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Vet Record CaseReports

CASE REPORT

Companion or pet animals

Urethro-venous intravasation of contrast medium as a complication during retrograde urethrography in a pug with urethral stricture and urethritis

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Abstract

A 12-year-old, neutered pug was referred with a suspicion of urethral stricture with a 3-week history of dysuria and stranguria, requiring multiple urinary catheterisations. Retrograde urethrography revealed focal luminal narrowing with irregular mucosal margins in the penile urethra. During the procedure, contrast medium was unexpectedly observed in the penile tissue, bulbus glandis and its venous sinuses, dorsal veins of the penis, internal pudendal veins, internal iliac veins, common iliac veins, and the caudal vena cava, signifying pathological contrast medium intravasation and prompting termination of the procedure. Urethroscopy confirmed the presence of urethral stricture and severe urethritis in the region of the bulbus glandis. Cytology of regional cytobrush samples revealed mixed inflammation with a bacterial infection. A scrotal urethrostomy was performed along with medical treatment for concurrent prostatitis, resolving the clinical signs. The patient was discharged without further complications. At the 1-month postoperative check-up, both clinical and ultrasonographic improvements were evident.

BACKGROUND

Retrograde urethrography is a widely used imaging modality in both human and veterinary medicine for the investigation of urethral disorders.[1–7] This procedure is readily accessible and can be performed by most veterinarians, requiring only a radiographic device, contrast medium and a urinary catheter.[5] Complications are uncommon, typically including iatrogenic urinary tract rupture with contrast medium extravasation and infection.[4,6,7] Urethro-venous intravasation of contrast medium is a rare and less recognised complication. While it has been infrequently reported in human literature,[2–4,6,7] only one case has been documented in veterinary literature involving a different location of the urethra compared to this case.[1] Early recognition of this complication is crucial to halt the procedure and prevent further complications, which could be potentially life-threatening.[1–4,6] This case report describes the radiographic findings of urethro-venous intravasation of contrast medium occurring in the region of the bulbus glandis during retrograde urethrography and aims to highlight this potentially serious complication of an otherwise routine procedure.

CASE PRESENTATION

A 12-year-old, 9.7 kg, neutered, male pug was initially presented to its attending veterinarian with a history of inappetence, vomiting, dysuria and stranguria. The veterinarian performed a complete blood count and serum biochemical analysis, both of which were unremarkable, except for neutrophilia (16,950 cells/μL; reference range: 2300–10,400 cells/μL) and monocytosis (2300 cells/μL, reference range: 100–900 cells/μL). He also performed abdominal radiographs and ultrasonography, revealing severe bladder distension and prostatomegaly, which was suspected to be secondary to benign prostatic hyperplasia. Multiple urinary catheters were placed to relieve bladder distension; some were removed immediately while others were left in situ for an unknown duration. After a 3-day hospitalisation period, the patient was surgically neutered and received progestin (osaterone acetate, 0.4 mg/kg, per os, once daily for seven days), α1-blockers (alfuzosin, unknown dose), non-steroidal anti-inflammatory drugs (NSAIDs; meloxicam, 0.1 mg/kg, per os, once daily for 7 days) and antibiotics (amoxicillin/clavulanic acid, 15 mg/kg, per os, twice daily, for 10 days). The dog showed no significant improvement during the week following surgery, after which the veterinarian performed a retrograde urethrography, revealing a narrowing of the penile urethral lumen at the level of the os penis, indicating a potential urethral stricture. Following the contrast study, corticosteroids (prednisolone, 0.5 mg/kg, per os, twice daily, unknown duration) and benzodiazepines (diazepam, 0.5 mg/kg, per os, once daily, unknown duration) were added to the previous treatments after cessation of NSAIDs, and the patient was discharged home.

Approximately 10 days later, the dog was presented once again to its attending veterinarian with worsening clinical signs, including vomiting, lethargy and anorexia. Clinical palpation revealed marked bladder distension, and urethral catheterisation was performed with difficulty, leading to the decision to refer the patient.

Upon arrival at the referral centre, a physical examination revealed no abnormalities. A urinary catheter was still in place.

INVESTIGATIONS

At the referral centre, complete blood count and serum biochemical analysis were repeated, revealing persistent neutrophilic (24,250 cells/μL; reference range: 2950–11,640 cells/μL) and monocytic (2590 cells/μL; reference range: 160–1120 cells/μL) leukocytosis; hypercreatininemia (289 μmol/L; reference range: 44–159 μmol/L) and uraemia (42.6 mmol/L; reference range: 2.5–9.6 mmol/L). There were no abnormalities on venous blood gas analysis. A urine analysis was also performed on a sample collected by cystocentesis, revealing a urine specific gravity of 1.012 (reference range: 1.025–1.035), a urine dipstick positive for red blood cells (2+) and proteins (2+) and a pH of 6.5. Cytology and sediment analysis were unremarkable. A urine culture was not performed.

An abdominal ultrasound was performed the day after admission to the referral centre, with the patient placed in dorsal recumbency, using a fixed ultrasound device equipped with a microconvex probe (PVT-712BT: 4.3–11 mHz, Aplio α 450, Canon Medical Systems). The prostate was enlarged and heterogeneous with a peripheral hypoechoic halo and multifocal well-delineated cavitary lesions within the parenchyma measuring up to 1 cm. Some lesions had thin walls, while others had thick walls, and contained content ranging from anechoic to echoic. The peri-prostatic fat was hyperechoic. This constellation of findings is compatible with benign prostatic hyperplasia, prostatic cysts, and probable abscesses, given the echoic content within some cavitary lesions, along with concomitant prostatitis. Both kidneys demonstrated hyperechoic peri-pelvic fat, and both ureters had thickened walls in their proximal aspects. This is consistent with bilateral pyelonephritis and proximal ureteritis. The ventral aspect of the urinary bladder wall was thickened, and the peripheral fat was hyperechoic, which is compatible with cystitis. Finally, the medial and internal iliac lymph nodes were increased in size, hypoechoic with peripheral steatitis, consistent with regional lymphadenopathy. The visible portions of the urethra, including the penile urethra, were also evaluated, with no clear abnormalities observed.

Plain orthogonal radiographs (latero-lateral, with pelvic limbs flexed and extended, and ventro-dorsal projections) of the caudal abdomen were acquired (Figure 1), followed by a retrograde urethrography under fluoroscopic guidance and general anaesthesia (Figures 2 and 3). Both radiographic exams and fluoroscopy use x-rays to obtain images. Fluoroscopy involves continuous x-ray exposure, enabling dynamic evaluation, which is particularly useful when used in conjunction with a contrast medium, as in this case, allowing real-time observation of the filling of the urethral lumen. In contrast, radiographic exams are static and produce still images. For the retrograde urethrography, a Foley urinary catheter was placed into the distal penile urethral lumen, the balloon was inflated, and a 1:1 mixture of iodinated non-ionic contrast medium (Iohexol, 300 mg I/mL), characterised by low osmolality (672 mOsm/kg water), and saline solution was gradually injected manually, with a maximum volume set at 5 mL/kg. No abnormal resistance was felt by the operator during the procedure. The plain radiographs confirmed prostatomegaly, with the prostate measuring more than 70% of the distance from the pubis to the sacral promontory in the dorso-ventral plane, causing dorso-ventral compression and dorsal displacement of the descending colon and rectum in lateral views (Figure 1). Additional findings, irrelevant to the patient's clinical presentation, included hip joint osteoarthritis, a mineralised fragment lateral to the right cranial acetabular margin, a transitional vertebra (L7) and lumbar spondylosis. Retrograde urethrography enabled marking of the urethra and the urinary bladder by contrast medium, revealing two distinct areas of focal luminal narrowing. The first, located at the level of the os penis, exhibited irregular mucosal margins, which were consistent with urethral narrowing likely caused by inflammatory changes or trauma. The second narrowing, found within the prostatic urethra, showed smooth mucosal margins, suggesting that it was primarily due to prostatic enlargement, which likely resulted in compression of the urethral lumen. These findings indicate two separate mechanisms of urethral narrowing. Other than in the urethra and urinary bladder, contrast medium unexpectedly and gradually appeared during the procedure in the adjacent penile tissues, bulbus glandis and its venous sinuses, and the ascending venous pathway (dorsal veins of the penis, internal pudendal veins, internal iliac veins, common iliac veins and caudal vena cava) as well as in the external iliac and urethral veins, signifying pathological contrast medium intravasation (Figures 2 and 3). Upon observation of the contrast marking of these venous structures, the procedure was immediately halted. The patient's vital parameters were monitored during the procedure and remained within normal limits.

Directly following the urethrography, a prostatic wash was performed to investigate the suspicion of prostatitis. It showed

LEARNING POINTS/TAKE-HOME MESSAGES

- Urethro-venous contrast medium intravasation is a rare and potentially under-recognised complication of retrograde urethrography.
- Risk factors include alterations in the integrity and permeability of the urethral wall, as well as increased pressure, even subclinical, due to luminal stricture/stenosis or excessive injection pressure. Patients with urethritis and/or urethral stricture are therefore at increased risk of this complication.
- Possible consequences include nephropathy, anaphylaxis, bacteraemia, sepsis and even death.
- If urethro-venous contrast medium intravasation is suspected, the procedure should be stopped, the patient should be closely monitored and antibiotherapy should be started as soon as possible.

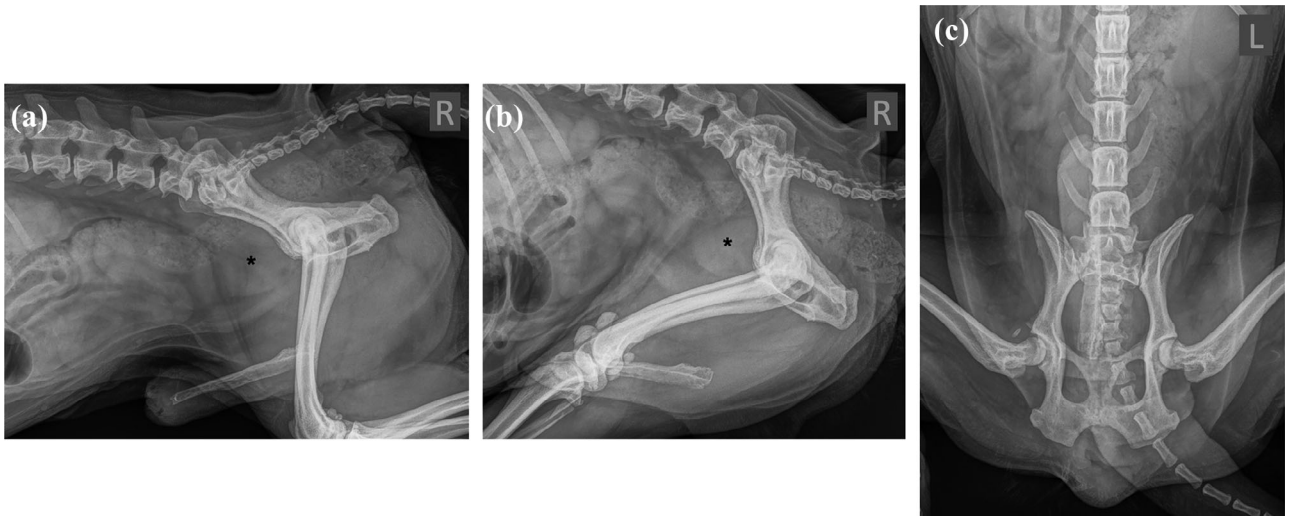

FIGURE 1 Right lateral (a and b) and ventro-dorsal (c) plain radiographs of the caudal abdomen of a 12-year-old neutered male pug referred for suspicion of urethral stricture with a history of dysuria and strangury. The prostate is enlarged (black asterisk, a and b) measuring dorso-ventrally more than 70% of the distance from the pubis to the sacral promontory and causing dorso-ventral compression and dorsal displacement of the descending colon and rectum in lateral views, thereby confirming prostatomegaly.

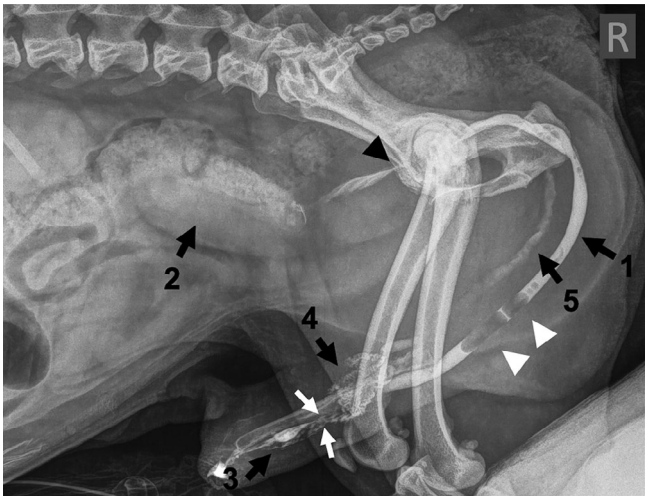

FIGURE 2 Right lateral radiograph of the caudal abdomen of the same dog as in Figure 1 after initiation of retrograde urethrography. The urethral lumen[1] and urinary bladder lumen[2] are marked by the contrast medium. Air bubbles are visualised within the penile urethral lumen (white arrowheads). Focal luminal narrowing and irregular mucosal margins of the penile urethra are visualised at the level of the os penis (white arrows), most likely secondary to urethritis, potentially associated with mucosal scarring, resulting from traumatic urinary catheterisations and/or passage of uroliths. There is also focal narrowing of the lumen of the prostatic urethra with smooth mucosal margins (black arrowhead), likely caused by prostatic enlargement secondary to benign prostatic hyperplasia and prostatic inflammation, which causes compression of the urethral lumen. In addition to the urethra and urinary bladder, the contrast medium also marks the following structures: penile tissues,[3] bulbus glandis and its venous sinuses[4] and dorsal veins of the penis.[5]

numerous polymorphonuclear neutrophils visible before the prostate massage, a marked increase in the number of neutrophilic polymorphonuclear neutrophils, and the presence of lymphocytes and macrophages after prostatic massage, without evidence of bacteria or cellular atypia. These findings were consistent with chronic prostatitis without indications of bacterial infection. The results of bacterial culture and antibiotic sensitivity tests of the prostatic wash came back 6 days later, identifying *Corynebacterium durum*, suspected to be a contaminant, and *Escherichia coli*, which was sensitive to enrofloxacin.

Urethroscopy was performed the day after the retrograde urethrography and the prostatic wash. This technique is valuable when used in conjunction with retrograde urethrography, as it provides real-time images of the urethral lumen and mucosal surface, allowing for the detection of subtle surface lesions that may be missed during retrograde urethrography. It also enables the practitioner to obtain cytobrush or biopsy samples. However, it does not provide as much information about the overall anatomy of the urethra compared to retrograde urethrography. The urethroscopy confirmed a severe urethral stricture associated with a mucosal lesion in the region of the bulbus glandis. Cytological samples obtained from the area using a cytobrush showed mixed inflammation (neutrophilic and macrophagic; acute to chronic active) of marked intensity, associated with a bacterial infection.

A computed tomography scan of the abdomen and perineal regions was proposed to evaluate the urethral lesions and any concurrent abnormalities, but was declined by the owner due to financial reasons.

DIFFERENTIAL DIAGNOSIS

In this case, the two luminal narrowings of the urethra observed on retrograde urethrography were attributed to different pathogenic mechanisms. The narrowing of the prostatic urethra, characterised by smoothly marginated mucosal edges, was considered secondary to benign prostatic hyperplasia and prostatic inflammation. This narrowing was therefore likely due to prostatic enlargement causing compression of the urethral lumen. In contrast, the penile urethral narrowing, characterised by irregular mucosal margins, was most likely secondary to urethritis, potentially associated with mucosal scarring, resulting from traumatic urinary catheterisations and/or passage of uroliths. This conclusion is supported by the patient's clinical signs and history. Although a neoplastic process was also considered, it was deemed less likely in this case.

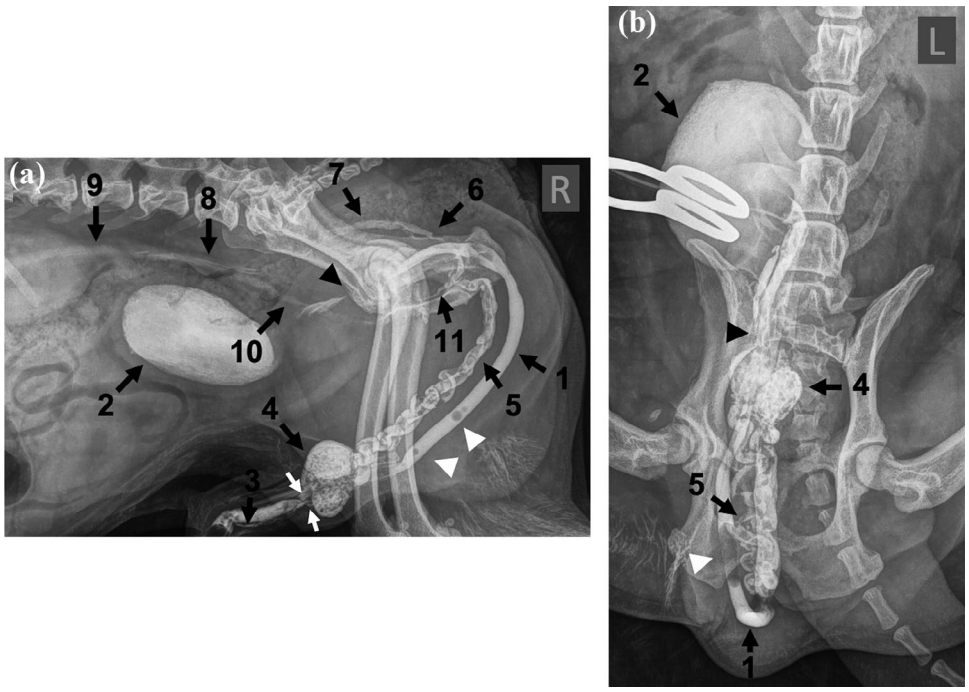

FIGURE 3 Right lateral (a) and ventro-dorsal (b) radiographs of the caudal abdomen of the same dog as in Figures 1 and 2 during retrograde urethrography, at a later stage of the procedure than in Figure 2. The urethral lumen[1] and urinary bladder lumen[2] are marked by the contrast medium. Air bubbles are visualised within the penile urethral lumen (white arrowheads). Focal luminal narrowing and irregular mucosal margins of the penile urethra are visualised at the level of the os penis (white arrows), most likely secondary to urethritis, potentially associated with mucosal scarring, resulting from traumatic urinary catheterisations and/or passage of uroliths. There is also focal narrowing of the lumen of the prostatic urethra with smooth mucosal margins (black arrowhead), likely caused by prostatic enlargement secondary to benign prostatic hyperplasia and prostatic inflammation, which causes compression of the urethral lumen. In addition to the urethra and urinary bladder, the contrast medium also marks the following structures: penile tissues,[3] bulbus glandis and its venous sinuses,[4] dorsal veins of the penis,[5] internal pudendal veins,[6] internal iliac veins,[7] common iliac veins,[8] caudal vena cava,[9] external iliac veins[10] and urethral vein.[11]

At the onset of the retrograde urethrography procedure, the initial marking of the adjacent penile tissues and various vascular structures by the contrast medium appeared discrete and poorly defined. Under fluoroscopy, this was initially interpreted as contrast extravasation into the soft tissue surrounding the penile urethra, briefly raising suspicion for an anatomical abnormality such as urethral duplication. However, as the venous sinuses of the bulbus glandis and the broader venous system became fully opacified and identifiable, the procedure was promptly terminated. At this point, urethro-venous intravasation of contrast medium was considered the main differential diagnosis, interpreted as a complication of the procedure rather than the underlying cause of the initial clinical signs.

TREATMENT

Transabdominal ultrasound-guided drainage of the two largest prostatic cavitary lesions, suspected to be abscesses, was performed on the same day as the urethroscopy, followed by transabdominal ultrasound-guided injections of oxytetracycline HCl into each cavity. The injected volumes of oxytetracycline HCl matched the amount aspirated during drainage of the cavitary lesions (approximately 1 mL in total). The patient was hospitalised and received maintenance fluid therapy and enrofloxacin (10 mg/kg, intravenously, once daily).

Based on the findings, a scrotectomy, followed by a scrotal urethrostomy, was performed 4 days after presentation at the referral clinic to bypass the lesions of the penile urethra and alleviate the clinical signs. The urethral meatus was of satisfactory size, and no intraoperative complications were observed.

OUTCOME AND FOLLOW-UP

The patient was hospitalised for an additional 2 days postoperatively, receiving analgesia (methadone, intravenously, every 4 hours with gradually decreasing doses) and NSAIDs (meloxicam, 0.1 mg/kg, intravenously, once daily) in addition to the previously mentioned antibiotic therapy (enrofloxacin, 10 mg/kg, intravenously, once daily) and maintenance fluid therapy. Advanced monitoring was conducted to ensure the absence of complications related to the urethro-venous contrast medium intravasation and the surgery. The patient was discharged upon demonstrating clinical improvement. NSAIDs (meloxicam, 0.1 mg/kg, intravenously, once daily) were prescribed for an additional 5 days after discharge, and antibiotherapy (enrofloxacin, 5 mg/kg, intravenously, once daily) was continued until the 1-month postoperative follow-up consultation. At the 1-month postoperative follow-up, the dog exhibited marked clinical improvement, though episodes of urinary incontinence had appeared. These episodes were characterised by urine pooling and spotting beneath the dog, most often during sleep. A follow-up ultrasonographic examination revealed a significant reduction in the previously observed abnormalities. Medical treatment

was therefore discontinued. An update received via email approximately 4.5 months post-surgery indicated that the dog remained in good clinical condition, although episodes of urinary incontinence persisted. The owner declined any further investigations.

DISCUSSION

Complications during or following retrograde urethrography are rare, with iatrogenic urinary tract rupture and infection being the most common.[4,6,7] Extravasation of contrast medium has been described into the peritoneal space, cavernous tissues of the penis or soft tissues adjacent to the urethra in case of urethral rupture.[1,2,5] Urethro-venous contrast medium intravasation, also known as urethro-vascular or urethro-cavernous reflux, a rare complication of retrograde urethrography, has been reported only once in a dog more proximally in the urethra.[1]. In the present case, urethro-venous intravasation caused opacification of the bulbus glandis, its venous sinuses, and the entirety of the dorsal penile veins, as well as the previously described internal pudendal and iliac veins, and caudal vena cava. The contrast marking of these structures is important to recognise as early on in the procedure as possible to halt the injection and prevent further complications.

Intravasation results from the alteration of the urethral wall's integrity and permeability, allowing contrast medium to enter surrounding penile tissues and the ascending venous pathway.[1,2] It may be associated with urethral stricture, infectious/non-infectious urethritis, previous traumatic urethral instrumentation and/or passage of uroliths. Furthermore, the inflammation also causes increased local wall vascularity.[1,7] In this case, urethritis and/or previous urethral catheterisations likely caused alteration of the integrity and permeability of the urethral wall, leading to intravasation. This case report is the first to describe urethroscopic and cytological findings in the context of urethro-venous intravasation.[8] The results confirmed urethral stricture and urethritis at the intravasation site, therefore, supporting the previously described aetiologies of the condition.[1–4,6,7] Increased injection pressure, which can occur in cases of urethral stenosis, has also been linked to an elevated risk of intravasation in human literature.[1–4] Cases in which automated pumps are used for the injection show a higher risk of increased injection pressure compared to manual injections, where resistance can be felt and the injection pressure can be adjusted. In this case report, the operator did not feel any noticeable increase in pressure during the manual injection, which is similar to what was described in a previously reported veterinary case.[1] This highlights the fact that even subclinical increases in pressure can potentially lead to complications such as contrast medium intravasation.

In human literature, a waiting period of 48–72 hours post urethral instrumentation or trauma is recommended before performing retrograde urethrography to reduce the risks of urethro-venous intravasation.[1,2,6,7] This waiting period was not adhered to in this case. The main concern in veterinary medicine would be the added costs of an extended hospitalisation.

Rapid recognition of urethro-venous intravasation is essential as it can lead to serious complications, including bacteraemia, sepsis and even death, particularly when luminal content of the urethra, including bacteria, enter the venous system. Antibiotherapy should begin promptly, though in this case, it was started approximately 24 hours after the intravasation. Vital parameters should be monitored during hospitalisation in such cases. A urine culture, not performed here, is important in such cases to identify urinary tract infection, ideally before urethrography. A previous veterinary study proposed amoxicillin and trimethoprim-sulphonamide as first-line options for urinary tract infections.[1] In this case, enrofloxacin was chosen due to suspected chronic prostatitis, despite no bacterial findings on the prostatic wash.[9] Culture results later confirmed the sensitivity of the *E. coli* strain to enrofloxacin, justifying this choice of antibiotics. Prophylactic antibiotics before retrograde urethrography are debated due to the risks of antibiotic resistance, but they may be necessary in some cases.[1,2,6,7] Other complications of urethro-venous intravasation also include anaphylaxis and contrast-induced nephropathy, emphasising the need for a full patient history and any previous adverse reactions to contrast medium.[1–4,6]

Retrograde urethrography should ideally be performed under fluoroscopic guidance or with successive radiographs to closely monitor the procedure and stop it promptly if signs of urethro-venous intravasation appear. In this case, the intravasation was difficult to visualise on fluoroscopy, mostly due to overlapping femurs in the area of interest.

At the 1-month postoperative follow-up consultation, the owner reported that the patient had developed urinary incontinence. This is a complex condition, involving both storage and voiding disorders, and can be classified as congenital or acquired. Given the sudden onset of clinical signs at an advanced age, an acquired cause was deemed most probable. In this case, based on the history and clinical presentation, the main differential diagnoses include urethral sphincter mechanism incompetence and prostatitis. Acquired urethral sphincter mechanism incompetence has been observed post-neutering in dogs, with treatment options including medical therapy (e.g., alpha-adrenergic agonists like phenylpropanolamine and testosterone cypionate) and surgical interventions (e.g., urethral hydraulic occluders).[10–12] Urinary incontinence secondary to prostatitis could align with the dog's clinical history; however, the persistence of incontinence after the resolution of prostatitis symptoms makes this aetiology less likely. Ideally, further diagnostic tests, including urodynamic tests, cystoscopy and additional imaging, would be performed to clarify the cause. However, the owner declined any further investigations.

AUTHOR CONTRIBUTIONS

All authors (Jérémie Ficheroulle, Emilie Vangrinsven, Stefan Deleuze, Stéphanie Claeys and Géraldine Bolen) acquired, analysed and interpreted the data, and validated the manuscript. Jérémie Ficheroulle and Géraldine Bolen wrote the paper.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

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The authors received no specific funding for this work.

ETHICS STATEMENT
The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. No ethical approval was required as this is a clinical case of a client-owned animal treated at our hospital clinic using high standard (best practice) of veterinary care. All decisions were made with diagnosis and treatment as sole objectives; at no point did the publication of this case report influence the decisions made. Informed client consent was provided for the diagnostic procedures and treatments described, as well as for the use of these data and the publication of this case report.

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IMAGE QUIZ
Figure 2 Right lateral radiograph of the caudal abdomen of a dog after initiation of retrograde urethrography.

MULTIPLE-CHOICE QUESTION
Which structure is annotated with the number 5?

POSSIBLE ANSWERS TO MULTIPLE-CHOICE QUESTION
A. Dorsal arteries of the penis
B. Corpus spongiosum
C. Duplication of the urethra
D. Dorsal veins of the penis
E. Corpus cavernosum

CORRECT ANSWER
A. The dorsal veins of the penis.

The dorsal veins of the penis are marked by contrast medium following urethro-venous contrast medium intravasation occurring at the level of the bulbus glandis as a complication of the retrograde urethrography secondary to urethritis and urethral stricture in this region.