Canine Incontinence

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ABSTRACT: At one time, dogs primarily lived outdoors, and the ability to consciously control urination was not considered an essential attribute in a canine companion. With dogs increasingly sharing living space with their owners, urinary continence has become critical. Fortunately, most causes of canine incontinence are easily recognized and most dogs respond to appropriate treatment. This article reviews normal urine storage and voiding, causes of incontinence, the typical clinical presentation, diagnostics, and treatment.

Perhaps the most celebrated event in any puppy's life is when the owners declare that their pet is housebroken. Forty years ago, dogs primarily inhabited the yard, and abnormalities of the urinary tract leading to incontinence were thought to be rare. Since then, dogs have moved out of the yard and relocated to the living room, bedroom, and even their owner's bed. This sharing of living space has made the ability to appropriately eliminate urine an essential quality in a canine companion.

Incontinence is defined as an involuntary escape of urine during the storage phase of the urinary cycle. This can appear clinically in many ways; however, the most common presentation is intermittent or continuous dribbling of urine combined with episodes of normal voiding. Causes of incontinence include urethral sphincter incompetence, an anatomic abnormality in the termination of the ureters, inability of the bladder to dilate, spasms of the bladder, or damage to the nerves controlling micturition. However, in one study of 563 dogs presenting with signs consistent with urinary incontinence, 85% were diagnosed with either urethral sphincter incompetence or ectopic ureters.

PHYSIOLOGY

The urinary tract consists of four functional anatomic parts (Figure 1):

- The kidneys produce urine.
- The ureters direct urine from the kidneys to the bladder.
- The bladder acts both as a low-pressure storage vessel and a high-pressure pump.
- The urethra acts as a valve and directs urine out of the body.

The kidneys and the ureters are often called the upper urinary tract, whereas the bladder and urethra are called the lower urinary tract.

Functionally, the urinary cycle is divided into two phases: the filling phase and the emptying phase. During the normal filling cycle, the body of the bladder acts as a flaccid reservoir, accepting fluid from the ureters while the bladder trigone and the urethra act as a closed valve. The hypogastric nerve, which originates from the L1 to L4 spinal segments, provides sympathetic stimulation of b-receptors in the body of the bladder, resulting in relaxation and stretching, while stimulation of a-receptors in the trigone region and proximal urethra causes constriction (Figure 2). Thus the sympathetic nervous system dominates the filling phase of normal micturition by constricting the outflow of the bladder while allowing the body to distend. In addition, the sympathetic stimulation inhibits urination by blocking parasympathetic transmission.

As the bladder fills, sensory receptors embedded in the bladder wall become activated. Information from these
receptors travels via the pelvic nerve to the spinal cord, where the information is relayed to the brainstem\(^5\) (Figure 2). In the brainstem, afferent impulses are integrated with information from the forebrain.\(^7\) If it is an appropriate time to void, the impulse to empty the bladder is carried down the spinal cord. Parasympathetic neurons, which travel in the pelvic nerve, transmit impulses to the parasympathetic ganglia in the bladder wall.\(^6,7\) Nerve fibers leave this nucleus and innervate detrusor muscle fibers, thereby contracting the bladder body and opening the bladder neck.\(^6,7\) Areas of fusion between adjacent muscle fiber membranes called tight junctions allow the contraction to spread quickly and evenly throughout the bladder.\(^5,6\) The pudendal nerve is simultaneously inhibited, allowing relaxation of the external urethral sphincter.\(^5-7\) The parasympathetic arm of the autonomic nervous system dominates the emptying phase of the urinary cycle by coordinating contraction of the bladder and relaxation of the bladder neck, proximal urethra, and external sphincter.

### HISTORY AND EXAMINATION

A detailed history is an important first step and allows the clinician to determine whether a patient is actually incontinent. Nocturia, pollakiuria, and urgency can be confused with incontinence. Questions should focus on the timing, volume, and events surrounding the urine leakage (e.g., excitement) as well as the quality and quantity of the purposeful urinations. Once incontinence is confirmed, the history alone may help direct the course of diagnostics (e.g., a young female dog with a history of dribbling urine since birth is likely to have a significantly different problem than an older spayed dog that is dribbling urine while sleeping; Table 1).

Along with the general physical examination, a detailed inspection of the genitals should be completed. The area around the penis or vulva should be checked for wetness, urine staining of fur, or scalding of skin. The external genitalia should be examined to ensure anatomic correctness. Observing the animal urinate can be helpful in confirming normal voiding. Minimal laboratory data should include a complete blood count, serum chemistry profile, and urinalysis with culture. A complete blood count and serum chemistry profile can help rule out systemic disease, whereas a urinalysis may indicate cystitis. Results of the urine culture can be confusing. Although urinary tract infections (UTIs) can lead to urge incontinence, infection can also result from a number of anatomic abnormalities. Therefore, further diagnostics are indicated when incontinence or infection does not resolve with appropriate antibiotic therapy.

The neurologic examination is a critical and sometimes overlooked aspect of the incontinence workup. Disorders affecting the spinal cord above L5 (upper motor neuron lesions) result in clinical signs different from disorders affecting the sacral spinal cord (spinal segments S1 through S3).\(^5\) Upper motor neuron lesions classically produce involuntary, erratic, reflexive emptying of the bladder with increased resistance of the external sphincter.\(^5,6\) The result is an impaired stream of urine, increased residual volume, decreased storage volume, and, in many cases, loss of bladder sensation.\(^5,6\) Non-urinary tract signs (i.e., paresis or paralysis, hyperreflexia, decreased proprioception, decreased pain perception) of upper motor neuron disease tend to be easy to detect.\(^8\) Lesions of the sacral spinal cord prevent bladder sensation from traversing along the pelvic nerve and up the spinal column.\(^6\) As a result, no conscious or reflexive attempts to urinate are made, and the bladder becomes overdistended (i.e., lower motor neuron bladder).\(^6\) Sacral lesions also result in pudendal nerve dysfunction and loss of external sphincter resistance.\(^5,8\) Sacral lesions result in an easily expressed, overdistended bladder with urine dribbling from overflow.\(^5,6\) Lesions of the sacral spinal cord can be subtle and require careful evaluation. An easily expressed large bladder in a dog with no obvious neurologic deficits should raise suspicion that a sacral lesion is involved. Squeezing the distal portion of the penis or edge of the vulva and observing the anus for a reflexive contraction can help evaluate afferent and efferent pudendal nerve function.\(^5\)

### CONDITIONS CAUSING INCONTINENCE

**Urethral Sphincter Incompetence**

Urethral sphincter incompetence is the most common form of canine urinary incontinence.\(^4\) Although it has been reported in males, it is much more common in females, affecting 5.1% to 9.7% of spayed dogs.\(^9,10\) If only large-breed dogs are considered, the incidence approaches 12.5% of spayed females.\(^10\) The onset of incontinence usually starts 2 to 3 years after an uneventful spay but can occur weeks to years after an ovariohysterectomy.\(^9\) Owners typically describe urine dribbling that is most noticeable when the animal is sleeping.\(^11\) The exact mechanism by which removal of the ovaries leads to incontinence is unknown. It has been theorized that because
estrogen exerts a permissive effect on the a-receptors of the internal urethral sphincter, removal of estrogen results in decreased responsiveness of the muscle to sympathetic stimulation and decreased internal sphincter tone.\(^\text{12}\) Interestingly, 35% of dogs with spay-related urinary incontinence do not respond to estrogen supplementation.\(^\text{13,14}\) In addition, dogs in which estrogen secretion has been suppressed with progesterone have not been reported to develop urethral incompetence.\(^\text{14}\) These factors suggest that estrogen may play only one part in a more complex syndrome. Although urethral incompetence occasionally occurs in male dogs, it has not been definitively associated with castration.\(^\text{15}\)

Because of the prevalence of urethral incompetence in middle-aged spayed dogs, the typical clinical presentation, and the relative safety of the drugs used to treat this condition, some clinicians advocate diagnosing this condition by empirically treating suspected cases.\(^\text{11-16}\) However, a definitive diagnosis can be obtained only by a urethral pressure profile (UPP) using specialized equipment.\(^\text{17}\) The UPP can be especially helpful in the diagnosis of urethral incompetence in patients presenting with an atypical signalment or in cases that are refractory to treatment. To perform a UPP, a specialized catheter with multiple lumens is inserted through the urethra and into the bladder of a sedated dog. The catheter is positioned so that the opening of one lumen is in the bladder while the opening of another is in the urethra. Then, while a computer-controlled motor slowly pulls the catheter out (at 1 mm/sec), pressure is monitored in the bladder and along the length of the bladder neck and proximal urethra. When finished, the computer generates three pressure curves. The first tracing represents the pressure along the bladder neck and urethra, whereas the second represents pressure in the bladder body. The difference between these two, represented by a third waveform, is the urethral pressure that is in excess of the pressure in the bladder. This is known as the urethral closure pressure. The two most important pieces of information provided by the system are the maximal urethral closure pressure and the functional urethral length.\(^\text{18}\) These allow the clinician to determine not only whether the pressure exerted by the urethral sphincter is adequate but also whether the length is normal.\(^\text{18}\) Because of the specialized equipment needed, these tests are usually conducted at referral hospitals and academic institutions.

\(a\)-Adrenergic agonists are the preferred treatment for spay-related urethral incompetence (Table 2). Phenylpropanolamine, a nonselective adrenergic agonist commonly used to treat this condition, significantly increases urethral function in otherwise incontinent dogs.\(^\text{12,19}\) Total resolution of incontinence can be expected in more than 85% of cases, whereas a significant decrease in urine dribbling is reported in almost all dogs.\(^\text{19,20}\) The side effects of phenylpropanolamine include hypertension, restlessness, irritability, tachycardia, increased intraocular pressure, and hepatic glycogenolysis.\(^\text{12}\) Therefore, the use of this drug should be avoided in patients with hypertension, diabetes mellitus, or glaucoma.\(^\text{12}\) In cases that do not respond adequately to \(a\)-adrenergic agonists, combination therapy with estrogen supplementation can be attempted.\(^\text{21}\) Both drugs should initially be given at the recommended dose; if the drugs are effective, the \(a\)-agonist should be reduced to the lowest effective dose.\(^\text{21}\) Diethylstilbestrol is a synthetic estrogen that has been successfully used to treat spay-related incompetence.\(^\text{12,21}\) Side effects are rare but include bone marrow suppression, alopecia, behavior change, and signs consistent with estrus.\(^\text{12,21}\) Diethylstilbestrol is not commercially available but can be obtained from compounding pharmacies.\(^\text{12}\) Imipramine, a tricyclic antidepressant, inhibits norepinephrine reuptake at the neuronal synapse, thereby increasing sympathetic tone.\(^\text{12}\) Although this drug may be useful in treating refractory cases of sphincter incompetence, there has been little research to document its effectiveness. Potential side effects, including sedation, aggression, constipation, hypotension, and tachycardia, may limit its use.\(^\text{12}\)

In some patients, incontinence may not be adequately controlled with medical management. In addition, some dogs in which continence is initially achieved experience recrudescence over time. Fortunately, several alternative therapies exist. Colposuspension is a procedure in which the urethra and vagina are surgically moved cranially so that the bladder neck is relocated to an intraabdominal position. Reported long-term continence rates for this surgery range from 13% to 53%, although a significantly larger percentage of owners reported partial relief from urine dribbling.\(^\text{22-24}\) Another promising procedure involves endoscopic injection of collagen or extracellular matrix into the urethral submucosa.\(^\text{25-27}\) In this procedure, submucosal injections result in urethral bulging into the lumen, resulting in improved urethral closure pressure.\(^\text{26}\) Sixty-eight percent of dogs treated with this method attained full urinary continence after the procedure, and an additional 25% of owners reported a significant improvement.\(^\text{25,26}\)
The primary limitation of this procedure seems to be its temporary nature (i.e., many dogs return to incontinence over time).\textsuperscript{26,27}

Medical treatment of urethral sphincter incompetence in male dogs is similar but significantly less rewarding than treatment of their female counterparts. Only 44\% of male dogs with sphincter incompetence improve with administration of phenylpropanolamine.\textsuperscript{28} Testosterone alone or in combination with α-agonists may improve continence; however, the hormone must be administered by injection to be effective and is associated with serious side effects, including aggression and prostatomegaly.\textsuperscript{28} Estrogen may enhance the effects of phenylpropanolamine but is also associated with significant side effects.\textsuperscript{21} Vasopexy has been suggested as a possible treatment for male dogs in which urethral sphincter incompetence is not responsive to medical management.

**Ureteral Ectopia**

Ureteral ectopia is a congenital abnormality characterized by termination of one or both ureters at a point distal to the bladder neck (Figure 3). Ectopic ureters are divided into extramural and intramural based on their point of attachment and behavior.\textsuperscript{1,29} An extramural ectopic ureter attaches and empties directly into the urethra or sometimes the vagina or uterus\textsuperscript{1} (Figure 4). Intramural ectopic ureters attach to the bladder but fail to open into the lumen. Rather, the ureter tunnels below the submucosa and into the urethra or vagina.\textsuperscript{29} In either case, the flow of urine bypasses the bladder neck, and affected animals typically leak urine from birth. In cases of unilateral ectopic ureter, normal urinary voiding is reported because one ureter is properly emptying into the bladder. In bilateral cases, normal urination may not occur.\textsuperscript{30} Eighty percent to 89\% of canine ectopic ureters occur in females, and at least one-quarter of these cases are bilateral.\textsuperscript{2,31,32} Although ectopic ureters have been reported in cats, they are probably rare.\textsuperscript{33,34} We would typically suspect ectopic ureters in a female puppy with a history of dribbling urine since birth. Because more than half of the puppies with ectopic ureters have a concurrent UTI, correct diagnosis may be delayed while attention is focused on the failure of antibiotic therapy to resolve incontinence.\textsuperscript{30}

In patients with a compatible history, the diagnosis of ectopic ureters has traditionally been confirmed by conducting excretory urography, retrograde vaginourethrography, or some combination of these two procedures.\textsuperscript{2,32,35} Recent studies\textsuperscript{35,36} suggest that these methods can correctly identify only 70\% to 78.2\% of ectopic ureters. Newer techniques have proven to be significantly more reliable in their ability to detect ectopic ureters. The use of rigid cystoscopy has been shown to correctly identify 100\% of ectopic ureters, whereas helical computed tomography (CT) can identify 91\% of cases.\textsuperscript{35,36} However, there is a small chance of cystoscopy leading to incorrect labeling of a normal ureter as ectopic.\textsuperscript{35} Although the use of CT is limited to a small number of referral practices and academic institutions, the use of rigid endoscopy is becoming more widely available, is accurate in identifying ectopic ureters, and allows visual inspection of the ureteral orifice, bladder wall, urethra, and vagina.

Several successful surgical techniques have been described to treat ectopic ureters.\textsuperscript{29,37} However, a presurgical workup consisting of a UPP and abdominal ultrasonography can help predict clinical outcome.\textsuperscript{38} For reasons that are not completely understood, more than half of all dogs surgically treated for ectopic ureters experience some degree of incontinence.\textsuperscript{32,38} The UPP (Figure 5) has proven to be helpful in predicting which dogs will be continent, continent with medication, and incontinent following surgery.\textsuperscript{38} Because surgical correction of ectopic ureters is costly and no procedure is without risk, this information could provide clients with realistic expectations and should be considered part of the presurgical workup. Hydronephrosis is also a relatively common presurgical finding in patients with ectopic ureters.\textsuperscript{32,35} Presurgical abdominal ultrasonography can help evaluate the architecture of the kidneys and determine the need for additional renal function testing; nonfunctional hydronephrotic kidneys should be removed.

**Detrusor Instability**

Detrusor instability (hyperspasticity) is characterized by sudden awareness of an urgency to urinate combined with an involuntary bladder contraction. Clinical presentation includes nocturia, pollakiuria, urgency, and incontinence.\textsuperscript{39} Instability secondary to infection, neoplasia, or uroliths is called urge incontinence.\textsuperscript{39} In some cases, an underlying inflammatory condition is not found and the condition is referred to as idiopathic detrusor instability.\textsuperscript{39} The first step in the diagnosis of this condition involves ruling out an underlying cause. As with all cases of urinary incontinence,
thorough physical and neurologic examinations and patient history are essential. Urinalysis with microscopic analysis and culture is also vital, as is ultrasonography of the bladder wall and contents. When an underlying condition is found, the first priority is to treat the condition.

Definitive diagnosis of idiopathic detrusor instability involves conducting cystometrography. In this test, a catheter is inserted into the bladder, which is slowly filled with saline. A normal bladder allows filling without significant resistance until the threshold volume (22 ml/kg) is reached. In dogs with idiopathic detrusor instability, the volume of fluid that can be infused before involuntary bladder contraction is dramatically reduced. Because bladder voiding is controlled by the parasympathetic nervous system, detrusor instability is treated with anticholinergic drugs, including flavoxate, oxybutynin, and dicyclomine.

Malposition of the Urinary Bladder
Malposition of the urinary bladder within the pelvis (i.e., "pelvic bladder") is often associated with urinary incontinence. This condition usually occurs in large-breed female dogs, although it has also been reported in males. The bladder is ordinarily positioned in the abdomen. In affected patients, the bladder neck and some portion of the body are located in the pelvic canal (Figure 6). It is not clear why 50% of dogs with this condition are incontinent. One theory extrapolated from the human literature suggests that because the bladder neck is normally within the abdomen, increased abdominal pressure is ordinarily applied to both the body and neck of the bladder. Thus although coughing increases pressure on the bladder body, it also increases resistance provided by the bladder neck. Because the bladder neck is outside the abdomen in affected patients, they experience only the increased bladder pressure and therefore leak urine. Others have suggested that pelvic bladder is part of a syndrome characterized by a shortened urethra, dysfunctional detrusor musculature, and abnormal urethral musculature. A UPP and cystometrography might be helpful in better categorizing the condition in individual patients. The diagnosis depends on contrast cystometrography (Figure 6), although lateral radiographs may indicate bladder malposition. Contrast radiography typically shows an abnormally shaped bladder that fails to taper at the junction with the urethra, which is displaced caudally in the pelvic canal. Empirical treatment with phenylpropanolamine is thought to be helpful but unlikely to result in total resolution of signs. Some have recommended colposuspension in cases in which medical management is unrewarding.

Urovaginal and Urethrorectal Fistulas
Urovaginal and urethrorectal fistulas are uncommon causes of incontinence in dogs. Urovaginal fistula has been documented as a complication of ovariohysterectomy and occurs secondary to entrapment of the distal ureter by a ligature. The primary clinical sign is incontinence that begins shortly after an uneventful spay and is unresponsive to medical management. Diagnosis is sometimes possible with intravenous urography but may require more invasive techniques, such as antegrade ureterography. Urethrorectal fistula may be congenital or the result of trauma. Although English bulldogs may have a genetic predisposition to develop the congenital form of this condition, it has been described in other breeds. Dogs with urethrorectal fistula typically present with persistent UTIs and passage of urine from the anus. The diagnosis can be made by cystography or retrograde urethrogram under fluoroscopy. Successful surgical correction of both urovaginal and urethrorectal fistulas has been described.

CONCLUSION
Canine incontinence can be extremely frustrating for clients. Urine-stained carpets, sofas, and bedding can quickly lead to aggravation with both the pet and veterinarian. Fortunately, the most common causes of incontinence can be easily diagnosed and, in most cases, adequately treated with medication, although some cases may require more invasive measures.

REFERENCES