Urethral incompetence is the most common reason for urinary incontinence in the dog. Management of these patients can start out as being relatively straightforward; however, many dogs need adjustments in their therapy as they age or develop additional health concerns. This article reviews the medical and surgical options available for treatment of urethral incompetence and provides guidelines to choosing the best one for each patient, as well as comments on prevention for potentially at-risk dogs.

**MEDICAL THERAPY**

Medical therapy is considered the first line of management in dogs with acquired urethral incompetence (UI). Often it is initiated on an empirical basis, with minimal pretreatment diagnostics other than a urinalysis and urine culture. In spayed female dogs, this is acceptable; however, in intact females and in males, further evaluation for other urinary tract disorders, particularly urethral functional obstruction and overflow incontinence, is warranted.

Medical therapy is most commonly aimed at increasing urethral tone by stimulating α-receptors in the smooth muscle of the urethra with α-agonists and/or increasing the number and sensitivity of those receptors with estrogen compounds. Estrogen also appears to have a trophic effect on the periurethral tissues and vasculature and thus may reduce incontinence through improved urethral support. In addition, there is ongoing investigation into other hormones in the pituitary-gonadal axis and their role in urethral incompetence.

**URETHRAL INCOMPETENCE** is most common in dogs who are spayed or neutered; however, the exact mechanism and relationship to estrogen and testosterone decline is unclear.
α-Agonist Therapy

α-Receptors, which are part of the sympathetic nervous system, are mediators of smooth muscle contraction and relaxation in a variety of tissues. Stimulation of α1A receptors in the smooth muscle of the urethra and bladder neck leads to increased urethral closure pressures and is an important part of resting urethral tone.

α1-Agonists are likely the most commonly used UI therapy in veterinary medicine. α-Agonists can be used in dogs and cats and in both sexes. The most serious potential adverse effect is hypertension, because of the lack of specificity of the agonists for the lower urinary tract and stimulation of vascular smooth muscle. Other adverse effects, such as behavioral changes and decreased appetite, are related to sympathetic stimulation.

Phenylpropanolamine (PPA) (Proin, prnpharmacal.com) is the most widely used α-agonist for the treatment of UI. This FDA-approved drug is commercially available in doses designed for use in dogs. The dose and frequency needed for each animal tend to vary widely and may need to be increased over time to maintain continence (Table 1).

Clinical response to PPA administration ranges from 75% to 90%.1,2 Male dogs with UI can be treated with PPA; however, the response (<50%) is poorer than in female dogs. This is possibly caused by misdiagnosis of dogs with functional urethral obstruction and overflow incontinence. PPA has also been used safely in cats with UI, although there are little data available regarding its efficacy.

Hypertension, or a predisposition to hypertension caused by concurrent disease, is a major contraindication to using PPA. In otherwise healthy dogs with normal blood pressure, PPA rarely induced hypertension at recommended doses.3,4 However, in patients with conditions such as chronic kidney disease, hyperadrenocorticism, and protein-losing nephropathy, it should be used with extreme caution and blood pressure should be regularly monitored.

A good general guideline is to perform an indirect systolic blood pressure on any patient before treatment with PPA and repeat the evaluation after 1 to 2 weeks of therapy. Milder adverse effects associated with PPA include restlessness, aggression, changes in sleeping patterns, and gastrointestinal signs. These are also usually alleviated by a reduction in dose or frequency.1,5

Estrogen Therapy

Estrogen therapy has been used to treat incontinence for decades. Estrogen plays an important role in the strength and robustness

### TABLE 1 Dosages of Drugs for Management of Urethral Incompetence

<table>
<thead>
<tr>
<th>DRUG CLASSIFICATION</th>
<th>DRUG</th>
<th>DOSAGE</th>
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<tbody>
<tr>
<td>α-Agonist</td>
<td>Phenylpropanolamine</td>
<td>0.5–1.5 mg/kg PO q8–12h</td>
</tr>
<tr>
<td></td>
<td>Estriol</td>
<td>2 mg/dog PO q24h for 14 days, then 1 mg/dog PO q24h for 14 days, then 0.5 mg/dog PO q24h, then maintenance at the lowest effective dose</td>
</tr>
<tr>
<td>Estrogen compound</td>
<td>Diethylstilbestrol</td>
<td>1 mg/dog PO q24h for 7 days, then q 5–7 days, then adjusted for efficacy</td>
</tr>
<tr>
<td></td>
<td>Conjugated estrogen</td>
<td>0.02 mg/kg PO q24h for 5–7 days, then q 2–4 days, adjusting as needed</td>
</tr>
<tr>
<td>GnRH analog</td>
<td>Depot deslorelin acetate</td>
<td>5–10 mg/dog SC q 6 months*</td>
</tr>
<tr>
<td>Testosterone</td>
<td>Testosterone cypionate</td>
<td>2.2 mg/kg IM monthly</td>
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</tbody>
</table>

*The dose listed is extrapolated from human doses; the dosing interval varies widely, with the average based on limited studies. The author recommends that the dosing interval be based on recurrence of clinical signs in the individual dog.
of pelvic and periurethral tissues. It enhances glandular function, impacts collagen strength, and increases the number and sensitivity of α-receptors in the smooth muscle of the urethra. There is strong evidence that estrogen increases the baseline resting urethral pressure in animal models of incontinence.6 These compounds are usually well tolerated and are a good choice for female dogs with concurrent diseases that predispose them to hypertension or that are intolerant of α-agonist treatment.

Estrogens should not be used in male dogs because of the potential for prostatic squamous metaplasia.7 The use of estrogens in cats with UI has not been reported and is controversial. Although there has been speculation on the role of estrogens in the development of feline mammary neoplasia, a direct link has yet to be proven.

Some practitioners avoid the use of estrogen compounds because of the potential for irreversible myelosuppression seen in dogs treated with estrogen compounds for mismating or to induce estrus.8,9 While this is a potential toxicosis, the doses associated with bone marrow suppression are generally at least 10 times higher than those recommended for management of UI. The need for monitoring for signs of bone marrow suppression with a complete blood count is controversial, and agreed-upon standard of care recommendations cannot be given. However, caution should be taken when using these compounds in patients with underlying myelosuppressive disease or at high doses.

**Estriol** (Incurin, merck-animal-health-usa.com) is the only commercially available FDA-approved estrogen for the treatment of UI in the United States (Table 1). Female dogs appear to have similar response rates to estriol and DES (89% and 87%, respectively).9,10 Adverse effects with its use include mammary and vulvar swelling and attractiveness to male dogs. These side effects are generally mild and resolve with appropriate dose reduction.

**Diethylstilbestrol (DES)** is a synthetic, nonsteroidal estrogen first synthesized in 1938. It was widely used in the United States and worldwide to reduce pregnancy complications and treat a variety of conditions in women until 1971; it was found to contribute to an increased risk of neoplasia and birth defects in the children of expectant mothers who took the drug. Since that time, DES has not been available commercially and is only available to the veterinary community through compounding pharmacies.

DES has been used to treat UI in dogs for more than 40 years, although there are few studies evaluating its efficacy.9 Adverse effects are similar to those seen with other estrogens, such as mammary and vulvar swelling and attractiveness to males. As with estriol, these are usually dose-related and subside with dose reduction.

One advantage of using DES to treat UI in dogs is the convenience of treating a patient on a weekly basis rather than daily (Table 1). In addition, treatment frequency can be adjusted (eg, every 5 days rather than every 7) to accommodate the declining response to treatment in some patients without having to increase the capsule size or medicate multiple times a day.

**Conjugated estrogens** (Premarin, pfizer.com) naturally derived from the urine of pregnant mares have been used to treat a variety of postmenopausal symptoms in women. There are anecdotal reports of the successful use of conjugated estrogens in spayed female dogs with UI (Table 1); however, no studies have been published. It is likely that the efficacy and adverse effect profile are similar to those of DES.

**Gonadotropin-Releasing Hormone (GnRH) Analogs**

In the spayed female dog, the removal of the negative feedback effect of estrogen leads to increases in follicle stimulating hormone (FSH) and luteinizing hormone (LH). It has been hypothesized that the increase in these gonadotropins has either a direct negative impact on the urethral closure pressure or results in decreased bladder function.11,12

The use of depot GnRH analogs, such as depot deslorelin acetate (Table 1), which ultimately
decrease LH and FSH, has been investigated in incontinent spayed females and was found to be 54% effective when used alone and 92% effective when combined with PPA. Ongoing investigation into the use of gonadotropin immunization and other related therapies is promising, although FSH and LH suppression has yet to become a widespread treatment for UI. In addition, some preparations are very costly and others are not available in North America.

**Testosterone Cypionate**

Testosterone cypionate has had some anecdotal use in males with UI and may provide some improvement (Table 1). It is unclear whether this is a direct effect on the urethral musculature, its support structures, or increased prostatic urethral resistance. No studies have been performed to assess its efficacy in male dogs with UI. Adverse effects associated with testosterone supplementation include behavior changes and prostatic hyperplasia.

**FAILURE OF MEDICAL THERAPY**

Frequently both an estrogen and PPA are used in the same patient for severe or refractory incontinence. Evidence supporting a synergistic increase in efficacy is controversial; however, anecdotal reports of greater improvement than on a single medication regimen exist.

Dogs that do not respond to appropriate medical therapy should be evaluated for other lower urinary tract disease via imaging, including abdominal ultrasonography and/or contrast radiography. Cystoscopy is routinely performed in patients with urinary incontinence to rule out anatomic abnormalities that may be contributing to clinical signs. Urodynamic evaluation can be performed to rule out overactive bladder and confirm the diagnosis of UI. Male dogs should be evaluated for urine retention and functional urethral obstruction.

For patients with UI that fail medical therapy, or for which medical therapy is not an option, several interventional and surgical options exist. When evaluating the published success of these procedures, it is important to note that they have primarily been evaluated in patients that are not responding to medical therapy and thus may have a more severe form of urethral sphincter mechanism incompetence (USMI). No studies have evaluated them as first-line treatment options.

**INTERVENTIONAL PROCEDURES**

**Urethral Bulking**

Injectable urethral bulking agents, particularly bovine crosslinked collagen, have been used to increase resting urethral pressure in dogs.
with UI. Although many materials have been investigated, the theory behind all injectable bulking agents is to increase the stretch in the sphincter muscle fibers, leading to an increased resting closure pressure in the urethra. In addition, the implant may narrow the diameter of the urethral lumen, allowing the urethral sphincter to close more effectively. The material is injected submucosally into the proximal urethra via cystoscopy (Figure 1).

Based on two long-term reviews, postprocedure continence in female dogs with UI was 66% to 68%; of those who are not continent, 46% to 60% achieved continence with the addition of medical therapy.16,17 The largest drawback of this procedure is the variability in duration of effect. Median duration of continence without additional medical therapy ranged from 8 months to 2 years.

SURGICAL THERAPY

Surgical management of UI is chosen for dogs intolerant of medical treatment or, most often, with progressive and refractory incontinence. Surgical therapy of urinary incontinence has traditionally focused on increasing the transmission of intra-abdominal pressure to the proximal urethra or improving the stability and pressure within the urethra.

Artificial Urethral Sphincter Placement

A newer procedure for canine urinary incontinence is gaining in popularity and availability. The surgical placement of an artificial adjustable hydraulic urethral sphincter (Figure 2) around the urethra has been studied in female dogs and anecdotally used in males. The device allows the dog to urinate normally while maintaining continence. A small port is connected subcutaneously to the sphincter cuff and may be adjusted by injection of saline to tighten the sphincter. Anecdotally, some dogs have not needed addition of saline to the port postoperatively, since the placement of the sphincter itself appears to provide enough support and occlusion of the urethra to allow continence to be maintained. Continence was maintained for up to 2 years in 4 of 4 dogs.18 In a recent review, 27 of 27 dogs had significantly improved continence scores after placement of the sphincter, with only 2 dogs having complications involving partial urethral obstruction.19 Surgical placement of an artificial urethral sphincter appears to have good success in male dogs that fail medical therapy.
Colposuspension

In animals with a normally positioned bladder, rises in intra-abdominal pressure transmit to the proximal urethra as well as the bladder, preventing urine leakage. In animals with a caudally positioned or “pelvic” bladder, the proximal urethra is not within the abdominal cavity, and this pressure is not exerted on the urethra. This creates a pressure gradient from bladder to urethra and leads to urine leakage.

Colposuspension is a procedure in which the lateral vaginal walls are attached to the prepubic tendon, thus drawing the bladder neck and proximal urethra further into the abdomen. This has been found to have variable success (53%) but has a high failure rate because of breakdown of the attachment to the pelvic ligament. An 11.3% complication rate has been reported related to urine retention and dysuria.

Urethropexy

Urethropexy repositions the bladder cranially by anchoring the proximal urethra to the prepubic tendon. Similar to colposuspension, this increases transmission of intra-abdominal pressure increases to the urethra as well as the bladder and bladder neck, preventing a negative pressure gradient into the outflow tract.

Success has been reported to be similar to colposuspension, but with shorter efficacy, likely because of avulsion of the urethropexy from the prepubic tendon. Urethropexy may have an increased complication rate (21%) compared with colposuspension, with surgical revision being required in animals with urethral obstruction.

Combined Urethropexy-Colposuspension

A recent report of a combined technique of urethropexy and colposuspension revealed an improved success rate (70%) and durability compared with either procedure alone, as well as fewer complications (10%).

Transobturator Vaginal Tape

The Hammock theory describes stress urinary incontinence in women as related to weakening of the structures supporting the bladder and urethra where they are both subject to intra-abdominal pressures. In humans, this is often managed with procedures that stabilize the mid-urethra during increases in abdominal pressure, using a surgically placed tape to pull the vagina and urethra against the pubis.

In women, there have been significant complication rates with these procedures, frequently requiring removal of the tape. This procedure has been adapted for use in dogs with some success; however, its use is not widespread. Concerns about similar complications to those seen in women may be partially responsible. Additional studies evaluating larger numbers of dogs and long-term followup are needed.

PREVENTION

Of course, the best management for UI would involve efforts to prevent it. It is well known that UI is most common in dogs that are spayed or neutered; however, the exact mechanism and relationship to estrogen and testosterone decline is unclear. A number of studies have evaluated the relationship of UI and age at spay or neuter. The results have been somewhat disparate, but there is general agreement that the risk of UI increases if a female dog is spayed before 3 months of age.

In a recent study, I found that the age of ovariohysterectomy (OVH) did not appear to affect risk of development of UI in dogs with an expected adult weight of <15 kg. Smaller breeds are known to be at lower risk of urinary incontinence, and it appears that risk is not affected by age of spay. In larger breeds—dogs with an expected adult weight >15 kg—there is a decreased risk of UI with every month delay in OVH. The larger the dog, the more pronounced this alteration in risk becomes.

The decision of when to spay a dog can be challenging. The risks of delaying spay
surgery, such as increased chance of mammary carcinoma, and benefits, like a lower risk of UI, should be openly discussed with the owner and tailored to the individual.

Some evidence suggests that obesity may increase the risk of incontinence in spayed female dogs; however, appropriate investigation into the contribution of body condition score is lacking. At this time, the contribution of obesity to the development of incontinence is unknown.

REFERENCES


Glossary

**DES** diethylstilbestrol

**FSH** follicle stimulating hormone

**GnRH** gonadotropin-releasing hormone

**LH** luteinizing hormone

**OVH** ovariohysterectomy

**PPA** phenylpropanolamine

**UI** urethral incompetence

**USMI** urethral sphincter mechanism incompetence
1. Which of the following medical therapies for UI would be the best first choice in a 10-year-old, female spayed, mixed-breed dog with coexisting chronic kidney disease?
   a. Estrogens
   b. Phenylpropanolamine
   c. Pseudoephedrine
   d. GnRH analogs

2. Which surgical therapy for UI is best suited for male dogs?
   a. Colposuspension
   b. Urethral collagen injection
   c. Artificial urethral sphincter
   d. Urethropexy

3. Which of the following is the best course of action when a spayed female dog develops vulvar swelling while taking estriol?
   a. Discontinue the medication and consider surgical options
   b. Discontinue estriol and start DES
   c. Reduce the dose of estriol and monitor for maintenance of continence
   d. Add phenylpropanolamine to the estriol

4. A client brings their female spayed dog in for a belated recheck 3 months after starting DES. You discover the owner has not decreased the dose from the induction level of 1 mg/day. In fact, the dog did not gain complete continence and the owner has increased the dose to 3 mg/day for the last month. The dog is lethargic and has a decreased appetite. What is the most important diagnostic test to perform when looking for estrogen toxicity in this dog?
   a. Serum chemistry
   b. Abdominal ultrasound
   c. Systolic blood pressure
   d. Complete blood count

5. Which of the following surgical procedures appears to be the most durable?
   a. Colposuspension
   b. Artificial urethral sphincter placement
   c. Urethropexy
   d. Bulking therapy with bovine crosslinked collagen

6. Which of the following factors appears to carry the most risk for development of UI?
   a. Obesity
   b. Ovariohysterectomy after first estrus
   c. Ovariohysterectomy before 3 months of age
   d. Ovariohysterectomy after 1 litter

7. Which of the following procedures is based on the principle of increasing the stretch in the urethral sphincter muscles and increasing resting closure pressure?
   a. Artificial urethral sphincter placement
   b. Colposuspension
   c. Urethropexy
   d. Bulking therapy with injectable agents

8. A 9-year-old spayed female collie has been treated for UI with phenylpropanolamine (PPA) for 5 years. She has been having an increase in leakage events in the last 6 months and has only partially improved with dose escalation. You are concerned about further increasing the dose of PPA. Which of the following is the best next option?
   a. Add an estrogen to the PPA regimen
   b. Bulking therapy
   c. Colposuspension
   d. Artificial urethral sphincter placement
9. Which of the following is the best medical therapy for male dogs with UI?
   a. Deslorelin acetate
   b. Testosterone cypionate
   c. Diethylstilbestrol (DES)
   d. Phenylpropanolamine (PPA)

10. Which two surgical procedures appear to have good success when combined in a patient with UI?
   a. Artificial urethral sphincter placement and bulking therapy
   b. Colposuspension and bulking therapy
   c. Colposuspension and urethropexy
   d. Urethropexy and bulking therapy

**NOTE** Questions online may differ from those here; answers are available once CE test is taken at vetmedteam.com/tvp.aspx. Tests are valid for 2 years from date of approval.