of the linear incision in the ventral wall of the bladder neck and proximal urethra reduces the luminal diameter of the bladder neck, thereby elongating the proximal urethra.

Collagen Injection Technique

Position the patient in right lateral recumbency under general anesthesia. Clip and aseptically prepare the vulva and perivulvar region. A 19- or 14-French rigid cystoscope with a 30° angle is used for uroendoscopy and the injection procedure. Endoscopy is performed using a sterile fluid infusion to create a clear visual field. Mucosal hemorrhage can be controlled with the infusion of cold fluids. An assistant with sterile gloves should prepare the collagen and injection device.

Perform a complete evaluation of the lower urinary and reproductive structures to rule out anatomic causes of urinary incontinence before injecting the collagen. Position the tip

FIGURE 9

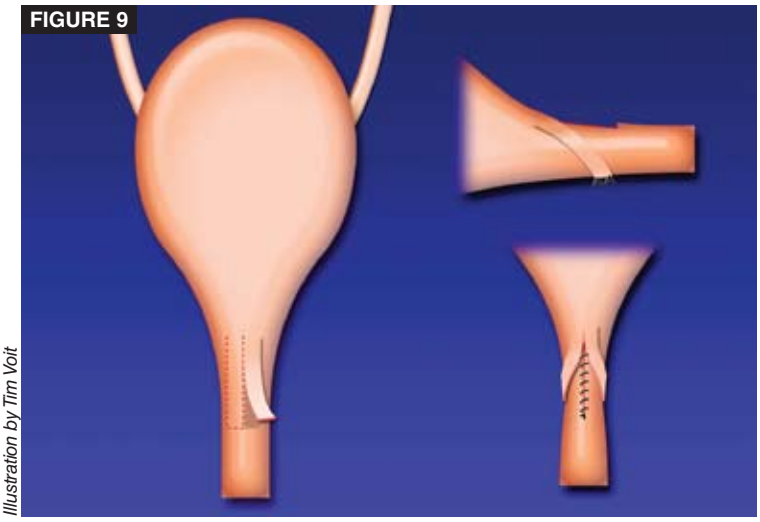


Illustration by Tim Voit

Illustration of the modified urethral sling procedure. A ventral midline incision is made through the seromuscular layer of the bladder neck and proximal urethra. Two rectangular seromuscular pedicle flaps are elevated from the ventral surface of the bladder neck region. The flaps are passed around each side of the vesicourethral junction and secured on the dorsal aspect, providing external compression of the bladder neck. Primary closure of the seromuscular defect on the ventral bladder neck tapers the bladder neck and elongates the proximal urethra.

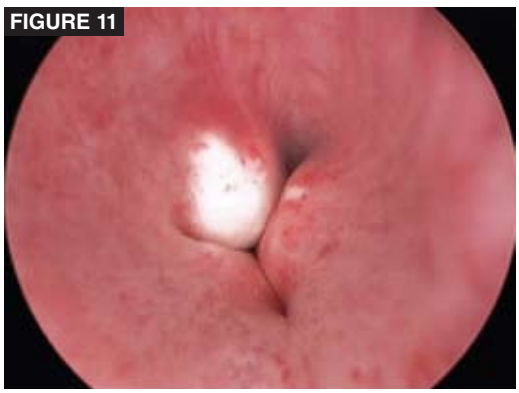
of the cystoscope within the proximal urethra to visualize the vesicourethral junction, and aseptically pass the injection device through the biopsy channel of the cystoscope until the beveled needle end is visible in the optical field. The recommended site for collagen injection is approximately 1.5 to 2 cm caudal to the vesicourethral junction. Position the cystoscope to facilitate insertion of the beveled tip of the injection device immediately below the urethral mucosa into the submucosal layer. Slowly inject the collagen, watching for immediate elevation of the urethral mucosa to create a mounding effect (**FIGURE 10**). If the needle is positioned too deep, there is minimal to no intraluminal deformation of the urethral mucosa. The collagen is commonly injected at three to four sites in a circle. The amount of collagen injected at each site is determined visually. Injection of excessive collagen at any given site can result in mucosal disruption and leakage of collagen from the site. The procedure is considered complete when the injection sites appose one another, achieving visual obstruction of the urethral lumen (**FIGURE 11**).

Patients should be continent immediately after this procedure. Dogs with moderate to severe inflammation or urinary tract infection may experience some minor incontinence until the infection/inflammation is resolved medically. If incontinence persists after the initial collagen injections, this procedure can be repeated, enhancing the previously injected sites. Administration of PPA has been shown to further enhance control of urinary continence after collagen injection. Complete urinary outflow obstruction has not been reported in dogs. Follow-up endoscopic examinations have uniformly demonstrated that the submucosal collagen deposits can remain visually unchanged for years. Relapse of incontinence after prolonged successful control with collagen injections may be related to absorption of the phosphate buffer component of the collagen preparation.

FIGURE 10

Endoscopic view of submucosal collagen injection. The injection needle is passed through the biopsy channel of the cystoscope and positioned immediately below the mucosal layer of the urethra distal to the vesicourethral junction.

FIGURE 11



Endoscopic view of completed submucosal collagen injections. Visual occlusion of the urethral lumen.

Future Directions in Treatment

Recognizing that no medical or surgical treatments of female dogs with USMI have been uniformly successful, current investigations are focusing on the practical use of gonadotropin-releasing hormone analogues as a single therapy or in combination with other medical or surgical treatments (**BOX 1**). In addition, work has begun to evaluate the efficacy of a percutaneously controlled static hydraulic urethral sphincter in dogs.[23] This system consists of a doughnut-shaped silicone vascular occluder attached to a subcutaneous fluid injection port. The luminal diameter of the occluder can be adjusted by the infusion of small volumes of saline through the injection port. The occluder is surgically placed around the bladder neck to provide external compression, preventing passive urine outflow, and the degree of occlusion is adjusted until optimal control (i.e., the patient can void urine without obstruction and retain urine without incontinence) is achieved.[23]

Conclusion

Surgical treatment of USMI is focused on dogs in which appropriate medical therapies have failed or medical conditions prevent the use of medical treatment. Surgery or minimally invasive procedures such as collagen implantation may provide further control of continence in some difficult cases. C

SURGICAL VIDEO

To see a video of collagen injection, visit **CompendiumVet.com**.

References

1. Gregory SP. Developments in the understanding of the pathophysiology of urethral sphincter mechanism incompetence in the bitch. *Br Vet J* 1994;150:135-150.

2. Holt PE. Importance of urethral length, bladder neck position and vestibulovaginal stenosis in sphincter mechanism incompetence in the incontinent bitch. *Res Vet Science* 1985;39:364-372.

3. McLoughlin MA. Management of urinary incontinence. *Proc BSAVA Symp* 2004.

4. Hoelzler MG, Lidbetter DA. Surgical management of urinary incontinence. *Vet Clin North Am Small Anim Pract* 2004 (34):1057-1073.

5. Stöcklin-Gautschi NM, Hässig M, Reichler IM, et al. The relationship of urinary incontinence to early spaying in bitches. *J Reprod Fertil Suppl* 2001:57:233-236.

6. Fowler JD, Rawlings CA, Mahaffey MB, et al. Immediate urodynamic and anatomic response to colposuspension in female beagles. *Am J Vet Res* 2000;61:1353-1357.

7. Rawlings CA, Barsanti JA, Mahaffey MB, Bement S. Evaluation of colposuspension for treatment of incontinence in spayed female dogs. *JAVMA* 2001;219(6):770-775.

8. Gregory SP, Holt PE. The immediate effect of colposuspension on resting and stressed urethral pressure profiles in anesthetized incontinent bitches. *Vet Surg* 1994;23:330-340.

9. Mahaffey MB, Barsanti JA, Barber DL, Crowell WA. Pelvic bladder in dogs without urinary incontinence. *JAVMA* 1984;184(12): 1477-1479.

10. Adams WM, DiBartola SP. Radiographic and clinical features of pelvic bladder in the dog. *JAVMA* 1983;182(11):1212-1217.

11. Rosen AE, Ross L. Diagnosis and pharmacological management of disorders of urinary incontinence in the dog. *Compend Cont Educ Pract Vet* 1981;3:601-610.

12. Richter KP, Ling GV. Clinical response and urethral pressure profile changes after phenylpropanolamine in dogs with primary sphincter mechanism incompetence. *JAVMA* 1985;187:605-611.

13. Byron JK, March PA, Chew DJ, DiBartola SP. Effect of phenylpropanolamine and pseudoephedrine on the urethral pressure profile and continence scores of incontinent female dogs. *J Vet Intern Med* 2007;21(1):47-53.

14. Massat BJ, Gregory CR, Ling GV, et al. Cystourethropexy to correct refractory urinary incontinence due to urethral sphincter mechanism incompetence preliminary results in ten bitches. *Vet Surg* 1993;22(4):260-268.

15. White RN. Urethropexy for the management of urethral sphincter mechanism incompetence in the bitch. *J Small Anim Pract* 2001;42:481-486.

16. Holt PE. Surgical management of congenital urethral sphincter mechanism incompetence in eight female cats and a bitch. *Vet Surg* 1993;22(2):98-104.

17. Fowler JD, Holmberg DL. Proximal urethral reconstruction using a distally based bladder tube flap an experimental study. *Vet Surg* 1987;16(2):139-145.

18. Muir P, Goldsmid SE, Bellenger CR. Management of urinary incontinence in five bitches with incompetence of the urethral sphincter mechanism by colposuspension and a modified sling urethroplasty. *Vet Rec* 1994;34:38-41.

19. Nickel RF, Wiegand U, Van Den Brom WE. Evaluation of a transpelvic sling procedure with and without colposuspension for treatment of female dogs with refractory urethral sphincter mechanism incompetence. *Vet Surg* 1998;27:94-104.

20. Arnold S, Jaeger P, DiBartola S, et al. Treatment of urinary incontinence in dogs by endoscopic injection of Teflon. *JAVMA* 1989;195:1369-1374.

21. Arnold S, Hubler M, Lott-Stolz G, Rusch P. Treatment of urinary incontinence in bitches by endoscopic injection of glutaraldehyde cross-linked collagen. *J Small Anim Pract* 1996;37:163-168.

22. Barth A, Reichler IM, Hubler M, et al. Evaluation of long-term effects of endoscopic injection of collagen into the urethral submucosa for treatment of urethral sphincter incompetence in female dogs: 40 cases (1993-2000). *JAVMA* 2005;226(1):73-76.

23. Adin CA, Farese JP, Cross AR, et al. Urodynamic effects of a percutaneously controlled static hydraulic urethral sphincter in canine cadavers. *Am J Vet Res* 2004;65(3):283-288.