Urogenital defects in dogs

Claudio Brovida, DVM, PhD
ANUBI® Hospital for Domestic Animals, Moncalieri, Italy

Dr. Brovida graduated from the Veterinary School of Turin, Italy and developed his professional interests in small animal practice, with particular focus on internal medicine, nephrology, and urology. He is currently Director of the ANUBI® Ospedale per Animali da Compagnia in Moncalieri, where he established a hemodialysis and blood purification unit in 1996. A past President of the World Small Animal Veterinary Association (WSAVA), at present he is an active member of the International Renal Interest Society (IRIS) and the WSAVA Renal Pathology Clinical Group.

KEY POINTS

- Various structural anomalies can occur in the canine urogenital organs resulting in alterations to reproductive and/or urinary function.
- Such defects principally involve the urinary system; ectopic ureters in female dogs are the most commonly encountered problem.
- The most useful methods for diagnosis are various imaging modalities, such as ultrasound, contrast medium radiology, computer tomography and cystoscopy.
- Urinary tract infections (UTI) are the most common secondary complication seen with urogenital defects.
- Surgery is the preferred treatment for most urogenital anomalies.

Introduction

The urinary system is formed by a coordinated development of different tissues that interact during the embryonic phase. The bladder and urethra are formed by the partitioning of the cloaca, the caudal portion of the embryonic intestine. The uro-rectal cavity subdivides into upper and lower sections to form the rectum and the urogenital cavity respectively.

The urogenital cavity is linked caudally with the amniotic cavity and cranially with the allantois, part of the placenta, through the urachus and the allantoic cord. The bladder subsequently develops from the proximal urachus and the cranial portion of the urogenital cavity, while the ureters develop from the caudal portion of the urogenital cavity. At birth, the urachus narrows and finally closes.

As the embryo develops, the mesonephric ducts and the embryonic ureters form separate openings in the caudal portion of the urogenital cavity. With the development of the bladder, the ureters open cranially at the level of the bladder neck, while the mesonephric ducts give rise to the proximal urethra. The mesonephric duct also forms the basis for the development of the external genital organs in the male and the vagina in the female (1,2).

A number of morphological and functional anomalies involving the urinary and genital tracts can occur in dogs, although some are rare and will only be mentioned briefly (see Table 1). This article considers the most common canine urogenital anomalies encountered in clinical practice, the most appropriate procedures required to achieve a correct diagnosis, and the relevant treatment options.

Ectopic ureters

An ectopic ureter is an anatomical anomaly characterized by the fact that the distal portion of the ureter does not open correctly at the level of the bladder trigone, but rather finishes elsewhere within the urinary tract or lower genitalia; the anomaly may be either uni- or bilateral in affected animals. The pathogenesis of the condition is linked to an anomalous development or incorrect
Table 1. Urogenital defects in dogs (1,2,21).

<table>
<thead>
<tr>
<th>Defect</th>
<th>Characteristics</th>
<th>Breed susceptibility</th>
<th>Gender predilection</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ectopic ureter</td>
<td>Uni- or bilateral</td>
<td>Siberian husky, Newfoundland, English bulldog, Labrador retriever, golden retriever, collie, West Highland white terrier, fox terrier, Skye terrier, miniature toy poodle, mixed breeds</td>
<td>Far more common in females than males</td>
<td>Urinary incontinence, UTI See text</td>
</tr>
<tr>
<td></td>
<td>Intra- or extra-mural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ureterocele</td>
<td>Orthotopic or ectopic</td>
<td>None</td>
<td>Reported in females</td>
<td>See text</td>
</tr>
<tr>
<td>Bladder hypoplasia or agenesis</td>
<td>Continual dripping of urine; can be associated with ectopic ureter</td>
<td>Various</td>
<td>Females</td>
<td>Urinary incontinence, UTI</td>
</tr>
<tr>
<td>Pelvic bladder</td>
<td>Trigone positioned in pelvic cavity, short urethra (in females)</td>
<td>Various</td>
<td>Males and females</td>
<td>Can be associated with urinary incontinence. See text</td>
</tr>
<tr>
<td>Bladder exstrophy</td>
<td>Failure of the abdominal wall to close during fetal development results in protrusion of the bladder wall through the ventral abdominal wall. Other viscera such as intestines and genitalia may also be noted</td>
<td>English bulldog</td>
<td>Females</td>
<td>Urinary incontinence, UTI</td>
</tr>
<tr>
<td>Urachus anomalies</td>
<td>Incomplete closure of urachus after birth; various malformations can occur, e.g. a diverticulum of the cranial bladder wall, urachal cysts, patent urachus</td>
<td>Various breeds</td>
<td>Males and females</td>
<td>UTI, urinary incontinence. See text</td>
</tr>
<tr>
<td>Calculi associated with congenital metabolic defects</td>
<td>Tubular defects in cystine transport giving rise to cystine calculi</td>
<td>Various breeds</td>
<td>Males and females</td>
<td>Dysuria, stranguria, poliakiuria, hernatura, UTI</td>
</tr>
<tr>
<td></td>
<td>Altered uric acid metabolism results in inadequate transformation of uric acid to allantoin and the formation of urate calculi.</td>
<td>Dalmatian</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hepatic-vascular defects (porto-systemic shunts) cause hepatic dysfunction with a consequent reduction in the conversion of uric acid to allantoin and the formation of urate calculi.</td>
<td>Larger breeds (intra-hepatic shunts) and Toy breeds (extra-hepatic shunts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urethral aplasia or hypoplasia</td>
<td>Incomplete development of the urethra, with the bladder attached to the vagina</td>
<td>None</td>
<td>Females</td>
<td>Urinary incontinence. See text</td>
</tr>
<tr>
<td>Urethral-rectal fistula</td>
<td>Fistula formation between the urethra and large intestine</td>
<td>English bulldog</td>
<td>More frequent in males than females</td>
<td>Dysuria, abnormal feaces, wet perineum, UTI</td>
</tr>
<tr>
<td>Urogenital malformation</td>
<td>Seen especially with pseudo-hermaphroditism, resulting from concurrent development of the organs derived from the Müllerian ducts (uterus, oviduct and part of the vagina) and masculinization of the urogenital sinus.</td>
<td>None</td>
<td>Males and females</td>
<td>Dysuria, urinary incontinence, UTI</td>
</tr>
<tr>
<td>Epispadia and hypospadia</td>
<td>Epispadia: a congenital defect whereby the distal urethra varies in size and the meatus is positioned too far dorsally.</td>
<td>None</td>
<td>Males and females</td>
<td>May be asymptomatic</td>
</tr>
<tr>
<td></td>
<td>Hypospadia: a congenital defect seen mainly in males whereby a malformation of the penis and prepuce results in the urethra being incorrectly positioned ventrally</td>
<td>Boston terrier</td>
<td>Males</td>
<td></td>
</tr>
<tr>
<td>Urethral prolapse</td>
<td>Severe protrusion of the urethral mucosa</td>
<td>Brachycephalic breeds</td>
<td>Males</td>
<td>Blood on prepuce</td>
</tr>
<tr>
<td>Urethral duplication</td>
<td>A defect normally associated with duplication of other organs (rectum, colon, bladder, vagina, penis) or anomalies such as renal hypoplasia or cryptorchidism; usually identified in immature dogs</td>
<td>None</td>
<td>Males and females</td>
<td>Various depending on the type of anomaly; urinary incontinence, UTI</td>
</tr>
<tr>
<td>Ectopic urethra</td>
<td>Anomalous positioning of the urethral meatus</td>
<td>English bulldog</td>
<td>Female</td>
<td>Often asymptomatic; possible UTI</td>
</tr>
</tbody>
</table>
UROGENITAL DEFECTS IN DOGS

migration of the embryonic mesonephric ducts, which as noted above develop into the ureters. Due to the close correlation with the mesonephrons, ectopic ureters can be associated with other congenital anatomical anomalies such as renal hypoplasia, ureteroceles, urachal residues and alterations in the vaginal anatomy. In the female, an ectopic ureter can end in the urethra, at the neck of the bladder, in the vagina, or (more rarely) in the uterus. In males, an ectopic ureter normally opens into the urethra (3). An ectopic ureter is defined as being intramural if it is located within the bladder but ends in an anomalous position; sometimes the ureter will enter the bladder at the level of the trigone but continue within the bladder wall before ending distally in the urethral lumen or in the genital tract. An ectopic ureter is defined as being extramural when it runs completely outwith the bladder wall before entering the urethra at some point.

The most common clinical presentation is urinary incontinence, which may or may not be associated with urinary tract infection (UTI). Typically urine may be noted dripping at the genitalia. In a female the vulva is persistently wet, with the hair foul smelling and impregnated with urine (Figure 1). In males, due to the long urethra, the presence of the prostate, and the resistance of the peri-urethral tissues, symptoms may be less obvious. The diagnosis is confirmed by detecting the anatomical defect by imaging. Traditionally, intravenous urography was the method of choice to identify an ectopic ureter and the anomalies often associated with it (e.g., megaureter, hydronephrosis) (Figure 2). Ultrasound scanning can also identify the ectopic nature of the terminal portion of the ureter, making it possible to assess the ureter’s exit point in the bladder trigone, which in certain cases can be very close to the start of the urethra. Doppler color imaging can assist in assessing urine peristaltic flow (Figure 3). One study has shown that intravenous urography and ultrasound offer a similar diagnostic sensitivity of around 91% (4) but a volume computer tomography (CT) scan with contrast and cystoscopy currently offers the best diagnostic accuracy. CT imaging allows the trajectory of the ureter and the intra- or extra-mural nature of the defect to be determined accurately (Figure 4). Cystoscopy can identify the position of the ectopic opening of the ureter, and also allows introduction of a probe through the endoscope channel to identify if there are multiple connections between the ureter, bladder trigone and urethra (5) (Figure 5). With these patients, it is important to bear in mind that UTI is common and that any infection must be adequately controlled by appropriate antimicrobial treatment before
conducting more invasive diagnostic procedures to assess the anatomical defect.

Ectopic ureters can be treated endoscopically or surgically. Intramural ectopic ureters can be ablated using laser therapy with endoscopic guidance. This technique has the double advantage in that it is non-invasive (6) and can be carried out at the same time as diagnosis. Surgical correction of an intramural ectopic ureter is done via cystotomy, exposing the bladder lumen via a midline approach. Extramural ureters that completely bypass the bladder neck are re-implanted in the bladder after the distal portion is dissected free (7). Resolution of incontinence is achieved in about 59% of cases (8) but dogs that continue to show incontinence may also have functional anomalies of the bladder neck and urethra (9).

**Ureteroceles**

A ureterocele is a cystic dilation of the distal portion of the ureter at the level of the bladder trigone, often protruding inside the bladder itself (10-12). The ureterocele’s position can be intravesical (orthotopic), or outside the bladder caudal to the trigone (ectopic). Signs can be...
UROGENITAL DEFECTS IN DOGS

Figure 5. Cystoscopic views of an ectopic ureter; (a) the ectopic ureter enters the bladder (arrow) and continues caudally into the urethra. (b) A probe inserted by cystoscopy into the ureter’s opening in the urethra.

Figure 6. A 6-month-old female border collie with ureterocele that presented with clinical symptoms of dysuria and stranguria.

(a) A post-contrast transversal CT image showing contrast medium accumulated in a diverticulum of the right ureter within the bladder lumen (arrowed).

(b) At surgery a large ureterocele was found at the level of the trigone.

(c) Subsequent to the removal of the ureterocele a slender catheter was inserted into the right ureter to assist in reconstruction of the mucosa; a larger catheter has been inserted in the proximal urethra.
completely absent initially but may develop with time, and may vary depending on the exact nature of the defect (e.g., urinary incontinence if there is an ectopic ureter (11,12)). Cyst formation can cause compressions at varying levels of the trigone or proximal urethra, causing urinary retention with dysuria or stranguria. Mega-ureter and hydronephrosis can also develop as a consequence of persistent compression of the ureteral lumen, and recurring UTI is a common complication.

Ureteroceles can be diagnosed using ultrasound scans (13), descending excretory urography, CT, or cystoscopy. Treatment consists of initially treating any infectious complications and subsequently arranging for the surgical elimination of the defect (Figure 6). When available, laser therapy via endoscopy can provide an excellent option for treating orthotopic ureteroceles (11-13).

Persistent urachus

During the embryonic phase, urine stored in the bladder is eliminated through the urachal canal which connects the bladder to the umbilicus. After birth, the urachus normally atrophies to a thin fibrous connective tissue remnant attached to the cranial aspect of the bladder, but in some cases the urachal closure is incomplete, giving rise to a variety of anatomical anomalies: i) a residual portion can remain, leading to a vesico-urethral diverticulum, ii) a urachal cyst can form cranial to the bladder if the epithelium continues to secrete fluid or continuity with the bladder lumen persists (Figure 7), or iii) the urachus can remain open and connect with the umbilicus. Urachal diverticuli can vary in size from extremely small (and possibly invisible macroscopically) to large, easily identified recesses (1). Often these diverticuli increase in size subsequent to bladder infection developing, or they may regress totally over time. Similarly, the signs will vary depending on the extent of the defect. If the urachus remains patent, urine loss will be noted at the umbilicus; in the case of a very small diverticulum, there may be no signs and the anomaly may be discovered by chance (Figure 8). The most common finding is associated with the presence of recurrent lower urinary tract infection secondary to the urachal diverticulum, which causes stagnation of small quantities of urine. In other circumstances a residual urachus may be detected as a result of investigating signs related to other urinary tract anomalies such as bladder calculi.

The diagnosis of vesico-urachal diverticulum can be made via ultrasound scan, contrast cystography and cystoscopy. Where there is a persistent patent urachus with urine loss at the umbilicus, cystography will demonstrate the duct. Treatment is initially directed at eliminating any UTI (14,15) but if the infection persists and imaging techniques confirm the anatomical defect
it may be necessary to eliminate the diverticulum surgically by reconstructing the cranial portion of the bladder.

**Pelvic bladder**

The term “pelvic bladder” refers to a defect in the positioning of the bladder, whereby the trigone is found to be caudal to the pubis. This defect can be associated with a short urethra or urethral hypoplasia (Figure 9) but the definition can be controversial and the exact diagnosis of the defect greatly depends on how thoroughly contrast radiological examination (vagino-urethral retrograde cystography) is performed, and it is essential to achieve adequate distension of the bladder during imaging (16). Signs (such as urinary incontinence) may or may not be noted (17) if a pelvic bladder is present. In some cases urinary incontinence which is unresponsive to treatment without other obvious causes (18) may be the primary presenting sign, but concurrent factors such as UTI and/or ectopic ureters can influence the presentation. As mentioned above, the diagnosis is confirmed using contrast radiography (Figure 10). Urinary incontinence may be controlled with α-adrenergic agonists, but if pharmacological treatment is unsuccessful, consideration can be given to collagen injections at the level of the urethra, or achieving abdominal positioning of the bladder via urethropexy or colposuspension (19,20).

**Conclusion**

When persistent urinary incontinence is diagnosed, or recurrent UTI continues despite antimicrobial treatment, it is important to consider the presence of urogenital defects in the differential diagnosis. The correct diagnosis is based on the detection and localization of the anatomical defect and current diagnostic methods, especially CT and cystoscopy, allow an extremely accurate
assessment of such problems. Before performing diagnostic tests it is very important to correctly sterilize the urinary tract if UTI is present, ensuring that any pathogenic bacteria is isolated and the most appropriate and least nephrotoxic antimicrobial medication is chosen. Given that some of the anomalies referred to above can be associated with direct or indirect involvement of the kidneys, it is also essential to exclude the possible presence of renal inflammation and/or defects using appropriate urine and blood analysis.

References