Nitzan Kroter discusses this procedure in reference to a case involving the removal of calcium phosphate renoliths in a cat with only one functional kidney

**Summary**

A 12-year-old cat was presented for chronic weight loss. Clinical evaluation and investigation revealed an atrophied left kidney with nephroliths and an enlarged right kidney containing multiple renal calculi.

Bilateral calcium phosphate renal calculi were diagnosed. This report describes pyelolithotomy in a cat.

Pyelolithotomy was performed to avoid damage to the renal parenchyma, which could occur during a nephrotomy, and, therefore, minimise further damage to an already compromised kidney. Before performing surgery, consideration of the patient’s renal function is important to obtain optimal results. Maintaining normal urine production in the pre-operative and postoperative period is important in all cases.

Pyelolithotomy in the dog is covered and described in the literature; the author is unaware of a detailed description of pyelolithotomy in a cat.

**Key words**

kidney, pyelolithotomy, urine
A NEUTERED domestic shorthaired male feline presented with a complaint of marked weight loss over the preceding few months. It weighed 2.6kg.

When recorded two-and-half years previously, its weight had been 5.5kg. The owner reported recent increased activity, the cat was more talkative and attention seeking, and had a normal appetite. There was no history of polydipsia or polyuria, and there had been no vomiting or diarrhoea.

Clinical examination and investigation

The patient had a body condition score of 2/4 and an unkempt coat, but it was responsive and alert. It showed normal vital parameters and had mild dental plaque. Heart rate, respiration and temperature were within normal limits. Abdominal palpation revealed an enlarged right kidney, which was associated with mild resentment to palpation. The left kidney was also sensitive and very small. The thyroid glands were not palpable.

Blood pressure was within the normal reference range. Haematology, serum chemistry and urinalysis were suggestive of chronic renal insufficiency and proteinuria. There was no evidence of infection and urine crystals were not identified. Total T4 was within the normal reference range.

Ultrasound examination results can be seen in Figures 1, 2 and 3. The radiological examination results can be seen in Figure 4.

Problem list and differential diagnosis

• Renal azotaemia.

• Left renal atrophy and calculi.

• Right renal compensatory hypertrophy and calculi.

• Mild dental disease.

Pre-operative management

The cat was admitted to hospital for initial treatment to improve the renal parameters. After four days of treatment – consisting of intravenous fluid administration with lactated Ringer’s solution, oral phosphate binders, intravenous cimetidine, a renal prescription diet and antibiotics – the azotaemia had improved and the appetite was good.

Surgical procedure
Methadone and midazolam were used for pre-medication. Midline celiotomy and left nephrectomy were performed. The ureter was followed distally, close to the bladder trigone, and was then ligated and transacted.

The right kidney was exposed and the renal fat dissected to isolate the renal vessels and proximal ureter. A 5mm incision was made from the proximal ureter to the renal pelvis.

The aim of the incision was to establish an entrance to the renal pelvis without entering renal parenchyma, and to avoid a more distal incision to the narrow ureter. The ureter was then cannulated with a thin, male cat-orientated urinary catheter to prevent renoliths from escaping distally to the ureter during the procedure.

All calculi were removed using a combination of hydro-retroflush, a malleable 30G wire loop and a mini-Volkman curette. A 20G intravenous catheter, connected to a 20ml saline syringe, was inserted into the renal pelvis. Firm pressure was applied upon the syringe – but not a forceful flush – and retrieved a large amount of grit-like calculi and brought many to the surface.

The Volkman curette was only used for final retrieval through the small surgical incision. The malleable 30G wire loop was used to extricate calculi material and loosen deeper uroliths from the renal calyx without traumatising further soft tissue.

Every care was taken not to damage the renal parenchyma, which could have resulted in further renal injury. Once all calculi had been removed, the ureter was flushed distally to confirm patency and the male cat catheter was removed.

A large 14G hypodermic needle was passed from the pyelolithotomy incision to the exit obliquely via the caudal renal pole, through the abdominal wall and to the skin. A thin, soft silicone urinary catheter (Figure 5) was inserted into the end of the needle to enter the ureter and act as a temporary stent.

A second catheter was inserted in a similar fashion to end up in the renal pelvis. It was then connected to a closed system suction system to allow urine collection and to create a urinary diversion system. Each catheter was later marked A and B respectively, and both were secured to the skin.

The pyelolithotomy incisions were sutured over the catheter using 7/0 polydioxanone (PDS) with a simple, interrupted suture pattern. The kidney was secured to the abdominal wall to prevent “floating” and to avoid any pulling on the tubes. A protective abdominal bandage was applied.

**Postoperative care**

Intravenous fluid therapy was continued, and was reduced to a maintenance rate after complete
Blood pressure was monitored regularly. Urine output was measured via the closed-system collecting system. Urea creatinine and total proteins were measured to observe for signs of deterioration. Nasogastric feeding started soon after recovery; voluntary feeding commenced two days postoperatively.

Urine output was monitored via the negative pressure closed system for four days. After four days, the catheter marked A was removed to allow bladder filling.

Catheter B was disconnected from the negative-pressure system, allowing restoration of normal urinary flow from the kidney to the bladder. Catheter B was finally removed only after the author had confirmed that the proximal ureter was patent and urine flow was normal.

**Postoperative outcomes and complications**

Once catheter A had been removed four days postoperatively, bladder filling was monitored via palpation, effected three times a day.

A daily ultrasound examination was also performed. Very little bladder filling was noted after 24 hours, and no urination was observed.

Ultrasound examination revealed a small amount of free abdominal fluid. Urine could not be retrieved from catheter B and was, therefore, removed. Bladder filling was only noted the next day, and the cat started urinating the day after the bladder started filling.

Urea (23mmol/L) and creatinine (400umol/L) levels were elevated during these two days, but returned to acceptable levels (urea 12mmol/L, creatinine 228umol/L) thereafter. Urinespecific gravity was SG 1.028.

**Follow-up**

Bodyweight, urea, creatinine, albumin and phosphate were monitored daily; urine production was monitored every two hours. Maintenance treatment for chronic renal insufficiency and diet modification was implemented.

Benazepril oral tablets (2.5mg once daily), oral phosphate binders and a renal prescription diet were prescribed. The nephroliths were analysed and the results revealed a calcium oxalate monohydrate surface (five per cent) and a calcium phosphate apatite stone (95 per cent).

Although the azotaemia never resolved, it did stabilise and the cat’s appetite remained good.
A follow-up examination was conducted seven months postoperatively. At this point, bodyweight (Figure 6) had increased to 3.4kg, coat quality had improved and appetite was reported to be good.

Moderate renal azotaemia and isosthenuria were persistent, yet stable, throughout the longterm follow-up examinations.

**Discussion**

Renal calculi in cats are not uncommon, and the treatment chosen would largely depend on the type of stones (Figures 7a to 7b) involved.

The clinical presentation may be varied, from incidental findings, mild inappetence or depression, signs of feline lower urinary tract disease, pyrexia of unknown origin, vomiting and weight loss (as in this case), to signs of acute or chronic renal failure.

The diagnosis is based on the presenting clinical complaint, urinalysis and radiographic and ultrasound examination.

Occasionally, an intravenous pyelogram may be beneficial to demonstrate radiolucent renal calculi. Full urinalysis, urine culture and sensitivity, serum chemistry and haematology, as well as blood pressure monitoring, should be integral parts of the diagnosis process.

The treatment for renal calculi will depend on the type of stones present, the presence of infection and the functional state of the kidneys. In some cases, dietary modification may dissolve the calculi. In this case, there was no evidence of crystals in the urine. No bacteria were cultured from a sterile urine sample; the cat’s condition had deteriorated and there was only one functional kidney.

Nephrotomy is a welldescribed surgical procedure for the removal of nephroliths. Bolliger et al (2005) reported a modest relative reduction in renal function and a minimal effect on total glomerular filtration rate following nephrotomy in healthy cats. However, any detrimental effects of nephrotomy may be magnified in cats with diseased kidneys that may have little or no capacity for repair or compensation. This cat could not tolerate further renal function deterioration, and renal transplants are not available in the UK (mostly due to ethical reasons).

Three options for treatment were considered: supportive treatment, euthanasia and surgical management. Due to the decline in the cat’s condition, the presence of only one functional kidney and the poor estimated long-term prognosis, surgical management was elected.

The left kidney was small, atrophic and most likely nonfunctional. It had calculi, which were a potential source of infection and the kidney was painful on palpation. For these reasons, it was removed.
Pyelolithotomy was elected to retrieve the renoliths without compromising renal tissue. A small proximal ureterotomy was essential to allow room for manipulation. Every attempt was made to incise as little as possible distally to avoid the complication of ureteral stricture formation. Great care was taken to avoid the renal vessels. Meticulous dissection of the surrounding fat helped to avoid unwanted haemorrhage.

Distal migration of calculi can occur during manipulation of the kidney, curetting and scooping, retro-flushing and irrigation. Safe removal of calculi from the distal ureter of a cat could be extremely difficult and, therefore, it is important to incise and cannulate the distal portion to prevent distal ureteral obstruction.

In this case, every effort was made to avoid any further load on the already compromised kidney. The correct instruments, the choice of suture materials, illumination and magnification will greatly ease the technical demands of this procedure and reduce the rate of possible complications.

In some cases, where hydronephrosis and hydroureter occur, the lumen of the proximal ureter and renal pelvis would be wide enough for primary closure with no need for further support or a urinary diversion system. In this case, the proximal ureter was narrow and oedematous, which posed a concern regarding postoperative stenosis and strictures.

A narrow, swollen ureter is a recipe for stricture and blockage. Therefore, the catheter system was inserted to prevent these potential complications. The removal of the soft-silicone catheters A and B from the kidney left two small open holes at the caudal pole. This resulted in urine escaping to the retroperitoneal space. This was selflimiting, as the holes granulated and sealed with time.

To avoid urine leakage, it may be beneficial to create a more diagonal tunnel when using the hypodermal needle for catheter placement. The diagonal tunnel may increase resistance for direct flow and favour bladder filling sooner.

To date, the author has performed another successful pyelolithotomy in a cat with xanthine nephroliths. In this case, however, there was no need for the implementation of a urinary diversion system and suture line support due to sufficient ureteral dilatation. An intravenous pyelogram is beneficial for all cases intended for pyelolithotomy. This improves renal assessment and pre-surgical planning.

The exact point of incision into the renal pelvis of a cat appears to depend on the severity of the pathology, and the variation of anatomical location and distribution of the blood supply to the kidney.

A detailed study is needed to optimise the accuracy of the entrance to the renal pelvis and reduce the probability of complications.
References and further reading