

Post-traumatic urinoma in two cats: Imaging diagnosis

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Abstract: A urinoma is a collection of urine surrounded by a fibrotic wall and, in the veterinary medicine, this condition is rarely reported. The aim of this study is to describe the clinical and therapeutic features of two cats with post traumatic urinomas, with particular attention paid to the imaging findings. In both patients, well-defined anechoic fluid collections in the retroperitoneal space were identified by ultrasound examinations and the laboratory tests suggested the urinous nature of the fluid. With excretory urography, the only relevant findings revealed were the abdominal and retroperitoneal loss of detail, whereas the combination of multiple techniques in Case 1 and the delayed study in Case 2, detected contrast leakage and fluid collections in the retroperitoneal space. Both patients fully recovered after either surgical or conservative treatments. In conclusion, different imaging modalities have been helpful to properly diagnose urinomas in cats and especially combined and/or delayed studies were of paramount importance for the final diagnosis.

Keywords: feline urinoma; ultrasonography; radiography; computed tomography; excretory urography; retrograde cystourethrography

In cats, urinary tract rupture may occur as a result of car accident, pelvic fractures, bite wounds, penetrating injuries, urethral calculi and iatrogenic injury during urethral catheterisation or surgery (Weisse et al. 2002; Anderson et al. 2006; Meige et al. 2008; Halfacree et al. 2011; Addison et al. 2014). Uro-retroperitoneum is the most common complication of urinary tract rupture, and urine extravasation may result in a urinoma (Bacon et al. 2002). The term urinoma refers to an encapsulated collection of leaked urine outside the urinary tract caused by a disruption of the urinary collecting system at any level from the calix to the urethra (Titton et al. 2003; McGeady and Breyer 2013; Phillips et al. 2017); in veterinary medicine, this is an uncommon condition, and only few reports of urinomas are described in feline medicine (Geel 1986; Lemire and

Read 1998; Bacon et al. 2002; Moores et al. 2002; Worth and Tomlin 2004). The aim of this work was to report two different cases of urinomas in two feline patients with particular attention to some aspects of the diagnostic imaging that, according to our knowledge, have not yet been described in veterinary medicine.

Case 1 presentation

A 6-year-old male domestic neutered short-hair cat was referred to the Veterinary Hospital for dysuria, hyporexia and weight loss. The cat was allowed to roam outdoors, and had a history of a car accident that occurred four weeks before the referral. During the physical examination,

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a bilateral swelling on the ischiatic region was observed. The complete blood count (CBC) and serum chemistry revealed mild anaemia (Hct 19%, reference interval 27–47%), azotaemia (creatinine 50.0 mg/l, reference interval 7.0–20.0) and hyperphosphatemia (phosphorus 63.0 mg/l, reference interval 25.0–50.0). The urinalysis was unremarkable, and the culture was negative.

The ultrasound (US) examination revealed multiple and well-defined anechoic fluid collections in the caudal abdomen. The biochemical tests performed on the fluid collected through centesis strongly suggested a urinary nature of the fluid (a fluid creatinine concentration to plasma creatinine concentration ratio of 8.7; a fluid potassium concentration to plasma potassium concentration ratio of 2.7) (Aumann et al. 1998). An excretory urography with 800 mg/kg of iodinated contrast

medium (Iopamiro[®], Bracco Imaging S.p.A., Milan, Italy) administered intravenously (i.v.), was performed; the acquisition protocol comprised a plain lateral radiograph followed by lateral and ventrodorsal (VD) radiographs 1, 2, 5, 10 and 15 min after the administration of the contrast medium. The plain radiograph showed a loss of abdominal and retroperitoneal detail. Moreover, multiple pubic fractures and soft tissue swelling at the level of the perineum were present. The excretory urography showed the contrast medium filling both kidneys, the ureters and the bladder (Figure 1). Two hours later, due to the inconclusive excretory urography, a delayed computed tomography (CT) study of the urinary tract was performed; the non-enhancing multiloculated fluid collection (median density 14 HU) in the retroperitoneal space, starting from the left kidney and extending caudally

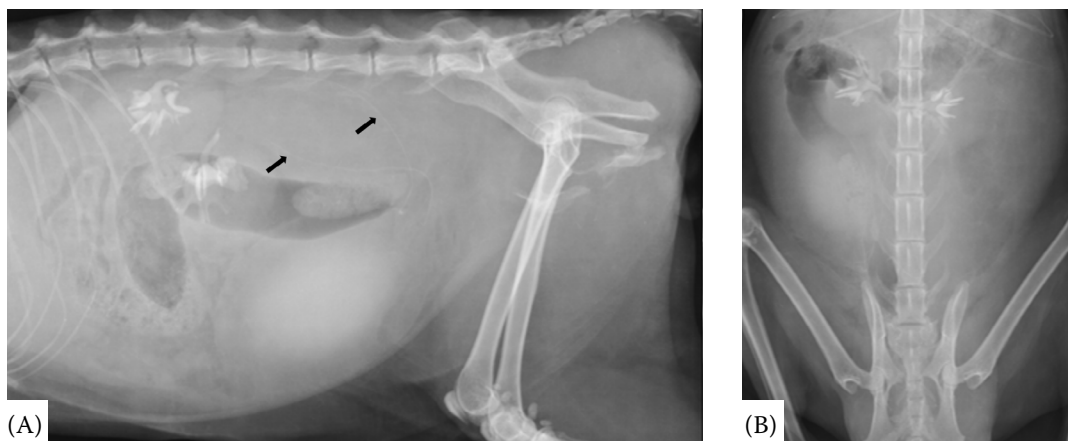


Figure 1. Case 1. Excretory urography. Lateral (A) and ventrodorsal (B) projections 15 min after administration of the contrast medium showed normal kidneys, ureters (black arrows), and a urinary bladder. The loss of abdominal and retroperitoneal detail, multiple pubic fractures and soft tissue swelling opacity at the level of the perineum were already detected in the plain study

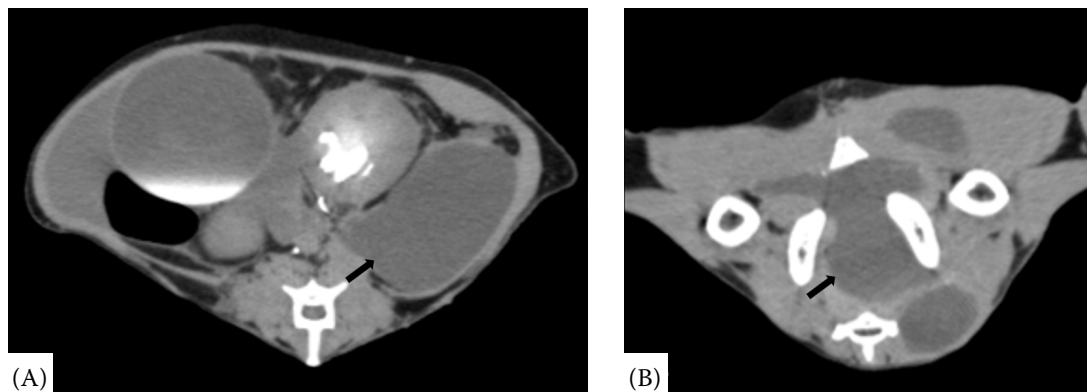


Figure 2. Case 1 (A, B). The two-hour delayed CT study of the urinary tract showed the non-enhancing multiloculated fluid collection in the retroperitoneal space (black arrows), while some contrast medium was still present in the kidneys and in the urinary bladder

along the iliopsoas muscle to the perineal space and left femur was detected, while some contrast medium was still present in the kidneys and in the urinary bladder (Figure 2). After 4 h, a further radiographic examination was performed; the result was the mild to moderate increased opacity in the retroperitoneal and perineal space and an emptying delay of both kidneys (Figure 3). A retrograde cystourethrography was then performed with a 20% solution of the same contrast medium; a leakage of the contrast from the proximal urethra was detected, with the filling of a tubular structure and of the soft tissue perineal mass (Figure 4).

The final diagnosis was a urethral rupture with a urinoma formation, extending from the retro-

peritoneal space to the perineal region. The owner, after being informed of the possible treatments, decided, in agreement, with the clinicians for a conservative treatment, and a 5-French Foley catheter was applied in the urethra and left in place for four weeks (Figure 5). The patient underwent haemato-biochemical tests and a urinalysis every week (Table 1) and was monitored every two weeks with a urine culture and retrograde cystourethrography until the spontaneous reabsorption of the urinomas occurred. A prophylactic antimicrobial therapy was not administered because of the absence of any clinical or clinic-pathological evidence of infection. After two years of follow-up, the patient is in good condition with no detected recurrence.



Figure 3. Case 1. The lateral view of the abdomen and pelvis 4 h after the administration of the contrast medium. A mild to moderate increased opacity in the retroperitoneal and perineal space was present

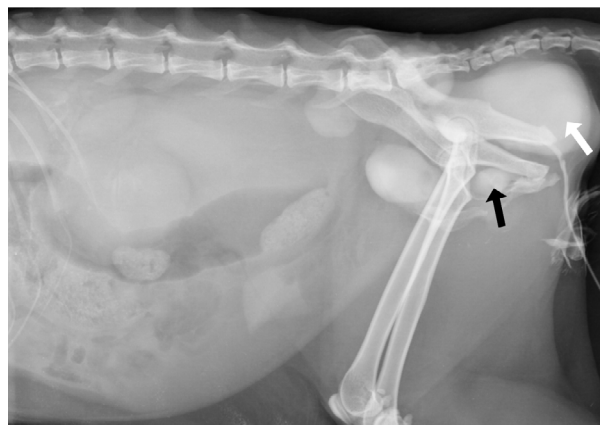


Figure 4. Case 1. The retrograde cystourethrography highlighted the leakage of the contrast from the proximal urethra, with the filling of a tubular structure (black arrow) and of the soft tissue perineal mass (white arrow)



Figure 5. Case 1. Four weeks from the diagnosis. After having extracted the Foley catheter, lateral (A) and ventrodorsal (B) view of the abdomen and pelvis after retrograde cystourethrography showed a mild loss of retroperitoneal detail, while the lesion in the perineum was no longer visible

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Table 1. The results of the blood and urine analysis of the cat presented as Case 1. Only the abnormal values are reported

Time	Admission	1 st control	2 nd control	3 rd control	4 th control	Reference range
Haematocrit (%)	19	21	28	–	–	27–47
Creatinine (mg/l)	50	32	20	–	–	7–20
Phosphorus (mg/l)	63	50	–	–	–	25–50
Urinary sediment	no	cylinders, epithelial cells, amorphous material	cylinders, epithelial cells, amorphous material	cylinders, rare epithelial cells, amorphous material	–	no to rare
Urinary pH	–	6.0	6.0	6.0	6.2	5.5–8.5
Urinary bilirubin (mg/l)	–	10	6	6	–	0–5
Urinary blood	–	positive	positive	positive	positive	negative
Urinary protein (mg/l)	–	1 000	1 000	–	–	0–1 000

Case 2 presentation

An adult female stray cat was referred to the Veterinary Hospital for a perforating wound in the inguinal region and a subsequent abdominal wall rupture and small intestine displacement in the subcutis. The complete blood count and serum chemistry evidenced marked leucocytosis with a left shift (Table 2), and the US performed at the previous clin-

ic suggested urine leakage from the kidney or ureter. The urinalysis was within normal limits. An excretory urography was performed without evidence of urine leakage, so surgery to reduce the hernia and repair the wound was performed. Cephazolin with 25 mg/kg (Cefazolina Teva[®], 1 g powder and solvent for the intramuscular solution injection, Teva Pharmaceutical Industries Ltd. Milan, Italy) was administered i.v. just before the surgery and every 8 h

Table 2. The results of the blood and urine analysis of the cat presented as Case 2. Only the abnormal values are reported

Time	Admission	Post-nephrectomy	Reference range
Erythrocytes (10 ⁶ /μl)	7.94	4.55	5.0–10.0
Leucocytes (10 ³ /μl)	38.1	14.7	5.5–19.5
Neutrophils-bands (μl)	762	0	0–300
Neutrophils-segments (μl)	34 290	12 642	2 500–12 500
Platelets (10 ³ /μl)	115	391	300–800
Haemoglobin (g/l)	108	65	80–150
Haematocrit (%)	34.7	21.2	30–45
Glucose (mg/l)	1 360	–	730–1 250
Triglycerides (mg/l)	830	–	80–800
Total protein (g/l)	55	54	58–80
Albumin (g/l)	24	27	25–40
Globulin (g/l)	31	27	28–55
Urinary bilirubin (mg/l)	10	–	0–5
Urinary blood	positive	–	negative
Urinary protein (mg/l)	1 000	–	0–1 000
Urinary sediment	cylinders, epithelial cells, amorphous material	–	no to rare

for the following five days. The perioperative analgesia consisted of methadone (Semfortan[®] 10 mg/ml; Eurovet Animal Health B.V. AE Bladel, Netherland) (0.2 mg/kg) intramuscularly (i.m.) and was induced with midazolam (Ipnovel[®], 5 mg/ml; Delpharm, Milan, Italy) (0.2 mg/kg) and propofol (Proposure[®] 10 mg/ml; Boehringer Ingelheim, Ingelheim am Rhein, Germany) to effect (2.4 mg/kg *pro toto*) and was maintained with isoflurane in an oxygen/air mixture (ratio 2 : 1) and the analgesia was provided with a variable rate infusion (VRI) of fentanyl (Fentadon[®] 50 mcg/ml; Eurovet Animal Health B.V. AE Bladel, Netherlands) (5–10 µg/kg/hr). The post-operative analgesia was achieved with buprenorphine (Bupaq[®] 0.3 mg/ml; Virbac, Milan, Italy) (20 µg/kg) i.v. every 6 hours. Two weeks after the surgery, the cat became hyporexic. The complete blood count, serum chemistry and urinalysis were normal, while the abdominal US revealed a well-defined anechoic fluid collection in the left perinephric region and, after the biochemical tests were performed on the fluid collected by centesis, a urine extravasation was suspected (a fluid creatinine concentration to plasma concentration ratio of 29.3; a fluid potassium concentration to plasma potassium concentration ratio of 2.0) (Aumann et al. 1998). An excretory urography with 800 mg/kg of iodinated contrast medium, (Iopamiro[®]; Bracco Imaging S.p.A., Milan, Italy) administered intravenously, was elected; the imaging protocol comprised plain VD and lateral radiographs, and VD and lateral radiographs 3, 5, 20, 30, 50 min and 4 h after contrast medium injection. The right kidney and both

ureters were normal, the left renal pelvis appeared mildly dilated, with a soft tissue radiopacity mass of 3.9 cm laterolaterally, 3.4 cm dorsoventrally, and 4.5 cm craniocaudally (Figure 6) enhancing after 4 h from the contrast medium injection localised in the retroperitoneal space; the contrast leakage in the retroperitoneal space and abdomen, and delayed emptying of the left kidney were detected at the same time (Figure 7).

With the owner's consent, after a thorough discussion of the therapeutic options, a left nephrectomy was elected. In order to resolve the emerging metabolic derangement, fluids (3 ml/kg/hour, Ringer's lactate solution; S.A.L.F., Bergamo, Italy), gastrointestinal protectants, i.e., ranitidine (1.5 mg/kg q12h; Zantadine[®] injectable solution 5 ml 30 mg/ml; Ceva Santé Animale, France) and antiemetics (maropitant 1 mg/kg q24h, Prevomax[®]; Dechra Veterinary Products, Torino, Italy) were administered intravenously for 4 days. During the second day, the appetite clearly improved, and the surgery was scheduled for the following week.

The pre-operative analysis was within normal limits and before the surgery, to better assess the lesion, a plain CT was performed, followed by 7 scans acquired every 10 min after the intravenous injection of 600 mg/kg of iodinated contrast medium (Iopamiro[®]; Bracco Imaging S.p.A., Milan, Italy).

The plain CT showed three fluid filled collections along the path of the proximal third of the left ureter. After 10 min, a communication between the proximal third of the left ureter and the first fluid filled lesion was evident. The progressive

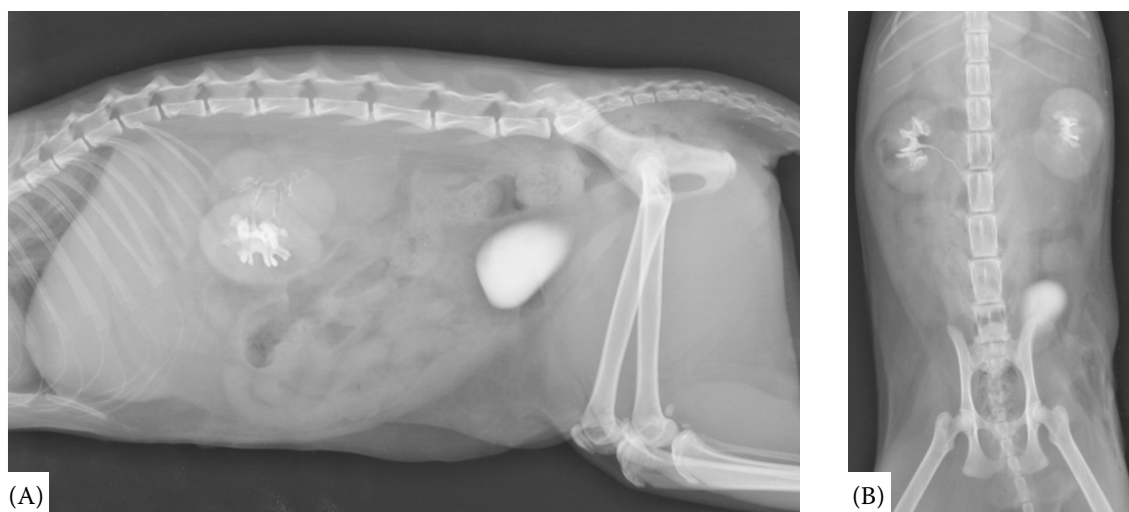


Figure 6. Case 2. The excretory urography evidenced a normal right kidney and both ureters (A, B), while the left renal pelvis appeared mildly dilated, with a soft tissue radiopacity mass visible caudomedially to the left kidney (B)

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Figure 7. Case 2. Delayed study, lateral (A) and ventrodorsal (B) view of the abdomen and pelvis 4 hours from contrast medium injection, the soft tissue mass in the retroperitoneal space was enhancing; contrast leakage in the retroperitoneal space and abdomen was also present as well as emptying delay of the left kidney

contrast filling of all the lesions was detected from 20 min to 70 min and the contrast medium leakage was evident in the ventrocaudal abdomen after 70 minutes (Figure 8).

The cat underwent an exploratory laparotomy and a small tear in the proximal part of the left ureter was detected; a left nephrectomy with a mass excision was then performed.

The cat was premedicated with methadone (Semfortan® 10 mg/ml; Eurovet Animal Health B.V. AE Bladel, Netherlands) (0.2 mg/kg) and midazolam (Ipnovel®, 5 mg/ml; Delpharm, Milan, Italy) (0.2 mg/kg) i.m. mixed in the same syringe and injected in the hind limb. The perioperative analgesia was achieved with a VRI of remifentanyl

(Remifentanil Sandoz®, 1 mg; Lek Pharmaceuticals d.d., Ljubljana, Slovenia) (0.1–0.4 µg/kg/min) and ketamine (Ketavet® 100, 10%; Intervet Productions Srl, Aprilia, Italy) (10 µg/kg/min). Cephazolin (25 mg/kg) i.v. was given before the skin incision and every 90 min until the end of surgery, during which a small tear in the proximal part of the left ureter was detected and a left nephrectomy with a mass excision was then performed. The ketamine was disconnected 20 min before the end of the surgery and methadone (0.15 mg/kg) was given i.v. at the end of the surgery and when the Botucatu pain scale score was > 7 (Della Rocca et al. 2018). The pain scale was applied hourly for the first 4 h and then every 2 hours.

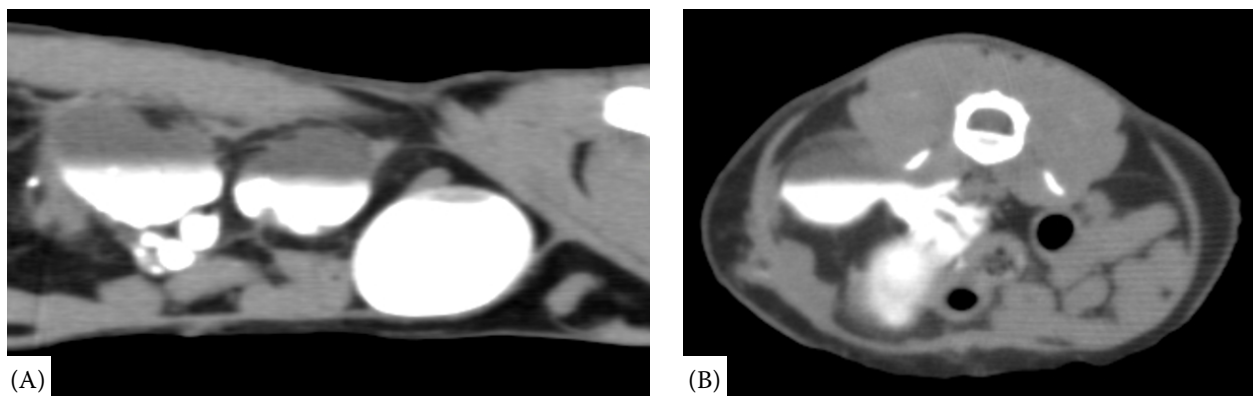


Figure 8. Case 2. (A) The sagittal reconstruction of the CT study 55 min after the contrast injection showed the fluid filled collections along the path of the left ureter with the partial filling of the contrast medium. (B) The transverse view 70 min after the contrast injection showed the partial filling of the urinoma and the leakage of the contrast medium in the ventrocaudal abdomen

The cat had periodic follow up tests every six months; after two years the patient is still non-azotaemic without further complications.

DISCUSSION

In human medicine, urinomas are often described as consequences of blunt trauma, urinary tract obstruction by uroliths, intra-abdominal malignancy, retroperitoneal fibrosis or post instrumentation (Titton et al. 2003; Goldwasser et al. 2018). This condition is also described in fetuses mostly because of the urine extravasation after the rupture of the kidney second to an underlying urinary tract obstruction or trauma (Gorincour et al. 2006; Zaccara et al. 2011; Yitta et al. 2014).

The development of a urinoma is due to the chronic low-grade escape of urine sufficient to exceed absorption and the local inflammatory response of the surrounding perirenal fat; urine causes lipolysis of the fat within 48 h and fibroblastic hyperplasia and round cell infiltration of the necrotic fat produces a fibrous capsule around the urine collection within three to six weeks (Bacon et al. 2002; Goldwasser et al. 2018).

Imaging diagnostic plays a key role in the diagnosis of urinomas, with CT and retrograde urethrography considered as the diagnostic imaging modalities of choice (Titton et al. 2003).

In particular, a CT may allow for the detection of urine leaks by delayed phase imaging, i.e., 5–20 min after the injection of the contrast medium, since iodinated urine increases the attenuation of the urinoma over time (Titton et al. 2003; Goldwasser et al. 2018).

In veterinary medicine and in feline medicine in particular, urinomas are a rare condition, with few reports available in literature; in the majority of the cases, urinomas are described as post-traumatic in nature (Geel 1986; Bacon et al. 2002; Moores et al. 2002; Worth and Tomlin 2004).

As for felines, urinomas have been rarely described in other species. A urinoma in a dog was described as a result of iatrogenic ureteral trauma during an ovariohysterectomy (Tidwell et al. 1990) and in a parturient cow after dystocia (Lopez et al. 1995).

In this work, we reported two more cases of post-traumatic urinomas in cats; as was for the other cats (Bacon et al. 2002; Worth and Tomlin

2004), the patients described here, were referred for non-specific symptoms (anorexia, weight loss) and both of them suffered traumatic injuries several weeks prior to the case presentation. As regards to the hematobiochemical analysis, a routine test is unremarkable (Bacon et al. 2002) or, more often, suggestive of a post-renal disorder (Geel 1986; Moores et al. 2002; Worth and Tomlin 2004); also, a non-specific inflammatory leucogram may be present (Lemire and Read 1998), as observed in a cat described in this report.

Furthermore, single imaging studies may be unable to detect urinary lesions, potentially leading to an underdiagnosis and, in the cases reported here, combining the different imaging modalities has been helpful for the final diagnosis but, what deserves to be highlighted, is the importance of the delayed imaging studies to detect the lesion contrast enhancement. Indeed, in the first case described, the US examination, plain radiographs only revealed multiple anechoic fluid collections in the caudal abdomen and the loss of abdominal and retroperitoneal detail, respectively, and the standard excretory urography was normal. Even the delayed CT showed a non-enhancing multiloculated fluid collection, while only a further radiographic examination at 4 h from the contrast injection revealed a pool of contrast medium in the retroperitoneal and perineal space, and after the retrograde cystourethrography, a leakage of the contrast from proximal urethra was detected, leading to a final diagnosis of urethral rupture with consequent multiple urinomas; in the second case, the combination of the US and excretory urography revealed a well-defined anechoic fluid collection in the left perinephric region and a soft tissue radiopacity mass caudal to the left kidney were detected, respectively. Only the radiographs after 4 h from the contrast injection showed the enhancing mass lesions and contrast leakage.

Also, the CT study before the surgery showed the progressive filling of the urinoma from 20 min to 70 min, with the leakage only visible in the delayed scan (70 minutes).

The delayed imaging studies were the key to get the final diagnosis in our urinoma cases; according to what has been previously described, time is needed to observe the iodinate urine attenuation, so delayed studies are necessary to detect urinomas in the case of a urine tract rupture (Titton et al. 2003; Goldwasser et al. 2018). Furthermore, our results are consistent with what is currently per-

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formed in human medicine, where CT delayed phase images, in particular, are of paramount importance to properly diagnose urinomas (Titton et al. 2003).

In most cases of feline urinomas, cystic fluid-filled lesions were suspected on the basis of US and radiographic findings, such as the loss of detail in the retroperitoneal space with soft tissue radiopacity masses of various sizes without any evidence of contrast enhancement (Lemire and Read 1998; Bacon et al. 2002; Moores et al. 2002). A mass opacification was described 20 min after contrast medium injection in only two reports (Geel 1986; Worth and Tomlin 2004). This report firstly describes the usefulness of 4-hour delayed radiographs in conjunction with the excretory urography) and, in one case, a retrograde cystourethrography in detecting the contrast fluid filling. Moreover, the CT findings of the feline urinomas were reported here, since this technique has never been included in the diagnostic protocols described in previous reports.

These imaging findings from the delayed studies, combined with clinical and laboratory alterations, were of paramount importance to obtain the final diagnosis in the two cats described in this report while explorative laparotomies were performed in order to proper diagnose and treat this condition in previous reports (Geel 1986; Bacon et al. 2002; Moores et al. 2002; Worth and Tomlin 2004) and, in one case, urinomas were diagnosed during a necropsy (Lemire and Read 1998). Previous reports about feline urinomas described a surgical resection (Bacon et al. 2002; Worth and Tomlin 2004) as a therapeutic option; in the present study, both conservative and surgical excision were successful with a good outcome for our patients without further complications.

To conclude, urinomas, despite being a rare condition, should be considered as a potential complication in cats with a history of trauma. Since clinical and clinic-pathological signs may be unremarkable or suggestive of a non-specific post-renal disorder, combining different imaging techniques, together with delayed studies, is essential to achieve the final diagnosis in order to plan the proper therapeutic approach in these patients.

Conflict of interest

The authors declare no conflict of interest.

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