

# Urinary incontinence in veterinary patients: not just a medical problem

*Urinary incontinence is a complex and multifactorial disease in veterinary patients, requiring thorough evaluation to provide the best treatment recommendation and prognosis, writes Kathryn Marguerite Pratschke MVB MVM CertSAS DipIECVS MRCVS, small animal surgical specialist*



and also the somatic nervous system (pudendal nerves, again from the first to third sacral spinal segments). The detrusor muscle contracts in response to motor innervation from the parasympathetic system via cholinergic muscarinic receptors, and relaxes in response to beta-adrenergic stimulation. Stimulation from the sympathetic system also contracts the internal urethral sphincter, this time via alpha-adrenergic receptors, but the external urethral sphincter receives separate motor innervation from the somatic system via cholinergic (nicotinic) receptors.

Urination involves both storage and voiding phases. During storage, sympathetic stimulation relaxes the detrusor muscle and contracts the internal urethral sphincter. Contraction of the external sphincter provides extra support as required, for example in response to transient rises in intra-abdominal pressure such as when coughing or sneezing. Stretch receptors within the bladder wall normally trigger urination via the pelvic nerve once distension reaches a threshold point, but there are also pain receptors that can respond to extreme distension or inflammation; these mediate their effects via the pelvic and also the hypogastric nerves. When voluntary urination is initiated, the abdominal muscles contract, the perineal muscles relax and the micturition reflex causes a drop in sphincter tone concomitant with contraction of detrusor muscles.

The pontine micturition centre in the brain co-ordinates the physiological events involved in urination. This centre is subject to control from higher centres that allow voluntary control over urination, as with house-training in dogs. Voluntary cortical control of urination takes effect at the level of the urethral striated musculature via the pudendal nerve.

## SURGICAL CONDITIONS INVOLVED IN URINARY INCONTINENCE

A variety of causes have been implicated in urinary incontinence in veterinary patients, including congenital abnormalities of the urinary and/or genital tracts, neurological, neoplastic, infectious, inflammatory and behavioural. From a surgical perspective, the two most important conditions are ectopic ureter(s) and urethral sphincter mechanism incompetence.

### Ectopic ureter(s)

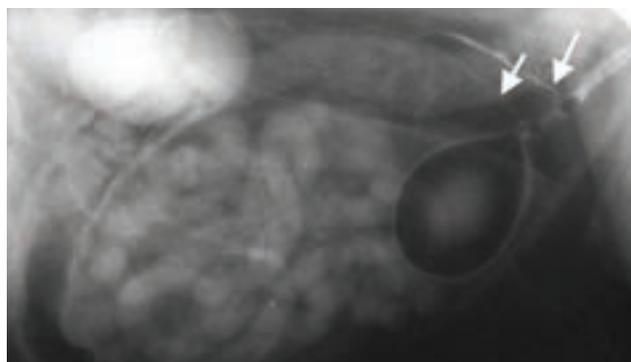
The ureters normally enter the bladder on its dorsolateral surface, within the region of the trigone. Ectopic ureters may be extramural or intramural in morphology. Extramural ectopic ureters bypass the bladder completely before joining the urogenital tract further distally (Figure 1); these

## INTRODUCTION

Storage of urine and successful voiding at the appropriate time is a complex procedure that requires co-ordination of the detrusor muscle of the bladder wall, the internal and the external urethral sphincters.

Although we commonly use terminology implying the presence of actual sphincters within the urethra, this is perhaps a bit misleading. The proximal urethra provides an area of smooth muscle 'sphincter-like' activity; however, no anatomical sphincter – either internal or external – can be identified microscopically. This smooth muscle is continuous with the detrusor muscle, so any anomaly or pathology that affects the bladder neck muscle will tend to also affect the proximal urethra.

Nervous control of the micturition reflex involves sympathetic nerves (hypogastric from the first to fourth lumbar spinal segments), parasympathetic nerves (pelvic nerves from the first to third sacral spinal segments)



**Figure 1:** This radiograph shows bilateral extramural ectopic ureters in a cat, with both ureters bypassing the bladder to join the urethra directly (white arrows).

seem to be more common in cats than in dogs. Intramural ectopic ureters often look as though they have joined the bladder as normal but then, instead of opening through a ureteral orifice, they follow a submucosal course within the bladder wall before opening further distally in the urogenital tract (Figure 2). They can in some cases have two openings – one at a roughly normal location into the bladder and a second (usually more dominant) opening further distally. Ectopia may be unilateral or bilateral, and can occur in conjunction with other congenital anomalies, eg. ureteral duplication, bladder hypoplasia, renal hypoplasia, or congenital urethral sphincter mechanism incontinence (USMI).

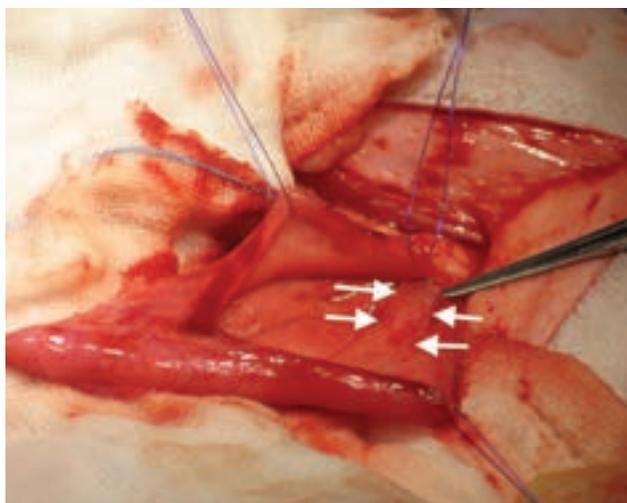
What actually causes ureteral ectopia during embryogenesis is unknown, although nutritional, genetic and hormonal factors have all been suggested. Overall, unilateral ectopia has been reported more commonly in dogs, and bilateral disease in cats. Cystitis, pyelonephritis and renal abnormalities are common findings in dogs with ureteral ectopia. Congenital dysplasia and congenital cystic disease result in small kidneys that may or may not be functional, while obstruction from abnormal ureteral location or ascending infection can lead to hydronephrosis +/- hydroureter. Where these additional abnormalities are present it can complicate decision-making.

### Acquired urethral sphincter mechanism incompetence

Urethral sphincter mechanism incompetence (USMI) is the most common cause of acquired urinary incontinence in dogs. It mainly affects medium-to-large-breed dogs, mostly middle-aged spayed bitches. USMI is a multifactorial condition associated with decreased urethral resistance, with urine leakage occurring when the intra-abdominal pressure rises, eg. during recumbency or barking. It is unclear which of the neuromuscular, vascular, and passive

**Table 1:** Intrapelvic bladder or caudal displacement of the bladder – what does it actually mean?

This is a radiographic diagnosis, not a clinical or aetiological one. It is hallmarked by an apparently abnormal location of the bladder and elongation of the bladder neck across the pelvic brim, often an indistinct vesiculourethral junction and possibly a shortened urethral length. Although intrapelvic bladder is often seen with urinary incontinence, it is also seen in up to 20% of animals without urinary incontinence. It can also be artefactual, from underfilling of the bladder. Currently, the clinical significance of the radiographic intra-pelvic bladder is incompletely understood.



**Figure 2:** This intramural ectopic ureter has been temporarily obstructed with digital pressure at the level of the pelvic brim in order to allow urine to build up within the ureter to cause visible distension (white arrows). This can aid identification of the intramural portion for neoureterostomy.

elastic components of the sphincter mechanism fail in USMI, and it is possible that more than one form of the condition exists.

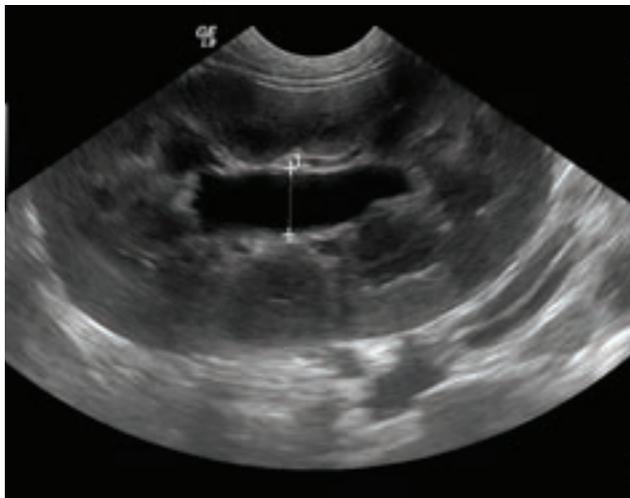
Clinical signs may develop anything from a few weeks to several years after spaying, but most commonly two to three years later, making a direct cause-effect link difficult to establish. Studies regarding a relationship between age of neutering and USMI are difficult to interpret, as the strength of the evidence is not uniform, in addition to which many of the commonly cited papers carry either a moderate or high risk of bias due to their study design. A recent systematic review of the evidence (Beauvais et al, 2012) concluded that "...overall the evidence is not consistent nor strong enough to make firm recommendations on the effect of neutering or age at neutering on the risk of urinary incontinence". Initial treatment of the condition is medical but surgery may be recommended if the animal does not respond or becomes refractory to medical treatment; if side-effects develop to the medication; or if owners are reluctant to medicate long-term.

### Congenital urethral sphincter mechanism incompetence

This tends to be a problem of large-breed dogs, predominantly bitches although males can occasionally be affected. Leakage of urine is usually more copious than in animals with ureteral ectopia and, similar to the acquired form of USMI, is often worst when the animal is recumbent. Urethral abnormalities may be present – the urethra may be shortened, hypoplastic or even absent, and both diverticula and dilation can develop. In cats, these types of abnormalities are usually seen as part of a condition known as genitourinary dysplasia. Approximately half of bitches with juvenile incontinence have been previously reported to become continent following their first oestrus, so when presented with an incontinent juvenile bitch it is prudent to avoid early neutering.

### INVESTIGATION OF URINARY INCONTINENCE

- A full history, including detailed description of the onset, nature and timing of incontinence, should be



**Figure 3: Ultrasound is a readily available method for assessment of the upper urinary tract; this image shows hydronephrosis associated with an ectopic ureter. A final decision regarding whether ureteronephrectomy is required rather than neoureterostomy or implantation can often only be made at surgery – there is no substitute for good surgical judgement!**

- obtained in all cases;
- Physical examination (including neurologic assessment, vaginal and rectal examination) should be carried out in all cases. Abnormalities that may be identified on physical examination include perivulvar wetness, odour and scalding; persistent hymen, vaginal bands or vestibulovaginal stenosis on vaginal exam/vaginoscopy; abnormal placement of the vulva (recessed) or abnormal appearance (juvenile vulva); +/- signs associated with urinary tract infection;
- Any urinary tract infections present should be identified and ideally treated prior to further diagnostic tests, particularly any contrast studies. This will require submission of a urine sample (preferably obtained by cystocentesis) for culture and sensitivity testing to identify any specific pathogens involved. Urinalysis, including sediment exam, may give an indication that infection is present, but will not tell you what bacteria are present, nor the most appropriate antibiotic to choose in order to avoid resistance problems;
- Survey abdominal radiographs will usually not provide a diagnosis, but can help evaluate the size, shape and position of the kidneys, bladder +/- prostate;
- Excretory urography (intravenous urography, IVU) and retrograde vaginourethrography with radiographs are still routinely performed in a practice setting for investigation of incontinence, but a positive and anatomically accurate diagnosis of ureteral ectopia has only been reported in 62-77% of confirmed cases using these methods. The diagnostic imaging method of choice for evaluating dogs for ectopic ureters is now considered to be cystoscopy (+/- fluoroscopy) or contrast-enhanced computed tomography (CT IVU). A key limitation with using cystoscopy in isolation is the inability to evaluate the upper urinary tract for concurrent diseases such as hydronephrosis, hydroureter and pyelonephritis. For this reason, cystoscopy should always be combined with a second modality that allows accurate assessment of the upper urinary tract, with CT IVU being one of the better options available;

- Ultrasound examination (Figure 3) can be a very useful diagnostic tool for assessment of the upper urinary tract and bladder, but is operator dependent. The diagnostic accuracy in the hands of an experienced ultrasonographer is probably similar to excretory urography. Ultrasound has, however, the advantage of ready availability and lower expense when compared with advanced imaging and cystoscopy.

### MANAGEMENT OF ECTOPIC URETER(S)

Ectopic ureters are more commonly diagnosed in dogs than in cats, and in females than in males, although the fact that males tend to be less overtly symptomatic may mean that this is artefactual rather than a real difference in distribution. Certain breed predispositions are recognised in dogs, with Siberian huskies, Golden retrievers, Labrador retrievers, miniature poodles and some terrier breeds (Skye, Fox) being over-represented. Based on the limited information available regarding ectopic ureters in cats, there seem to be no gender or breed predispositions.

Surgical correction is the treatment of choice for ectopic ureters, although laser ablation has been increasingly used in the past few years for intramural ureters in dogs (see below). It is important to ensure that the presence of any other congenital abnormalities such as abnormal kidneys (which might complicate anaesthesia/surgery) or urethral hypoplasia (which might compromise the prognosis) have been identified and discussed with owners in advance. It is difficult to find any guidelines in the veterinary literature regarding timing of surgery although, anecdotally, many people talk about delaying surgery until at least 12-16 weeks of age to allow patient size to increase; patient size may be a particular limiting factor with laser ablation via cystoscopy. There is, however, no evidence to show that postponing treatment is beneficial, or that it makes a positive difference to outcome. Delaying surgery may increase the risk of secondary changes such as ureteral dilation and hydronephrosis, which can adversely affect outcome. Up to a certain point, ureteral dilation and even hydronephrosis can be reversible with correction of the ureteral ectopia, but once they go beyond a certain point then the only option is ureteronephrectomy (Figure 4). Surgical correction of intramural ureters is via neoureterocystostomy, ie. creation of a new ureteral stoma within the bladder with the distal ectopic portion being either ligated or resected, depending on individual preference. Extramural ectopic ureters are treated by ligation of the distal ureter, transection and re-implantation to the bladder. Extramural morphology seems to be more common in cats than in dogs, which is relevant because the small patient size makes successful ureteral implantation more challenging.

### Outcome following surgery

Resolution of incontinence after surgical correction of ectopic ureters is reported in anything from 22-82%, reflecting different patient populations, gender distributions, presence of comorbidities, including USMI, and probably also changes in our understanding and technical management of the condition over time. The two most recent studies of outcome following surgery quoted 72% and 82% success rates without additional therapy required postoperatively. Although the available information regarding



**Figure 4:** In some cases the extent of hydroureter and hydronephrosis present mean that ureteronephrectomy is the appropriate decision, due to the risk of ascending infection along a non-functional ureter and subsequent pyelonephritis.

ectopic ureters in male dogs is relatively limited compared to female dogs, there is a suggestion that they may carry a better prognosis following treatment, which may reflect the relatively lower incidence of comorbidities such as USMI. The response to surgery in cats with ectopic ureters seems to be good based on the figures available in the literature, possibly better than dogs. However, it has to be acknowledged that this is based on small numbers of patients, which always compromises the reliability of the information.

### Cystoscopic laser ablation of ectopic ureters

Laser ablation of intramural ectopic ureters under cystoscopic guidance has been proposed as a minimally invasive alternative to surgery and has become increasingly popular in recent years. The technique is not appropriate for extramural ureters. As yet, there are limited studies reporting outcome with this approach. One of the first, in 2010, reported only four out of 16 (25%) as having complete resolution of incontinence without further medication or treatment, with a further five requiring additional medical management to regain continence (overall continence rate, 56%).

A more recent study from 2012 reported that 14 of 30 dogs treated by laser ablation (47%) did not require any additional treatments to maintain urinary continence. Of the 16 residually incontinent dogs, the addition of medical management, transurethral collagen injections, or placement of a hydraulic occluder was effective in an additional nine dogs, improving the overall urinary continence rate to 77% (23/30 dogs). These results are comparable to those found in older surgical reports, but not those from the two most recent studies (which were 72-82%), so the relative efficacy is still not completely clear.

The steep learning curve associated with cystoscopy and laser use makes the procedure technically demanding. In addition, there are not-insignificant cost implications in obtaining and maintaining a cystoscope and diode laser. These factors, plus the additional safety requirements for laser use, will likely make this procedure impractical for most general veterinary practices.

## MANAGEMENT OF URETHRAL SPHINCTER MECHANISM INCOMPETENCE USMI or detrusor overactivity?

Detrusor overactivity is well recognised in people (overactive bladder syndrome), and is characterised by involuntary contractions of the detrusor muscle at small bladder volumes. In the dog, the term 'detrusor hyperactivity' is used for uncontrolled detrusor contractions of neurological origin, and the term 'detrusor instability' describes involuntary detrusor contractions of non-neurological origin. Although causative agents have been identified – acute or chronic inflammation, neoplasia, uroliths, idiopathic – the pathophysiology of bladder overactivity in dogs remains unknown. Clinical signs are reported in both male and female dogs and include nocturia, pollakiuria, urgency and urinary incontinence. As diagnosis can only be made by cystometry, a tool not available in clinical practice, it tends to be a diagnosis of exclusion or assumption in veterinary patients. Dogs with USMI can also have detrusor overactivity, and this might explain some apparently refractory cases.

### MEDICAL/CONSERVATIVE OPTIONS

All dogs with suspected USMI should have a trial period on medical management before considering surgery.

In theory, sympathomimetics and parasympatholytics should improve continence by manipulating urethral tone and intravesical pressure, respectively. Results from clinical trials of these medications are variable, however, and evidence based on large numbers of patients, followed long-term, is lacking.

- Phenylpropanolamine (PPA) produces contraction of the bladder neck and proximal urethra by acting on alpha-adrenergic receptors, although the exact manner in which it does this is unknown. Continence rates of between 75-90% are reported with PPA, but unfortunately not all of these are durable. Decreased urethral response can be observed after prolonged administration, possibly due to receptor desensitisation, leading to recurrence of incontinence. Side-effects reported include hypertension, restlessness, anxiety and tachycardia. Caution is advised in administration to dogs with concurrent cardiac issues, as tachyphylaxis has been seen following first administration;
- Ephedrine HCl is a mixed-acting sympathomimetic drug, whose efficacy is considered less predictable than that of PPA. A complete response rate of 74% has been reported, with partial response in a further 24%. Side-effects include restlessness, hypertension, excitability and tachycardia;
- Oestriol is a short-acting natural oestrogen with few side-effects, even in chronic administration. A complete response rate of 65% has been reported, with partial response in a further 17%. Minor associated side-effects include swelling of the vulva, attractiveness of males and metrorrhagia. Oestrogens are contraindicated in immature bitches with congenital USMI because of side-effects associated with the negative feedback on the hypophysis. Long-acting synthetic oestrogen preparations, such as oestradiol or diethylstilbestrol, are associated with bone marrow depletion in a dose-dependent manner. Bitches can become refractory to treatment over time, possibly

due to a decreased number of bladder and urethral receptors and a decrease in peroxidase activity;

- Anti-muscarinic agents are the first choice where detrusor overactivity is suspected. In a patient that has had only a partial response to the more commonly used medications listed above, it may be worth considering an anti-muscarinic as they may have USMI complicated by detrusor overactivity. The first-choice treatment for veterinary patients is oxybutinin. Information regarding continence rates with this medication is not available for veterinary patients, but in humans improvement of continence is seen in between 55-90%. The principal side-effects of anti-muscarinic drugs include sedation, vomiting, constipation and urinary retention. They should not be used in animals with cardiac pathology, arrhythmia, hypertension, hyperthyroidism, glaucoma or obstructive uropathy.

### Submucosal urethral collagen injection

This is typically considered under the heading of 'conservative' treatment rather than surgical due to its minimally invasive nature. Urethral submucosal injections consist of endoscopic injection of bulking agents to increase urethral resistance. Teflon was the original product used; currently, collagen is the preferred option. After a single injection of collagen, temporary continence can be expected for anything from a few months to a few years, based on the available evidence. Urethral submucosal injection of collagen is an attractive treatment from an owner's point of view due to its very minimally invasive nature and low risk of complications. It is important, however, for owners to realise that it is not cheap, the initial result will likely deteriorate with time, and repeat injections and/or use of other medications may be necessary.

### SURGICAL OPTIONS

Many surgical procedures have been described for management of urinary incontinence in veterinary patients, including colposuspension, cystourethropy, urethropexy, urethral lengthening, transpelvic and urethral slings and artificial sphincters. As yet, there is limited objective evaluation of any of these procedures. Only the main techniques in current clinical use are described here.

**Oestrogen and alpha-adrenergic agonists can be used together to reduce the individual doses needed of each, as oestrogens sensitise the urethral smooth muscle to alpha-adrenergic stimulation.**

### Colposuspension

Colposuspension was first described for use in women by Burch in 1961 and later adapted by Holt in 1985 for treatment of USMI in the bitch. The principle behind this technique is that the vagina is anchored to the prepubic tendon on each side in order to locate the bladder neck in an intra-abdominal position. This is postulated to increase urethral length, to increase functional urethral length, to increase leak-point pressure, and to improve the transmission of intra-abdominal pressure changes to the proximal urethra.

The technique for veterinary patients requires that bitches be neutered either previously or at the same time as

colposuspension. Although immediate response rates can be in the region of 65-70%, the long-term effect of colposuspension (ie. beyond 12 months) reduces to approximately 40-50%.

### Urethropexy

With urethropexy, the urethra is anchored to the ventral abdominal wall at the level of the cranial pubic brim by placing two polypropylene sutures from one prepubic tendon to the other through the muscular layers of the urethra without penetrating its lumen. The objective is to relocate the bladder neck into a more cranial position. Urethropexy may also affect urethral resistance locally – a discrete kink has been demonstrated in the urethra at the level of the urethropexy on post-operative vaginourethrograms.

Urethropexy was reported in 2001 on 100 bitches for the management of USMI, with a success rate comparable to colposuspension. Post-operative complications were observed in approximately 20% and included an increased frequency of micturition, dysuria, and anuria.

### Combined urethropexy/colposuspension

A recent publication described colposuspension combined with urethropexy in a single procedure, giving reported resolution of incontinence in 70% with a low complication rate of 10% comprising transient dysuria. These figures are very encouraging, although the numbers in this study (30 dogs) were a lot less than in the previous studies

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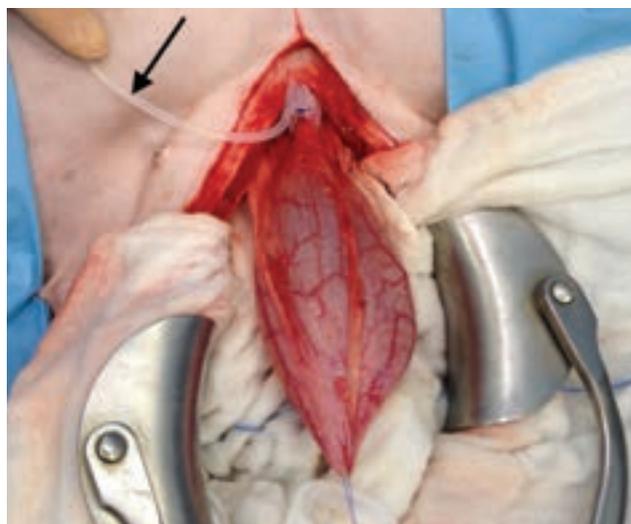
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**Figure 5:** This picture shows an artificial urethral sphincter (AUS) in place around the proximal urethra. The tubing leading away from the cuff (black arrow) will be exited through the abdominal wall to lie subcutaneously where it will connect to a custom-designed subcutaneous injection port. Variable volumes of saline can be injected to adjust resistance to flow through the urethra on a patient-by-patient basis.

for colposuspension (150 dogs) and urethropexy (100) dogs which may have affected the reported outcome and complication rates.

### Artificial urethral sphincters (AUS)

This surgical approach has been used most widely in men suffering from severe iatrogenic USMI secondary to surgery or radiation therapy for prostatic neoplasia, but is also used in women with refractory USMI after failure of less invasive techniques. In humans, the artificial sphincter is inflated and deflated as needed by manual

pressure through a system implanted under the skin. Artificial sphincters were first reported in veterinary patients in 1989, using a 0.5cm-wide strip of Dacron-impregnated Silastic material wrapped circumferentially around the urethra. The goal of the procedure was to increase mechanical urethral resistance while still allowing dilation of the urethra during micturition due to the elasticity of the implant. Mixed results were reported, with a reasonable response rate but also quite a high complication rate. The subsequent development of a percutaneously controlled static hydraulic urethral sphincter shows more promise. Currently, the most commonly used option comprises an inflatable silicone occluder placed around the proximal urethra and connected to a subcutaneous infusion port (Figure 5). This implant can be used in 'empty' mode to slightly increase urethral resistance or it may be actively inflated with progressive injection of saline to achieve a satisfactory anti-leak pressure. Although early reports had mixed results, the reported success rates have improved significantly in recent years, with a 2013 study reporting 22/25 patients as having a median continence score of 9 (where 1 = constant leakage and 10= completely continent).

### CONCLUSION

Urinary incontinence is a complex and multifactorial disease in veterinary patients, requiring thorough evaluation of patients to provide the best treatment recommendation and prognosis. Although no treatment option guarantees success, there are now a number of very good options, both medical and surgical, for the more common causes of urinary incontinence.

### REFERENCES AVAILABLE ON REQUEST

## Reader Questions and Answers

#### 1: WHICH SYSTEM CAUSES THE DETRUSOR MUSCLE TO RELAX?

- A: The sympathetic nervous system.
- B: The parasympathetic nervous system.
- C: The muscarinic nervous system.
- D: The somatic nervous system.

#### 2: IF A URETER LEAVES THE KIDNEY AND THEN BYPASSES THE BLADDER WITHOUT CONTACTING IT BEFORE JOINING THE GENITOURINARY TRACT AT THE VAGINA, HOW IS ITS MORPHOLOGY DESCRIBED?

- A: Intramural ectopic.
- B: Extramural ectopic.
- C: Genitourinary dysplastic.
- D: Extramural hypoplastic.

#### 3: WHICH OF THE FOLLOWING MEDICATIONS WOULD YOU CONSIDER INAPPROPRIATE FOR USE IN A FOUR-MONTH-OLD GOLDEN RETRIEVER WITH SUSPECTED CONGENITAL URETHRAL SPHINCTER MECHANISM INCOMPETENCE?

- A: Phenylpropanolamine.
- B: Tolterodine.
- C: Oestriol.
- D: Ephedrine.

#### 4: WHICH OF THE FOLLOWING STATEMENTS ABOUT COLPOSUSPENSION IN DOGS IS NOT TRUE?

- A: Colposuspension carries an immediate success rate of approximately 60-67% but this is not maintained long term.
- B: Colposuspension can be combined with cystopexy to increase the long-term success rate to approximately 70%.
- C: If colposuspension is to be performed on an intact female then they must be neutered before doing the colposuspension.
- D: Colposuspension is postulated to increase urethral length, functional urethral length, and leak-point pressure.

#### 5: TRUE OR FALSE – DETRUSOR OVERACTIVITY IS THE NAME FOR A FORM OF URETHRAL SPHINCTER MECHANISM INCOMPETENCE SEEN IN OLDER ANIMALS.

ANSWERS: 1: A, 2: B, 3: C, 4: B, 5: FALSE – DETRUSOR OVERACTIVITY IS A TERM USED TO DESCRIBE THE CONDITION OF OVER-ACTIVE BLADDER IN HUMANS; DETRUSOR INSTABILITY AND DETRUSOR HYPERACTIVITY ARE THE TWO VARIATIONS DESCRIBED IN DOGS.