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Chinese herbal medicine combined with cystotomy for feline bladder stones

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Abstract

A 2-year-old 3.5-Kg castrated male Chinese domestic cat was hospitalized for intermittent vomiting, hematuria, pain in urine, depression and anorexia. The cat was diagnosed with bladder stones combined with feline lower urinary tract disease (FLUTD) by clinical examination, laboratory examination and imaging examination. The cat was treated with cystotomy and Chinese herbal medicine (Ba Zheng San), showing no adverse reactions throughout the treatment. Since discharged on day 10 the cats took Ba Zheng San granules orally twice a week for three months, meanwhile supplied with sufficient drinking water and commercial dog ration containing Ba Zheng San for FLUTD preventing effect. Renal function, urinalysis and B-scan ultrasonography were tested one month after the operation, and the results were normal. both re-examination of six months and two years post recovery showed that the cat remains healthy, no recurrence of bladder stones. The results of this study indicate that the combination of open cystotomy and Ba zheng San have good treatment effect on FLUTD induced by feline bladder stones, and Ba Zheng San granules and the cat ration containing Ba Zheng San can effectively prevent the recurrence of feline bladder stones.

Keywords: Bladder stones, Feline lower urinary tract disease (FLUTD), Cystotomy, Chinese herbal medicine; Ba Zheng San (Eight Righteous powder), feline

Introduction

Feline bladder stone is a common disease affecting feline urinary system. The clinical incidence is increasing as more and more cats are raised as pets in China. Urolithiasis as urinary system problem is prevalent worldwide, accounting for about 15%-23% of all FLUTD cases, and most of them are bladder stones (Bartges and Callens, 2015; Gomes *et al.*, 2022) ^[5, 12]. The clinical symptoms of different cases of feline bladder stones vary greatly, and the clinical manifestations vary according to the size, number and location of stones (Gomes *et al.*, 2022) ^[12]. Most affected cats present with dysuria, frequent urination, hematuria, and calculous dysuria.

The number, composition, size, and location of stones are usually detected by serum biochemical test, urine examination, X-ray examination, and B-scan ultrasonography (Grauer, 2015; Bartges, 2016; Remichi *et al.*, 2020; Seo *et al.*, 2021) ^[14, 23, 29, 30]. The most common bladder stones in felines are calcium oxalate and struvite (Grauer, 2015; Kopecny *et al.*, 2021) ^[14, 19], radiological exam can predict the mineral composition of some uroliths, but some cannot be clearly discerned (Weichselbaum *et al.*, 2001; Kopecny *et al.*, 2021) ^[35, 19]. There are several treatment methods available for feline bladder stones, including conservative treatment with dietary regulation (Tefft *et al.*, 2021) ^[32], cystoscopic-guided stone basket-retrieval (Weisse and Berent, 2015) ^[6], open cystotomy (Lulich *et al.*, 2016) ^[23], and minimally invasive surgery (Cruciani *et al.*, 2020; Buote *et al.*, 2022) ^[8, 7].

Chinese herbs can also be applied to treat feline bladder stones, such as Ba Zheng San (Eight Righteous powder), which can be used to treat urinary crystals, urinary stones, cystitis, or urinary system infections (Xie and Eckermann-Ross, 2012; Liu *et al.*, 2019; Poullos *et al.*, 2021) ^[36, 24, 27].

Because of geographical differences, diet and breed differences, case information and treatment methods of feline cystolithiasis varied in different countries. This report aims to introduce and discuss the treatment of open cystotomy and Chinese herbal medicine (Ba Zheng San) on a case of feline bladder stone two years ago, and the prevention effects of the herbal supplements after operation

Methods

- **Clinical Assessment:** The cat underwent a thorough clinical examination to assess signs of urinary obstruction, dehydration, and overall health and Diagnostic imaging (radiography and ultrasound) was performed to confirm the presence of bladder stones.
- **Pre-Surgical Preparation:** Fluid Therapy: Initiated intravenous fluid therapy to correct dehydration and support renal function.
- **Herbal Medicine Administration:** A licensed veterinary herbalist formulated a customized herbal decoction consisting of Che Qian Zi, Mu Tong, Huang Bai, and Dan Shen.
- **Surgical Procedure:** The cat was anesthetized using standard protocols for feline surgeries' a ventral midline incision was made to access the abdominal cavity. The bladder was carefully identified, and a cystotomy was performed by incising the bladder wall. Bladder stones were manually extracted, and the bladder was thoroughly flushed with sterile saline to ensure complete removal of stones and the bladder wall was sutured closed in two layers using absorbable sutures, followed by closure of the abdominal incision in layers.
- **Post-Operative Care:** Continued intravenous fluid therapy for hydration and renal support, Administered analgesics and antibiotics for pain management and prevention of infection and Continued administration of the herbal decoction post-surgery, twice daily for two weeks to promote healing and prevent recurrence of stones.

Results and Discussion

Disease history: Huizhou Chong Hui Kang Pet Hospital received a 2-year-old 3.5-Kg castrated male Chinese domestic cat with regular immunization and deworming. Chief complaint: intermittent vomiting, blood in urine, pain in urine, depression, anorexia.

Clinical examination: The body temperature was 102.2°F, the breathing rate was increased to 32 bpm, and the heart rate was 160 bpm. The cat lay prone and kept steady, palpated abdominal wall tension, palpated bladder pain, granular hard objects, and no abnormalities in other organs; There is dirt on the hair around the penis, mild edema of the prepuce, and the preliminary diagnosis is bladder stone and bladder tumor.

Diagnosis workup: Hematological examination included routine blood examination, serum biochemical examination, blood gas electrolyte examination and feline Serum Amyloid A (fSAA) examination. The total platelet count and average hemoglobin content were increased, the hemoglobin and hematocrit contents were decreased, the glucose, urea nitrogen and creatinine contents were increased, and the calcium content was decreased, suggesting that the cat may have kidney injury. The cat urea nitrogen content is too high, the kidney function will decline, the test results are high potassium ion, hemoglobin is high, and the partial pressure of

carbon dioxide is higher than normal. The fSAA inflammation index was 112.75 mg/L (moderate inflammatory reference value 50-150mg/L), indicating a moderate inflammatory response in the cat.

Urine routine examination showed that the pH value of the cat's urine was 7.5, which was alkaline, urine bile gen, occult blood response, white blood cells, and urine protein were positive, and urine specific gravity was normal, indicating that there was damage to the kidney and urinary tract or slight damage to the liver. Urine sediment microscopically showed a large number of struvite crystals (magnesium ammonium phosphate, $Mg(NH_4)[PO_4] \cdot 6H_2O$) like substances in the affected cat urine sediment (Figure 1).

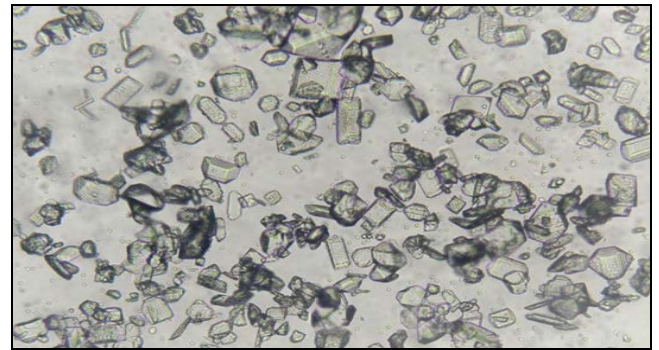


Fig 1: Microscopic examination of urinary sediment reveals struvite crystals (10×10)

X-ray examination showed that the bladder wall was obviously thickened, and the bladder image was clear and not full. The outline of the stone is clear with high density image. There were many air images in the bowel, and no abnormalities in other organs (Figure 2). The abdomen of the cat was shaved and the cat lay on its back for safety. B-scan ultrasonography examination of the bladder and urethra was performed. The examination showed a small bladder size with strong echo image, 0.87cm×0.27cm in size (Figure 3).

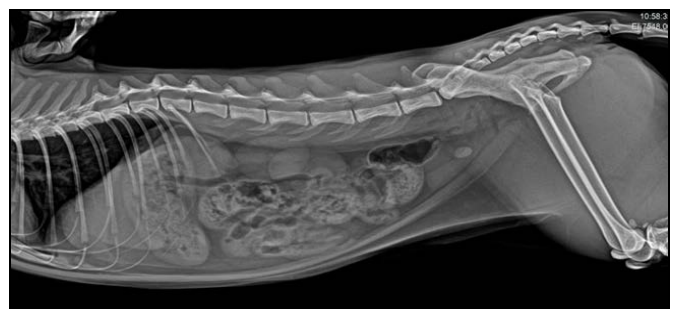


Fig 2: X-ray examination reveals high-density images in the cat's bladder

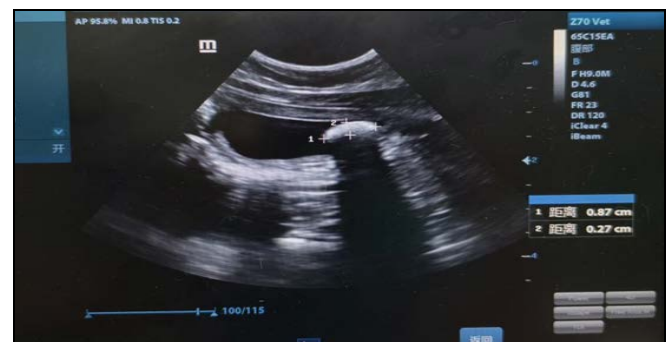


Fig 3: B-type ultrasound examination of small bladder volume with strong echo image (0.87cm×0.27cm)

According to a comprehensive analysis of the results of clinical examination, laboratory examination and imaging examination, it was found that there were a large number of struvite crystals in the cat's urine, pain in urine, blood in urine, abnormal renal function indicators and bladder stones. The male cat was diagnosed with bladder stones combined with lower urinary tract syndrome based on the above diagnostic criteria (Lund and Eggertsdottir, 2019) [25]. Cystotomy combined with Chinese veterinary medicine is recommended for the treatment of the disease.

Treatment plan

Because the stone particles are large, the clinical symptoms are serious, and the use of litholytic drugs is difficult to obtain a good effect quickly, so the open cystotomy was performed to remove the stone. The cat was positioned supine, a catheter was inserted to drain urine, and a 6 cm incision was made along the ventral midline near the pubic region. Sterile wet gauze lifted the incision from the abdominal cavity, and gauze isolated the area, and the remaining urine in the bladder was extracted with a sterile syringe (Figure 4). The bladder was cut open at the top of the bladder, where blood vessels were less distributed, and the stones were removed with sterile hemostatic forceps (Figure 5). Rinse the catheter with saline repeatedly in reverse to ensure no residual stones. The first layer of bladder was sutured successively using serosal muscle layer, and the second layer was sutured using Cushing's suture. After sutured, 20mL levofloxacin injection was injected into the bladder to observe whether bleeding and leakage occurred again, and then the bladder was rinsed with warm levofloxacin solution and returned to the abdominal cavity. The abdomen was closed regularly and the skin was sutured subcuticle.



Fig 4: Bladder isolated with gauze

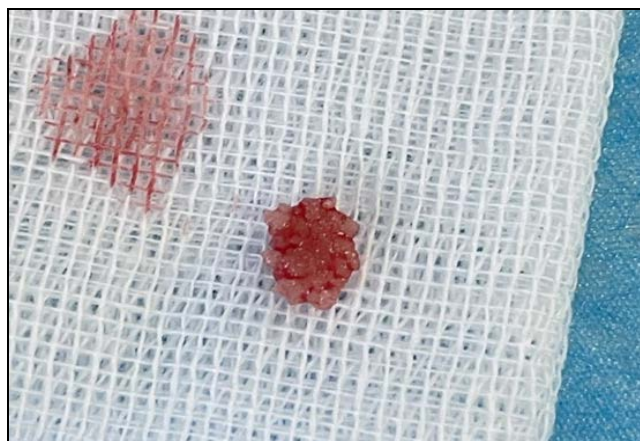


Fig 5: Stones removed from the bladder

After resuming diet, Chinese herbal medicine (Ba Zheng San) was used to treat the cat. In addition to routine postoperative care and medication, the cat was given oral Ba Zheng SAN granule 1.8 g twice a day for 7 days considering the lower urinary tract syndrome and bladder stones. The herbal medicine was taken to release the extra moisture, clear the damp-heat of the bladder, nourish the bladder and prevent the recurrence of stones.

To prevent postoperative infection, the Elizabeth ring was set on the cat after the operation to prevent it from licking the wound. The wound was routinely cleaned and disinfected, the body temperature was closely monitored and the urination was observed and recorded. The catheter attached with a suitable urine bag was indwelled for 4 days, and the bladder and urethra were irrigated daily with levofloxacin solution. To prevent traumatic pain and stress, analgesia and sedation should be used and the hospital environment be quiet. For antibacterial and anti-inflammatory effects, applied Levofloxacin injection 45 mL intravenously, amikacin injection 0.7mL subcutaneously, twice a day. At the same time, water, nutrition and energy was supplemented intravenously once a day to promote urination. Phenolsulfoethylamine injection was administered once a day for 8 days according to the condition. The cat was discharged on day 12.

Long-term prevention of recurrence of the disease is beneficial for the cat to recover: taking Ba Zheng San twice a week for three months, sufficient drinking water and prescription food supplemented with Chinese herbal medicine (Ba Zheng San) for urinary tract health. Renal function, urine routine and B-scan ultrasonography were tested one month after operation, and the results were normal. After recovery interval of six months and two years, the patient showed normal performance, no recurrence of bladder stones.

Salts in cat urine, such as calcium oxalate and magnesium ammonium phosphate, will precipitate from the urine under supersaturated conditions and form crystals, which gradually grow into stones as the crystals gather on the organic core. Feline stones tend to form in the bladder, so they are most common in the bladder and urethra, but may also be located in the kidneys and ureters (Grauer, 2015) [14]. There are many studies on the pathogenesis of feline bladder stones, such as disease (Grauer, 2015) [14], heredity (Mizukami *et al.*, 2015) [26], breed, age, sex, diet and environmental factors (Hesse *et al.*, 2012; Albasan *et al.*, 2012; Lulich *et al.*, 2016; Remichi *et al.*, 2020) [16, 1, 29, 23]. Studies have shown that in the early stage of bladder stone formation in cats, the symptomatic symptoms are not apparent, or non-specific signs (vomiting and anorexia) are observed (Appel *et al.*, 2010) [2]; Or there is no sign at all, especially when the stone occurs in kidney (Lulich *et al.*, 2016) [23]. Clinical symptoms observed were mostly dysuria, frequent urination, hematuria, calculous dysuria, etc. and urinary asthenia and renal failure in severe cases (Grauer, 2015) [14]. This study analyzed that the pathogenesis of this case of Chinese domestic cat may be caused by diet (long-term consumption of complete dry cat food, less drinking water) and living environment factors (free activity to indoor life). The clinical symptoms of the cat in this report were obvious, including hematuria, pain, intermittent vomiting, depression, and loss of appetite.

In this study, the crystal properties of urine sediment were detected by microscope (Weichselbaum *et al.*, 2001) [35]. The preliminary analysis showed that the crystals in urine were magnesium ammonium phosphate crystals, and the density of radiological examination indicated that the stones were

composed of guanolite. Yet since the internal composition of stones were not observed, the given conclusion was relatively limited. At present, qualitative analysis and quantitative analysis are the commonly adopted methods for stone analysis.

Qualitative analysis methods are usually preferred for bladder stones with relatively simple composition, in which the crushed stone samples are exposed to some special reagents, and the composition is determined by the color changes from chemical reactions. However, the limitation of qualitative analysis methods are that they cannot discern mixed stones. Quantitative analysis methods for mixed and complex bladder stones, such as optical crystallography, X-ray microanalysis, infrared spectroscopy and energy dispersion spectroscopy (EDS), are more accurate and can identify the composition of uroliths in each layer (Gomes *et al.*, 2022) [12]. After accurately identifying the mineral composition of urolithiasis, different treatment approaches can be taken according to different stone components, and the best recommendations can be made for each specific case to cure and prevent urolithiasis (Grauer, 2015; Houston *et al.*, 2016; Kopecny *et al.*, 2021) [14, 17, 19].

The specific treatment method can be selected according to the different composition, size and location of the stone. First, small enough to pass through the urethra and diet and medication can dissolve the stone. Ba Zheng San is formulated with Psyllium, Qumai, Dianhu, talc, mountain gardenia kernel, glycyrrhiza, Mutong and rhubarb, as they are boiled in water, concentrated and consolidated to granules. The finished granules can be prescribed as oral route or integrated into complete cat food for the health benefit of the lower urinary tract (Xie and Eckermann-Ross, 2012; Liu *et al.*, 2019; Poulos *et al.*, 2021) [36, 24, 27]. As it's formulated to clear extra moisture and heat, and dissolve stone, it's commonly used to treat urinary crystals, urinary stones, cystitis or urinary system infection, as etc.

For severe lithiasis, hydrocotyle verticillata, lygodium japonicum and pyrrosia lingua can be selectively added to the basic formula (Liu *et al.*, 2019) [24]. Meanwhile specific dietary regulation is recommended depending on the state of the illness, for example, in the case of struvite stones, the cats would be put on diet of low content of phosphorus and magnesium, as higher uric acid level promotes the dissolution of alkaline stones (Tefft *et al.*, 2021) [32]. Second, for stones that cannot be dissolved by drugs but can pass through the urethra, assisted voiding urohydropropulsion, cystoscopic-guided stone basket-retrieval (with caution in male cats), cystoscopic-guided intracorporeal laser lithotripsy (Berent and Adams, 2015) [6] are recommended. Third, for oversized bladder stones or clinical cases of obstructive urolithiasis, insoluble stones (calcium oxalate) or allantoids (Lulich *et al.*, 2016) [23], optional methods are open cystotomy, urethrotomy (Lulich *et al.*, 2016) [23], urethrostomy (Wilson and Harrison, 1971) [34], or minimally invasive surgical treatments including laparoscopic-assisted cystotomy (LAC) and percutaneous cystolithotomy (PCCL) (Cruciani *et al.*, 2020; Buote *et al.*, 2022) [8, 7]. In this case, open cystotomy combined with Chinese herbal medicine (Ba Zheng San) was used to treat bladder stones. According to the kidney function and the characteristics of the stones, the cat was put on cystotomy on the second day to remove the stones, followed by pain alleviation, antibacterial and anti-inflammatory treatment. Diuresis was applied after surgery to promote urination and maintain normal kidney indexes. On the fourth day after

surgery, the cat switched back to normal diet and orally took Ba Zheng daily to treat and prevent bladder stones.

Ba Zheng San, a Chinese herbal medicine, is effective in removing extra moisture and heat, dissolving bladder stone, benefiting the bladder and preventing stone recurrence (Xie and Eckermann-Ross, 2012) [36]. Ba Zheng San is also commonly used for upper urinary tract diseases such as kidney disease and prostatitis (Wang *et al.*, 2023; Hanzlicek *et al.*, 2014) [33, 15], since it proves to be effective in preventing and healing urinary tract infections (Liu *et al.*, 2019; Poulos *et al.*, 2021) [24, 27].

Acupuncture, electro acupuncture (EAP) and/or drug puncture (vitamin B12 injection) combined with Chinese herbal medicine have been reported to be effective in urinary diseases including feline bladder stones and feline lower urinary tract syndrome caused by cat idiopathic cystitis (Shmalberg *et al.*, 2019) [31]. Three herbal preparations of San Ren Tang, Wei Ling Tang or Alisma have been shown to have no diuretic effect, nor did they reduce urinary saturation of struvite or calcium oxalate compared with placebo (Daniels *et al.*, 2018) [9]. This indicates that the selection of Chinese herbal medicine should be based on previous experience research results, as different formulations can produce different therapeutic effects depending on the types of disease and animals (Xie and Eckermann-Ross, 2012; Quintavalla and Fausto, 2024) [36, 28].

In summary, according to the characteristics of feline bladder stones and FLUTD, this case chose cystotomy for stone extraction, and used Ba Zheng San along with cat lower urinary tract prescription food for postoperative treatment and prevention. During the two-year observation period, the cat was in good condition with no recurrence of stone and no incidence of lower urinary tract complex disease, indicating that the combination of open cystotomy and Ba Zheng San has a good effect on the treatment of FLUTD induced by feline bladder stones, and Ba Zheng San can effectively prevent the recurrence of feline bladder stones. The next step is to explore the use of Bazheng powder in the treatment of primary cystitis or FLUTD caused by crystalline urine, hoping to achieve the same results.

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Conclusion

Feline bladder stones represent a significant health issue in cats, with increasing incidence rates linked to rising pet ownership. This case study highlights the successful treatment of a cat with bladder stones through a combination of open cystotomy and the Chinese herbal medicine Ba Zheng San. The approach not only facilitated the removal of stones but also promoted healing and prevented recurrence. The positive outcomes observed over a two-year follow-up period underscore the efficacy of integrating traditional surgical methods with herbal therapies. Future research should further investigate the application of Ba Zheng San in managing other urinary tract disorders, potentially enhancing treatment protocols for feline lower urinary tract disease.

Conflict of Interest

Not available

Financial Support

Not available

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